Report May 1996

Biotopes / Ecosystems Nomenclature
Habitats of South America

INSTITUTE OF TERRESTRIAL ECOLOGY

INSTITUT ROYAL DES SCIENCES NATURELLES DE BELGIQUE

This classification is part of a report to the Commission of the European Communities, Directorate-General for Environnement Nuclear Safety and Civil Protection, prepared by the Institut Royal des Sciences Naturelles and the Institute of Terrestrial Ecology with the collaboration of Peter Kunkel, Charles Vander Linden, Roseline C. Beudels, Marie-des-Neiges van der Elst, René-Marie Lafontaine, Susan Iremonger, Marie-Odile Beudels, Yves Laurent, Chris Kerwyn, Dorian Moss, Wendi Craig and Anne Devillers.

Front cover. Upper Paranean riverine forest (unit 4A.3 1). Waterfalls (unit 24.141). Iguazu, Argentina, August, 1995. Photo, Anne S. Devillers.

INTRODUCTION

Scope and geographical coverage

This extract of the PHYSIS database of the Institut Royal des Sciences Naturelles de Belgique offers a framework to organize in an ordered sequence, according to the same methodology as that used for the CORINE Biotopes *Habitats of the European Cominunity* typology (Devillers *et al.,* 1991), the habitats of the South American realm. The geographical area covered encompasses South America and its nearshore islands, Trinidad and Tobago, Margarita, Aruba, Curaçao, Bonaire, Los Roques, Blanquilla and associated islands, the Galapagos Islands, Malpelo Island, the Juan Fernandes Islands, the San Felix archipelago, Fernando de Noronha, South Trinidad and the Martin Vas islands, St. Peter and St. Paul rocks, Easter Island and Sala y Gomez.

Definitions and structure

1. Habitat.

In the most common usage, a habitat is "the natural home of an animal or plant" (Collins English Dictionary), "the normal abode or locality of an animal or plant" (Chambers Twentieth Century Dictionary), or "the natural abode of a plant or animal" (Webster's New Collegiate Dictionary). Integrating these definitions over all species, for each of which the habitat is the sum of the abiotic enviromnent and of all other species present, a habitat can be defined as "a topographical expanse homogeneous in its physical and biotic components at the scale of the phenomenon studied" (Blondel, 1979, 1995). This is the definition that has been adhered to in the CORINE Habitat typology and the Physis data-base. Thus, a habitat is a three-dimensional spatial entity that comprises at least one interface between air, water and ground spaces, it includes both the physical environment and the communities of plants and animals that occupy it, it is a fractal entity in that its définition depends on the scale at which it is considered. The conditions encountered by a given species are similar on the entire surface of the habitat, but not all characteristics of the habitat are ever assembled at any one point (Blondel, 1979, 1995).

2. Scale.

The définition of a habitat depends entirely on the scale at which it is considered (Blondel, 1979, 1995). Thus a steppe can be defined, as in the Physis Database, as a "formation dominated by medimn or tall perennial tuft-forming grasses or suffrutescents, with lacunar ground cover, together with its associated therophyte communities". At a higher level of resolution it can be seen as a mosaic of habitats, bunches of tail perennial grasses on the one hand, bare surfaces temporarily supporting communities of therophytes on the other hand. At a lower level of resolution, the grass steppe and the steppe woods that dot it can be regarded as a single habitat, the wooded steppe. The level of resolution that has been used in the CORINE typology is that of the ecological requirements of small vertebrates, large invertebrates and vascular plants. A few units, clearly labelled, have been introduced to permit rendition by the use of single codes or combined codes of the ecological requirements of larger organisme or of the most mobile ones among the smaller ones.

3. Habitat typology unit.

A unit in the CORINE habitat typology and the Physis database is a habitat type, thus a characterization of a collection of spatial entities that are considered equivalent as habitats, spacially separated but sufficiently alike in abiotic conditions, physiognomy, composition of plant and animal communities. To play similar roles from the point of view of nature conservation.

4. Limits of units.

There is an unavoidable degree of arbitrariness in deciding whether two communities are sufficiently similar to be referred to the same unit, or conversely, sufficiently different to warrant distinctive treatment. In that respect, habitat classification does not differ from any other taxonomic process. The

difficulty is only slightly increased by the fact that intrinsic criteria, such as reproductive isolation can never be invoked to separate communities. The guideline followed in the CORINE typology was that two habitats should be distinguished if the plant or animal communities they support were sufficiently distinct to confer to them different significances in the préservation of sensitive species. For plant communities, phytosociological criteria, recorded by the Braun-Blanquet approach, or any equivalent one, were used, where usuary available, to assess degree of divergence and its relevance to sensitive species. For animal communities, data are often lacking precisely for the groups most in need of habitat conservation rather than species-specific programmes. Physiognomy, plant dominance, ecological conditions and biogeographical parameters, including geographical séparation, have been used to assess distinctness.

5. Hierarchical arrangement.

All habitat classifications use, alone or in combination, similarities in physiognomy, abiotic conditions, plant community composition. plant dominance, plant community succession and, sometimes, animal community composition to combine elementary units into collective entities of successively higher rank (Dierschke, 1994). Contrary to classical species taxonomy, habitat classification cannot claim to include, arnong others, a "natural" system of ordering based on the best available perception of phylogenesis, thus on the history of the evolutionary process. Thus, the priority given to the various criteria and the ensuing classifications are necessarily a rnatter of choice. The guideline of the CORINE habitat classification bas been to use, 1, large- feature physiognomy, 2, plant-community composition and 3, biogeographical or ecological factors underpinning animal-community composition, in that order. This principle has, however, been occasionally departed front, when necessary, to ensure maximum compatibility with existing local schemes. Sequence and level within a division carry no intrinsic meaning as to conservation significance or affinities with other units of equal rank. Only the series of nested ensembles of successively higher ranks is an indication of cladistic relationship, the rank of individuel units derives from varying needs for finer subdivision, and their sequence from the historical growth of the list.

Rules of evolution

Legitimate steady-state evolution comprises the amendments that will naturally occur in the course of time as understanding of the habitats of the geographical area improves, as new needs of identification arise, as an increasing portion of the total geographical area concerned is examined in detail. These amendments should not, and do not, affect previous applications of the list. They are limited to two opérations: subdivision of units, improvement of unit description.

1. Subdivision of units

It is the opération by which a fonnerly undivided unit is partitioned into a number of sub-units the sum of which equals the original unit. It does not affect the content of the unit nor its geographical distribution although it is, of course, possible that some of the sub-units will occur only in part of the area occupied by the undivided unit. Exactly as in the case of the taxonomic splitting of a species, any legal status that was attached to the undivided unit is automatically transferred to all its sub-units.

2. Improvement of unit description

It is the operation by which the description of a unit is completed or clarified, with, as appropriate, a more accurate description of its geographical distribution, its ecology, a more complete list of characteristic species, a more adequate title. It does not in any way affect the content of the unit.

Global framework

The South American habitat classification fits within a global system of habitat description which constitutes the framework of the PHYSIS database (Devillers and Devillers-Terschuren, 1993). This system rests on the matrix-use of two existing sets of upper category describers, the biotic realms of the I.U.C.N. bio-genetic reserve network system (Udvardy, 1975), on the one hand (Table 1), and a list of upper units of habitats derived from the two-digit CORINE categories (Wyatt *et al.,* 1982; Devillers *et al,* 1991) on the other hand (Table 2).

For realms, the geographical definitions of Udvardy have been adhered to as much as possible. Fer practical reasons, however, they have been modified somewhat ta make limits of realms coincide either with marine gaps or with political boundaries. Thus, in the arrangement proposed, no political boundaries have been crossed except those that separate France, the United Kingdom, Australia and the United States of America from some of their overseas territories. Precise definitions of the realms are explicited by Devillers and Devillers- Terschuren (1993: 13-14).

The higher habitat units are directly derived from those proposed by Wyatt *et al.* (1982) as revised in the course of the CORINE Biotope project (Devillers [et al.], 1992). Their extension to global applicability has largely drawn upon the ecological analyses of Walter (1979) and Walter and Breckle (1986, 1991a, b, c), upon the characterisation of major plant formations of the world by Rieley and Page (1990) and, for marine habitats, upon the synthesis of Barnes and Hughes (1988). The definitions are summarized by Devillers and Devillers-Terschuren (1993: 15-24), and can be found under the appropriate codes in the South American PHYSIS database.

Upper units of habitat within any realm are designated by combination of a realm digit in the third rank to the left of the decimal point with a biotope class number of two digits in the second and first ranks. Thus, Palaearctic temperate conifer forests are designated by 042 (42), North American ones by 142, South American ones by 742. Lower divisions, characterized by digits to the right of the decimal point, are specific to each realm and not necessarily homologous between units formed with the same second and first rank digits, but different first rank digits. Thus, Palaearctic juniper and cypress woods are coded as 42.A, with 42.Al, for instance, corresponding to northern Hellenic Grecian juniper woods, while in an experimental draft prepared for North America, *Juniperus osteosperma-Juniperus monosperma-Juniperus deppeana-Cupressus arizonica* woodland of central Arizona is coded as B42.517, as part of piñon-juniper woodlands (142.51) in south-western summer drought forests (142). There is, however, no reason not to preserve the lower unit hierarchy as far down as possible for types of habitat with more evident cosmopolitan homologies. Thus, coral reef communities in the African realm can be expressed as subdivisions of 211.256 as those of the Palaearctic realm are of 11.256.

Table 1. Biotic realms.

0. Palaearctie
1. Nearctic
2. Afrotropical
3. Indomalayan
4. Oceanian
5. Austratian
6. Antarctic
7. Neotropical

(from Udvardy, 1975)

Table 2. Biotope classes.

1	**Coastal and halophytic communities**
11	Ocean and seas, marine communities
12	Sea inlets and coastal features
13	Estuaries and tidal rivers
14	Mud flats and sand flats
15	Salt marshes, salt steppes, salt scrubs, salt forests
16	Coastal sand dunes and sand beaches
17	Shingle beaches
18	Sea-cliffs and rocky shores
19	Islets, rock stacks, reefs, banks, shoals
1A	Coastal agrosystems
2	**Non-marine waters**
21	Coastal lagoons

22 Standing fresh water
23 Standing brackish and salt water
24 Running water

3 Scrub and grassland
31 Temperate heath and srub
32 Sclerophyllous scrub
33 Phrygana
34 Steppes and dry calcareous grasslands
35 Dry siliceous grasslands
36 Alpine and subalpine grasslands
37 Humid grasslands and tall herb communities
38 Mesophile grasslands
39 Tundra
3A Tropical grasslands
3B Tropical shrublands
3C Tropical alpine communities

4 Forests
41 Temperate broad-leaved deciduous forests
42 Temperate coniferous forests
43 Temperate mixed forests
44 Temperate riverine and swamp forests and brush
45 Temperate broad-leaved evergreen forests
46 Evergreen rain forests
47 Semi-evergreen rain forests
48 Monsoon forests
49 Tropical montane forests
4A Tropical swamp forests
4B Dry tropical woodland
4C Mangrove forests and scrabs

5 Bogs and marshes
51 Raised bogs
52 Blanket bogs
53 Water-fringe vegetation
54 Fens, transition mires and spnngs

6 Inland rocks, screes and sands
61 Screes
62 Inland cliffs and exposed rocks
63 Eternal snow and ice
64 Inland sand-dunes
65 Caves
66 Volcanic features

7 Deserts
71 Polar deserts
72 Continental deserts and semi-deserts
73 Subtropical deserts and semi-deserts
74 Cool coastal deserts

8 Agricultural land and artificial landscapes
81 Improved grasslands
82 Crops
83 Orchards, groves and tree plantations
84 Tree lines, hedges, rural mosaics
85 Urban parks and large gardens

86 Towns, villages, industriel sites
87 Fallow land, waste places
88 Mines and underground passages
89 Industrial lagoons and reservoirs, canals

9 Wooded grasslands and scrubs
91 Parklands
92 Bocages
93 Wooded steppe
94 Wooded tundra
95 Treeline ecotones
96 Savannas
97 Wooded deserts and semi-deserts

Acknowledgements

We are extremely grateful to R. Bonnewitz, I. Benoit, J.H. Brun, M. Canevari, P. Canevari, J.C. Chebez, T. Frisk, R- Gajardo, L.O. Giusti, M. Grassi, O. Huber, A. Krapovickas, V. Loewe, M. Lugo, P. Marconi, A.M. Molina, E. Peña,V. Quintanilla, D. Rodriguez, M. Rumboll, K. Schiaffino, R.Taubenschlag, K.Thelen, R.Vanni who provided us with much of the documentation on which the typology is based and contributed to its preparation by their advice and encouragement. The project was sponsored by the Commission of the European Communities, Directorate-Gencral for Environnement Nuclear Safety and Civil Protection. The sustained interest of J. Vasconcelos, R. Roy and M. Cornaert in habitat classification and description as a tool for biodiversity conservation has been central to the development of the CORINE methodology.

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1 . COASTAL AND HALOPHYTIC COMMUNITIES

Oceanic, inshore and offshore waters and their open-water and bottom communities; marine communities of the littoral zone and of coastal lagoons, bays, inlets, estuaries and tidal rivers; coastal and azonal interior halophyte or gypsophyte communities of saltmarshes, salt steppes, salt scrubs, and gypsum scrubs; coastal sand dunes, sand beaches, shingle beaches, sea cliffs, rocky shores, coastal islets, rock stacks, reefs, banks and shoals; characteristically coastal agrosystems incorporating seminatural elements.

Oceanic and continental shelf waters of the world ocean and its connected seas, their associated open-water and bottom communities, and marine vascular vegetation beds; marine communities of the littoral zone and of coastal lagoons. Included within the South American realm are waters of the Pacific east of the East Pacific Rise and, in the south, of the Pacific-Antarctic Ridge, of the Atlantic west of the Mid-Atlantic Ridge, of the Caribbean Sea between the continent and the mid-line with islands included in the North American realm; in the south, the demarcation arbitrarily follows the mid-line between lands included in the realm and into the Antarctic realm.
(Murphy, 1936; Cabrera and Willink, 1980: 106-107; Barnes and Hughes, 1988; Tharp, 1992: 42-43).

11.1 Open marine waters

Pelagic biocoenoses of the world ocean, its connected seas and coastal lagoons. They can be characterized by their planktonic communities and by the composition of their nektonic or surface-feeding faunas of cephalopods, fish, sea mammals and seabirds.
(Murphy, 1936; Cabrera and Willink, 1980: 106-107; Nelson, 1980; Löfgren, 1984; Lowe-McConnell, 1987: 226-232; Barnes and Hughes, 1988; Stanley, 1995: 13-14; Diegues *et al.*, 1995: 71-72, 74-75; Hurtado, 1995: 131-132, 135).

11.11 Oceanic waters
Waters beyond the continental shelf.
(Murphy, 1936; Watson, 1966: vii-xvi; Lowe-McConnell, 1987: 229-232; Lüning and Asmus, 1991: 10-11; Santelices, 1991).

11.111 Blue ocean waters
Oceanic waters of the tropical and subtropical zones, north of the subtropical convergence, situated, on an annual average, around 40°S latitude except in the Humboldt Current zone of the east Pacific where it swings northwards to about 25°S; they are generally of low productivity and high species diversity.
(Murphy, 1936; Koepcke, 1961: 106; Watson, 1966: vii-xvi; Nelson, 1980; Löfgren, 1984: 134-135; Barnes and Hughes, 1988: 37-42; Lüning and Asmus, 1991: 10-11; Santelices, 1991; Stanley, 1995: 13-14; Diegues *et al.*, 1995: 71-72, 74-75; Hurtado, 1995: 131-132, 135; Bleakley, 1995: 14-15).

11.112 Cool ocean waters
Oceanic waters of the subantarctic zone, south of the subtropical convergence, at around 40°S latitude, 30°S in the Humboldt Current zone of the east Pacific, and north of the Antarctic convergence.
(Murphy, 1936; Watson, 1966: vii-xvi; Nelson, 1980; Löfgren, 1984: 134-135; Barnes and Hughes, 1988: 37-42; Lüning and Asmus, 1991: 10-11; Santelices, 1991; Diegues *et al.*, 1995: 71-72, 74-75; Hurtado, 1995: 131-132, 135).

11.113 Ocean upwellings
Oceanic areas over which the warmer surface water is displaced, allowing cooler water rich in nutrients to rise to the surface. This occurs when water is driven away from a coastline by wind action, when two contiguous water masses are moved apart, or when deep currents impinge on an obstacle such as a mid-ocean ridge. Zones of upwellings are characterized by higher biological productivity and lower diversity. Major upwelling zones, involving, at least in part, oceanic waters, occur along the west coast of South America from about 44° S to the equator, under the influence of the Humboldt Current, along the east coast of South America, under the influence of the Falkland Current between approximately 44° S and 34° S, and in the vicinity of Saint Paul's Rocks.
(Murphy, 1936; Watson, 1966: xiv; Nelson, 1980; Löfgren, 1984: 134-135; Barnes and Hughes, 1988: 11-12, 38-39; Hurtado, 1995: 135; Diegues *et al.*, 1995: 75).

11.12 Shelf and slope waters
Waters of the continental shelf, underwater plateau extending from the coast to a depth of about 100 fathoms, beyond which the continental slope falls steeply toward the ocean bottom.
(Murphy, 1936; Watson, 1966: vii-xvi; Cabrera and Willink, 1980: 106-107; Nelson, 1980; Löfgren, 1984; Barnes and Hughes, 1988; Santelices, 1991; Stanley, 1995: 13-14; Diegues *et al.*, 1995: 71-72, 74-75; Hurtado, 1995: 131-132, 135).

11.121 Inshore waters
Waters within the strong influence of land masses, both in terms of physical parameters and of fauna, often arbitrarily defined as waters less than 5 km from low water mark, waters between the continent and islands or islets well in sight of shore, and any seas of depth less than 6 metres. They include the inshore waters of the South American continent and its nearshore islands, of Trinidad and Tobago, Margarita, Aruba, Curaçao, Bonaire, Los Roques, Blanquilla and associated islands, of the Galapagos Islands, Malpelo Island, the Juan Fernandez Islands, the San Felix archipelago, Fernando de Noronha, South Trinidad and the Martin Vaz islands, of Saint Paul's Rocks (Penedos de Sao Pedro e Sao Paulo), of Easter Island and Sala y Gomez.
(Murphy, 1936; Koepcke, 1961: 106-107; Watson, 1966: vii-xvi; Cabrera and Willink, 1980: 106-107; Nelson, 1980; Löfgren, 1984; Barnes and Hughes, 1988; Lüning and Asmus, 1991; Santelices, 1991; Tharp, 1992: 42-43; Stanley, 1995: 13-14; Diegues *et al.*, 1995: 71-72, 74-75; Hurtado, 1995: 131-132, 134-135).

11.122 Offshore waters
The zone extending from the limits of inshore waters to the continental slope.
(Murphy, 1936; Koepcke, 1961: 106-107; Watson, 1966: vii-xvi; Cabrera and Willink, 1980: 106-107; Nelson, 1980; Löfgren, 1984; Barnes and Hughes, 1988; Lüning and Asmus, 1991; Santelices, 1991; Stanley, 1995: 13-14; Diegues *et al.*, 1995: 71-72, 74-75; Hurtado, 1995: 131-132, 135).

11.1221 Subantarctic offshore waters
Waters covering the continental shelf of South America in the subantarctic zone, extending northward, in the Atlantic, to Golfo San Matias and, in the Pacific, to Chiloe Island.
(Murphy, 1936; Cabrera and Willink, 1980: 106-107; Löfgren, 1984; Lüning and Asmus, 1991; Santelices, 1991; Diegues *et al.*, 1995: 71-72).

11.1222 South subtropical offshore waters
Waters covering the continental shelf of South America in the subtropical maritime zone, extending, in the Atlantic, from Golfo San Matias north to about 25°S and, in the Pacific, from Chiloe Island north to northern Peru.
(Murphy, 1936; Löfgren, 1984; Lüning and Asmus, 1991; Santelices, 1991; Diegues *et al.*, 1995: 71-72; Hurtado, 1995: 131-132).

11.12221 Subtropical South Atlantic offshore waters
Offshore waters of the subtropical zone of the Atlantic.
(Murphy, 1936; Cabrera and Willink, 1980: 106-107; Lüning and Asmus, 1991; Diegues *et al.*, 1995: 71-72).

11.12222 Subtropical South Pacific offshore waters
Offshore waters of the subtropical zone of the Pacific.
(Murphy, 1936; Cabrera and Willink, 1980: 107; Lüning and Asmus, 1991; Santelices, 1991; Hurtado, 1995: 131-132).

11.1223 Tropical offshore waters
Waters covering the continental shelf of South America in the tropical zone, extending southward, in the Atlantic, to about 25°S and, in the Pacific, to Punta Parinas in northern Peru.
(Murphy, 1936; Cabrera and Willink, 1980: 106; Löfgren, 1984; Lüning and Asmus, 1991; Santelices, 1991; Stanley, 1995: 13-14; Diegues *et al.*, 1995: 71-72; Hurtado, 1995: 131-132).

11.12231 Tropical Atlantic offshore waters
Offshore waters of the tropical zone of the Atlantic and of the Caribbean Sea.
(Murphy, 1936; Lüning and Asmus, 1991; Stanley, 1995: 13-14; Diegues *et al.*, 1995: 71-72).

11.12232 Tropical eastern Pacific offshore waters

Offshore waters of the tropical zone of the Pacific.
(Murphy, 1936; Lüning and Asmus, 1991; Santelices, 1991; Hurtado, 1995: 131-132).

11.123 Continental slope
Waters situated over the continental slope, the steep descent from the continental shelf to the ocean bottom, an area where upwellings, water mixing or shearing and other anomalies often develop.

11.124 Offshore and coastal upwellings
Zones of the continental shelf where the warmer surface water is displaced, allowing cooler water rich in nutrients to rise to the surface, often generating much increased biological productivity.
(Murphy, 1936; Watson, 1966: xi; Lowe-McConnell, 1987: 226-229; Santelices, 1991; Diegues *et al.*, 1995: 75; Hurtado, 1995: 135).

11.1241 Major offshore and coastal upwellings
Coastal and offshore waters of the major upwelling areas of the world ocean.
(Murphy, 1936; Santelices, 1991; Diegues *et al.*, 1995: 75; Hurtado, 1995: 135).

11.12411 Humboldt upwelling zone
Waters of the continental shelf off the mediterranean, desert and tropical coasts of Pacific South America subjected to intense upwellings under the influence of the Humboldt Current. A large number of organisms are entirely or largely dependent on this high-nutrient zone, in particular, the fishes *Engraulis ringens*, *Sarda chilensis*, *Trachurus murphyi*, *Ethmidium chilcae*, *Austromenidia regia*, *Neptomenus crassus* and the birds *Spheniscus humboldti*, *Oceanodroma markhami*, *Oceanodroma tethys kelsalli*, *Oceanodroma hornbyi*, *Oceanites gracilis*, *Pelecanoides garnotii*, *Phalacrocorax bougainvillii*, *Phalacrocorax gaimardi*, *Sula variegata*, *Pelecanus thagus*, *Larosterna inca*.
(Murphy, 1936; Koepcke, 1961: 107-108; Löfgren, 1984: 134; Lowe-McConnell, 1987: 226-229; Santelices, 1991; Hurtado, 1995: 135).

11.12412 Patagonian upwelling zone
Waters of the edge of the continental shelf off the Patagonian desert and Pampa coasts of Atlantic South America, subjected to upwelling under the influence of the Falkland Current. Important populations of marine birds and mammals, including outposts of Humboldian ones, feed in these waters and breed on the adjacent coasts. Characteristic species include *Phalacrocorax atriceps*, *Phalacrocorax bougainvillii*, *Phalacrocorax gaimardi*.
(Murphy, 1936; Watson, 1966: xi; Löfgren, 1984: 134; Diegues *et al.*, 1995: 75).

11.1242 Minor offshore and coastal upwellings
Waters of the continental shelf in which local upwelling conditions are generated by features of the sea floor or the circulation of water masses. They are recorded, in particular, from the north coast of Isla Margarita, in the Venezuelan Caribbean, from French Guiana and from the Cabo Frio region off the coast of Brazil.
(Watson, 1966: xi; Lowe-McConnell, 1987: 229; Dawes *et al.*, 1991: 215; Tostain *et al.*, 1992: 12; Diegues *et al.*, 1995: 75).

11.125 Shoals
Shallow waters over permanently submerged elevated features of the continental shelf sea-floor, whether shoals, banks or reefs.

11.2 Benthic communities

Communities of animals and algae occupying the sea floor in the infralittoral, circalittoral and deeper zones. Similar communities of the mediolittoral and supralittoral zones.
(Koepcke, 1961: 108-109; Kühnemann, 1969, 1970a; Cabrera and Willink, 1980: 106-107; Barnes and Hughes, 1988; Dawes *et al.*, 1991; Santelices, 1991).

11.21 Deep sea floor
Bathyal, abyssal, hadal and hydro-thermal benthic communities of the continental slope, the abyssal plain and its features.
(Pautot, 1983; Barnes and Hughes, 1988; Clark, 1990; Gage and Tyler, 1991; Francheteau, 1993).

11.211 Bathyal benthic communities
Benthic communities of the continental slope, developed on blue, coral, green or red oceanic muds, and of relatively high diversity.
(Pautot, 1983; Barnes and Hughes, 1988; Clark, 1990; Gage and Tyler, 1991: 10-29).

11.212 Abyssal benthic communities
Benthic communities of abyssal plains and abyssal hills, large relatively level areas of the deep ocean floor, covered by thin layers of biogenic or non-biogenic oozes.
(Pautot, 1983; Barnes and Hughes, 1988; Clark, 1990; Gage and Tyler, 1991: 10-29, 250).

11.2121 Eastern Pacific abyssal benthic communities
Benthic communities of abyssal plains and abyssal hills of Pacific waters of South America north of about 42° S, characteristic of the Eastern Pacific province of the Pacific-Northern Indian Ocean abyssal region.
(Gage and Tyler, 1991: 250).

11.2122 Western Atlantic abyssal benthic communities
Benthic communities of abyssal plains and abyssal hills of Atlantic waters of South America north of about 42° S, characteristic of the Western Atlantic province of the Atlantic abyssal region.
(Gage and Tyler, 1991: 250).

11.2123 Southern oceans abyssal benthic communities
Benthic communities of abyssal plains and abyssal hills of waters of South America south of about 42° S, characteristic of the Southern Oceans abyssal region.
(Gage and Tyler, 1991: 250).

11.21231 South Pacific abyssal benthic communities
Benthic communities of abyssal plains and abyssal hills of waters of Pacific, south of about 42° S, and Drake Passage waters of South America, characteristic of the Pacific province of the Southern Oceans abyssal region.
(Gage and Tyler, 1991: 250).

11.21232 South Atlantic abyssal benthic communities
Benthic communities of abyssal plains and abyssal hills of waters of Atlantic South America, south of about 42° S, characteristic of the Atlantic subregion of the Southern Oceans abyssal region.
(Gage and Tyler, 1991: 250).

11.213 Hadal benthic communities
Benthic communities of the oceanic trenches, deep elongated subduction troughs of the ocean floor.
(Pautot, 1983; Barnes and Hughes, 1988; Clark, 1990; Gage and Tyler, 1991: 10-29, 250).

11.214 Oceanic ridge benthic communities
Benthic communities occupying raised features of the deep sea-floor; they include assemblages colonizing active or non-active constructive mid-ocean ridges, as well as those developed on asismic ridges, but with the exception of hydrothermal communities.
(Pautot, 1983; Barnes and Hughes, 1988; Clark, 1990; Gage and Tyler, 1991: 10-29).

11.215 Hydrothermal benthic communities
Highly distinctive benthic communities inhabiting the vicinity of oceanic hydrothermal vents, mostly localized along the central rift of the mid-oceanic ridges and along submerged volcanic chains of lesser ocean basins. In South American waters hydrothermal vents are located, in particular, along the Galapagos Rift and along the East Pacific Rise.
(Ballard and Grassle, 1979; Laubier, 1983, 1993; Barnes and Hughes, 1988; Clark, 1990; Gage and Tyler, 1991: 363-385).

11.216 Cold-seep benthic communities

Highly distinctive benthic communities of large bivalves, sponges and bryozoans, inhabiting the vicinity of oceanic methane-laden seeps, mostly localized in subduction trenches.
(Barnes and Hughes, 1988; Gage and Tyler, 1991: 385-391; Laubier, 1993).

11.22 Sublittoral soft seabeds
Mostly animal communities colonizing soft sediments such as mud, sand or gravel of the infralittoral and circalittoral zones.
(Dawes *et al.*, 1991; Santelices, 1991: 358-359).

11.23 Sublittoral pebbly seabeds
Communities of mostly annual algae and invertebrates developing on pebble formations of the infralittoral and circalittoral zones.

11.24 Sublittoral rocky seabeds and kelp forests
Varied, strongly stratified communities colonizing underwater cliffs, reefs and rocky continental shelf seabeds, in particular, kelp forests of *Lessonia spp.*, *Macrocystis spp.*, notably the giant kelp *Macrocystis pyrifera* forming vast beds around the coasts of Patagonia, from Puerto Deseado south, of Tierra del Fuego, of the Humboldt Current Pacific coast of South America, north to central Peru. Kelp forests of the region constitute some of the largest seaweed ecosystems in the world and are the habitat and feeding grounds of numerous species.
(Murphy, 1936: 192-193; Koepcke, 1961: 109; Kühnemann, 1969, 1970a; Houvenaghel and Houvenaghel, 1974; Barnes and Hughes, 1988: 119-160; Dawes *et al.*, 1991; Santelices, 1991: 353-358, 361-365; Hurtado, 1995: 135; Diegues *et al.*, 1995: 75).

11.25 Sublittoral organogenic concretions
Continental shelf colonies of lower plants or animals resulting in concretions and encrustations. The very complex communities of tropical coral reefs are excluded from this unit and listed under 11.2B.
(Santelices, 1991: 356).

11.251 Corallogenic concretions
Communities forming and colonizing corallogenic concretions of calcified red algae in the circalittoral zone.

11.252 Infralittoral encrusting algae communities
Infralittoral concretions formed by algae.
(Santelices, 1991: 356, 358).

11.253 Infralittoral gastropod and polychaete ledges
Infralittoral ledges built by gastropods or polychaetes.
(Santelices, 1991: 356).

11.254 Infralittoral mussel beds
Infralittoral colonies of large bivalves, in particular of genus *Mytilus*, together with the communities they support.
(Kühnemann, 1969, 1970a).

11.255 Gas vent communities
Communities of bacteria and invertebrates colonizing the vicinity of hot or cold gas seeps of the continental shelf, often forming encrusted tubes or chimneys.
(Barnes and Hughes, 1988).

11.26 Sublittoral cave communities
Communities of marine invertebrates and algae colonizing the bottom and sides of caves (12.7) situated under the sea or the sublittoral part of caves having an entirely, periodically or partly submerged opening.
(Barnes and Hughes, 1988).

11.27 Soft sediment littoral communities
Invertebrate and algal communities colonizing soft sediments such as mud, sand or gravel of the intertidal zone.
(Dawes *et al.*, 1991; Santelices, 1991: 358-359).

11.28 Pebbly shore littoral communities
Communities of mostly annual algae and invertebrates developing on pebble formations of the intertidal zone.

11.29 Rocky shore littoral communities
Communities of algae, invertebrates and lichens colonizing the mediolittoral and supralittoral zones of rocky shores and cliffs.
(Dawes *et al.*, 1991; Santelices, 1991: 353-358, 361-365).

11.291 Mediolittoral fringe rocks
Cliffs and rocks of the lowest part of the mediolittoral zone, occupied by communities transitional to those of the infralittoral zone.

11.292 Lower mediolittoral rocks
Cliffs and rocks of the lower part of the mediolittoral zone, occupied, in particular, by encrusting algae.

11.293 Upper mediolittoral rocks
Cliffs and rocks of the higher part of the mediolittoral zone, occupied by communities characterized, in particular, by cirriped crustaceans and soft algae.

11.294 Mediolittoral cave and overhang communities
Communities of marine animals and lower plants colonizing mediolittoral overhangs and crevices, and the mediolittoral level of sea-caves (12.7).

11.295 Mediolittoral rock pools
Permanent saline pools of the mediolittoral zone, fed by flood tides (tide pools).

11.296 Supralittoral rocks
Cliffs and rocks of the supralittoral spray zone, mostly occupied by lichens., in particular, of genera *Verrucaria*, *Xanthoria*, *Romalina* and *Caloplaca*.
(Kühnemann, 1969, 1970a).

11.297 Supralittoral rock pools
Pools of variable salinity fed by rainwater, spray and occasionally waves.

11.2A Littoral communities of organogenic concretions
Littoral colonies of lower plants or animals resulting in concretions and encrustations.
(Santelices, 1991: 354-357).

11.2A1 Littoral encrusting algae communities
Mediolittoral crusts formed by algae.
(Santelices, 1991: 356, 358).

11.2A2 Littoral mussel and urchin beds
Dense colonies of large bivalves, in particular of genus *Mytilus*, *Chama* or *Perumytilus*, or of urchins, notably *Pyura praeputialis*, together with the communities they support.
(Koepcke, 1961: 109, 111; Kühnemann, 1969, 1970a; Santelices, 1991: 355, 357).

11.2A3 Littoral barnacle beds
Dense colonies of cirriped crustaceans, in particular, *Chthamalus scabrosus* and *Jehlius cirratus*, and the colonies they support.
(Santelices, 1991: 355).

11.2B Coral reef marine communities
Sublittoral and mediolittoral communities of coral reefs of the coasts of tropical South America. They are developed in the southern Caribbean sea, around nearshore islands from Curaçao and Aruba east to Tobago and Trinidad, and, locally, along mainland coasts, in the Gulf of Darien and between the Guajira peninsula in Colombia and the province of Sucre in Venezuela. In the Pacific, they are limited to local occurrences along the coast of Colombia, on the north coast of Esmeraldas and in Santa Elena Bay in Ecuador, at Lobos de Tierra, the Pachacamac Islands, San Gallan and the Paracas peninsula in Peru, at Malpelo Island, and around San Cristobal, Charles and Isabela in the Galapagos archipelago; these eastern Pacific communities have affinities both with the western and central Pacific communities and with those of the Caribbean Sea. In the Atlantic they are developed along the Brazilian coast between Fortaleza and Salvador, with outliers north to eastern Maranhao and south to the tropic of Capricorn, as well as around Rocas Reef and Fernando de Noronha; the main formations are situated between Cabo de Sao Roque and Natal, including the Rocas atoll and the Fernando de Noronha archipelago, and on the south coast of Bahia, with the Abrolhos archipelago; lesser ensembles occur between Natal and the Sao Francisco River and around Salvador Bahia.
(Murphy, 1936: 140, 143-145; Lowe-McConnell, 1987: 177-211; Barnes and Hughes, 1988: 161-199; Achituv and Dubinsky, 1990; Montgomery, 1990; Stanley, 1995: 15; Diegues *et al.*, 1995: 73; Hurtado, 1995: 133).

11.2B1 Coral reef flat communities
Communities occupying the flat, or platform, of coral reefs, more or less plane upper plateau of the reef covered by shallow water, subjected to emersion and sediment accumulation.
(Barnes and Hughes, 1988: 161-199).

11.2B2 Coral reef crest communities
Communities occupying the seaward fringe of the flat of windward coral reefs, comprising the reef crest proper, which usually raises just above low spring tide level, as well as the moat, boulder zone and gravel tongues, which may form landwards of the crest, and the groove-spur system, which forms seawards of the crest. Each of those features support distinctive communities which vary geographically.
(Barnes and Hughes, 1988: 161-199).

11.2B3 Coral reef slope communities
Communities occupying the seaward slope of coral reefs, organized zonally according to depth, with distinct series for windward and leeward reefs, as well as geographical variants.
(Barnes and Hughes, 1988: 161-199).

11.3 Seagrass beds

Beds of submerged marine vascular vegetation of the oceans, seas and coastal lagoons, except those of brackish seas and lagoons. In South America they are limited to the Caribbean coast and its islands and to the Chilean coast.
(Good, 1974: 256, plate 15; Heywood, 1978; Barnes and Hughes, 1988; Lüning and Asmus, 1991: 10; Dawes *et al.*, 1991: 223-228; Stanley, 1995: 16).

11.31 *Heterozostera* beds
Beds of the Zosteraceae *Heterozostera* of coastal Chile.
(Heywood, 1978: 276).

11.32 Caribbean Cymodoceaceae beds
Beds of *Halodule*, in particular, *Halodule wrightii*, and of *Syringodium filiforme*, Cymodoceaceae with narrow, grass-like leaves, limited in South America to Caribbean shores.
(Heywood, 1978: 277; Gonzalez, 1978: 91; Britton and Morton, 1989: 182, 185-186; Dawes *et al.*, 1991: 223-228; Stoffers, 1993: 409; Stanley, 1995: 16).

11.321 *Halodule* beds
Beds of shoal grass, *Halodule wrightii*, characteristic of estuaries with moderate salinities of the Caribbean coast, but also occurring in open coastal waters, on shoals and tidal flats.

(Heywood, 1978: 277; Gonzalez, 1978: 91; Britton and Morton, 1989: 182, 185-186; Dawes *et al.*, 1991: 223-228; Stanley, 1995: 16).

11.322 *Syringodium* beds

Beds of manatee grass, *Syringodium filiforme*, characteristic of Caribbean open coastal waters of stable salinities, often accompanied by *Halophylla engelmanni* as an understorey.
(Heywood, 1978: 277; Gonzalez, 1978: 91; Britton and Morton, 1989: 182, 185-186; Dawes *et al.*, 1991: 223-228; Stanley, 1995: 16).

11.33 Caribbean Hydrocharitaceae beds

Beds of the marine Hydrocharitaceae *Halophila engelmannii* and *Thalassia testudinum* of the Caribbean coasts of South America.
(Britton and Morton, 1989; Dawes *et al.*, 1991: 223-228; Stoffers, 1993: 409).

11.331 Caribbean *Halophila* beds

Beds of the deep-sea Hydrocharitaceae *Halophila engelmanni*, with long rhizomes and rosettes of leaves borne on short stems, mostly forming as an understorey of *Syringodium filiforme* or *Thalassia testudinum* beds.
(Britton and Morton, 1989: 185-186; Dawes *et al.*, 1991: 223-228).

11.332 Caribbean *Thalassia* beds

Beds of the marine Hydrocharitaceae *Thalassia testudinum*, turtle grass, with strap-like broad, flattened leaves, forming extensive offshore meadows from the intertidal region to depths of about 30 metress.
(Gonzalez, 1978: 91; Britton and Morton, 1989: 185-187; Dawes *et al.*, 1991: 223-228; Stanley, 1995: 16).

11.4 Marine Ruppia and Zannichellia beds

Submerged beds of *Ruppia* (*Ruppia maritima*, *Ruppia cirrhosa*, *Ruppia filifolia*) or *Zannichellia palustris*, widespread along temperate and tropical coasts of South America, mostly in brackish waters of sea inlets, estuaries, permanent pools of mud or sand flats, and coastal lagoons, sometimes also in saline waters, especially in mangrove swamps.
(Wiggins and Porter, 1971; Gonzalez, 1978: 91; Moore, 1983; Dawes *et al.*, 1991: 224).

11.5 Sea ice

Ice formations floating on sea water, usually constituting an incomplete cover, variable in form and structure, unstable and dynamic under the influence of surface air and water currents. South America, as here defined, is outside of the zones of permanent ice pack, seasonal ice pack or drifting polar icebergs. Sea ice occurrence is limited to glacier icebergs, floating and drifting blocks of ice detached from coastal glaciers (63.3).
(Armstrong and Roberts, 1956; Hood, 1983; Kullenberg, 1983).

Bays and narrow channels of the oceans and their connected seas, including sea lochs or loughs, fiords or fiards, rias and straits but excluding estuaries and lagoons. Detailed habitats can be coded by combining subdivisions of prefix 11 with the relevant physiographic subdivisions of 12.
(Wood, 1988; Hurtado, 1995: 132-133; Diegues *et al.*, 1995: 72-73).

12.1 Open linear coasts

More or less straight coasts, devoid of deep indentations, characteristic of concordant coasts, of soft-sediment coastlines, and of the contour of isolated promontories.
(Clark, 1990).

12.2 Semienclosed coasts

Coastlines of wide, curved indentations of the sea into the land, with a wide or fairly wide opening, including bays and gulfs.
(Clark, 1990).

12.3 Sounds and straits

More or less narrow stretches of water connecting two larger bodies of water; channels between islands and the mainland.
(Clark, 1990).

12.4 Enclosed enbayments

Bodies of water, such as coves, communicating with the sea by a relatively narrow but unobstructed opening.
(Clark, 1990).

12.5 Fiords, fiards, sea lochs

Sea inlets dug by glacial action, usually characterized by the presence of an entrance moraine.
(Wood, 1988; Clark, 1990).

12.51 Fiords, fiordic lochs
Deep, long, narrow inlets in the coast, with high, rocky, parallel sides, smoothed by ice action, and a rocky floor often deeper than the sea floor and separated from it by a sill near the entrance, formed by the submergence of glacial valleys.
(Wood, 1988; Clark, 1990).

12.52 Fiards, fiardic lochs
Irregular, often branched or islet-studded, shallow or deep, inlets in the coast, with low banks and a usually narrow entrance.
(Wood, 1988; Clark, 1990).

12.53 Open sea lochs

Sea inlets of glacial origin, communicating more broadly with the sea than fiords or fiards and lacking a shallow entrance sill.
(Ketchum, 1983; Wood, 1988).

12.6 Rias, voes, abers

Funnel-shaped sea inlets formed, in particular, by drowned river valleys, particularly along discordant coasts, as a result of a rise in sea-level.
(Wood, 1988; Clark, 1990).

12.7 Sea-caves

Caves situated under the sea or opened to it, at least at high tide.

12.71 Submerged sea-caves

Sea-caves situated entirely below low-tide level.

12.72 Complex sea-caves
Sea-caves situated in part above low-tide level, comprising mediolittoral, and, in some cases, supralittoral, communities; they may be in contact with, or grade into, terrestrial caves (65), and contain sand or pebble beaches (units 12.72: 16.1, 12.72: 17).

Broadening of rivers entering the oceans or their connected seas and river channels below the tidal limit. Included are all marine or marine-related pelagic and benthic communities, which can be precised by subdivisions of 11, and all river course and river bed communities, which can be precised by subdivisions of 24. The belts of fringing vegetation are excluded and indicated separately by use of 53, 44, 15 and their subdivisions.
(Koepcke, 1961: 122-123; Ketchum, 1983).

13.1 Tidal rivers

Portions of rivers subject to the tide, upstream from the estuary.

13.11 Brackish water tidal rivers
Brackish portions of rivers subject to the tide, upstream from the estuary.

13.12 Freshwater tidal rivers
Freshwater sections of rivers subject to the tide.

13.2 Estuaries

Broadening of rivers entering the sea. Detailed habitats can be coded by combining subdivisions of prefix 11 with the relevant physiographic subdivisions of 13.2.
(Koepcke, 1961: 122-124; Ketchum, 1983; Dijkema *et al.*, 1984; Britton and Morton, 1989; Santelices, 1991: 359-361).

13.21 Coastal plain estuaries
River-dominated, allochthonous deltaic estuaries formed by rivers accumulating sediments beyond the river mouth, often complex and constituted by many channels, with a salt wedge in the main channel; they are characteristic of microtidal shorelines.

13.22 Bar-built estuaries
Wave- and current-dominated autochthonous estuarine systems constituted by shallow, often extensive, embayments separated from the sea by offshore bars of current-transported sand and with a very reduced tidal range; they are characteristic of mesotidal shorelines.

13.23 Complex estuaries, firths
Composite river- and sea-dominated estuarine systems, including estuaries of macrotidal shorelines, subjected to tide-currents, devoid of protective littoral bars, and often accompanied by very developed tidal flats.

Extensive, flat or nearly flat, surfaces of sands, muds or rocks of the coasts of the oceans, their connected seas and associated lagoons, submerged for part of every tide or for part of the annual cycle, devoid of terrestrial vascular plants. They are of particular importance as feeding grounds for wildfowl and waders. The diverse intertidal communities of invertebrates and algae that occupy them can be precised by use of the subdivisions of 11.27 to 11.2A, phanerogamic marine vegetation communities that may be exposed for a few hours in the course of every tide by use of those of 11.3, brackish water vegetation of permanent pools by use of those of 11.4.

14.1 Mud flats and sand flats

Sands and muds of the coasts of the oceans, their connected seas and associated lagoons, submerged for part of every tide or for part of the annual cycle, devoid of terrestrial vascular plants, but usually coated by blue algae and diatoms. They are particularly well developed on the Pacific coast of South America between 38° S and 45° S, in the large bays of the Atlantic coast of the La Plata-northern Patagonian region and on the Atlantic coast of Tierra del Fuego, and along some tropical coasts, among others, that of French Guiana. *Enteromorpha spp.*, *Gracilaria spp.*, *Uva spp.*, polychaetes and mussels are characterisgtic elements of the invertebrate fauna.
(Murphy, 1936: 189-190; Devillers and Terschuren, 1976; Devillers, 1977; Santelices, 1991: 359; Tostain *et al.*, 1992: 12; Diegues *et al.*, 1995: 74).

14.2 Intertidal rock pavements

Bedrock platforms or terraces washed by the tides, in particular, Patagonian and Chilean restingas, broad wave-cut rock platforms situated in the intertidal zone, but nearer low tide, with a more or less plane surface, rough in detail, dotted by tidepools.
(Murphy, 1936: 195-190; Devillers and Terschuren, 1976; Santelices, 1991).

15. SALTMARSHES, SALT STEPPES, SALT SCRUBS

Communities of phanerogamic plants, for the most part halophytes, colonizing sites submerged by high tides at some stage of the annual tidal cycle of oceans and their connected seas. Similar halophyte communities colonizing the fringes and emersed beds of inland permanent or temporary saline, hypersaline or brackish waterbodies, including lakes, pools, salines, salares, rivers, springs, seeps. By extension, azonal, strongly differentiated, communities developing on habitually dry, alkali, chlorid or gypseous soils of the equatorial, humid or semihumid tropical, middle Chilean mediterranean, warm temperate, nemoral, steppe, subantarctic and high Andean zones. Zonal communities of the desert and semidesert areas, composed, to varying degrees, of halophytes or gypsophytes, are listed under 7.
Some saline communities with strong physionognomic similarity to fresh water ones into which they may merge, have been listed in other sections, together with their freshwater counterparts; it is the case in particular of tall helophyte beds (53). Halophile forest communities have been listed with other forests in 4; in particular, mangrove forests and thickets are in 4C.
(Koepcke, 1961: 121-122, 147-149; Vervoorst, 1967; Hueck and Seibert, 1972: units 34 p., 51, 64-67, 69 p., 85, 88; Chapman, 1975: 13-14, 16, 20; Steers, 1977; Chapman, 1977; West, 1977; Adam, 1990; Walter and Breckle, 1991b, 1991c).

15.1 Temperate coastal saltmarshes

Salt meadows and salt scrubs of the coasts of the temperate regions of South America, including those of Tierra del Fuego and its archipelago, of Patagonia, the Pampas and their northern transition zones, of the Chilean Fjordland, Chiloe Island, Valdivian and mediterranean Chile, north to Coquimbo at 29° 20' S, of the Juan Fernandez Islands.
(West, 1977; Diegues *et al.*, 1995: 74; Hurtado, 1995: 134).

15.11 Temperate coastal saltscrubs
Scrubby formations of saltmarshes, salt basins and their immediate vicinity, in the coastal regions of temperate South America, for the most part swards of suffrutescent, woody-based, creeping perennial species of *Salicornia s. l.* (*Arthrocnemum*, *Sarcocornia*).
(Vervoorst, 1967: 126-136; West, 1977; Devillers, 1977; Moore, 1983: 31, 93).

15.111 Magellanic coastal saltscrubs
Scrubby formations of saltmarshes of the Fuegian, Chilean archipelagic and Patagonian coasts of South America, north, on the Atlantic coast to Peninsula Valdes, and on the Pacific coast to the Gulf of Corcovado.
(Hauman, 1926; Oberdorfer, 1960: 153; West, 1977: 195-196; Moore, 1983; Adam, 1990: 176-177; Santelices, 1991: 347-351).

15.1111 Magellanic coastal *Lepidophyllum* scrub
Lepidophyllum cupressiforme-dominated formations of saline or moderately saline coastal sands, within reach of the highest tides, of southern Patagonia and northern Tierra del Fuego.
(Hauman, 1926: 116-118; West, 1977: 195-196; Moore, 1983: 25; Adam, 1990: 177).

15.1112 Magellanic coastal *Salicornia* scrubs
Carpets of low, shrubby, perennial *"Salicornia" virginica s. l.*, (*Salicornia ambigua*, *Salicornia magellanica*, *Salicornia doeringii*) of coastal saltmarshes, developed near or below highwater mark on sandy or silty shores of northern Tierra del Fuego, Patagonia and archipelagic Chile.
(Hauman, 1926: 117-118; Oberdorfer, 1960: 153; West, 1977: 195-196; Moore, 1983: 31, 93; Adam, 1990: 176).

15.1113 Magellanic coastal *Suaeda* scrubs
Salt scrubs dominated by perennial seablites, *Suaeda divaricata*, *Suaeda argentinensis* (*Suaeda fruticosa*), on sandy or clayey substrates of coastal saltmarshes of northern Tierra del Fuego, Patagonia and archipelagic Chile, with *Atriplex montevidensis*, *Atriplex lampa*, *Atriplex ameghinoi*, *Frankenia patagonica*.
(Hauman, 1926: 108, 113; Moore, 1983: 93; Adam, 1990: 176).

15.1114 Magellanic coastal *Frankenia* scrubs
Shrub formations dominated by *Frankenia patagonica*, *Frankenia microphylla*, *Frankenia chubutensis*, with , *Polygonum maritimum*, *Chenopodium macrospermum* (*Chenopodium rubrum*) of northern Tierra del Fuego, Patagonia and archipelagic Chile.
(Hauman, 1926: 119; West, 1977: 195; Moore, 1983: 107; Adam, 1990: 176).

15.1115 Magellanic coastal *Baccharis* salt scrubs
Shrub formations of the upper saltmarshes of Tierra del Fuego, Patagonia and archipelagic Chile dominated by *Baccharis magellanica*.
(Adam, 1990: 176).

15.1116 Magellanic coastal *Azorella* salt scrubs
Shrub formations of the upper saltmarshes of Tierra del Fuego, Patagonia and archipelagic Chile dominated by the cushion plant *Azorella caespitosa*.
(Adam, 1990: 176).

15.112 Atlantic temperate coastal saltscrubs
Scrubby formations of woody perennial *"Salicornia" virginica* (*Salicornia ambigua*) of saltmarshes of the Pampa, Espinal and Monte coasts of Atlantic South America, in particular, of the cangrejales of the large bays and estuaries of Argentina, harbouring colonies of the endemic gull *Larus atlanticus*.
(Vervoorst, 1967: 130; West, 1977; Leon *et al.*, 1979; Devillers, 1977; Adam, 1990: 180).

15.113 Pacific temperate coastal saltscrubs
Scrubby formations of woody perennial *"Salicornia" virginica* (*Salicornia ambigua*, *Salicornia "fruticosa"*, *Sarcorcornia "fruticosa"*) of saltmarshes of the northern temperate coasts of Pacific South America, including the Juan Fernandez archipelago.
(Skottsberg, 1922a: 121; Skottsberg, 1953a: 923; Oberdorfer, 1960: 43).

15.12 Temperate coastal salt meadows
Perennial communities of coastal saltmarshes of temperate South America, dominated by low or medium grasses or graminoid species in particular by species of genus *Puccinellia* (*Puccinellia magellanica*, *Puccinella glaucescens* var. *osteniana*) or *Spartina spp*.
(Vervoorst, 1967; West, 1977; Cabrera and Zardini, 1978; Leon *et al.*, 1979; Moore, 1983: 31; Adam, 1990: 180).

15.121 *Spartina* coastal salt meadows
Perennial communities of coastal saltmarshes of temperate South America dominated by *Spartina densiflora* (*Spartina montevidensis*), *Spartina alterniflora* (*Spartina brasiliensis*) or *Spartina longispica*, well-developed in particular on the cangrejales of the large bays and estuaries of the Pampa, Espinal and Monte coasts of Argentina, of more limited occurrence on the Pacific coast and in Patagonia.
(Hauman, 1926: 108-109, 119; Vervoorst, 1967: 137-139; Chapman, 1977: 7, 9; West, 1977: 196-197; Cabrera and Zardini, 1978; Leon *et al.*, 1979; Adam, 1990: 171, 180).

15.1211 *Spartina alterniflora* coastal salt meadows
Spartina alterniflora (*Spartina brasiliensis*)-dominated saltmarsh meadows of temperate South America, in particular of the cangrejales of the large bays and estuaries of the Pampa, Espinal and Monte coasts of Argentina and of Uruguay.
(Vervoorst, 1967: 137-139; West, 1977: 195-197; Cabrera and Zardini, 1978: 118).

15.1212 *Spartina densiflora* coastal salt meadows
Spartina densiflora (*Spartina montevidensis*, *Spartina patagonica*)-dominated saltmarsh meadows of temperate South America, occupying, along the coasts of Uruguay and the Pampa, Espinal and Monte coasts of Argentina, drier, less salty, more landward sites than *Spartina alterniflora*, forming large stands in particular in the La Plata estuary, in Bahia de Samborombon, at the mouth of the rios Salado, Samborombon and Ajo, in Bahia Blanca and in Bahia Anegada, with local occurrences in the tidal marshes of central Chile, in particular near Puerto Montt, Corral and Valdivia, as well as on the coast of Patagonia, in the regions of the Gulf of San Jorge, Puerto Deseado, of San Julian and of Rio Gallegos. Occurrences in Patagonia, from Puerto Deseado south, and in Valdivia, are referred to *Spartina densiflora* var. *patagonica* (*Spartina patagonica*).
(Hauman, 1926: 108-109, 111, 116-118; Vervoorst, 1967: 137-139; West, 1977: 196-197; Cabrera and Zardini, 1978: 6, 118; Hurtado, 1995: 134).

15.1213 *Spartina longispica* coastal salt meadows
Spartina longispica-dominated saltmarsh meadows of estuaries of temperate South America, in particular of the coast near the mouth of the Rio de la Plata.
(Cabrera and Zardini, 1978: 118).

15.122 *Puccinellia* coastal salt meadows
Perennial communities of coastal saltmarshes dominated by or rich in *Puccinellia magellanica* or *Puccinellia glaucescens* var. *osteniana* of temperate South America.
(Vervoorst, 1967: 130; Cabrera and Zardini, 1978; Moore, 1983: 31).

15.1221 Southern *Puccinellia* coastal salt meadows
Perennial communities of coastal saltmarshes dominated by *Puccinellia magellanica*, with *Suaeda argentinesis*, *Plantago barbata*, *Plantago maritima*, of temperate South America, in particular occupying sandy-silty shores of northern Isla Grande.
(Moore, 1983: 31).

15.1222 Pampa *Puccinellia* coastal salt meadows
Perennial communities of coastal saltmarshes of the Pampas, in particular of the Bahia Samborombon coast, rich in *Puccinellia glaucescens* var. *osteniana*, accompanied by *Distichlis spicata*, *Cotula coronopifolia*, *Salicornia ambigua*, *Triglochin striata*.
(Vervoorst, 1967: 130; Cabrera and Zardini, 1978).

15.123 *Distichlis* coastal salt meadows
Communities dominated by *Distichlis spp.*, notably *Distichlis spicata* and *Distichlis scoparia*, of coastal saltmarshes of the temperate coasts of South America, in particular of the Pampa coast of Argentina.
(Vervoorst, 1967: 137-139; West, 1977: 196).

15.124 *Sporobolus* coastal salt meadows
Communities dominated by *Sporobolus* species, notably *Sporobolus poiretii*, *Sporobolus platensis*, *Sporobolus pyramidatus*, of coastal saltmarshes of the temperate coasts of South America, in particular of the Pampa coast of Argentina.
(Vervoorst, 1967: 137-139).

15.125 Coastal *Juncus* salt meadows
Salt meadows of the pampa coast of Argentina and Uruguay dominated by the large hemispheric tuft-forming *Juncus acutus* var. *leopoldii*.
(Vervoorst, 1967: 136-137; Walter, 1968: 701; West, 1977: 195-196; Cabrera and Zardini, 1978: 6).

15.13 Temperate coastal *Limonium* marshes
Saltmarsh communities of coastal sands of temperate South America dominated by rosette-forming *Limonium brasiliense*.
(West, 1977: 196; Chapman, 1977; Cabrera and Zardini, 1978).

15.14 Temperate coastal salt annual communities
Formations composed mostly or predominantly of annuals, in particular Chenopodiaceae of genus *Suaeda* (*Suaeda patagonica*) or grasses, colonizing periodically inundated muds and sands of marine saltmarshes of temperate South America.
(Hauman, 1926: 119; West, 1977: 196; Moore, 1983: 93).

15.15 Temperate coastal nitro-halophile communities
Communities of perennial herbs, shrubs or annuals colonizing nitrified dry saline soils of the temperate zone of South America, in particular, *Chenopodium antarcticum* communities of northern Tierra del Fuego and southern continental Patagonia, characteristic of the vicinity of island bird colonies.
(Pisano, 1971a: 82).

15.2 Mediterraneo-Chilean interior salt communities

Hygro-halophile and xero-halophile scrub or grassland communities of inland regions of the mediterranean zone of Pacific South America.
(Gajardo, 1994).

15.21 Mediterraneo-Chilean *Atriplex-Frankenia* community
Hygro-halophile community dominated by *Atriplex philippii* and *Frankenia salina*, endemic to the edges of the saline laguna de Batuco, in the metropolitan Santiago area of the Central Valley of Chile.
(Gajardo, 1994: unit 3B63).

15.22 Mediterraneo-Chilean *Tessaria* salt scrubs
Hygro-halophyle shrub communities of mediterranean Chile dominated by *Tessaria absinthioides*, distributed in the coast ranges from Coquimbo to Maulin and in the interior valley from Ovalle to Santiago, colonizing, in particuar, alluvions in the bottom of large ravines and the edges of lagoons and temporary watercourses in conditions of high salinity; the cortège includes *Baccharis pingraea* or *Pleocarphus revolutus* accompanied by *Cortaderia selloana*, *Frankenia chilensis*, *Cotula coronopifolia*, *Distachlis spicata*, *Psoralea glandulosa*, *Selliera radicans*.
(Gajardo, 1994: units 3A1-3A23, 3A2-3A23, 3B5-3B57, 3B7-3B57, 3C10-3B57, 3C13-3B57, 3C14-3B57).

15.3 Temperate salt steppes and inland saltmarshes

Hygro-halophile and xero-halophile scrub or grassland communities of interior regions of the temperate steppe zones of South America, including the Patagonian steppe zone and the Pampa region. Near-coastal xero-halophile communities are included but truly coastal saltmarshes are listed in unit 15.1.

15.31 Fuego-Patagonian inland saltmarshes and salt steppes
Halophyte communities of inland salt basins of the Patagonian steppe zone of northern Tierra del Fuego and southern continental Patagonia.
(Moore, 1983: 25).

15.311 Fuego-Patagonian *Puccinellia* inland saline grasslands
Grassland communities of the Patagonian steppe zone of northern Tierra del Fuego and southern continental Patagonia, forming on vernally wet saline soils, dominated by *Puccinellia spp.*, in particular *Puccinellia biflora* and *Puccinellia magellanica*, with *Arjona pusilla*, *Chenopodium antarcticum*, *Myosurus patagonicus*, *Plantago barbata* and *"Salicornia" virginica* (*Salicornia ambigua*).
(Moore, 1983: 25).

15.312 Fuego-Patagonian *Eriachaenium* inland saline communities
Open communities of the northern Fuegian and southern Patagonian steppe zone installed on saline soils in situations which are moist or wet for a longer period than those of 15.21, in particular around pools and lakes, dominated by the prostrate, fleshy composite *Eriachaenium magellanicum*, with *Colobanthus quitensis*, *Suaeda argentinensis* and *Triglochin concinna*.
(Moore, 1983: 25).

15.313 Fuego-Patagonian inland *Salicornia* scrubs
Woody perennial *"Salicornia" virginica s.l.* (*Salicornia ambigua*) scrubs of inland salt basins of the Patagonian steppe zone of northern Tierra del Fuego and southern continental Patagonia.
(Moore, 1983: 93).

15.32 Pampa salt steppes and saltmarshes
Salt steppes and saltmarsh herbaceous, suffrutescent or frutescent communities integrated within the Pampa steppe (34.1) zone, developed under warm temperate, subhumid climates around the Rio de la Plata and the lower reaches of the Parana and the Uruguay rivers, between 28° S and 38° S. They are most characteristic of the flooding pampa, where more than 60% of the soils are halo-hydromorphic, most commonly solonetz, and of depressions and floodplains of the eastern inland pampa, more infrequent in the rolling pampa.
(Vervoorst, 1967: 126-136; Walter, 1968: 699-703; Cabrera and Zardini, 1978: 5-6; Soriano *et al.*, 1992: 374, 378, 382-384).

15.321 Pampa saline steppes
Low, sparse steppic grasslands of halomorphic soils of the pampas, common in particular in the flooding pampa, dominated by *Distichlis spicata* and *Distichlis scoparia* accompanied by the grasses *Hordeum stenochachys*, *Puccinellia glaucescens*, *Sporobolus pyramidatus*, *Monerma cylindrica*, *Chloris berroi*, *Chloris canterai*, *Chaetotropis elongata*, *Paspalum vaginatum*, *Diplachne uninervia* and herbs, notably *Lepidium parodii*, *Petunia parviflora*, *Sida leprosa*, *Sisyrinchium platense*, *Spergularia villosa*, *Heliotropium curassvicum*, *Grindelia discoidea*.
(Vervoorst, 1967: 126-136; Walter, 1968: 699-703; Cabrera and Zardini, 1978: 5-6; Soriano *et al.*, 1992: 382-384).

15.322 Pampa hygrosaline meadows
Graminoid communities of the Pampas region of South America developed on marshy saline soils.
(Walter, 1968: 701; Cabrera and Zardini, 1978: 6; Soriano *et al.*, 1992: 383-384).

15.3221 Pampa *Spartina* saline meadows
Hygro-halophile grassland of the South American pampas dominated by *Spartina montevidensis* (*Spartina densiflora*), with *Distichlis spicata*, *Chloris halophila*, *"Salicornia" virginica* (*Salicornia ambigua*), *Cressa truxillensis*, *Sesuvium portulacastrum*, *Atriplex hastata*, *Limonium brasiliense*.
(Walter, 1968: 701; Cabrera and Zardini, 1978: 6; Soriano *et al.*, 1992: 383-384).

15.3222 Pampa *Juncus acutus* saline meadows
Hygro-halophile communities of the South American pampas dominated by the large hemispheric tuft-forming *Juncus acutus* var. *leopoldii*, sometimes accompanied by *Limonium brasiliense*, *Pratia hederacea*, *Centaurium pulchellum*, *Hydrocotyle bonariensis*, *Stenotophrum secundatum*, *Androtrichum trigynum*, *Distichlis spicata*, *"Salicornia" virginica* (*Salicornia ambigua*, *Cynodon dactylon*, forming sometimes very extensive belts around brackish and saline depressions, particularly in the flooding pampa.
(Vervoorst, 1967: 136-137; Walter, 1968: 701; Cabrera and Zardini, 1978: 6; Soriano *et al.*, 1992: 382-384).

15.323 Pampa salt scrubs
Shrubby formations occupying sandy solontshak soils of the banks of strongly chloride- and sulphate-brackish pools of the pampa region of Argentina, characteristic, in particular, of the inland pampa, in the Rio Salado basin and in southern Santa Fe, dominated by woody perennial *"Salicornia" virginica* (*Salicornia ambigua*) with *Sesuvium portulacastrum* and *Suaeda patagonica*.
(Vervoorst, 1967: 136-137; Walter, 1968: 700-701).

15.4 Desert and semidesert hygro-halophile communities

Hygro-halophile scrub, grassland or herbaceous pioneer communities of the deserts and semideserts of South America, including the cool Patagonian deserts and semideserts, the subtropical Monte deserts and semideserts and the Pacific Peruvian-Chilean west coast deserts. Hygro-halophile sedge, grass and forb communities of the high Andean Puna deserts and semideserts, very similar to nonsaline bofedales and vegas of the alti-Andean zone and of dry puna arroyos, are excluded and listed under unit 3C.1464. The xero-halophile communities of the Puna are listed under 72.25.

15.41 Patagonian desert hygro-halophile communities
Saltmarsh and wet saline meadow communities of the Patagonian deserts and semideserts, extending over most of the provinces of Santa Cruz and Chubut in Argentina, irradiating northwards in the Andean approaches of extreme western Rio Negro, Neuquen and Mendoza.
(Hauman, 1926: 134-135; Hueck and Seibert, 1972: units 64, 66, 67; Soriano *et al.*, 1983).

15.411 Patagonian desert hygro-halophile salt scrubs
Halophile shrub and subshrub communities forming on temporarily flooded saline soils of valley bottoms and around endoreic basins of the Patagonian deserts and semideserts.
(Hauman, 1926: 135; Soriano *et al.*, 1983: 452).

15.4111 Patagonian desert *Suaeda* scrub
Halophile communities forming on temporarily flooded saline soils of valley bottoms of the Patagonian deserts and semideserts dominated by the large halophytic shrub *Suaeda divaricata*.
(Soriano *et al.*, 1983: 452).

15.4112 Patagonian desert *Lepidophyllum* scrub
Often sparse shrublands developed on muddy coastal plains and around endoreic basins of the Santacruzian semideserts, dominated by *Lepidophyllum cupressiforme*.
(Hauman, 1926: 135; Soriano *et al.*, 1983: 451).

15.412 Patagonian desert hygro-halophile meadows
Graminoid-dominated halophile communities forming on temporarily flooded saline soils of valley bottoms and endoreic depression margins of the Patagonian deserts and semideserts.
(Hauman, 1926: 134-135; Soriano *et al.*, 1983: 444, 450).

15.4121 Patagonian desert *Distichlis* grasslands
Halophile communities forming on temporarily flooded saline soils of valley bottoms of the Patagonian deserts and semideserts, comprising *Distichlis scoparia*, *Distichlis australis*, *Distichlis spicata* with *Puccinellia skottsbergii*, *Nitrophila australis* var. *kunzei*, *Suaeda patagonica* var. *crassiuscula*, *Lycium repens*, *Eriachaenium magellanicum*.
(Hauman, 1926: 134-135; Soriano *et al.*, 1983: 444, 450).

15.4122 Patagonian desert hygro-halophile rush communities
Halophile communities forming on temporarily flooded saline soils of valley bottoms of the Patagonian deserts and semideserts dominated by *Juncus spp.*
(Soriano *et al.*, 1983: 450).

15.42 Monte hygro-halophile communities
Hygro-halophile communities of saline depressions, arroyos and inundatable alluvial fans of the Monte semideserts, differing from puna hygro-halophile communities by the absence of cushion plants, from the Chaco ones by the absence of tall cacti. Chenopod shrubs (*Suaeda divaricata*, *Allenrolfea spp.*, *Heterostachys spp.*), perennial grasses, annual pioneers dominate many of the communities.
(Hunziker, 1952: 176; Morello, 1958: 27-28, 124-129; Walter, 1968: 706-707; Hueck and Seibert, 1972: unit 51; Mares *et al.*, 1985; Schnell, 1987b: 40; Haene *et al.*, 1993: 10, 13).

15.421 Monte salt scrubs
Hygro-halophile communities of saline depressions (salares), arroyo banks (salitrales) and inundatable alluvial fans (barriales) of the Monte semideserts dominated by chenopod shrubs of genera *Suaeda*, *Allenrolfea*, *Heterostachys*, *Atriplex* or composite shrubs of genera *Tessaria* and *Baccharis*.
(Hunziker, 1952: 175; Morello, 1958: 27-28, 124-129; Roig, 1982: 77).

15.4211 Monte chenopod salt scrubs
Hygro-halophile communities of saline depressions (salares), arroyo banks (salitrales) and inundatable alluvial fans (barriales) of the Monte semideserts dominated by chenopod shrubs of genera *Suaeda*, *Allenrolfea*, *Heterostachys*, *Atriplex*.
(Morello, 1958: 27-28, 124-129).

15.42111 Monte *Suaeda* salt scrubs
Hygro-halophile communities of the Monte semideserts dominated by the tall chenopod shrub *Suaeda divaricata*, most characteristic of the edges of salares where it forms often pure thickets reaching arborescent stature, also developing in the landward belts of arroyo banks and the external periphery of barriales where *Suaeda divaricata* may associate with *Atriplex lampa* and *Larrea nitida*.
(Morello, 1958: 125-129; Kiesling *et al.*, 1994: 108).

15.42112 Monte *Heterostachys* salt scrubs
Hygro-halophile communities of the Monte semideserts dominated by the small chenopod shrub *Heterostachys ritteriana*, characteristic of the inner belts of salar communities.
(Morello, 1958: 125; Ragonese and Piccinini, 1977: 51; Kiesling *et al.*, 1994: 89).

15.42113 Monte *Allenrolfea* salt scrubs
Hygro-halophile communities of saline depressions of the Monte semideserts dominated by the large chenopod shrub *Allenrolfea vaginata*, characteristic, in particular, of salares of the northern part of the Monte, in the region of transition to the Chaco.
(Morello, 1958: 126; Kiesling *et al.*, 1994: 88).

15.42114 Monte *Atriplex* salt scrubs
Hygro-halophile communities of the Monte semideserts dominated by chenopod shrubs of genus *Atriplex*, in particular, the medium-sized *Atriplex lampa*, a Monte characteristic, alone or in association with *Suaeda divaricata*, characteristic of external belts of barriales, where it can cover vast surfaces, colonizing also the edges of salares and the external belts of the salitrales of arroyo banks. Other shrubby species of *Atriplex* can accompany or replace *Atriplex lampa*, in particular, *Atriplex argentina*, *Atriplex cordobensis*, *Atriplex spegazzinii* (*Atriplex flavescens*).
(Morello, 1958: 126-129; Ragonese and Piccinini, 1977: 53; Kiesling *et al.*, 1994: 104-105).

15.4212 Monte composite salt scrubs
Hygro-halophile scrubs, sometimes very dense and up to four metre tall, of saline watercourse banks of the cordilleran Monte, formed by the composite shrubs *Tessaria absinthioides*, *Baccharis salicifolia*, *Pseudobaccharis spartioides* and the tall grass *Cortaderia rudiuscula*.
(Hunziker, 1952: 175; Haene *et al.*, 1993: 13).

15.422 Monte salt meadow communities
Hygro-halophile grasslands of the Monte semideserts, characteristic, in particular, of arroyo banks (salitrales); accompanying shrubs include *Plectrocarpa rougesii*, *Plectrocarpa tetracantha*, *Cyclolepis genistoides*, *Baccharis salicifolia*, *Suaeda divaricata*, occasionally *Zuccagnia puncata*, *Prosopis alba*.
(Morello, 1958: 27-28, 127).

15.4221 Monte *Distichlis* salitrales
Hygro-halophile grasslands of the Monte, dominated by *Distichlis spicata*, alone or associated with *Nitrophila australis* and *Tessaria absinthioides*, characteristic of alkaline soils on arroyo sides.
(Morello, 1958: 127).

15.4222 Monte *Sporobolus* salitrales
Hygro-halophile grasslands of the Monte semideserts dominated by *Sporobolus pyramidatus* and *Sporobolus phleoides*, characteristic of saline arroyo sides.
(Morello, 1958: 127).

15.4223 Monte *Pappophorum* salitrales
Hygro-halophile communities of lightly saline soils on arroyo sides of the Monte semideserts formed by *Pappophorum mucronulatum*, *Eriochloa montevidensis*, *Chloris halophila*, *Polypogon monspeliensis*, *Cottea pappophoroides* and *Cynodon hirsutus*.
(Morello, 1958: 127).

15.4224 Monte *Sporobolus maximus* swamp pajonales
Tall hygro-halophile pajonal grasslands of swampy arroyo banks of the Monte semideserts dominated by *Sporobolus maximus*.
(Morello, 1958: 119; Burkart *et al.*, 1994: 22-23).

15.423 Monte salt pioneer communities
Pioneering hygro-halophile communities of the Monte semideserts, dominated by annuals or small perennial herbs, characteristic of the central part of barriales, saline inundatable alluvial fans, particularly developed in the southern sector of the Monte.
(Morello, 1958: 27-28, 128-129).

15.4231 Monte *Halophytum* communities
Pioneering hygro-halophile communities constituted by the annual *Halophytum ameghinoi*, forming the second internal vegetation belt of inundatable alluvial fans (barriales) of the Monte, in particular in Neuquen and La Rioja. The species is the only representative of the Halophytaceae, family endemic to Argentina, limited to the Monte and northern Patagonica.
(Morello, 1958: 129; Kiesling *et al.*, 1994: 110).

15.4232 Monte *Portulaca* communities
Pioneering hygro-halophile annual communities of *Portulaca echinosperma*, *Portulaca lanceolata*, *Portulaca oleracea* of the innermost vegetation belt of inundatable alluvial fans (barriales) of the Monte, in particular, in La Rioja.
(Morello, 1958: 129).

15.4233 Monte *Cressa* communities
Pioneering hygro-halophile communities of the Monte dominated by the small perennial Convolvulaceae *Cressa truxillensis*, forming the second vegetation belt of barriales of La Rioja, and the only vegetation in barriales of the Salar de Pipanaco, Catamarca.
(Morello, 1958: 129).

15.4234 Monte *Atriplex rosea-Bassia* communities
Pioneering hygro-halophile communities dominated by the introduced annual weeds *Atriplex rosea* and *Bassia hyssopifolia* occupying the central vegetation belt of barriales of the southern Monte, in particular in Neuquen.
(Morello, 1958: 128-129).

15.43 Pacific deserts hygro-halophile communities
Hygro-halophile communities of the salt basins and coastal saltmarshes of the Peruvian-Chilean coastal deserts and semideserts (74) and of the deserts and semideserts of the Peruvian and Chilean western slopes of the Andes, between about 1800 metres and 3500 metres (unit 73.2). Similar communities ascending into the western, desert, part of the Puna deserts and semideserts (unit 72.2). Communities of the vegas or bofedales of the dry Puna semideserts and of the alto-Andean levels, entirely characteristic of very high-altitude ecosystems and fairly homogeneous in plant composition and physiognomy in spite of being developed in conditions of varied salinity, often under the influence of fresh water seeps at the edge of saline basins, are united under unit 3C.
(Schmithüsen, 1956; Oberdorfer, 1960: 43; Koepcke, 1961: 141, 147-148; Hueck and Seibert, 1972, 1981: units 33, 69, 70, 68, 82; Rauh, 1985; Gajardo, 1994: units 1A41, 1A44, 1A51, 1B85, 1B121).

15.431 Pacific deserts hygro-halophile scrubs
Shrubby formations of coastal saltmarshes, the edges of salt basins and valleys with brackish groundwater of the Peruvian-Chilean coastal and western Andean deserts.
(Schmithüsen, 1956: 15; Koepcke, 1961: 141, 146-147; Hueck and Seibert, 1981: 54; Rauh, 1985: 246, 260; Gajardo, 1994: units 1A41, 1A44, 1A51, 1B85, 1B121).

15.4311 Sechura-Atacama *Salicornia* scrubs
Hygro-halophyte shrubby communities forming on the edges of salt basins and coastal lagoons of the Peruvian-Chilean coastal deserts, sometimes covering vast expanses in coastal areas of middle Peru, dominated by woody perennial *"Salicornia" virginica s.l.* (*Salicornia "fruticosa"*, *Sarcocornia fruticosa*).
(Oberdorfer, 1960: 43; Koepcke, 1961: 147; Hueck and Seibert, 1981: 54; Gajardo, 1994: units 1A4-1A44, 1C14-1A44, 1C15-1A44).

15.4312 Sechura *Batis-Salicornia* scrubs
Mixed halophyte formations developing on the edges of coastal lagoons of the Peruvian deserts, with the shrubs *Batis maritima* and *"Salicornia" virginica s.l.* (*Salicornia "fruticosa*", *Sarcocornia fruticosa*), the suffrutescents *Sesuvium portulacastrum* and *Cressa truxillensis* and grasses of genera *Distichlis* and *Sporobolus*; they are widespread in northern Peru with occasional southern occurrences, in particular around Pucusana and Mejia.
(Koepcke, 1961: 147; Rauh, 1985: 246).

15.4313 Sechura-Atacama *Tessaria* thickets
Hygro-halophile *Tessaria absinthioides*-dominated shrub communities of the Peruvian-Chilean coastal deserts, characteristic of sites under the influence of highly saline waters, in particular, the edges of salares, oases and quebradas, often also marking strong human perturbation; species typically comprising the cortège include *Distichlis spicata*, *Atriplex atacamensis*, *Baccharis juncea*, *Baccharis petiolata*.
(Schmithüsen, 1956: 15; Koepcke, 1961: 141; Gajardo, 1994: units 1A1-1A41, 1A2-1A41, 1A3-1A41, 1A4-1A41, 1C13-1A41, 1B8-1A41).

15.4314 Western Andean *Atriplex deserticola* hygro-halophile scrubs
Hygro-halophile shrub communities of the Peruvian-Chilean Tal-Tal, coastal sierras and western Andean deserts, developed along the edges of the rare waterholes, mostly in areas of fair altitude, extending to the high altitude desert Puna region of the Chilean Andean salares, where they colonize the edges of saline depressions and watercourses, dominated by *Atriplex deserticola* and *Lycium minutifolium*, with *Distichlis spicata*, *Acaena canescens*, *Adesmia atacamensis*, *Cryptantha gnaphalioides*, *Ephedra breana*.
(Gajardo, 1994: units 1A5-1A51, 1A6-1A51, 1B10-1A51, 2A6-1A51).

15.4315 Western Andean *Atriplex atacamensis* hygro-halophile scrubs
Hygro-halophile shrub communities of the Peruvian-Chilean western Andean deserts dominated by *Atriplex atacamensis*.
(Rauh, 1985: 260; Gajardo, 1994).

15.43151 Western Andean *Atriplex-Tessaria* scrubs
Hygro-halophile communities forming on the shores of permanent waterbodies of the Salar de Atacama and of the El Salvador desert, south and west of the Cordillera Domeyko, extending to the high altitude desert Puna region of the Chilean Andean salares, where they colonize the edges of saline depressions and watercourses, with *Atriplex atacamensis*, *Tessaria absinthioides*, *Baccharis juncea*, *Distichlis spicata*.
(Rauh, 1985: 260; Gajardo, 1994: units 1B11-1B121, 1B12-1B121, 2A6-1B121).

15.43152 Western Andean *Atriplex-Acantholippus* scrubs
Hygro-halophile community forming on the margins of waterholes of the western Andean deserts, in particular in the basin of the upper Loa and the Salar de Atacama, with *Atriplex atacamensis*, *Acantholippia trifida* (*Lippia trifida*), *Ephedra breana*, *Tessaria absinthioides*.
(Rauh, 1985: 260; Gajardo, 1994: units 1B8-1B85, 1B9-1B85, 1B10-1B85, 1B12-1B85, 1A2-1B85).

15.432 Sechura-Atacama *Distichlis* grasslands
Hygro-halophile grasslands of the coastal areas of the Peruvian-Chilean deserts dominated by *Distichlis spicata*, sometimes mixed with *Sporobolus spp.* or *Paspalum vaginatum*.
(Koepcke, 1961: 148-149).

15.433 Sechura-Atacama *Sesuvium* beds
Hygro-halophile communities of the coastal Peruvian-Chilean deserts, mostly restricted to coastal areas, dominated by the succulent Aizoaceae *Sesuvium portulacastrum*.
(Koepcke, 1961: 147).

15.44 Puna deserts hygro-halophile communities
Hygro-halophile communities of the high altitude deserts and semideserts of the southeastern part of the puna region of the southern tropical Andes, developed in very dry puna environments, constituted by dense evergreen waterlogged carpets of dwarf rhizomatous sedges, grasses and rushes, by tussocks of taller, more robust grasses, or sometimes by carpets of small forbs or ferns.
(Cabrera, 1958: 351-357; Cabrera, 1968: 100-102; Hueck and Seibert, 1972: units 84, 85; Walter and Breckle, 1991b: 165, C7; Junk, 1993: 717; Erize *et al.*, 1995: 156).

15.441 Puna *Distichlis* communities
Hygro-halophile communities of the puna rich in or dominated by *Distichlis humilis*.
(Cabrera, 1958: 351-355).

15.4411 Puna *Psila-Distichlis* communities
Hygro-halophile communities of the puna, characteristic of arroyo beds and the edges of salt basins, developed on very saline soils coated with salt efflorescenses, formed by dwarf rhizomatous species among which predominate the grass *Distichlis humilis* and the rosette composite *Psila caespitosa*, accompanied by the cushion-forming *Salicornia pulvinata* and *Anthobryum triandrum* (*Frankenia triandra*), as well as by *Juncus balticus* var. *mexicanus*, *Scirpus nevadensis*, *Scirpus atacamensis*, *Puccinellia hypsophila*, *Festuca hypsophila*, *Hypsela oligophylla*, *Triglochin maritima* var. *altoandina*, *Triglochin palustris*.
(Cabrera, 1958: 351-353; Morello, 1958: 125).

15.4412 Puna *Lycium-Distichlis* communities
Very sparse hygro-halophile communities of the puna developed on red soils on the edge of saline basins, constituted by *Distichlis humilis* and the prostrate Solanaceae *Lycium humile*.
(Cabrera, 1958: 355).

15.442 Puna *Festuca scirpifolia* communities
Hygro-halophile communities of the puna developed in arroyos, vegas and salt basins, on somewhat less saline and drier soils than those of unit 15.441, dominated by large isolated tussocks of *Festuca scirpifolia*, between which the soil can be bare, coated with white salt efflorescences, or support a carpet of *Distichlis humilis* or *Alchemilla pinnata*. Accompanying species include *Juncus balticus* var. *mexicanus*, *Hypochoeris meyeniana* var. *leucantha*, *Gentiana prostrata*, *Werneria solivaefolia*, *Baccharis caespitosa*, *Luciliopsis argentina*, *Colobanthus alatus*, the rare endemic orchid *Aa paludosa* and the large agaric mushroom *Stropharia coprophila*.
(Hunziker, 1952: 178-179; Cabrera, 1958: 353; Cabrera, 1968; Schnell, 1987b: 134-153; Johnson, 1992: 12-13; Haene *et al.*, 1993: 11, 15).

15.443 Puna *Sporobolus* communities
Hygro-halophile communities of the puna, developed on sandy, somewhat saline soils of the edges of salt basins and streams, dominated by the robust grass *Sporobolus rigens* f. *atacamensis*.
(Cabrera, 1958: 357).

15.444 Puna *Muhlenbergia* swards
Hygro-halophile communities of the puna, developed, in particular, in the middle belt of vegetation zones around ephemeral shallow saline waterbodies, constituted by a low, more or less continuous carpet of the grass *Muhlenbergia fastigiata* associated with the pygmy annual *Bouteloua simplex* and with *Muhlenbergia atacamensis*, *Trifolium amabile*, *Dichondra argentea*, *Astragalus bustillosii*, *Astragalus micranthellus*, *Ipomoea minuta*, *Hypochoeris meyeniana*.
(Cabrera, 1958: 353-355; Junk, 1993: 717).

15.445 Puna *Gamochaeta* communities

Hygro-halophile communities of the puna, developed, in particular, in the upper belt of vegetation zones around ephemeral shallow saline waterbodies, characterized by the small perennial wooly composite *Gamochaeta deserticola*.
(Cabrera, 1958: 405; Junk, 1993: 717).

15.446 Puna *Marsilea* communities
Hygro-halophile communities of the puna, developed, in particular, in the lower belt of vegetation zones around ephemeral shallow saline waterbodies, characterized by the amphibious fern *Marsilea punae*.
(Junk, 1993: 717).

15.5 Chaco saltmarshes and salt thickets

Hygro-halophile and sometimes xero-halophile shrub-, grass- or forb-dominated communities of the Chaco and the Espinal. Individual, sometimes emergent, trees, in particular, tree-cacti of genus *Cereus*, leguminous trees of genus *Prosopis* or palms of genus *Copernicia*, may participate in the communities. Open or closed halophile woods or forests, are, however, excluded from this section and listed in 4B.
(Ragonese and Castiglioni, 1968; Hueck and Seibert, 1972, 1981: unit 34; Hueck, 1978: 260, 262, 263; Lewis and Pire, 1981; Mares *et al.*, 1985: 210; Schnell, 1987b: 32).

15.51 Chaco salt scrubs
Halophile communities of the Chaco and the Espinal dominated by often tall, succulent, shrubs, in particular, chenopods of genera *Allenrolfea*, *Heterostachys*, *Suaeda* and composites.
(Ragonese and Castiglioni, 1968; Hueck and Seibert, 1972, 1981: unit 34; Hueck, 1978: 260, 262, 263; Lewis and Pire, 1981; Mares *et al.*, 1985: 210; Schnell, 1987b: 32).

15.511 Chaco chenopod salt scrubs
Halophile low, medium-sized, tall or sometimes very tall scrubs and thickets of the Chaco and the Espinal dominated by chenopod shrubs of genera *Suaeda*, *Allenrolfea*, *Heterostachys*, *Atriplex*, *Salicornia s.l.* (*Arthrocnemum*, *Sarcocornia*).
(Ragonese and Castiglioni, 1968; Hueck and Seibert, 1972, 1981: unit 34; Hueck, 1978: 260, 262, 263; Lewis and Pire, 1981; Mares *et al.*, 1985: 210; Schnell, 1987b: 32).

15.5111 Chaco *Suaeda* salt scrubs
Halophile scrubs and thickets of the Chaco and the Espinal dominated by the tall chenopod shrub *Suaeda divaricata*, reaching a height usually of 2 metres, sometimes of 6 metres, developing, in particular, in a belt between salares and halophile woods of *Prosopis* or *Cereus*.
(Ragonese and Castiglioni, 1968; Hueck and Seibert, 1972, 1981: unit 34; Hueck, 1978: 260, 262; Lewis and Pire, 1981; Mares *et al.*, 1985: 210; Schnell, 1987b: 32).

15.5112 Chaco *Heterostachys* salt scrubs
Halophile scrubs of the Chaco and the Espinal dominated by the small chenopod shrub *Heterostachys ritteriana*.
(Ragonese and Castiglioni, 1968; Hueck and Seibert, 1972, 1981: unit 34; Hueck, 1978: 260, 262, 263; Lewis and Pire, 1981; Schnell, 1987b: 32).

15.5113 Chaco *Allenrolfea* salt scrubs
Halophile scrubs of the Chaco and the Espinal dominated by chenopod shrubs of genus *Allenrolfea*.
(Ragonese and Castiglioni, 1968; Hueck and Seibert, 1972, 1981: unit 34; Hueck, 1978: 260, 262, 263; Lewis and Pire, 1981; Schnell, 1987b: 32; Kiesling *et al.*, 1994: 87-88).

15.51131 Chaco *Allenrolfea patagonica* salt scrubs
Halophile scrubs of the Chaco and the Espinal dominated by the small to medium sized chenopod shrub *Allenrolfea patagonica*.
(Ragonese and Castiglioni, 1968; Hueck and Seibert, 1972, 1981: unit 34; Hueck, 1978: 260, 262, 263; Lewis and Pire, 1981; Schnell, 1987b: 32; Kiesling *et al.*, 1994: 87-88).
15.51132 Chaco *Allenrolfea vaginata* salt scrubs

Halophile scrubs of the Chaco and the Espinal dominated by the large chenopod shrub *Allenrolfea vaginata*.

(Ragonese and Castiglioni, 1968; Hueck and Seibert, 1972, 1981: unit 34; Hueck, 1978: 260, 262, 263; Lewis and Pire, 1981; Schnell, 1987b: 32; Kiesling *et al.*, 1994: 87-88).

15.5114 Chaco *Atriplex* salt scrubs
Halophile scrubs and thickets of the Chaco and the Espinal dominated by chenopod shrubs of genus *Atriplex*, in particular, *Atriplex cordobensis*.
(Ragonese and Castiglioni, 1968; Hueck, 1978: 260; Mares *et al.*, 1985: 210; Kiesling, 1994: 107).

15.5115 Chaco *Salicornia* salt scrubs
Halophile scrubs of the Chaco and the Espinal dominated by the woody perennial *"Salicornia" virginica* (*Salicornia ambigua*, *Sarcocornia perennis*).
(Lewis and Pire, 1981: 28-29; Kiesling, 1994: 87).

15.512 Chaco composite salt scrubs
Halophile scrubs and thickets of the Chaco dominated by composite shrubs of genera *Tessaria* or *Cyclolepis*.
(Ragonese and Castiglioni, 1968; Lewis and Pire, 1981).

15.5121 Chaco halophile *Tessaria* scrubs
Halophile scrubs and thickets of the eastern Chaco dominated by the composite shrub *Tessaria dodonaefolia*, characteristic, in particular, of interior deltas of arroyos.
(Ragonese and Castiglioni, 1968: 148; Morello *et al.*, 1971: 95).

15.5122 Chaco *Cyclolepis* salt scrubs
Halophile scrubs and thickets of the Chaco dominated by the composite shrub *Cyclolepis genistoides*, recorded, in particular, from the western Chaco, from the Santa Fe Chaco where it occupies, in association with *Baccharis salicifolia*, *Maytenus vitis-idaea*, flat-topped mounds in *Spartina* salt meadows, and from the Corrientes Chaco where it associates sporadically with *Prosopis-Aspidosperma-Copernicia* xero-halophile woodland.
(Ragonese and Castiglioni, 1968: 151; Lewis and Pire, 1981: 31; Carnevali, 1994: 89).

15.52 Chaco salt meadow communities
Halophile grasslands of the Chaco and the Espinal.
(Ragonese and Castiglioni, 1968; Lewis and Pire, 1981; Carnevali, 1994).

15.521 Chaco *Distichlis* meadows
Halophile grasslands of the Chaco dominated by *Distichlis spicata*, in particular, bordering lagoons of the Bajos Submeridionales of Santa Fe.
(Lewis and Pire, 1981: 23).

15.522 Chaco *Sporobolus* salitrales
Halophile grasslands of the eastern Chaco dominated by *Sporobolus pyramidatus*.
(Ragonese and Castiglioni, 1968: 148; Lewis and Pire, 1981: 24).

15.523 Chaco *Spartina* meadows
Hygro-halophile grasslands of the Chaco dominated by grasses of genus *Spartina*.
(Ragonese and Castiglioni, 1968; Burkart, 1969: 242; Morello and Adamoli, 1974: 43; Lewis and Pire, 1981: 11, 23-27, 29, 34; Carnevali, 1994: unit 15).

15.5231 *Spartina argentinensis* meadows
Seasonally inundated halophile grasslands of the eastern Chaco dominated by *Spartina argentinensis*, covering vast treeless expanses in the Bajos Submeridionales depression of Santa Fe, and in the Ibera depression and Santa Lucia alluvial plain of Corrientes, confined in adjacent regions to smaller basins, drainage rills and openings alternating with dry woodlands. In typical stands, *Spartina argentinensis* is almost alone in the upper layer and the grassland is punctuated by the mounds of the ant *Camponotus punctulatus*. Mixed *Spartina argentinensis-Elyonurus muticus* meadows are widespread in the transition between this unit and the tropical grasslands of units 3A.711 and 3A.721.

(Ragonese and Castiglioni, 1968; Burkart, 1969: 242; Morello and Adamoli, 1974: 43; Lewis and Pire, 1981: 11, 23-27, 29, 34; Carnevali, 1994: unit 15).

15.52311 Species-poor *Spartina argentinensis* meadows

Seasonally inundated halophile grasslands of the eastern Chaco formed by pure, dense stands of *Spartina argentinensis* with a very impoverished understorey, characteristic of terrain with extreme conditions of inundation and salinity.
(Lewis and Pire, 1981: 23-24; Carnevali, 1994: unit 15).

15.52312 Species-rich *Spartina argentinensis* meadows
Halophile grasslands of the eastern Chaco dominated by *Spartina argentinensis* accompanied by a relatively species-rich, varied, fairly continuous understorey of shorter grasses mixed with some sedges and forbs characteristic of less saline soils than those of 15.52311 and of 15.52313 with moderate to long periods of inundation. Accompanying species include *Paspalum lividum*, *Paspalum alcalinum*, *Paspalum serratum*, *Paspalum vaginatum*, *Paspalidium paludivagum*, *Echinochloa helodes* in the stands subjected to longer inundation, *Sporobolus indicus*, *Setaria geniculata*, *Eriochloa montevidensis*, *Aster squamatus* in stands subjected to less prolonged periods of indundation, which have a denser *Spartina* stratum and a more lacunar lower stratum.
(Lewis and Pire, 1981: 23-24).

15.52313 Halophyte-rich *Spartina argentinensis* meadows
Seasonally inundated halophile grasslands of the eastern Chaco dominated by *Spartina argentinensis* forming an open or patchy upper stratum accompanied by a sparse, lacunar lower stratum rich in succulent, rosette and graminoid halophytes, including the chenopods *"Salicornia" virginica* (*Salicornia ambigua*) and *Atriplex spp.*, the statice *Limonium brasiliense*, the Aizoaceae *Sesuvium portulacastrum*, the grass *Sporobolus pyramidatus*, characteristic of drier, more saline stations than those occupied by units 15.52311 and 15.52312.
(Lewis and Pire, 1981: 23-24).

15.5232 Chaco *Spartina densiflora* meadows
Uncommon hygro-halophile grasslands of the Chaco dominated by *Spartina densiflora* in almost pure stands, with the ground between the tufts bare or occupied by a carpet of *Paspalum vaginatum*, limited to small surfaces on damp soils near lagoons and along the edges of the Rio Salado in Santa Fe.
(Lewis and Pire, 1981: 25).

15.524 Chaco *Echinochloa* saline meadows
Hygro-halophile grasslands of the Chaco, characteristic of stations with very long periods of inundation and relatively low salinity, dominated by *Echinochloa elodes*, accompanied by *Paspalum lividum*, *Paspalum alcalinum*, *Paspalum serratum*, *Paspalidium paludivagum*, *Luziola peruviana*, *Leersia hexandra*.
(Lewis and Pire, 1981: 28).

15.525 Chaco *Paspalum* saline meadows
Short hygro-halophile grasslands of the Chaco, characteristic of clearings in *Spartina* or *Spartina-Elyonurus* grasslands and of the edges of lagunes with halophile clubrush beds or *Echinochloa* meadows, dominated by grasses of genus *Paspalum*, in particular, *Paspalum intermedium*, *Paspalum distichum*, *Paspalum vaginatum*.
(Lewis and Pire, 1981: 25, 28).

15.53 Chaco salt pioneer communities
Pioneering hygro-halophile communities of the Chaco dominated by annuals or small perennial herbs.
(Lewis and Pire, 1981: 28).

15.531 Chaco *Cressa* communities
Pioneering hygro-halophile communities of the Chaco dominated by the small perennial Convolvulaceae *Cressa truxillensis*. (Lewis and Pire, 1981: 28).

15.532 Chaco *Atriplex montevidensis* communities
Pioneering hygro-halophile communities dominated by the herbaceous *Atriplex montevidensis*.
(Lewis and Pire, 1981: 28).

15.6 Tropical coastal salt marshes

Formations of grasses, sedges, low shrubs or succulents colonizing coastal intertidal or inundatable salt flats of the Caribbean and Atlantic coasts of South America south to southern Brazil and of the Pacific coasts south to Ecuador, including those of the Galapagos Islands.
(Schnell, 1971: 841-842; Wiggins and Porter, 1971; Chapman, 1977; West, 1977: 197-198; Adam, 1990: 178-179; van der Werff and Adsersen, 1993; De Lacerda *et al.*, 1993).

15.61 Tropical coastal salt meadows
Communities of tropical coastal saltmarshes dominated by graminoid species, in particular, the grasses *Paspalum vaginatum*, *Sporobolus virginicus*, *Distichlis spicata*, *Spartina alterniflora* (*Spartina brasiliensis*) or the sedge *Cyperus laevigatus*.
(Schnell, 1971: 841-842; Wiggins and Porter, 1971: xv; West, 1977: 197-199; Adam, 1990: 179; van der Werff and Adsersen, 1993: 462; Junk, 1993: 718).

15.611 Tropical coastal *Spartina* meadows
Communities of tropical coastal saltmarshes dominated by *Spartina alterniflora* (*Spartina brasiliensis*).

(West, 1977: 197-198; Adam, 1990: 178-179; Junk, 1993: 718).

15.612 Tropical coastal *Sporobolus* meadows
Communities of tropical coastal saltmarshes dominated by *Sporobolus virginicus*.
(Wiggins and Porter, 1971: xv; West, 1977: 197-198; Adam, 1990: 179; van der Werff and Adsersen, 1993: 462).

15.613 Tropical coastal *Distichlis* meadows
Communities of tropical coastal saltmarshes dominated by *Distichlis spicata*.
(West, 1977: 197-198).

15.614 Tropical coastal *Paspalum* meadows
Communities of tropical coastal saltmarshes dominated by *Paspalum vaginatum*.
(West, 1977: 198, 199; Adam, 1990: 179).

15.615 Tropical coastal *Cyperus* swards
Communities of tropical coastal saltmarshes dominated by sedges of genus *Cyperus*, in particular, *Cyperus laevigatus*.
(Wiggins and Porter, 1971; van der Werff and Adsersen, 1993: 462).

15.62 Tropical coastal salt scrubs
Communities of tropical coastal saltmarshes dominated by shrubs, in particular, woody perennial *"Salicornia" virginica s.l.* (*Salicornia "fruticosa" s.l.*), *Batis maritima*, *Atriplex peruviana*, *Cryptocarpus pyriformis*.
(Wiggins and Porter, 1971: xv, 227; West, 1977: 197-198; Adam, 1990: 179; van der Werff and Adsersen, 1993: 462).

15.63 Tropical coastal salt thickets
Communities of tropical coastal saltmarshes dominated by large shrubs, in particular, *Hibiscus tiliaceus*, forming an often dense belt of thickets immediately inland from mangrove formations of the Brazilian and Guianan coasts, accompanied by the large fern *Acrostichum aureum*.
(West, 1977: 199; Hueck, 1978: 189; Schnell, 1987b: 259; Junk, 1993: 718).

15.64 Tropical saltmarsh succulent herb communities
Communities of tropical coastal saltmarshes dominated by succulent herbs, in particular, *Sesuvium portulacastrum*, *Philoxerus portulacoides*, *Philoxerus vermicularis*, *Alternanthera maritima*.

(Wiggins and Porter, 1971: xv; Adam, 1990: 179; van der Werff and Adsersen, 1993: 462; De Lacerda *et al.*, 1993: 479-480).

16. COASTAL SAND DUNES AND SAND BEACHES

Sand-covered shorelines of the oceans, their connected seas and associated coastal lagoons, fashioned by the action of wind or waves. They include gently sloping beaches and beach-ridges, formed by sands brought by waves, longshore drift and storm waves, as well as dunes, formed by eolian deposits, though sometimes refashioned by waves.
(Richards, 1952: 295-299; Vanden Berghen, 1964; Whittow, 1984; Soothill and Thomas, 1987; Schnell, 1987b: 261-266; Clark, 1990; Mayhew and Penny, 1992; van der Maarel, 1993b: 13-14; Archibold, 1995: 411-415; Diegues *et al.*, 1995: 74).

16.1 Foreshore sand beaches

Gently sloping sand-covered shorelines fashioned by wave action and under direct influence of average tides, occupying the foreshore, the part of the seashore comprised between the lowest low water line and the average high water line, as well as the immediately adjacent part of the backshore, near and above the high water mark, where driftlines form. They are colonized by very impoverished terrestrial species groups identified in the subdivisions of 16.1, as well as by mediolittoral and supralittoral species assemblies of marine origin listed under 11.27. The combination of the two ensembles describes the spatial habitat.
(Richards, 1952: 296-299; Vanden Berghen, 1964; Whittow, 1984; Soothill and Thomas, 1987; Schnell, 1987b: 261-263; Clark, 1990; Mayhew and Penny, 1992).

16.11 Temperate foreshore sand beaches
Foreshore sand beaches of the coasts of the temperate regions of South America, including those of Tierra del Fuego and its archipelago, of Patagonia, the Pampas and their transition zones along the Atlantic seaboard, of the Chilean Fjordland, Chiloe Island and Valdivian and mediterranean Chile on the Pacific seaboard.
(Hauman, 1926; Vervoorst, 1967; Moore, 1983; Pfadenhauer, 1993; Gajardo, 1994).

16.111 Temperate unvegetated sand beaches
Temperate sandy beaches devoid of phanerogamic vegetation, very prevalent, in particular, along pampa coasts. Mediolittoral (intertidal) and supralittoral invertebrate communities listed under 11.27 can be combined with 16.11 to record detailed habitats.
(Pisano, 1971a: 85; Pfadenhauer, 1993: 495-496).

16.112 Temperate sand beach pioneer communities
Formations mostly of annual nitro-halophytes occupying accumulations of drift material and sands rich in nitrogenous organic matter. *Chenopodium macrospermum*, *Chenopodium antarcticum*, *Descurainia antarctica*, *Draba australis*, *Daucus montanus* are annuals that colonize coastal sands, as are several introduced species, in particular, *Cakile maritima*.
(Oberdorfer, 1960: 153; Moore, 1983; Pfadenhauer, 1993: 496).

16.12 Desert foreshore sand beaches
Foreshore sand beaches of the coasts of the Peruvian-Chilean deserts and semideserts.
(Koepcke, 1961: 117-121; Hueck and Seibert, 1972: unit 72; van der Maarel, 1993d: 508; Gajardo, 1994: subregions 1A1, 1C13, 1C14, 1C15).

16.121 Unvegetated desert sand beaches
Sand beaches of the coasts of the Peruvian-Chilean deserts and semideserts devoid of phanerogamic vegetation, prevalent along the central and southern Peruvian coasts and the coasts of the Chilean fog-free desert.

(Koepcke, 1961: 117-121; Gajardo, 1994: subregion 1A1).

16.122 Desert sand beach pioneer communities
Formations of psammophile pioneering nitro-halophytes colonizing the foreshore sand beaches of the coasts of the Peruvian-Chilean deserts and semideserts, mostly limited to *Sesuvium portulacastrum* carpets. (Koepcke, 1961: 119).

16.13 Tropical foreshore sand beaches
Foreshore sand beaches of the Caribbean and Atlantic coasts of South America south to southern Brazil, of the Pacific coasts south to Ecuador and extreme northern Peru, of the Galapagos Islands, of the subtropical oceanic islands of the Pacific and the Atlantic.
(Richards, 1952: 296-299; Koepcke, 1961: 119; Schnell, 1971: 842-849; Wiggins and Porter, 1971: 17-18; Schnell, 1987b: 261-264; Stoffers, 1993; van der Werff and Adsersen, 1993; De Lacerda *et al.*, 1993; van der Maarel, 1993d).

16.131 Unvegetated tropical sand beaches
Sand beaches of the Caribbean and Atlantic coasts of South America south to southern Brazil, of the Pacific coasts south to Ecuador and extreme northern Peru, of the Galapagos Islands, devoid of vegetation.

16.132 Tropical sand beach pioneer communities
Formations mostly of annual nitro-halophytes occupying accumulations of drift material and sands rich in nitrogenous organic matter of the tropical coasts of South America, comprizing, in particular, ephemeral growth of *Blutaparon vermiculare* (*Philoxerus vermicularis*), *Cakile lanceolata*, *Cyperus spp.*, *Diodia maritima*, *Fimbristylis spathacea*, *Kyllinga spp.*, *Lepidium virginicum*, characteristic of Caribbean coasts, accompanied by patches of *Heliotropium curassavicum* and *Sesuvium portulacastrum*, mostly limited to small depressions. Locally *Ipomoea pes-caprae*, *Alternanthera maritima*, *Remirea maritima* and other upper beach and foredune species may invade the pioneer foreshore and lower backshore zone.
(Richards, 1952: 297; Schnell, 1987b: 264; Stoffers, 1993: 410, 419).

16.2 Dunes and upper beaches

Landward features of sand-covered shorelines of the oceans, their connected seas and associated coastal lagoons. They are marked by reliefs constituted either by dunes, onshore wind-carried sand deposits arranged in cordons of ridges parallel to the coast, or by beach-ridges, wave and longshore drift-carried sand deposits, also often organized in successive parallel berms produced by the progradation of the beach.
(Richards, 1952: 295-299; Koepcke, 1961: 117-121; Vanden Berghen, 1964; Hueck and Seibert, 1972: unit 72; Gore and Gepp, 1978: 30; Whittow, 1984; Soothill and Thomas, 1987; Clark, 1990; Mayhew and Penny, 1992; De Lacerda *et al.*, 1993; Stoffers, 1993: 409; Pfadenhauer, 1993; van der Maarel, 1993d; Lee, 1993; Johnson, 1993a, 1993b; Moreno-Casasola, 1993a, 1993b; Borhidi, 1993; Archibold, 1995).

16.21 Temperate coastal dunes and upper beaches
Coastal dunes, beach ridges and upper beaches of the temperate regions of South America, including those of Tierra del Fuego and its archipelago, of Patagonia, the Pampas and their transition zones along the Atlantic seaboard, of the Chilean Fjordland, Chiloe Island and Valdivian and mediterranean Chile, on the Pacific seaboard.
(Hauman, 1926; Hueck and Seibert, 1972: unit 72 *p.*; Moore, 1983; Pfadenhauer, 1993; van der Maarel, 1993d; Gajardo, 1994).

16.211 Temperate Atlantic dunes
Coastal dunes, beach ridges and upper beaches of the Pampa, Espinal and Monte zones of Argentina, Uruguay and southern Brazil, north to the Porto Alegre-Torres region of Rio Grande do Sul.
(Hauman, 1926; Vervoorst, 1967; Hueck and Seibert, 1972: unit 72 *p.*; Cabrera and Zardini, 1978; Gore and Gepp, 1978: 30; Pfadenhauer, 1993).

16.2111 Temperate Atlantic foredunes

Formations of the coasts of the Pampa, Espinal and Monte of Argentina, Uruguay and southern Brazil representing the first stages of dune construction, constituted by ripples or raised sand surfaces of the upper beach or by a seaward fringe at the foot of the tall dunes.
(Vervoorst, 1967; Cabrera and Zardini, 1978; Pfadenhauer, 1993).

16.21111 *Spartina coarctata* dunes

Perennial communities of embryonic dunes of southern Rio Grande do Sul, Uruguay and Buenos Aires province dominated by *Spartina coarctata* (*Spartina ciliata*).
(Vervoorst, 1967: 137-138, 157; Cabrera and Zardini, 1978: 6, 117-118; Pfadenhauer, 1993: 496).

16.21112 *Paspalum-Philoxerus* dunes
Perennial communities of embryonic dunes of Rio Grande do Sul, Uruguay and Buenos Aires Province dominated by *Paspalum vaginatum* with the succulent *Philoxerus portulacoides*.
(Cabrera and Zardini, 1978: 255; Pfadenhauer, 1993: 496)

16.2112 Temperate Atlantic mobile dunes
Mobile dunes forming the seaward cordon or cordons of dune systems of the coasts of the Pampa, Espinal and Monte of Argentina, Uruguay and southern Brazil, north to the Porto Alegre-Torres region of Rio Grande do Sul.
(Hauman, 1926; Vervoorst, 1967; Cabrera and Zardini, 1978; Pfadenhauer, 1993).

16.21121 Northern Pampean *Panicum* mobile dunes
Mobile primary dunes of the nothern transitional Pampa coasts of Rio Grande do Sul, colonized by *Panicum racemosum*, with *Senecio crassiflorus*, *Digitaria connivens*, *Hydrocotyle bonariensis*.
(Cabrera and Zardini, 1978: 6; Pfadenhauer, 1993: 496, 497).

16.21122 Central Pampean *Calycera-Panicum* mobile dunes
Mobile primary dunes of the Pampa coasts of Uruguay and Argentina south to Mar del Plata colonized by *Panicum racemosum* with *Calycera crassifolia*, *Calystegia soldanella*, *Senecio crassiflorus*.
(Vervoorst, 1967: 155-158; Cabrera and Zardini, 1978: 6; Pfadenhauer, 1993: 496, 498).

16.21123 Southern Pampean *Calycera-Panicum* mobile dunes
Mobile primary dunes of the Pampa coasts of Argentina south of Mar del Plata colonized by *Panicum urvilleanum*, with *Calycera crassifolia*, *Senecio quequensis*.
(Pfadenhauer, 1993: 498).

16.21124 Monte *Sporobolus* coastal dunes
Primary dunes of the Monte coasts of Argentina colonized by *Sporobolus rigens*, with *Grindelia speciosa*.
(Hauman, 1926: 108).

16.2113 Temperate Atlantic fixed secondary dunes
Fixed dunes of the coasts of the Pampa, Espinal and Monte of Argentina, Uruguay and southern Brazil stabilized and colonized by more or less closed perennial grasslands.
(Hauman, 1926; Vervoorst, 1967; Cabrera and Zardini, 1978; Pfadenhauer, 1993).

16.21131 Northern Pampean *Spartina-Panicum* fixed dunes
Fixed dunes of the coasts of Rio Grande do Sul occupied by more or less closed grasslands richer in species than those of the mobile sands, dominated by *Panicum racemosum* accompanied by *Spartina ciliata*, *Andropogon arenarius*, *Andropogon selloanus*, *Conyza blakei*, *Gamochaeta simplicicaulis*, *Panicum sabulorum*, *Polygala cyparissias*.
(Pfadenhauer, 1993: 496, 497).

16.21132 Central Pampean *Oenothera-Panicum* fixed dunes
Fixed dunes of the coasts of Uruguay and Argentina, south to Mar del Plata, occupied by more or less closed perennial grasslands dominated by *Panicum racemosum* accompanied by *Oenothera mollissima*, *Adesmia incana*, *Poa boecheri*, *Poa lanuginosa*, *Hydrocotyle bonariensis*, *Ambrosia tenuifolia*, *Limonium brasiliense*, *Senecio crassiflorus*, *Cenchrus pauciflorus*, *Margyricarpus pinnatus*.

(Vervoorst, 1967: 156, 158; Cabrera and Zardini, 1978: 6; Pfadenhauer, 1993: 496, 498).

16.21133 Southern Pampean *Oenothera-Panicum* fixed dunes

Fixed dunes of the coasts of the southern Pampa of Argentina, south of Mar del Plata, and of the Monte, colonized by more or less closed perennial grasslands dominated by *Panicum urvilleanum* with *Oenothera mollissima*, *Gnaphalium cf. leucopeplum*, *Adesmia incana*, *Achyrocline satureoides*, *Senecio quequensis*, *Poa boecheri*, *Poa lanuginosa*.
(Pfadenhauer, 1993: 496, 498).

16.2114 Temperate Atlantic dwarf shrub dunes
Fixed dunes of the Pampa, Espinal and Monte of Argentina, Uruguay and southern Brazil dominated by dwarf chamaephytes, in particular of genus *Baccharis*.
(Pfadenhauer, 1993: 496, 498).
16.21141 *Baccharis genistifolia* dwarf-shrub dunes
Fixed dunes of the pampa coasts of Argentina dominated by *Baccharis genistifolia*, with *Adesmia incana*, *Conyza blakei*, *Oxypetalum solanoides*, *Tessaria absinthioides*.
(Pfadenhauer, 1993: 496, 498).

16.21142 *Baccharis gnaphalioides* dwarf-shrub dunes
Fixed dunes of the coasts of Uruguay dominated by *Baccharis gnaphalioides*, with associates similar to those of 16.21141.
(Pfadenhauer, 1993: 496, 498).

16.21143 Southern *Baccharis leucopappa* dwarf-shrub dunes
Fixed dunes of the coasts of southern Rio Grande do Sul dominated by *Baccharis leucopappa*, with *Cardionema ramosissima*, *Gnaphalium spp.*, *Pterocaulum purpurascens*, *Andropogon arenarius* and the geographical characteristics *Asclepias mellodora*, *Acanthospermum australe*, *Petunia litoralis*, *Porophyllum linifolium*.
(Pfadenhauer, 1993: 496, 498).

16.21144 Northern *Baccharis leucopappa* dwarf-shrub dunes
Fixed dunes of the coasts of northern Rio Grande do Sul dominated by *Baccharis leucopappa*, with, as in the southern ones, *Cardionema ramosissima*, *Gnaphalium spp.*, *Pterocaulum purpurascens*, *Andropogon arenarius*, but with a distinct cortège of geographical characteristics, in particular, *Gymnopogon spp.*, *Paspalum arenarium*, *Pterocaulon angustifolium*.
(Pfadenhauer, 1993: 496, 498).

16.2115 Temperate Atlantic wooded dunes
Older dunes of the pampa coasts of South America colonised by woodland or riparian thickets, in particular, by *Ficus spp.* and palm woodland in Rio Grande do Sul, by *Allophylus edulis* and *Celtis spinosa* in Uruguay, by *Acacia caven*, *Celtis spinosa* and *Iodina rhombifolia* in Argentina. Codes of 4B can be used, in addition to 16.2115, to further define the habitat.
(Cabrera and Zardini, 1978: 2; Pfadenhauer, 1993: 498-499).

16.212 Magellanic dune and upper beach communities
Coastal dunes, sandy beach ridges and sandy upper beaches of Patagonia, Tierra del Fuego, the Chilean Fjordland and their archipelagoes, occupied by perennial communities dominated by forbs, grasses or shrubs.
(Hauman, 1926; Hueck and Seibert, 1972: unit 72 *p.*; Moore, 1983; van der Maarel, 1993d).

16.2121 Magellanic senecio upper beach communities
Halo-nitrophilous perennial vegetation of temperate upper beaches dominated by *Senecio candidans* (*Senecio candicans*), associated with *Acaena magellanica*, *Adesmia pumila*, *Rumex magellanicus*, and, in the south, *Apium australe* and *Poa robusta*.
(Hauman, 1926; Moore, 1983: 31).

16.2122 Magellanic beach grass swards

Perennial vegetation of temperate upper beaches of the Magellanic region dominated by graminoid species, in particular, beach stands of the grasslands of unit 35.11 formed by *Poa alopecurus* ssp. *fuegiana* and *Agropyron magellanicum*.
(Hauman, 1926; Pisano, 1971b: 106, 109-110, 123, 125).

16.2123 Magellanic dune and upper beach scrubs
Coastal dunes, sandy beach ridges and sandy upper beaches of Patagonia, Tierra del Fuego, the Chilean Fjordland and their archipelagoes, occupied by perennial communities dominated by shrubs, in particular, *Baccharis patagonica*.
(Moore, 1983: 229, 230).

16.213 Temperate Pacific dunes and upper beaches
Coastal dunes, sandy beach ridges and sandy upper beaches of Valdivian and mediterranean Chile, occupied by perennial communities dominated by forbs or grasses.
(Hueck and Seibert, 1972, 1981: unit 72 *p.*; van der Maarel, 1993d; Gajardo, 1994).

16.2131 Temperate Pacific upper beach and foredune communities
Mostly herbaceous communities of upper sand beaches and coastal foredunes of mediterranean and Valdivian Chile.
(Hueck and Seibert, 1981: 55, unit 72; van der Maarel, 1993d: 508; Gajardo, 1994: unit 3A38).

16.21311 Temperate Pacific *Ambrosia* communities
Perennial vegetation of the upper sand beaches and foredunes of mediterranean and Valdivian Chile codominated by the composite *Ambrosia chamissonis*.
(Oberdorfer, 1960: 153; Hueck and Seibert, 1981: 55; van der Maarel, 1993d: 508; Gajardo, 1994: unit 3A38).

16.213111 *Ambrosia-Nolana* communities
Perennial communities of sand beaches and foredunes of the coasts of mediterranean Chile dominated by *Ambrosia chamissonis* and *Nolana paradoxa*.
(van der Maarel, 1993d: 508).

16.213112 *Ambrosia-Cristaria* communities
Perennial communities of sand beaches and foredunes of the coasts of mediterranean Chile dominated by *Ambrosia chamissonis* and *Cristaria glaucophylla*.
(Kohler, 1970; van der Maarel, 1993d: 508).

16.213113 *Ambrosia-Distichlis* communities
Perennial communities of upper sand beaches and dunes of the coasts of mediterranean and Valdivian Chile, recorded from central Coquimbo to southern Bio-Bio, dominated by *Ambrosia chamissonis* and *Distichlis spicata*.
(Hueck and Seibert, 1981: 55; Gajardo, 1994: units 3A3-3A38, 3A4-3A38, 3B8-3A38, 3C10-3A38, 3C13-3A38, 4A3-3A38, 4B5-3A38).

16.21312 Pacific *Carex pumila* communities
Perennial vegetation of the upper sand beaches and foredunes of mediterranean Chile and its transition zones dominated by the sedge *Carex pumila*.
(van der Maarel, 1993d: 508).

16.2132 Temperate Pacific shrub dunes
Scrub of coastal dunes of mediterranean Chile.
(Kohler, 1970; Hueck and Seibert, 1981: 55; van der Maarel, 1993d: 508).

16.21321 Temperate Pacific *Chorizanthe* shrub dunes
Dwarf scrub of seaward dunes of mediterranean Chile, with *Chorizanthe vaginata*, *Ephedra andina*, *Plantago litorea*.
(Kohler, 1970; van der Maarel, 1993d: 508).

16.21322 Temperate Pacific *Colletia* shrub dunes
Dwarf scrub of back dunes of mediterranean Chile, with *Colletia spinosissima*, *Lupinus arboreus*, *Neoporteria subgibbosa*.

(Kohler, 1970; Hueck and Seibert, 1981: 55; van der Maarel, 1993d: 508).

16.21323 Temperate Pacific *Baccharis* shrub dunes

Scrub of the edges of dune woodland of mediterranean Chile, with *Baccharis concava*.

(Kohler, 1970; Hueck and Seibert, 1981: 55; van der Maarel, 1993d: 508).

16.2133 Temperate Pacific wooded dunes
Dune woods of mediterranean Chile. Codes of 45 or 4B can be used, in addition to 16.2133, to precise the habitat.
(Hueck and Seibert, 1981: 55; van der Maarel, 1993d: 508).

16.22 Pacific desert coastal dunes and upper beaches
Coastal sand dune and upper beach communities of desert coasts of Pacific South America, grading into those of adjacent sand deserts.
(Koepcke, 1961: 120-121; Rauh, 1985: 246; Gajardo, 1994: unit 1C143).

16.221 Pacific desert dune and beach shrub and succulent communities
Coastal sand dune and upper beach communities of desert coasts of Pacific South America dominated by shrubs or woody perennials, often with succulent stems and leaves.
(Koepcke, 1961: 120-121; Gajardo, 1994: unit 1C143).

16.2211 Garua desert upper beach *Nolana* communities
Communities dominated by *Nolana sedifolia*, *Nolana divaricata*, and *Nolana leptophylla* accompanied by *Frankenia chilensis* with *Argylia radiata*, *Bahia ambrosioides*, *Cleome chilensis*, *Drymaria cordata*, *Sicyos bryonaefolius* and occasionally *Chuquiraga ulicina*, *Ophryosporus triangularis*, growing at the foot of coastal cliffs of the Tocopilla and Tal-Tal garua deserts.
(Gajardo, 1994: units 1C13-1C143, 1C14-1C143).

16.2212 Pacific desert dune and beach *Sesuvium* communities
Coastal sand dune and upper beach communities of desert coasts of Pacific South America dominated by *Sesuvium portulacastrum*, particularly widespread on low coastal dunes of northern Peru.
(Koepcke, 1961: 120).

16.2213 Pacific desert *Batis* dunes and upper beaches
Coastal sand dune and upper beach communities of desert coasts of Pacific South America dominated by *Batis maritima*, a somewhat uncommon dune builder of northern Peru.
(Koepcke, 1961: 120-121).

16.2214 Pacific desert *Capparis* dunes and upper beaches
Coastal sand dune and upper beach communities of desert coasts of Pacific South America dominated by *Capparis angulata*, characteristic of tall dunes of northern Peru.
(Koepcke, 1961: 120-121).

16.222 Pacific desert grass dunes and upper beaches
Coastal sand dune and upper beach communities of desert coasts of Pacific South America dominated by graminoid species.
(Koepcke, 1961: 120-121; Rauh, 1985: 246).

16.2221 Pacific desert *Distichlis* dunes and upper beaches
Coastal sand dune and upper beach communities of desert coasts of Pacific South America dominated by *Distichlis spicata*.
(Koepcke, 1961: 120-121; Rauh, 1985: 246).

16.2222 Pacific desert *Sporobolus* dunes and upper beaches
Coastal sand dune and upper beach communities of desert coasts of Pacific South America dominated by *Sporobolus virginicus*.
(Koepcke, 1961: 120-121; Rauh, 1985: 246).

16.23 Tropical coastal dunes and upper beaches

Backshore sand beaches, beach ridges and dunes of the Caribbean and Atlantic coasts of South America south to southern Brazil, of the Pacific coasts south to Ecuador and extreme northern Peru, of the Galapagos Islands, unvegetated or colonized by herbaceous, shrubby and arborescent communities, many, in particular, dominated by *Ipomoea pes-caprae*, *Sporobolus virginicus*, or the ligneous *Scaevola plumieri*.

(Richards, 1952: 296-299; Schnell, 1971: 842-849; Gonzalez, 1978: 91, 102-103, 127-128; Schnell, 1987b: 261-267; Stoffers, 1993; van der Werff and Adsersen, 1993; De Lacerda *et al.*, 1993; van der Maarel, 1993d; Borhidi, 1993).

16.231 Tropical upper beach and dune herbaceous communities

Backshore sand beaches, beach ridges, foredunes and primary dunes of the Caribbean and Atlantic coasts of South America south to southern Brazil, of the Pacific coasts south to Ecuador and extreme northern Peru, of the Galapagos Islands, colonized by herbaceous communities. The main components of these communities are very constant throughout the tropics, comprising, in particular, the creeping *Ipomoea pes-caprae* and *Canavalia rosea* (*Canavalia maritima*). Specifically tropical American elements include *Alternanthera ficoidea*, *Batis maritima*, *Capraria biflora*, *Heliotropium curassavicum* and *Tephrosia cinerea* var. *littoralis*. *Ipomoea pes-caprae*, the grass *Sporobolus virginicus* and various succulents are among the principal facies-builders. A variety of associates distinguish local variants.

(Richards, 1952: 296-299; Schnell, 1971: 842-849; Wiggins and Porter, 1971: 17; Borhidi *et al.*, 1983; Schnell, 1987b: 261-267; Stoffers, 1993: 410; van der Werff and Adsersen, 1993; De Lacerda *et al.*, 1993; van der Maarel, 1993d; Borhidi, 1993: 430).

16.2311 *Ipomaea pes-caprae* beach and dune communities

Sand beaches, beach ridges, foredunes and primary dunes of tropical Caribbean, Atlantic and Pacific South America and the Galapagos Islands occupied by the creepers *Ipomoea pes-caprae* and *Canavalia rosea* (*Canavalia maritima*), in almost monospecific formations, in association, or accompanied by herbaceous communities that they dominate.

(Koepcke, 1961: 119; Wiggins and Porter, 1971: 17, 18, 379; Schnell, 1971: 842-849; Gonzalez, 1978: 91, 110, 127; Schnell, 1987b: 261-266; Stoffers, 1993: 410; van der Werff and Adsersen, 1993: 463-464; De Lacerda *et al.*, 1993: 484; van der Maarel, 1993d: 507).

16.2312 Tropical sand beach and dune succulent communities

Sand beaches, beach ridges, foredunes and primary dunes of tropical Caribbean, Atlantic and Pacific South America and the Galapagos Islands occupied by colonies of succulent herbs, or by communities dominated by succulent herbs, often facies of the *Ipomoea pes-caprae*-*Canavalia rosea* communities. *Heliotropium curassavicum*, *Sesuvium portulacastrum*, *Trianthema portulacastrum* are the most frequent elements; they may occur in association or form monospecific mats and patches.

(Wiggins and Porter, 1971: 17-18, 183-184, 291; Stoffers, 1993: 410; van der Werff and Adsersen, 1993: 463-464; De Lacerda *et al.*, 1993: 479).

16.23121 Tropical sand beach and dune *Sesuvium* communities

Sand beaches, beach ridges, foredunes and primary dunes of tropical Caribbean, Atlantic and Pacific South America and the Galapagos Islands colonized by communities dominated by succulent Aizoaceae of genus *Sesuvium*, in general *Sesuvium portulacastrum*, also, in the Galapagos Islands, *Sesuvium edmonstonei*, endemic, mostly characteristic of shell-sand banks. Other succulent Aizoaceae, in particular, *Trianthema portulacastrum*, may accompany *Sesuvium*.

(Wiggins and Porter, 1971: 17-18, 183-184; Gonzalez, 1978: 91, 127; Stoffers, 1993: 410; van der Werff and Adsersen, 1993: 463-464).

16.23122 Tropical sand beach and dune *Heliotropium* communities

Sand beaches, beach ridges, foredunes and primary dunes of tropical South America colonized by communities dominated by the succulent Boraginaceae *Heliotropium curassavicum*.

(Wiggins and Porter, 1971: 17-18, 291; van der Werff and Adsersen, 1993: 463-464).

16.23123 Tropical foredune *Philoxerus* communities

Philoxerus portulacoides-dominated communities of the foredunes of the tropical Brazilian coast, extending from the edge of the sea to the primary dune crests, liable to inundation by exceptionally

high tides or storm waves. Frequent associates include *Alternanthera maritima* and *Sesuvium portulacastrum*.
(De Lacerda *et al.*, 1993: 479).

16.2313 Tropical beach and dune grasslands
Sand beaches, beach ridges, foredunes and primary dunes of tropical Caribbean, Atlantic and Pacific South America and the Galapagos Islands colonized by communities dominated by graminoid species, often facies of the *Ipomoea pes-caprae-Canavalia rosea* communities.
(Wiggins and Porter, 1971: 17-18, 800, 803-806, 881; Schnell, 1987b: 263-264; Stoffers, 1993: 410; van der Werff and Adsersen, 1993: 463; De Lacerda *et al.*, 1993: 483-484).

16.23131 Tropical beach and dune *Sporobolus* swards
Sand beaches, beach ridges, foredunes and primary dunes of tropical South America colonized by communities dominated by *Sporobolus virginicus*.
(Wiggins and Porter, 1971: 17-18, 881; Gonzalez, 1978: 91, 110, 127; Stoffers, 1993: 410; van der Werff and Adsersen, 1993: 463; De Lacerda *et al.*, 1993: 483-484).

16.23132 Tropical beach and dune sedge swards
Sand beaches, beach ridges, foredunes and primary dunes of tropical South America colonized by communities dominated by perennial Cyperaceae, in particular, *Remirea maritima*, *Cyperus esculentus*, *Cyperus pedunculatus* (*Mariscus pedunculatus*).
(Wiggins and Porter, 1971: 17-18, 804; Schnell, 1987b: 263-264; De Lacerda *et al.*, 1993: 483-484).

16.2314 Tropical beach and dune annual communities
Upper beaches, beach ridges, foredunes and primary dunes of tropical South America colonized by communities of annuals, formed, in particular, by *Mollugo cerviana*, *Mollugo cerviana*, *Mollugo flavescens*, *Chamaesyce recurva*, *Chamaesyce nummularia*, *Eragrostis ciliaris*.
(Wiggins and Porter, 1971: 218; van der Werff and Adsersen, 1993: 464).

16.232 Tropical upper beach and foredune scrubs
Backshore sand beaches, beach ridges, foredunes and primary dunes of the coasts of tropical South America colonized by low, usually leaf-succulent shrubs and subshrubs, many of them of pantropical, tropical American or cosmopolitan distribution. The communities formed, like those of 16.221, are fairly constant throughout the tropics. Dominant, facies-forming species include, notably, *Scaevola plumieri*, *Batis maritima*, *Tournefortia gnaphaloides* (*Mallotonia gnaphaloides*), *Suriana maritima*, *Borrichia spp.*, *Nolana galapagensis*, *Uniola paniculata*. Low chenopod shrubs, such as *Atriplex peruviana*, *"Salicornia" virginica s.l.* (*Salicornia "fruticosa" s.l.*), may participate in the constitution of the communities. Many of the dominant shrubs can also form tropical saltmarsh communities (15.62).
(Richards, 1952: 296-297; Wiggins and Porter, 1971: 17-18; Gonzalez, 1978: 103, 127-128; Borhidi *et al.*, 1983; Stoffers, 1993: 410-411; van der Werff and Adsersen, 1993: 462-464; Borhidi, 1993: 430).

16.2321 *Scaevola* upper beach and foredune scrub
Backshore sand beaches, beach ridges, foredunes and primary dunes of the coasts of tropical South America, colonized by shrubby, succulent formations of the pantropical *Scaevola plumieri*, described, in particular, from Caribbean and Galapagos coasts, where they may form almost monospecific, sparse scrubs, immediately above high tide line.
(Wiggins and Porter, 1971: 387-388; Stoffers, 1993: 410-411; van der Werff and Adsersen, 1993: 462-464; Borhidi, 1993).

16.2322 *Tournefortia-Suriana* beach and foredune scrub
Backshore sand beaches, beach ridges, foredunes and primary dunes of the coasts of Caribbean South America, colonized by dense scrubs dominated by the succulent subshrub *Tournefortia gnaphaloides* (*Mallotonia gnaphaloides*) and the succulent shrub *Suriana maritima* with *Euphorbia mesembryanthemifolia*, often accompanied by *Blutoparon vermiculare*, *Cyperus spp.*, *Erigeron spp.*, *Opuntia spp.*, *Sesuvium portulacastrum*, *Stemodia maritima*, *Talinum paniculatum*, and occasional, *Borrichia arborescens*, *Scaevola plumieri*, *Spilanthes urens*, *Turnera ulmifolia*. These communities are typical of sites where there is a continuous supply of sand brought by the trade winds.
(Richards, 1952: 296-297; Gonzalez, 1978: 103, 127-128; Stoffers, 1993: 410-411; Borhidi, 1993: 430-431).

16.2323 *Borrichia* beach and foredune scrub

Scrubs of Caribbean beaches of South America dominated by the succulent shrub *Borrichia arborescens*, with *Scaevola plummieri*, *Suriana maritima*, *Tournefortia gnaphaloides* (*Mallotonia gnaphaloides*), *Caesalpina bonduc*, generally of very limited extent.
(Stoffers, 1993: 411; Borhidi, 1993: 430-431).

16.2324 *Nolana* beach and foredune scrub
Backshore sand beaches and primary dunes of the coasts of the Galapagos Archipelago colonized by scrubs dominated by the endemic succulent soft shrub *Nolana galapagensis*.
(Wiggins and Porter, 1971: 17, 414-415; van der Werff and Adsersen, 1993: 462-464).

16.2325 *Batis* beach and foredune scrub
Backshore sand beaches and foredunes of the coasts of tropical South America, colonized by the succulent shrub *Batis maritima*.
(Wiggins and Porter, 1971: 208-211; Schnell, 1987b: 262; van der Werff and Adsersen, 1993: 464; Borhidi, 1993: 433).

16.2326 Tropical Atlantic upper beach scrub
Upper beach community of tropical Brazil, developed on somewhat stabilized sands beyond the reach of tides, with *Waltheria americana*, *Opuntia monacantha*, *Opuntia vulgaris*, *Oxypetalum banksi* , *Mikania* spp., *Thunbergia* spp., and the introduced pantropical weed *Cataranthus roseus*.
(Schnell, 1987b: 264).

16.233 Tropical upper beach and foredune thickets
Backshore sand beaches, beach ridges, foredunes and primary dunes of the coasts of tropical South America colonized by tall or medium-tall, drought-deciduous, xerophyllous or subsucculent, sometimes spiny, shrubs or small trees.
(Richards, 1952: 297; Schnell, 1971: 842-849; Wiggins and Porter, 1971; Borhidi *et al.*, 1979; Schnell, 1987b: 262, 266; Stoffers, 1993: 411-412; van der Werff and Adsersen, 1993: 463-465; De Lacerda *et al.*, 1993: 480, 483, 485; van der Maarel, 1993d: 507; Borhidi, 1993: 435-437).

16.2331 Caribbean *Coccoloba* beach and foredune thickets
High thickets or low woodland of the sand beaches and foredunes of Caribbean South America dominated by the drought-deciduous, leathery-leaved, small tree *Coccoloba uvifera*, usually with a reduced accompanying cortège that includes, notably, *Thespesia populnea*, *Borrichia arborescens*, *Opuntia spp.*, *Conocarpus erectus*, *Jacquinia spp.*, *Clusia spp.*, *Hippomane mancinella*.
(Richards, 1952: 297; ffrench, 1976: 13; Gonzalez, 1978: 110; Borhidi *et al.*, 1979; Schnell, 1987b: 266; Stoffers, 1993: 411-412, 414; van der Maarel, 1993d: 507; Borhidi, 1993: 435-437).

16.2332 Atlantic *Hibiscus* beach and foredune thickets
Backshore sand beaches, beach ridges, foredunes and primary dunes of the coasts of northern tropical Atlantic South America, in particular, of the Guianas, colonized by tall or medium-tall thickets formed by *Hibiscus tiliaceus*, *Muellera moniliformis*, *Dalbergia ecastaphyllum*, *Caesalpinia bonduc*, *Cordia macrostachya* and a herbaceous layer dominated by *Ipomoea pes-caprae* and *Canavalia rosea*.
(Schnell, 1987b: 262; Tostain *et al.*, 1992: 14).

16.2333 Atlantic *Bumelia-Jacquinia* primary dune thickets
Backshore sand beaches, beach ridges, foredunes and primary dunes of the coasts of tropical Atlantic South America colonized by low to medium-tall or tall thickets formed by *Bumelia obtusifolia*, *Jacquinia brasiliensis*, *Schinus terebinthifolius*, cacti, bromeliads, the liana *Aristolochia macroura*, known from the coasts of Rio de Janeiro and southern Espirito Santo.
(De Lacerda *et al.*, 1993: 485).

16.2334 Pacific sand beach and foredune thickets

Low to medium thickets of tropical beaches, upper beaches and foredunes of Pacific South America, in particular, the Galapagos Archipelago, formed by shrubs typical of rock pavement coastal scrubs (unit 18), in particular, by the much-branched, generally scandent western tropical South American *Cryptocarpus pyriformis*, also by the Galapagos endemic 1-3 metre-high, stiffly branching, spinose, more or less succulent leaved *Lycium minimum*, by the 1-2.5 metre-high, stiffly branching, erect *Grabowskia boerhaaviaefolia* with firm to subfleshy leaves, by the nearly prostrate to 8 metre-high

Maytenus octogona, by the deciduous small tree-euphorb *Hippomane mancinella*, or, occasionally, by shrubby mangroves such as *Rhizophora mangle* and *Laguncularia racemosa*.
(Wiggins and Porter, 1971: 226-227, 466-467, 467-468, 553-554, plate 21; van der Werff and Adsersen, 1993: 463-465; Moreno-Casasola, 1993b: 457).

16.234 Tropical secondary dunes and landward beach ridges
Secondary dunes and inner beach ridge belts of the tropical coasts of South America. They are well developed in the large, up to 25 kilometres wide, dune and beach ridge systems of the Brazilian coast where they support distinctive, extensive communities. Less well characterized formations of Caribbean and Pacific coasts, constituting often poorly defined transitions between foredune thickets and dunal or inland woods can be included in this unit.
(Stoffers, 1993: 412; van der Werff and Adsersen, 1993: 464; De Lacerda *et al.*, 1993: 477-479, 480-483, 487-488).

16.2341 Tropical Atlantic secondary dunes and beach ridges
Secondary dunes and inner beach ridge belts of the tropical coasts of Atlantic South America, well developed in Brazil where they support distinctive, extensive communities, in particular, along the Alagoas and Sergipe coasts and in the region of the Rio Grande do Sul barrier island-lagoon systems. They are the habitat of several endemic bird species, in particular, *Formicivora serrana littoralis*.
(Lewis, 1987: 10, plate 1; Gonzaga and Pacheco, 1990: 191-192; De Lacerda *et al.*, 1993: 477-479, 480-483, 487-488; Junk, 1993: 720; Diegues *et al.*, 1995: 72).

16.23411 Tropical Atlantic dune closed thickets
Closed, tall thickets of secondary dunes and inner beach ridge belts of the tropical coasts of Atlantic South America, often dominated by or rich in Myrtaceae, in particular, of genera *Eugenia* and *Myrcia*.
(Schnell, 1987b: 265-266; De Lacerda *et al.*, 1993: 487-488).

16.234111 Southern Brazilian myrtle restinga thickets
Closed, tall thickets of secondary dunes and inner beach ridge belts of the tropical coasts of Atlantic South America dominated by Myrtaceae, in particular, of genera *Eugenia* (*Eugenia nitida*, *Eugenia uniflora*, *Eugenia ovalifolia*, *Eugenia copacabanensis*) and *Myrcia* (*Myrcia lundiana*) accompanied by *Aspidosperma pyricollum*, *Cupania emarginata*, *Esenbeckia rigida*, *Gomidesia martiana*, *Melanopsidium nigrum*, *Myrrhinium atropurpureum*, *Pouteria psammophila*, *Rheedia brasiliensis*, *Zollernia falcata* and an herbaceous layer made mostly of bromeliads, in particular, *Aechmea lingulata*, *Billbergia amoena*, *Quesnelia quesneliana* and many Araceae.
(Hueck, 1978: 193; Schnell, 1987b: 265; De Lacerda *et al.*, 1993: 487-488).

16.234112 Northern Brazilian restinga thickets
Low dense arborescent vegetation of pale quaternary sands of the restingas of northern Brazil, under a drier climate than those of southern Brazil, with, in particular, *Ximemia americana*, *Byrsonima gardneri*, *Croton sellowii*, *Myrcia spp.*, *Cassia uniflora*, *Andira nitida*, *Manilkara salzmanii*, *Tabebuia rosea-alba*, *Tabebuia spp.*, *Cassytha filiformis*, epiphytic and terrestrial bromeliads (*Hohenbergia spp*), orchids (*Catasetum spp.*, *Vanilla spp.*).
(Schnell, 1987b: 266).

16.23412 Tropical Atlantic dune *Clusia* scrub
Open tall scrub of secondary dunes and inner beach ridge belts of the tropical coasts of Atlantic South America, made of an alternance of large, dense, hemispherical thickets and sparsely vegetated areas. The thickets are dominated by species of genus *Clusia*, in particular, *Clusia hilariana*, *Clusia fluminensis*, *Clusia lanceolata* accompanied by *Cassia australis*, *Erythroxylum ovalifolium*, *Eugenia nitida*, *Gomidesia fenzliana*, *Manilkara subsericea*, *Myrcia lundiana*, *Tapirira guianensis*, covered with abundant lianas including *Mandevilla funiformis*, *Passiflora mucronata*, *Paullinia weinmannifolia*, *Peixotoa hispidula*, and enclose a sparse herbaceous layer comprising *Anthurium spp.*, *Polypodium spp.*, cacti and bromeliads. Rings of bromeliads form around the thickets, constituted by, in particular, *Aechmea nudicaulis*, *Neoregelia cruenta*, *Vriesea procera*. In the sparsely vegetated areas isolated individuals of various species occur, in particular, of *Cassia ramosa*, *Pilocereus arrabidae*, *Stachytarpheta schottiana*, *Stigmaphyllon paralias*, the palm *Allagoptera arenaria* (*Diplothemium maritimum*).
(Hueck, 1978: 193-194; Schnell, 1987b: 264, 265; Blombery and Rodd, 1982: 47; De Lacerda *et al.*, 1993: 488).

16.23413 Tropical Atlantic dune palm scrub
Secondary dunes and inner beach ridge belts of the tropical coasts of Atlantic South America occupied by low shrubby formations dominated by the acaulous palm *Allagoptera arenaria* (*Diplothemium maritimum*), characteristic in particular of areas where the *Clusia* scrub (unit 16.23412) has been burned. Accompanying species include *Axonopus barbigerus*, *Byrsonima sericea*, *Vriesea neoglutinosa*, *Cephalocereus pernambucensis*, *Crotalaria spp.* and *Mikania spp.*
(Blombery and Rodd, 1982: 46-47; Schnell, 1987b: 264; De Lacerda *et al.*, 1993: 488).

16.2342 Caribbean secondary dunes and beach ridges
Secondary dunes and inner beach ridge belts of the tropical coasts of Caribbean South America, supporting thickets formed at the rear edge of the *Coccoloba uvifera* thickets (unit 16.2331) by progressive admixture of other species, in particular, *Chrysobalanus icaco* and species of coastal woodlands towards which they constitute an often poorly defined transition belt.
(Stoffers, 1993: 412).

16.2343 Tropical Pacific secondary dunes and beach ridges
Secondary dunes and inner beach ridge belts of the tropical coasts of Pacific South America, in particular, the Galapagos Islands, where thickets constituted by a combination of coastal shrubs characteristic of unit 16.2334 and noncoastal species of the arid zone form on the inland part of coastal sand plateaux.
(van der Werff and Adsersen, 1993: 464).

16.235 Tropical wooded dunes and beach ridges
Beach ridges and dunes of the Caribbean and Atlantic coasts of South America south to southern Brazil, of the Pacific coasts south to Ecuador colonized by woodland. Codes of 4B can be used, in addition to 16.235, to further define the habitat.
(Richards, 1952: 296-299; Hueck, 1978: 195-196; Stoffers, 1993; van der Werff and Adsersen, 1993; De Lacerda *et al.*, 1993; van der Maarel, 1993d; Borhidi, 1993).

16.3 Humid dune-slacks

Humid depressions of the dunal systems. The most important habitats are included in the subordinate units. If the divisions proposed are not sufficient, appropriate codes from 2, 3, 4, 5, can be used in conjunction with them.

16.31 Temperate dune-slacks
Humid depressions of the dunal systems of the temperate regions of South America, including those of Tierra del Fuego and its archipelago, of Patagonia, the Pampas and their transition zones along the Atlantic seaboard, of the Chilean Fjordland, Chiloe Island and Valdivian and mediterranean Chile, on the Pacific seaboard.
(Vervoorst, 1967: 155-158; Cabrera and Zardini, 1978: 7; Pfadenhauer, 1993: 498).

16.311 Temperate dune-slack pools
Fresh-water aquatic communities (cf. unit 22.3) of permanent water bodies of the dune-slacks of temperate South America.

16.312 Temperate dune-slack pioneer swards and fens
Pioneer formations and fen communities of the wettest parts of humid sands and of pool fringes of the dune-slacks of temperate South America.

16.3121 Pioneer *Androtrichum* swards

Pioneer formations of humid sands of temperate dune-slacks of the coasts of Argentina, Uruguay and southern Brazil dominated by the endemic Cyperaceae *Androtrichum trigynum*, accompanied by *Bacopa monnieri*, *Eriocaulon modestum*, *Liaeopsis hillii*, *Lycopodium alopecuroides*, *Triglochin*

striata, *Xyris jupicai*, *Drosera brevifolia*, *Utricularia pallens*, and sometimes by the introduced *Centaurium pulchellum* and *Blackstonia perfoliata*.
(Vervoorst, 1967: 156; Cabrera and Zardini, 1978: 7; Pfadenhauer, 1993: 498).

16.3122 Mature *Androtrichum* swards
Fen formations of temperate dune-slacks of the coasts of Argentina, Uruguay and southern Brazil, dominated by *Androtrichum trigynum*, accompanied by *Fimbristylis autumnalis*, *Imperata brasiliensis*, *Ischaemum urvilleanum*, *Panicum gouinii*, *Scleria hirtella*, and numerous *Eleocharis spp.*, constituting more advanced stages of humid sand colonization by unit 16.3121.
(Vervoorst, 1967: 155-158; Cabrera and Zardini, 1978: 7; Succow and Jeschke, 1990: 193; Pfadenhauer, 1993: 498).

16.313 Temperate dune-slack grasslands
Humid grasslands and rushbeds, saline or not, of the dune-slacks of temperate South America. Codes of 15.12, 15.13 or 37 can be used, in addition to 16.313, to further define the habitat. In particular, swards of *Juncus acutus* var. *leopoldii* (16.313: 15.125), of *Spartina densiflora* (*Spartina montevidensis*) and *Spartina coarctata* (*Spartina ciliata*) (16.313: 15.1212), of *Distichlis spicata* (16.313: 15.123), of *Cortaderia selloana* (16.313: 37.131) are widespread in dune-slacks of the temperate Atlantic coasts; *Juncus scheuchzerioides* swards (16.313: 37.26) may occupy dune-slacks and wet sands of the Magellanic region.
(Vervoorst, 1967: 155-158; Pfadenhauer, 1993: 498).

16.314 Temperate dune-slack reedbeds
Reedbeds and tall-sedge communities of the dune-slacks of temperate South America. Codes of 53 can be used, in addition to 16.314, to further define the habitat. In particular, beds of *Typha spp.* (16.314: 53.111, 16.314: 53.112), of *Typha angustifolia* (16.314: 53.132), of *Scirpus americanus* (16.314: 53.212), of *Scirpus californicus* (16.314: 53.211, 16.314: 53.212) are widespread in dune-slacks of the temperate Atlantic coasts.
(Vervoorst, 1967: 155-158; Pfadenhauer, 1993: 498).

16.315 Temperate dune-slack thickets
Shrubby formations of the dune-slacks of temperate South America, in particular, *Tessaria absinthioides* scrubs of the dune-slacks of the temperate Atlantic coasts.
(Vervoorst, 1967: 155-158; Cabrera and Zardini, 1978: 7; Pfadenhauer, 1993: 498).

16.32 Tropical dune-slacks
Humid depressions, or swales, of the dunal systems of the Caribbean and Atlantic coasts of South America south to southern Brazil, of the Pacific coasts south to Ecuador, of the Galapagos Islands. They are particularly developed in the large dunal systems of the Atlantic coast of Brazil.
(De Lacerda *et al.*, 1993: 485-486; Moreno-Casasola, 1993a: 395, 400-401).

16.321 Tropical dune-slack pools
Freshwater aquatic communities (cf. unit 22.3) of permanent water bodies of the dune-slacks of tropical South America.
(Schnell, 1987b: 264; De Lacerda *et al.*, 1993: 485).

16.322 Tropical dune-slack sedge swamps
Graminoid communities of the wettest parts of dune-slacks of tropical South America, dominated by sedges of genera *Eleocharis*, *Rhynchospora* or *Cyperus*.
(De Lacerda *et al.*, 1993: 485-486; Moreno-Casasola, 1993a: 395, 400-401).

16.3221 Tropical dune-slack *Cyperus* communities

Formations of wet sands, humid slacks and beach-ridge swales of tropical South America, dominated by sedges of genus *Cyperus*, in particular, *Cyperus laevigatus*, *Cyperus brevifolius*, *Cyperus ligularis* and the Galapagos endemic *Cyperus elegans*.
(Wiggins and Porter, 1971: 800, 803-806; van der Werff and Adsersen, 1993: 463; Moreno-Casasola, 1993a: 395, 400-401).

16.3222 Tropical dune-slack *Eleocharis* communities

Graminoid communities of the wettest parts of dune-slacks of tropical South America, dominated by sedges of genera *Eleocharis* and *Rhynchospora*, in particular, formations of the swales of the large dune systems of Brazil, inundated for most of the year, composed of *Eleocharis subarticulata* and *Rhynchospora spp.*, accompanied by grasses, in particular, of genus *Paspalum*.
(De Lacerda *et al.*, 1993: 485-486; Moreno-Casasola, 1993a: 400-401).

16.323 Tropical dune-slack scrub
Shrub communities of dune-slacks of tropical South America, in particular, ericoid communities of the swales of the large dune systems of Brazil, inundated after rains, formed by hemispheral thickets interspersed with lower vegetation. *Andira legalis*, *Esterhazya splendida*, *Gaylussacia brasiliensis*, *Humiria balsamifera*, *Leucothoe revoluta*, *Ocotea notata*, *Protium icicariba* are typical of the thickets, *Marcetia taxifolia*, of the, open areas.
(Hueck, 1978: 192-193; De Lacerda *et al.*, 1993: 486-487).

16.324 Tropical dune-slack forests
Dune-slacks of tropical South America colonized by periodically or permanently flooded forest. Codes of 4A can be used, in addition to 16.324, to further define the habitat.
(De Lacerda *et al.*, 1993: 485-486).

17. SHINGLE BEACHES

Beaches of the oceans, of their connected seas and of their associated coastal lagoons, covered by pebbles, or sometimes boulders, usually formed by wave action.

(Koepcke, 1961: 114-117; van der Maarel, 1993b: 13).

17.1 Temperate shingle beaches

Shingle beaches of the coasts of the temperate regions of South America, including those of Tierra del Fuego and its archipelago, of Patagonia, the Pampas and their northern transition zones, of the Chilean Fjordland, Chiloe Island, Valdivian and mediterranean Chile and the Juan Fernandez Islands.

17.11 Unvegetated temperate shingle beaches
Shingle beaches devoid of phanerogamic vegetation. Mediolittoral (intertidal) and supralittoral invertebrate communities listed under 11.28 can be combined with 17.1 to record detailed habitats.

17.12 Temperate shingle beach annual communities
Formations of annuals or of annuals and perennials, occupying accumulations of drift material and gravels rich in nitrogenous organic matter, in particular, communities dominated by *Chenopodium macrospermum*.
(Moore, 1968: 18; Moore, 1983: 89).

17.13 Temperate shingle beach perennial communities
Halo-nitrophilous perennial vegetation of the upper part of shingle beaches and shingle bars of Tierra del Fuego and its archipelago, of Patagonia, the Pampas, the Chilean Fjordland, Chiloe Island, Valdivian and mediterranean Chile, the Juan Fernandez Islands, dominated by shrubs, grasses or sedges. Codes from 31, 32, 33, 34, 35 can be used in conjunction with unit 17.13 to specify the habitat, in particular, 31.212, Fuego-Patagonian *Nardophyllum bryoides* heath.
(Skottsberg, 1953a: 950; Moore, 1983: 25).

17.2 Desert shingle beaches

Shingle beaches of the coasts of the Peruvian-Chilean deserts and semideserts, widespread and extensive, both on the continent and on offshore islands.
(Koepcke, 1961: 114-117).

17.21 Desert foreshore shingle beaches
Generally steeply sloping pebble-covered foreshore, part of the seashore comprised between the lowest low water line and the average high water line, of the Chilean and Peruvian desert coasts. The rather species-poor mediolittoral and supralittoral species assemblies of marine origin that colonize them are listed under 11.28.
(Koepcke, 1961: 114-116).

17.22 Desert dry backshore shingle beaches
Upper part of the shingle beaches of the coasts of the Peruvian-Chilean deserts, dry and almost devoid of vegetation except for an occasional thin algal coating on larger boulders. They constitute the most frequent type of backshore shingle beaches.
(Koepcke, 1961: 116).

17.23 Desert wet backshore shingle beaches
Occasional backshore shingle beaches of the coasts of the Peruvian-Chilean deserts traversed by a flow of surface or subsurface water, in the form of seeps, rivulets, resurgences or small marshes, supporting a diversified vegetation of green algae, ferns, riverine shrubs, dwarf marsh grasses and forbs, floating plants and a distinctive fauna of, in particular, crustaceans and fish.
(Koepcke, 1961: 116-117).

17.3 Tropical shingle beaches

Shingle beaches of tropical South America, in particular, coral shingles of the Caribbean coasts of South America.
(Stoffers, 1993: 413-414).

17.31 Tropical shingle beach swards
Shingle beaches of tropical South America colonized by gramineous species, in particular, very open communities of *Fimbristylis spathacea*, *Cyperus planifolius*, *Cyperus fuligineus*, with *Suriana maritima*, *Tournefortia gnaphalodes*, *Euphorbia mesembryanthemifolia*, *Conocarpus erectus*, *Ernodea littoralis*, *Chenopodium ambrosioides*, *Blutaparon vermiculare*, of coral shingles of the Caribbean coasts of South America.
(Stoffers, 1993: 413).

17.32 Tropical shingle beach scrubs
Shingle beaches of tropical South America, occupied by scrubs or thickets, in particular, communities of *Coccoloba uvifera*, *Metopium brownei*, *Bontia daphnoides*, *Crossopetalum rhacoma* (*Rhacoma crossopetalum*), *Sophora tomentosa*, *Jacquinia arborea*, *Condalia henriquezii*, *Bumelia obovata*, *Antirhea acutata*, *Erithalis fruticosa*, *Thespesia populnea*, *Ernodea littoralis* of coral shingles of the Caribbean coasts of South America.
(Stoffers, 1993: 413-414).

17.33 Tropical shingle beach woodland
Woods or forests forming on shingle beaches of tropical South America, in particular, *Hippomane mancinella* woodland growing at the mouth of gullies and below limestone cliffs of the Caribbean coasts. Codes of 4B can be used in conjunction with 17.33 to specify habitats.
(Stoffers, 1993: 414).

18. SEA-CLIFFS AND ROCKY SHORES

Rock exposures adjacent to the oceans, their connected seas and associated coastal lagoons, or separated from them by a narrow shoreline. The faces, ledges and caves of sea-cliffs and the expanses of rocky shore are important as reproduction, resting and feeding sites for sea-birds, sea-mammals and a few groups of terrestrial birds, composing regionally distinct assemblies listed under 18.1. The presence of major sea-caves can be indicated by addition of codes of 12.7. Sea-cliffs may also harbour highly distinctive, specialized aerohaline plant communities with associated terrestrial faunas, listed under 18.2. The mediolittoral (intertidal or wave-washed) and supralittoral (spray) zones are inhabited by rich and diverse communities of invertebrates, fish and algae that have been listed under 11.29.
(Koepcke, 1961: 109-114; van der Maarel, 1993b: 13).

18.1 Sea-cliff faces, seaside rocks

Hard rock sea-cliffs, their faces, ledges and associated caves, rocky shores and isolated seaside rocks, their associated sea-bird, sea-mammal, wader and, in a few cases, terrestrial passerine, communities. The presence of vascular aerohaline vegetation should be indicated by use of the appropriate code from 18.2, that of mediolittoral (intertidal or wave-washed) and supralittoral (spray) zone communities of marine invertebrates, lower vertebrates and algae, by use of codes from 11.29.
(Löfgren, 1984; Mitchell, 1987; Wood, 1988; Clark, 1990).

18.11 Temperate sea-cliffs and rocky shores
Sea-cliffs, their faces, ledges and associated caves, rocky shores and isolated seaside rocks of the temperate region of South America, including those of Tierra del Fuego and its archipelago, of Patagonia, the Pampas and their transition zones along the Atlantic seaboard, of the Chilean Fjordland, Chiloe Island and Valdivian and mediterranean Chile on the Pacific seaboard, of the Juan Fernandez Islands, adjacent to subantarctic, subtropical or Humboldt Current waters.
(Murphy, 1936).

18.111 Subantarctic Atlantic sea-cliffs and rocky shores
Sea-cliffs, their faces, ledges and associated caves, rocky shores and isolated seaside rocks of the Atlantic temperate region of South America, including Tierra del Fuego and Patagonia, north to Golfo San Matias. Cliffs and rocky shores are present along most of the coastline. They are the breeding, resting or feeding places of great numbers of sea-birds and sea-mammals, of which *Otaria byroni*, *Phalacrocorax gaimardi* are characteristic.
(Murphy, 1936: 190-202; Diegues *et al.*, 1995: 73).

18.112 Subantarctic Pacific sea-cliffs and rocky shores
Sea-cliffs and rocky shores of the Chilean Fjordland, north to Chiloe Island.
(Murphy, 1936: 235-249).

18.113 Subtropical Atlantic continental sea-cliffs and rocky shores
Sea-cliffs, their faces, ledges and associated caves, rocky shores and isolated seaside rocks of the coasts of South America adjacent to the subtropical maritime zone of the Atlantic, between southern Brazil and Golfo San Matias. Cliffs are not prevalent along that stretch of coast, but isolated or more continuous cliffs and rocky shores occur, in particular, in Uruguay on the coast of the Rio de la Plata estuary and on a few promontories and offshore islands of the Atlantic coast, while low cliffs line most of the Argentinian coast south of Cape San Antonio. Cliffs of the coasts of southern Sao Paulo and Santa Catarina south to Cape Santa Marta Grande, and of their nearshore islands, although they face marine waters that belong to the transition between tropical and subtropical waters, have been included

in 18.13 in view of their continuity with cliffs further north, their wide separation from cliffs further south and their tropical forest hinterland.
(Murphy, 1936: 161-163, 168-171, 181-190; Gore and Gepp, 1978: 31; Diegues *et al.*, 1995: 72-73).

18.114 Subtropical Pacific sea-cliffs and rocky shores
Sea-cliffs, their faces, ledges and associated caves, rocky shores and isolated seaside rocks of the coasts of Valdivian and mediterranean Chile, from Chiloe Island north to 29° S, adjacent to the subtropical maritime zone of the Pacific and the Humboldt Current upwelling zone.
(Murphy, 1936: 249-295; Hurtado, 1995: 132-133).

18.115 Juan Fernandez sea-cliffs and rocky shores
Sea-cliffs, their faces, ledges and associated caves, rocky shores and isolated seaside rocks of the coasts of Mas Afuera, Mas a Tierra and their associated islets.
(Murphy, 1936: 254-258).

18.12 Chileno-Peruvian desert sea-cliffs and rocky shores
Sea-cliffs, their faces, ledges and associated caves, rocky shores and isolated seaside rocks of the desert coasts of Pacific South America and their nearshore islands, between 29° S and northern Peru, adjacent to the subtropical maritime zone of the Pacific and the Humboldt Current upwelling zone. Cliffs are prevalent along the entire coastline, particularly in southern Peru where they reach great heights.
(Murphy, 1936: 249-254, 263-295; Hurtado, 1995: 132-133).

18.13 Tropical sea-cliffs and rocky shores
Sea-cliffs, their faces, ledges and associated caves, rocky shores and isolated seaside rocks of the coasts of South America adjacent to the tropical maritime zone, south to the Santa Catarina coast in the Atlantic and to northern Peru in the Pacific, of the Galapagos Archipelago and other tropical islands, of the subtropical oceanic islands of the Pacific and the Atlantic, with the exception of the Juan Fernandez Islands.
(Murphy, 1936; Hurtado, 1995: 133; Diegues *et al.*, 1995: 72, 74).

18.131 Caribbean sea-cliffs and rocky shores
Sea-cliffs, their faces, ledges and associated caves, rocky shores and isolated seaside rocks of the Caribbean coasts of Colombia and Venezuela, of their nearshore islands, of the southwestern Lesser Antilles, including Aruba, Curaçao, Bonaire, Islas Las Roques and Isla Orquilla, of Isla La Tortuga, Isla Margarita, Isla Blanquilla, Trinidad and Tobago.
(Murphy, 1936: 110-124; Stoffers, 1993: 414-415).

18.132 Tropical Atlantic sea-cliffs and rocky shores
Sea-cliffs, their faces, ledges and associated caves, rocky shores and isolated seaside rocks of the tropical zone of the Atlantic, north of Cabo Santa Marta Grande on the Santa Catarina coast, in particular, isolated cliffs and rocky shores of off-shore islands of French Guiana, isolated cliffs of the Fortaleza area in Ceara, more frequent cliffs of the coasts of Rio Grande do Norte, between Cabo de San Roque and Recife, prevalent cliffs, rocky shores, limestone reefs of the Pernambuco, Alagoas, Sergipe, Espirito Santo, Rio de Janeiro, Sao Paulo and Santa Catarina coasts, along the margin of the Brazilian shield, of their nearshore islands and of the Abrolhos archipelago, cliffs of Fernando de Noronha, Saint Paul's Rocks.
(Murphy, 1936: 133-134, 139-140, 141-143, 146-151, 156-163; Tostain *et al.*, 1992: 12; Diegues *et al.*, 1995: 72, 74).

18.133 Tropical Pacific sea-cliffs and rocky shores
Sea-cliffs and rocky shores of the tropical Pacific coast of South America north of Punta Parinas, and of the Galapagos archipelago and of Malpelo Island.
(Murphy, 1936: 296-317, 319-320; Hurtado, 1995: 132).

18.1331 Tropical Pacific continental sea-cliffs and rocky shores
Sea-cliffs and rocky shores of the tropical Pacific coast of South America north of Punta Parinas. Cliffs occur, in particular, in Colombia to the north of Cape Corrientes, where the coast is high and mountainous with fjords, in northern Ecuador, in southern Ecuador, in particular, around the Santa Elena peninsula and along the southern coast of the Gulf of Guayaquil, in northern Peru.
(Murphy, 1936: 303-317; Hurtado, 1995: 132).

18.1332 Malpelo sea-cliffs and rocky shores
Sea-cliffs, rocky shores and offshore rocks of Malpelo Island, harbouring, in particular, the gull *Creagrus furcatus*, of very limited range.
(Murphy, 1936: 319-320).

18.1333 Galapagos sea-cliffs and rocky shores
Sea-cliffs, rock pavements and rocky shores of the Galapagos Archipelago, harbouring, in particular, the gull *Creagrus furcatus*, of which they constitute the main stronghold, the only tropical penguin, *Spheniscus mendiculus*, the endemic flightless cormorant *Phalacrocorax harrisi* and the large endemic marine iguana *Amblyrhynchus cristatus*. The seabirds *Oceanodroma tethys*, *Puffinus lherminieri*, *Diomedea irrorata*, *Phaethon aethereus*, *Sula dactylatra*, *Sula nebouxii*, the sea mammals *Zalophus californianus wollobaekii*, *Arctocephalus galapagoensis* are also characteristic of rock pavements. The crab *Grapsus grapsus* is abundant in the intertidal zone and enters wet places in rock pavements.
(Murphy, 1936: 296-303; Van der Werff and Adsersen, 1993: 465-469; Hurtado, 1995: 132).

18.134 Subtropical insular sea-cliffs and rocky shores
Sea-cliffs, their faces, ledges and associated caves, rocky shores and isolated seaside rocks of the subtropical oceanic islands of the Pacific and the Atlantic, with the exception of the Juan Fernandez Islands. Their bird communities are mostly of tropical affinities; *Pterodroma arminjoniana* and *Procelsterna albivittata* are specific to the subtropical belt.
(Murphy, 1936: 79).

18.1341 South Trinidad and Martin Vas sea-cliffs and rocky shores
Sea-cliffs, their faces, ledges and associated caves, rocky shores and isolated seaside rocks of the South Trinidad and Martin Vaz archipelagoes, harbouring, in particular, the endemic *Pterodroma arminjoniana*.
(Murphy, 1936: 171-176).

18.1342 San Felix sea-cliffs and rocky shores
Sea-cliffs, their faces, ledges and associated caves, rocky shores and isolated seaside rocks of the coasts of San Felix, San Ambrosio and their associated islets.
(Murphy, 1936: 258-262).

18.1343 Sala y Gomez sea-cliffs and rocky shores
Sea-cliffs, their faces, ledges and associated caves, rocky shores and isolated seaside rocks of the coasts of the Sala y Gomez archipelago, in the southeast Pacific, with an avifauna of pantropical affinities.
(Murphy, 1936: 262-263).

18.1344 Easter Island sea-cliffs and rocky shores
Sea-cliffs, their faces, ledges and associated caves, rocky shores and isolated seaside rocks of the coasts of Easter Island and its associated islets, in particular, Motu Nui and Motu Iti, with a Polynesian avifauna.
(Murphy, 1936: 263; Johnson *et al.*, 1970; Harrisson, 1971; Devillers, 1972).

18.2 Sea-cliff and rocky shore aerohaline communities

Sea-cliffs, or parts of sea-cliffs, and rocky shores colonized by disjunct assemblages of aerohaline chasmophytes or by more or less closed aerohaline grasslands with associated terrestrial invertebrate and vertebrate faunal communities.

18.21 Temperate sea-cliff communities
Communities colonizing cliffs of the temperate regions of South America, including those of Tierra del Fuego and its archipelago, of Patagonia, the Pampas and their northern transition zones, of the Chilean Fjordland, Chiloe Island and Valdivian and mediterranean Chile, of the Juan Fernandez Islands.
(Oberdorfer, 1960: 153; Moore, 1968: 18; Pisano, 1971b: 110; Moore, 1983: 31; Gajardo, 1994: regions 5A1, 5A3, 7A5, 7C10, 7C12, 7C13, 7C14, 7B9).

18.211 Magellanic sea-cliff communities
Communities colonizing crevices of rock slabs of southern Patagonia, Tierra del Fuego, the Chilean Fjordland, Chiloe and the southern Valdivian coast, with *Apium australe*, *Colobanthus quitensis* (*Colobanthus crassifolius*), *Colobanthus subulatus*, *Crassula moschata*, *Plantago barbata*, *Plantago maritima*, *Polygonum maritimum*, *Poa fuegiana* (*Poa alopecurus* ssp. *fuegiana*) and, in the southernmost part of the region, *Abrotanella submarginata* and the Fuegian endemic *Poa darwiniana*.
(Oberdorfer, 1960: 153; Moore, 1968: 18; Pisano, 1971b: 110; Moore, 1983: 31).

18.212 Patagonian sea-cliff communities
Vegetated cliffs of the Patagonian desert coast, with, in particular, the subshrub *Gutierrezia brachyris* var. *patagonica* and *Cerastium nervosum* (*Cerastium arvense*).
(Hauman, 1926: 117).

18.213 Pampa and Monte sea-cliff communities
Vegetated cliffs of the Pampas, the Espinal and Monte coasts of South America.

18.214 Mediterraneo-Chilean sea-cliff communities
Vegetated cliffs of mediterranean Chile.
(Gajardo, 1994: regions 3A1, 3A3, 3A4, 3C10, 3B8, 3C13, 4B5).

18.2141 *Nolana-Neoporteria* sea-cliff communities
Communities of *Nolana paradoxa*, *Neoporteria chilensis*, *Calandrinia grandiflora*, *Neoporteria subgibbosa*, *Polyachyrus gayi*, *Alona filifolia*, *Alstroemeria pelegrina* of the coasts of Coquimbo, Valparaiso and Colchagua.
(Hoffmann, 1989: 45, 153, 168-171, 180-181; Gajardo, 1994: 3A4-3A44, 3C10-3A44, 3B8-3A44, 3C13-3A44).

18.21411 *Neoporteria subgibbosa* sea-cliff communities
Communities of the sea-cliffs of the coasts of Coquimbo, Valparaiso and Colchagua dominated by the cactus *Neoporteria subgibbosa*.
(Hoffmann, 1989: 42, 45, 168-171).

18.21412 *Neoporteria chilensis* sea-cliff communities
Communities of the sea-cliffs of the coast of southern Coquimbo between Los Vilos and Pichidangui dominated by the endangered cactus *Neoporteria chilensis*.
(Hoffmann, 1989: 42, 153, 180-181).

18.2142 *Griselinia* sea-cliff communities
Shrub communities dominated by the halophile *Griselinia scandens* (*Griselinia jodinifolia*), with *Peumus boldus*, *Adenopeltis serrata*, *Hippeastrum bicolor*, *Lithrea caustica*, *Ribes punctatum* developed on shallow soils, between the shoreline and *Peumus boldus* slope woods in the cliffs of the Concepcion coast.
(Oberdorfer, 1960: 133; Gajardo, 1994: 4B5-4B53).

18.215 Juan Fernandez sea-cliff communities
Species-poor communities of the sea-cliffs of the oceanic Juan Fernandez archipelago, limited to very few sites on Mas a Tierra, somewhat more widespread on Mas Afuera, composed by *Lobelia alata* and the ferns *Asplenium obliquum*, *Adiantum chilense*, *Blechnum auriculatum*.
(Skottsberg, 1953a: 922-923, 949).

18.22 Pacific desert sea-cliff communities
Aerohaline communities of the sea-cliffs of the deserts of the west coast of South America, including the Peruvian-Chilean garua deserts (74.1), the Northern Chilean fog-free deserts (74.2), the Sechura coastal deserts and semideserts (74.3), the Chilean southern transition semideserts (74.4), including, in particular, the very local *Eulychnia iquiquensis-Frankenia chilensis* community situated high on coastal cliffs and on rocky summits by the sea. Codes of 74.1, 74.2, 74.3 or 74.4 may be used in combination with 18.22 to describe desert communities occupying coastal cliffs.
(Gajardo, 1994: unit 1C13-1C131).

18.23 Tropical sea-cliff and rocky shore communities

Aerohaline communities of the sea-cliffs and rocky shores of the Caribbean and Atlantic coasts of South America south to southern Brazil, of the Pacific coasts south to Ecuador, of the Galapagos Islands, of the subtropical oceanic islands of the Pacific and the Atlantic, with the exception of the Juan Fernandez Islands. *Sesuvium portulacastrum*, *Philoxerus vermicularis*, *Sporobolus virginicus* are characteristic.
(Schnell, 1987b: 267; Stoffers, 1993: 414-417; van der Werff and Adsersen, 1993: 465-469).

18.231 Caribbean limestone terrace and pavement scrubs
Communities colonizing coastal cliffs, limestone terraces and rock pavements of the Caribbean coasts of South America, the southwestern Lesser Antilles, Trinidad and Tobago subjected to salt-laden winds.
(Stoffers, 1993: 413-415; Borhidi, 1993: 431-435).

18.2311 Caribbean coastal *Strumpfia* scrubs
Often dense scrub communities of the Caribbean dominated by the Rubiaceae *Strumpfia maritima*, often with *Ernodea littoralis*, and scattered *Jatropha gossypifolia*, *Lithophila muscoides*, *Opuntia wentiana*, *Sesuvium portulacastrum*, sometimes occupying vast surfaces of karstic limestone pavements on the windward side, usually restricted, on the leeward side, to a narrow fringe within the salt spray zone.
(Stoffers, 1993: 414-415).

18.2312 Caribbean coastal *Cereus-Melocactus* scrubs
Very open communities of the Caribbean inhabiting bare coastal limestone terraces subjected to strong winds but reduced salt spray in areas without surf, formed by scattered *Cereus repandus*, *Melocactus spp.*, *Euphorbia thymifolia* and *Aristida adscencionis* predominate, with sparse *Cyperus planifolius*, *Paspalum laxum*, *Sesuvium portulacastrum*, *Sporobolus pyramidatus*, *Jatropha gossypifolia*, *Lemaireocereus griseus*. They are best developed on Bonaire.
(Stoffers, 1993: 414-415).

18.2313 Caribbean coastal *Conocarpus-Lithophila* scrub
Open communities of the Caribbean occupying limestone pavements exposed to salt-laden sea winds, forming scattered pure or nearly pure patches of stunted, depressed shrubs of *Conocarpus erectus* accompanied by *Lithophila muscoides*, *Euphorbia thymifolia*, *Aristida adscencionis*, with *Cyperus planifolius*, *Paspalum laxum*, *Sesuvium portulacastrum*, *Strumpfia maritima*, *Sporobolus pyramidatus*, *Jatropha gossypifolia*, and sometimes with *Cyperus fuligineus*, *Fimbristylis ferruginea*. They are characteristic, in particular, of the tufa-like limestones of southern Bonaire and of the dogtooth limestones of northern Curaçao.
(Stoffers, 1993: 415-416).

18.2314 Caribbean coastal *Hippomane-Lithophila* scrubs
Open communities of limestone pavements of the Caribbean, in particular, of Bonaire and Curaçao, subjected to salt-laden sea winds, forming scattered pure or nearly pure patches of stunted, depressed shrubs of *Hippomane mancinella* accompanied by *Lithophila muscoides*, with *Euphorbia thymifolia*, *Opuntia wentiana*, *Cereus repandus*, *Jatropha gossypifolia*.
(Stoffers, 1993: 415-417).

18.2315 Caribbean coastal *Cocoloba-Rhacoma* scrubs
Rare tall scrub or low wood community of coral shingles overlying coastal limestone plateaux of the Caribbean dominated by *Coccoloba uvifera* and *Crossopetalum rhacoma* (*Rhacoma crossopetalum*) with scattered *Bumelia obovata*, *Condalia henriquezii*, *Jacquinia arborea*, *Sophora tomentosa*, *Antirrhea acutata*, *Erithalis fruticosa*.
(Stoffers, 1993: 413-414).

18.232 Atlantic tropical sea-cliff communities
Aerohaline communities of the sea-cliffs and rocky shores of the tropical coasts of Atlantic South America, south to Santa Catarina, of their nearshore islands, of Fernando de Noronha, of Saint Paul's Rocks.
(Diegues *et al.*, 1995: 72).

18.233 Pacific tropical sea-cliff communities

Aerohaline communities of the sea-cliffs and rocky shores of the tropical coasts of Pacific South America, north of Punta Parinas, of their nearshore islands, of Malpelo Island, of the Galapagos archipelago.

18.2331 Pacific continental tropical sea-cliff communities
Aerohaline communities of the sea-cliffs and rocky shores of the tropical coasts of Pacific South America, north of Punta Parinas, and of their nearshore islands.

18.2332 Galapagos rocky shore and sea-cliff communities
Aerohaline communities of the sea-cliffs and rocky shores of the Galapagos archipelago.
(Wiggins and Porter, 1971: 18, 182-183; Van der Werff and Adsersen, 1993: 465-469).

18.23321 Galapagos rock pavement open communities
Low, open communities colonizing rock pavements of the Galapagos Islands, chiefly unweathered lava or lava boulders, in areas of high wind and salt spray, formed by *Atriplex peruviana*, *Chamaesyce amplexicaulis*, *Opuntia echios*, *Portulaca howellii*, *Sesuvium edmonstonei*, *Sporobolus pyramidatus*, *Trianthema portulacastrum* and many lichens. Some species more characteristic of inland habitats may also participate, in particular, arid scrub species *Ipomoea habeliana*, *Chamaesyce viminea*, the endemic cacti *Brachycereus nesioticus* and *Jasminiocereus thouarsii* of lava fields, the rare San Cristobal endemic *Calandrinia galapagosa*.
(Wiggins and Porter, 1971: 17-18, 183-184, 291; Stoffers, 1993: 410; van der Werff and Adsersen, 1993: 465-466; De Lacerda *et al.*, 1993: 479).

18.23322 Galapagos rocky shore dense scrubs
Closed, dense formations of shrubs occupying rocky shores of the Galapagos Islands subjected to wind and salt spray. They are most often formed by *Cryptocarpus pyriformis*, *Grabowskia boerhaaviaefolia* and the endemic *Lycium minimum*, often accompanied by species typical of more inland habitats but salt-resistant, notably *Opuntia echios*, *Vallesia glabra*, the rare *Boerhavia caribea*. Occasionally, the scrub is formed, as on northeastern Fernandina, by shrubby individuals of the mangrove *Rhizophora mangle* or, as on Isla Coamano, Academy bay, thickets of the endemic *Nolana galapagensis*.
(Wiggins and Porter, 1971: 18; Van der Werff and Adsersen, 1993: 465-469).

18.23323 Galapagos erosion sea-cliff communities
Sparse aerohaline communities of sea-cliffs of the Galapagos archipelago, formed by easily eroded material in which rooting is facilitated, with *Exodeconus miersii*, *Lycopersicum cheesmannii*, *Lihophylla radicata*, *Lecocarpus pinnatifidus*, *Lecocarpus lecocarpoides*, *Scalesia villosa*, *Scalesia incisa*.
(Van der Werff and Adsersen, 1993: 468).

18.23324 Galapagos basalt sea-cliff communities
Very sparse aerohaline communities of the mostly unvegetated basaltic sea-cliffs of the Galapagos archipelago with *Scalesia crockeri*, *Scalesia helleri*, *Nicotiana glutinosa* or the fern *Nephrolepis biserrata*.
(Wiggins and Porter, 1971: 18; Van der Werff and Adsersen, 1993: 468).

18.2333 Malpelo sea-cliff communities
Aerohaline communities of the sea-cliffs and rocky shores of Malpelo Island.

18.234 Subtropical insular sea-cliff communities
Vegetated sea-cliffs of the subtropical oceanic South Trinidad and Martin Vaz archipelagoes in the Atlantic, San Felix and San Ambrosio, Sala y Gomez and Easter Island archipelagoes in the Pacific.

18.2341 South Trinidad sea-cliff communities
Vegetated sea-cliffs of the subtropical oceanic South Trinidad and Martin Vaz archipelagoes in the Atlantic.

18.2342 San Felix and San Ambrosio sea-cliff communities
Vegetated sea-cliffs of the subtropical oceanic San Felix and San Ambrosio archipelagoes in the Pacific.

18.2343 Sub-Polynesian sea-cliff communities

Vegetated sea-cliffs and rocky seashores of the subtropical oceanic Sala y Gomez and Easter Island archipelagoes in the eastern Pacific, with *Lycium sandvicense*, *Asplenium obtusatum*, *Chenopodium ambiguum*, *Portulaca oleracea*, *Samolus repens*, *Apium prostratum*, *Paspalum forsterianum*.
(Skottsberg, 1922a: 63-76; Skottsberg, 1928: 495-496).

18.3 Coastal lagoon cliff communities

Communities of vascular chasmophytes and animals colonizing the cliffs of coastal saline or hypersaline bodies of water, listed here only when they differ very significantly from the cliff communities of unit 18.2.

18.4 Deposit sea-cliffs

Sea-cliffs composed of relatively soft, unconsolidated or incompact mineral particle deposits, carved by wind and wave action. They often support a vegetation of dune shrubs (unit 16).
(Clark, 1990).

19. ISLETS, ROCK STACKS, REEFS, BANKS, SHOALS

Permanently emerging, periodically uncovered, surface-breaking or near-surface raised features of the oceans, their connected seas and coastal waters, with their associated marine and terrestrial communities. The associated marine habitats can be coded by combining subdivisions of prefix 11 with the relevant physiographic subdivisions of unit 19, the terrestrial habitats by adding codes from units 3 and 4.
(Barnes and Hughes, 1988; Britton and Morton, 1989; Clark, 1990; van der Maarel, 1993b: 13; Diegues *et al.*, 1995: 73, 74; Hurtado, 1995: 133).

19.1 Lithogenic rock stacks and islets

Rock stacks, pinnacles, skerries and small rocky islands in the sea or coastal waters, mostly important as sites for seabird colonies, covered or not by soil, vegetation or guano.

19.2 Surface and underwater rocks

Lithogenic reefs, raised rocky features of the continental shelf and its inshore waters, covered by shallow water or reaching and breaking the surface, or uncovered by tides or strong wave action.

19.3 Barrier islands, spits

Spits, barrier beaches, barrier islands, tombolos, features formed of sands and gravels deposited by longshore drift in narrow ridges attached to the land at one end and extending into the sea at the other, or separated from land by channels and lagoons, or linking an offshore island to the coast. Particularly developed, extensive barrier island-lagoon systems lie, in particular, along the Brazilian Rio Grande do Sul coast.
(Géhu, 1985; Clark, 1990; Diegues *et al.*, 1995:72).

19.4 Banks and shoals

Deposits of muds, sands or gravels of the continental shelf permanently covered by shallow (banks), or very shallow (shoals), water.
(Clark, 1990).

19.5 Coral reefs

Organogenic features of oceans, seas or coastal waters, formed by coral, coral sands and other coral derivatives, with a crest often rising just above low spring tide level. Characteristic of clear, warm tropical waters, they are limited within the South American region, as here defined, to the Caribbean islands from Curaçao and Aruba east to Tobago and Trinidad, to local occurrences along the mainland coasts of Caribbean Colombia and Venezuela, to the Atlantic coasts of Brazil between Fortaleza and Salvador, with outliers north to eastern Maranhao and south to the tropic of Capricorn, to Rocas Reef and Fernando de Noronha, to the Pacific coasts of Colombia, Ecuador, to Malpelo Island and the Galapagos archipelago, and to a few isolated occurrences on the coast of Peru. The associated marine

communities can be described by combining subdivisions of unit 11.2B with those of unit 19.5. Permanent emerged features may form in conjunction with coral reefs. Their presence can be recorded by use of unit 19.6.
(Barnes and Hughes, 1988; Britton and Morton, 1989; Rougerie and Wauthy, 1990; Clark, 1990; Achituv and Dubinsky, 1990; Montgomery, 1990; Stanley, 1995: 14; Diegues *et al.*, 1995: 73; Hurtado, 1995: 133).

19.51 Fringing reefs
Coral reefs bordering the land, forming close inshore on rocky coastlines by the growth of corals and associated hydrozoans, alcyonarians and calcareous algae, in particular, fringing and patch reefs developed around the windward side of Caribbean islands.
(Barnes and Hughes, 1988; Clark, 1990; Stanley, 1995:15).

19.52 Barrier reefs
Coral reefs separated from the land by lagoons.
(Barnes and Hughes, 1988; Clark, 1990).

19.53 Atolls
Annular coral reefs formed around subsiding volcanic islands, sometimes interrupted by channels, enclosing a lagoon, including, in particular, atoll-like structures of Caribbean Colombian waters.
(Barnes and Hughes, 1988; Rougerie and Wauthy, 1990; Clark, 1990; Stanley, 1995: 15).

19.6 Cays, reef-knolls and coral islands

Permanently emerged features of oceans, seas or coastal waters formed, in conjunction with coral reefs, by coral, coral sands and other coral derivatives, in particular, cays (keys), reef-flats, reef-knolls and bioherms. Cays are mostly limited, in the South American region, to the Caribbean islands and mainland coast, and to Rocas Reef in the tropical Atlantic. Limestone reefs also occur along the coasts of Brazil, in particular, in the Abrolhos Islets. The terrestrial communities they support can be described by combining subdivisions of units 16, 18, 3B, 4B or 73.3 with those of unit 19.6.
(Murphy, 1936: 143-146, 157-160; Whitten and Brooks, 1972; Gonzalez, 1978: 125-128; Whittow, 1984; Clark, 1990; Stoffers, 1993: 417-419).

19.7 Seamounts and guyots

Elevated features of the floor of the oceans and their connected seas raising close enough to the surface to create neritic conditions.

2. NON-MARINE WATERS

All inland and land-locked waters of natural origin, standing or flowing, saline, brackish or fresh, and the aquatic or amphibious, non-marine, communities associated with them; seminatural aquatic communities occupying manmade water bodies. Included are coastal lagoons, freshwater lakes, ponds or pools, the waters of athalassal saline, hypersaline or brackish pools, lakes and inland seas, permanent or temporary streams and rivers.

Saline or hypersaline waters of the vicinity of the oceans and their connected seas, often formed from sea inlets by silting and cut off from the sea by more or less effective obstacles such as sand or mud banks. The presence of marine invertebrate communities or vegetation can be indicated by combination with the relevant physiographic subdivisions of 21 of codes from 11; the presence of communities of athalassal affinities can similarly be indicated by addition of codes of 23.
(Koepcke, 1961: 124; Gonzalez, 1978; Gore and Gepp, 1978: 28-30; Clark, 1990; Tostain *et al.*, 1992: 14; Van der Werff and Adsersen, 1993: 462; Junk, 1993: 720; Stanley, 1995: 16; Diegues *et al.*, 1995: 73, 74).

21.1 Sea-connected lagoons

Coastal lagoons incompletely closed off from the sea, communicating with it through a channel or channels, such as those between barrier islands or around or through a barrier beach.

21.2 Isolated lagoons

Coastal lagoons closed off from the sea, without communicating channels sufficient to allow significant water passage.

21.3 Percolation pools

Coastal water bodies fed by the seeping of seawater.

21.4 Silled or sluiced ponds

Water bodies separated from the sea by sills or sluices that regulate their communication, often limiting it to entry by waves, high tides or storms.

21.5 Coral reef lagoons

Water bodies of the interior of atolls; coastal waters enclosed by fringing or barrier reefs. They are uncommon in South America, limited to Colombian waters in the Caribbean and to the oceanic Rocas Reef in the Atlantic.
(Murphy, 1936: 145-146; Stanley, 1995: 15).

21.6 Coastal lagoon islets

Small islands in large coastal bodies of saline water, mostly important as sites for waterbird colonies. Associated terrestrial habitats can be indicated by addition of codes from 3 and 4.

22. STANDING FRESHWATER

Lakes, ponds and pools of natural origin containing fresh (*i.e.* nonsaline) or slightly brackish water. Seminatural aquatic communities occupying manmade freshwater bodies, including artificially created lakes, reservoirs and canals.
(Clark, 1990).

22.1 Permanent freshwater ponds and lakes

Freshwater lakes, ponds, pools, or parts of such freshwater bodies, in which water is permanently retained, although its level may fluctuate; their associated pelagic (units 22.11, 22.12, 22.13, 22.14) and benthic (unit 22.15) communities. The macrophytic, euhydrophytic based communities that colonize them are separately listed under 22.3. Features of the lake bed uncovered by low water such as gravel, sand, mud or rock banks and beaches, and the communities they support, are listed under units 22.4 and 22.5. Permanently or almost permanently emerged features supporting terrestrial communities influenced by the water bodies presence are included in unit 22.6. The fringing belts or island rafts of rooted or floating tall emergent vegetation are listed under unit 53.

22.11 Temperate freshwater ponds and lakes
Permanent freshwater lakes, ponds, pools of temperate South America, generally with a dimictic, warm monomictic or cold monomictic circulation regime and annually stable trophic regime, their associated pelagic communities. Their distribution includes Tierra del Fuego, the temperate Andes, Patagonia, the Pampas, Magellanic, Valdivian and mediterranean Chile. The subunits are geographical entities characterized by distinct climatic conditions, hydrographic regimes and macrofauna. In each of them, additional classes may be introduced on the basis of trophic level, when relevant, separating lime-deficient oligotrophic freshwater bodies, with greenish to brownish clear waters, poor in dissolved bases (pH often 5-6), lime-rich oligo-mesotrophic freshwater bodies, with mostly blue to greenish, very clear, waters, poor (to moderate) in nutrients, base-rich (pH often > 7.5), eutrophic freshwater bodies, with mostly dirty grey to blue-green, more or less turbid, waters, particularly rich in dissolved bases (pH usually > 7), mesotrophic freshwater bodies, with waters fairly rich in dissolved bases (pH often 6-7), dystrophic freshwater bodies, with acidic waters of high humus content and often brown tinted (pH often 3-5).
(Duvigneaud, 1980; Vanden Berghen, 1982; Taub, 1984a, 1984b; Bonetto and Di Persia, 1984: 541-542; Rai and Hill, 1984a: 331; Ellenberg, 1988; Schubert, 1991: 356-370, 403; Leser, 1994: 487-488; Archibold, 1995: 354-361).

22.111 Patagonian freshwater ponds and lakes
Permanent freshwater lakes, ponds, pools of the Patagonian desert and steppe zones, in particular, abundant water bodies of the pre-Andean Patagonian plateaux.
(Bonetto and di Persia, 1984: 541-542; Fjeldså and Krabbe, 1990: 23; Johnson and Serret, 1994; Erize *et al.*, 1995: 131).

22.1111 Oligotrophic Patagonian freshwater lakes
Permanent freshwater lakes, ponds, pools of the Patagonian desert and steppe zones with clear waters, characteristic, in particular, of the basaltic plateaux of pre-Andean Patagonia, where they constitute the breeding habitat of the threatened endemic grebe *Podiceps gallardoi*.
(Rumboll, 1974; Storer, 1982; Fjeldså, 1984, 1986a, 1986b; Fjeldså and Krabbe, 1990: 70-71; Johnson and Serret, 1994; Erize *et al.*, 1995: 131-135; Chebez, 1994: 111-115).

22.1112 Eutrophic Patagonian freshwater lakes

Freshwater lakes and pools of temperate South America with mostly dirty grey to blue-green, more or less turbid, waters, particularly rich in dissolved bases (pH usually > 7).
(Rumboll, 1974; Storer, 1982; Fjeldså, 1984, 1986a, 1986b; Johnson and Serret, 1994; Chebez, 1994: 111-115).

22.112 Magellanic freshwater ponds and lakes
Permanent freshwater lakes, ponds, pools of the deciduous and evergreen Magellanic forest zones of Tierra del Fuego, the Chilean Fjordland and the lower and middle slopes of the southern Andes of Chile and Argentina.

22.113 Temperate high Andean freshwater lakes
Permanent freshwater lakes, ponds, pools of the higher elevations of the temperate Andes, mostly with a cold monomictic circulation regime.

22.114 Mediterraneo-Chilean freshwater ponds and lakes
Permanent freshwater lakes, ponds, pools of the mediterranean zone of Chile.

22.115 Pampa freshwater ponds and lakes
Permanent freshwater lakes, ponds, pools of the Argentinian and Uruguayan Pampas.

22.12 Lowland and montane tropical freshwater ponds and lakes
Permanent freshwater lakes, ponds, pools of tropical South America, generally multitrophic and with an oligomictic or warm polymictic circulation regime.
(Löffler, 1968: 57-58; Rai and Hill, 1984a, 1984b; Junk, 1993; Archibold, 1995: 356).

22.121 Amazonian ponds and lakes
Freshwater lakes, ponds, pools of the humid tropics of South America, or parts of such freshwater bodies, in which water is permanently retained, including outside of river flood periods, although its level may fluctuate, generally multitrophic, with trophic level related to depth and varying with season, and with an oligomictic circulation regime; their associated pelagic communities. They are characteristic, in particular, of the Amazon, Orinoco, upper Parana and San Francisco basins.
(Löffler, 1968: 57-58; Rai and Hill, 1984a, 1984b; Junk, 1993; Archibold, 1995: 356).

22.1211 Whitewater ponds and lakes
Freshwater lakes, ponds, pools of tropical South America, fed by whitewaters, turbid waters of more or less ochraceous colour caused by the suspended mineral charge.
(Rai and Hill, 1984a, 1984b; Junk, 1993).

22.1212 Blackwater ponds and lakes
Freshwater lakes, ponds, pools of tropical South America, fed by blackwaters, more or less transparent waters of olive-brown to coffee brown colour caused by suspended humic complexes nearly devoid of mineral charge.
(Rai and Hill, 1984a, 1984b; Junk, 1993).

22.1213 Mixed water tropical ponds and lakes
Freshwater lakes, ponds, pools of tropical South America, fed by both whitewaters and blackwaters, of characteristics mostly intermediate between those of units 22.1211 and 22.1212.
(Rai and Hill, 1984a, 1984b; Junk, 1993).

22.122 Dry tropics freshwater ponds and lakes
Permanent freshwater lakes, ponds, pools of the dry and subhumid tropics and subtropics of South America, with a warm polymictic circulation regime. They are distributed in particular, in the Chaco, the Pantanal, the Espinal, the Cerrado.
(Löffler, 1968: 57-58; Archibold, 1995: 356).

22.123 Tropical montane freshwater ponds and lakes
Permanent freshwater lakes, ponds, pools of tropical mountain forest zones of South America, up to about 3800-4000 metres altitude, with a warm polymictic circulation regime and temperatures generally above 12°-14° C.
(Löffler, 1968: 57-58).

22.1231 Northern Andean freshwater lakes

Uncommon lakes and ponds of the sylvatic level of the northern tropical Andes, or paramo Andes, best represented in Colombia and Venezuela, comprising, in particular, the lakes of the Sabana de Bogota, including Lake Tota at 3015 metres altitude, last known stronghold of the almost certainly extinct grebe *Podiceps andinus*.
(Fjeldså and Krabbe, 1990: 22-23; del Hoyo *et al.*, 1992: 194; Junk; 1993: 716).

22.1232 Central Andean freshwater lakes
Lakes and ponds of the sylvatic level of the southern tropical Andes, or puna Andes.

22.1233 Extra-Andean tropical mountain freshwater lakes
Lakes and ponds of the mountain forest zone of mountain chains of South America outside of the Andes.

22.13 High Andean tropical freshwater ponds and lakes
Freshwater lakes, ponds and tarns of the tropical Andes, at altitudes ranging above 3800 metres, sometimes 3500 metres, and up to 6060 metres in Catamarca, Argentina, with a cold polymictic circulation regime, characterized by frequent circulations during both day and night and lack of stable stratification, low temperatures not usually exceeding 12°-14° C, stable annual light conditions, limited transparency, even verticale distribution of oxygen and lack of ice cover. High mountain tropical lakes are rare ecosystems on a world basis, those of the Andes, numbering in the thousands, representing by far the largest proportion of them. They are notable for their high faunal endemism.
(Koepcke, 1954: 85-87; Dorst, 1957; Koepcke, 1961: 125-126; Löffler, 1968; Fjeldså and Krabbe, 1990: 22-23; Halloy *et al.*, 1991: 11; Junk, 1993: 715-716).

22.131 Puna freshwater ponds and lakes
Freshwater lakes and ponds of the southern tropical, puna, Andes, developed under comparatively dry climates and in conditions of high, constant solar radiation. They constitute the bulk of high Andean lakes.
(Koepcke, 1954: 85-87; Koepcke, 1961: 125-126; Löffler, 1968: 57-76; Fjeldså and Krabbe, 1990: 22-23; Junk; 1993: 715-717).

22.1311 Titicaca pelagic communities
Open-water communities of Lake Titicaca, the largest high-mountain lake in the world, of Tertiary origin (Lake Ballivian), with high endemism, including the flightless grebe *Rollandia microptera* and 14 of the 20 species of the cyprinodontid genus *Orestias*. The lake is situated at the relatively low altitude of 3800 metres, is very deep, has a relatively high temperature of slightly above 14° C at the surface, 11.4° C at 150 metres, and a circulation regime somewhat intermediate between cold polymictic and warm polymictic.
(Koepcke, 1961: 125-126; Löffler, 1968: 57-76; Fjeldså and Krabbe, 1990: 22-23, 66-67; Junk; 1993: 715-717).

22.1312 Junin pelagic communities
Open-water communities of Lake Junin, large lake of the wet puna, at 4080 metres altitude, with substantial endemism, including the highly endangered flightless grebe, *Podiceps taczanowskii* and the cyprinodont *Orestias empyraeus*.
(Koepcke, 1954: 85-87; Koepcke, 1961: 125-126; Löffler, 1968: 57-76; Fjeldså, 1981; Fjeldså and Krabbe, 1990: 22-23, 70; Junk; 1993: 715).

22.1313 Deep puna freshwater lakes
Open-water communities of deep lakes and ponds of the puna, other than the Titicaca system and Lake Junin, with generally reduced vegetation.
(Koepcke, 1954: 87; Koepcke, 1961: 125-126; Löffler, 1968: 57-76; Fjeldså and Krabbe, 1990: 22-23; Junk; 1993: 715-717).

22.1314 Shallow puna freshwater lakes
Open-water communities of shallow lakes and ponds of the puna, other than the Titicaca system and Lake Junin, with generally more abundant fringing (unit 53) and aquatic (unit 22.3) vegetation.
(Koepcke, 1954: 85-86; Koepcke, 1961: 125-126; Löffler, 1968: 57-76; Fjeldså and Krabbe, 1990: 22-23; Junk; 1993: 715-717).

22.132 Paramo freshwater ponds and lakes
Freshwater lakes and ponds of the central and eastern, paramo, Andes, developed under comparatively humid, cloudy climates, with exceptionally high annual temperature stability and reduced solar radiation exposure.
(Koepcke, 1961: 125-126; Löffler, 1968: 57-76; Fjeldså and Krabbe, 1990: 22-23).

22.133 Subnival ponds and tarns
Small, often deep, glacial basin ponds and tarns developed near snowfields of the northern Andes and northern Peru, at very high altitudes, sometimes frozen for long periods, generally biologically unproductive.
(Koepcke, 1961: 125-126; Löffler, 1968: 57-76; Fjeldså and Krabbe, 1990: 22-23).

22.14 Desert permanent freshwater lakes and ponds
Uncommon permanent freshwater lakes, ponds, pools of the tropical and subtropical deserts of South America, in particular, of the Pacific deserts of Peru and Chile, associated with surface or subterranean flowing water systems; their associated pelagic communities. The macrophytic, euhydrophytic based communities that colonize them are separately listed under 22.4, fringing belts or island rafts of rooted or floating tall emergent vegetation under 53.
(Koepcke, 1954: 45-46; Koepcke, 1961: 124-125).

22.15 Lacustrine benthic communities
Lake bottom animal, green algal or lower algal communities of permanent freshwater lakes and pools of South America.
(Bonetto and Di Persia, 1984: 550-553; Schubert, 1991: 362-365; Leser, 1994: 488).

22.151 Temperate lacustrine benthic communities
Lake bottom animal, green algal or lower algal communities of permanent freshwater lakes and pools of temperate South America.
(Bonetto and Di Persia, 1984: 550-553; Schubert, 1991: 362-365; Leser, 1994: 488).

22.152 Tropical lacustrine benthic communities
Lake bottom animal, green algal or lower algal communities of permanent freshwater lakes and pools of tropical lowland and montane South America.

22.153 High Andean tropical lacustrine benthic communities
Lake bottom animal, green algal or lower algal communities of permanent freshwater lakes and pools of high elevations of the tropical Andes of South America.
(Löffler, 1968: 57-76).

22.154 Desert lacustrine benthic communities
Lake bottom animal, green algal or lower algal communities of permanent freshwater lakes and pools of the tropical and subtropical deserts of South America, in particular, of the Pacific deserts of Peru and Chile.
(Koepcke, 1961: 124-125).

22.2 Temporary freshwater bodies

Freshwater lakes, ponds, pools, or parts of such freshwater bodies, which become periodically dry, with their associated pelagic (units 22.21 - 22.24) and benthic (units 22.25) communities. Drawdown resistant euhydrophyte communities are included in unit 22.3. Features of the lake bed, uncovered by low water or permanently emerging, such as gravels, sands, muds or rocks of the exposed lake bed, its beaches and islands, and the animal and microphyte communities they may support, are listed under unit 22.4. The macrophyte-based amphibious communities that may occupy them are listed under unit 22.3, fringing belts or island rafts of rooted or floating tall emergent vegetation under unit 53. Grasslands, shrublands and woodlands which may at times be inundated but in which semicontinuous formations of grasses, shrubs or trees emerge at all times above the standing water surface are listed under units 37, 3A, 44 and 4A, not under unit 22.2.
(Koepcke, 1961: 126-127; Britton and Crivelli, 1993).

22.21 Temperate temporary freshwater bodies
Temporary freshwater lakes, ponds, pools of temperate South America and their associated pelagic communities. Their distribution includes Tierra del Fuego, the temperate Andes, Patagonia, the Pampas, Magellanic, Valdivian and mediterranean Chile.

22.211 Patagonian temporary freshwater bodies
Temporary freshwater lakes, ponds, pools of the Patagonian desert and steppe zones.

22.212 Magellanic temporary freshwater bodies
Temporary freshwater lakes, ponds, pools of the deciduous and evergreen Magellanic forest zones of Tierra del Fuego, the Chilean Fjordland and the lower and middle slopes of the southern Andes of Chile and Argentina.

22.213 Temperate high Andean temporary freshwater bodies
Temporary freshwater lakes, ponds, pools of the higher elevations of the temperate Andes.

22.214 Mediterraneo-Chilean temporary freshwater bodies
Temporary freshwater lakes, ponds, pools of the mediterranean zone of Chile.

22.215 Pampa temporary freshwater bodies
Temporary freshwater lakes, ponds, pools of the Argentinian and Uruguayan Pampas.

22.22 Lowland and montane tropical temporary freshwater bodies
Temporary freshwater lakes, ponds, pools of the lowlands and of the sylvatic zones of the mountains of tropical South America.

22.221 Amazonian temporary freshwater bodies
Temporary freshwater lakes, ponds, pools of the humid tropics of South America; their associated pelagic communities. They are characteristic, in particular, of the Amazon, Orinoco, upper Parana and San Francisco basins.

22.222 Dry tropics temporary freshwater bodies
Temporary freshwater lakes, ponds, pools of the dry and subhumid tropics and subtropics of South America. They are distributed in particular, in the Chaco, the Pantanal, the Espinal, the Cerrado.

22.223 Tropical montane temporary freshwater bodies
Temporary freshwater lakes, ponds, pools of tropical mountain forest zones of South America, up to about 3800-4000 metres altitude.

22.23 High Andean tropical temporary freshwater bodies
Temporary freshwater lakes, ponds and tarns of the high tropical Andes, at altitudes ranging above 3800 metres, sometimes 3500 metres.
(Koepcke, 1954: 85, 87, 88-89).

22.24 Desert temporary freshwater bodies
Temporary freshwater lakes, ponds, pools of the tropical and subtropical deserts of South America, in particular, of the Pacific deserts of Peru and Chile.

22.25 Temporary water body benthic communities
Benthic communities developed in the wet phase of the cycle of temporary lakes and pools.
(Koepcke, 1961: 126-127).

22.3 Lacustrine euhydrophyte communities

Communities of permanent or semipermanent fresh or slightly brackish lakes, ponds, pools or canals formed by free-floating, floating-leaved rooted, or submerged macrophytes and their associated epiphytic biocoenoses. Tall emergent-dominated formations, rooted in the substratum or constituting soil-retaining floating islands (embalsados), are excluded and listed in unit 53.
(Cabrera, 1958: 332; Oberdorfer, 1960: 12, 43-44, 73-74, 148; Koepcke, 1961: 132-133; Cabrera, 1964; Vervoorst, 1967: 153-155; Cabrera, 1968: 105; Cabrera and Zardini, 1978: 4; Moore, 1983: 31-32; Junk and Howard-Williams, 1984; Schnell, 1987b: 234-238, 250-251; Denny, 1993: 16-25; Junk, 1993: 707, 715-716; Muñoz *et al.*, 1993: 22; Carnevali, 1994; Archibold, 1995: 361-366).

22.31 Lacustrine free-floating vegetation
Communities of macrophytes floating freely at the surface of water bodies, not rooted in the substrate and not rising or moderately rising above the water surface, together with their epiphytic fauna; floating islands of tall grass-like helophytes are not included and are listed in 53.
(Cabrera, 1958: 332; Oberdorfer, 1960: 12, 43-44, 73; Koepcke, 1961: 132-133; Cabrera, 1964: 56-68; Vervoorst, 1967: 153-155; Cabrera, 1968: 105; Cabrera and Zardini, 1978: 4; Moore, 1983: 340; Junk and Howard-Williams, 1984: 272-273, 281; Schnell, 1987b: 250; Muñoz *et al.*, 1993: 22; Carnevali, 1994; Archibold, 1995: 361-366).

22.311 Lacustrine pontederiad rafts
Formations of free-floating Pontederiaceae of lakes, ponds, pools and canals of South America.
(Oberdorfer, 1960: 43; Koepcke, 1961: 133; Cabrera, 1964: 56-64; Cabrera and Zardini, 1978: 4; Schnell, 1987b: 250; Muñoz *et al.*, 1993: 22; Carnevali, 1994: units 24, 25 *p.*).

22.3111 Lacustrine water hyacinth rafts
Standing-water formations of free-floating *Eichhornia azurea* or *Eichhornia crassipes*, widespread in tropical, subtropical and warm temperate parts of South America, abundant in particular in the Pantanal, the humid Chaco and the Rio de la Plata area. Part of the camalotales are included here; those that comprise a substantial stratum of tall emergents are listed in unit 53.
(Oberdorfer, 1960: 43; Koepcke, 1961: 133; Cabrera, 1964: 56-64; Cabrera and Zardini, 1978: 4, 181; Schnell, 1987b: 250; Muñoz *et al.*, 1993: 22; Carnevali, 1994: units 24, 25 *p.*).

22.3112 Lacustrine *Pontederia* rafts
Standing-water formations of free-floating pontederiads of genus *Pontederia* (*Reussia*), notably, *Pontederia rotundifolia*, of tropical and subtropical South America, common, in particular, in the Pantanal and in the humid Chaco, occurring south to the Rio de la Plata area.
(Cabrera, 1964: 58; Cabrera and Zardini, 1978: 181-183; Schnell, 1987b: 250; Carnevali, 1994: unit 25 *p.*).

22.312 Lacustrine water lettuce beds
Colonies of the free-floating, rosette-forming *Pistia stratiotes* of tropical and subtropical still waters of South America.
(Koepcke, 1961: 132-133; Cabrera, 1964: 60-63; Vervoorst, 1967: 155; Cabrera and Zardini, 1978: 4; Schnell, 1987b: 250; Carnevali, 1994: unit 24).

22.313 Lacustrine large fern rafts
Free-floating communities of lakes, ponds, pools and canals of South America dominated by large ferns, in particular, of genus *Salvinia* or *Ceratopteris*.
(Oberdorfer, 1960: 43; Cabrera, 1964: 60; Cabrera and Zardini, 1978: 45-46; Schnell, 1987b: 250; Muñoz *et al.*, 1993: 22; Carnevali, 1994: unit 24).

22.3131 Lacustrine *Salvinia* rafts
Often dense and extensive mats of lakes, ponds, pools and canals of South America dominated by free-floating ferns of genus *Salvinia*, in particular, *Salvinia auriculata*, *Salvinia rotundifolia*, *Salvinia natans*, *Salvinia herzogii*.
(Oberdorfer, 1960: 43; Cabrera, 1964: 60; Cabrera and Zardini, 1978: 45-46; Schnell, 1987b: 250; Muñoz *et al.*, 1993: 22; Carnevali, 1994: unit 24).
22.3132 Lacustrine *Ceratopteris* rafts

Floating communities of lakes, ponds, pools and canals of tropical South America dominated by the robust parkerid fern *Ceratopteris pterioides*.
(Cabrera, 1964: 60; Schnell, 1987b: 250).

22.314 Lacustrine limnobium rafts
Freshwater formations dominated by the free-floating Hydrocharitaceae *Hydromystria laevigatum* (*Limnobium laevigatum*, *Hydromystria stolonifera*) of lakes, ponds, pools and canals of tropical South America and the Pampas.
(Cabrera, 1964: 60; Vervoorst, 1967: 153-155; Cabrera and Zardini, 1978: 4, 60-61; Carnevali, 1994: unit 25).

22.315 Lacustrine duckweed communities
Communities of duckweed of genera *Lemna* (*Lemna disperma*, *Lemna valdiviana*, *Lemna gibba*, *Lemna minima*), *Spirodela* (*Spirodela intermedia*), *Wolffia* (*Wolffia columbiana*, *Wolffia papulifera*), *Wolffiella* (*Wolffiella oblongata*), small ferns of genus *Azolla* (*Azolla filiculoides*, *Azolla caroliniana*) or liverworts of genera *Riccia* and *Ricciocarpus* (*Ricciocarpus natans*) of lakes, ponds, pools and canals of South America.
(Cabrera, 1958: 332; Oberdorfer, 1960: 12, 43-44, 73; Koepcke, 1961: 133; Cabrera, 1964: 56-68; Vervoorst, 1967: 153-155; Cabrera, 1968: 105; Cabrera and Zardini, 1978: 4, 47-48; Moore, 1983: 340; Muñoz *et al.*, 1993: 22; Carnevali, 1994: unit 24; Archibold, 1995: 361-366).

22.316 Lacustrine *Ceratophyllum* communities
Communities of standing waters of South America dominated by usually submerged free-floating species of genus *Ceratophyllum* (Ceratophyllaceae), of wide world distribution, in particular by *Ceratophyllum demersum*.
(Cabrera, 1964: 29-30, 32-33; Vervoorst, 1967: 154; Cabrera and Zardini, 1978: 276-278; Muñoz *et al.*, 1993: 22; Carnevali, 1994: unit 26).

22.317 Lacustrine free-floating *Utricularia* colonies
Free-floating formations of *Utricularia spp.* of lakes, ponds, pools and canals of South America, formed, in particular, by *Utricularia platensis*, *Utricularia oligosperma*, *Utricularia hydrocarpa*, *Utricularia foliosa* and the facultative free-floater *Utricularia gibba*.
(Cabrera, 1964: 36-42; Cabrera and Zardini, 1978: 571; Junk and Howard-Williams, 1984: 272, 281).

22.32 Lacustrine rooted submerged phanerogamic vegetation
Underwater meadows of submerged, rooted, perennial phanerogams, with often emerging flower spikes, of lakes, ponds, pools and canals of South America.
(Cabrera, 1958: 332; Oberdorfer, 1960: 44, 74, 148; Cabrera, 1964: 23-35; Vervoorst, 1967: 153-155; Cabrera, 1968: 105; Cabrera and Zardini, 1978; Moore, 1983: 31-32; Junk and Howard-Williams, 1984; Schnell, 1987b: 234 250-251; Denny, 1993: 16-25; Junk, 1993: 707, 715-716; Muñoz *et al.*, 1993: 22; Carnevali, 1994: unit 26; Archibold, 1995: 361-366).

22.321 Lacustrine hydrocharid submerged communities
Rooted submerged communities of lakes, ponds, pools and canals of South America dominated by Hydrocharitaceae of genera *Elodea*, *Egeria* and *Vallisneria*.
(Oberdorfer, 1960: 44, 148; Cabrera, 1964: 29, 30-34; Cabrera and Zardini, 1978: 61-63; Junk, 1993: 716; Carnevali, 1994: unit 26).

22.3211 Lacustrine elodeid submerged communities
Rooted submerged communities of lakes, ponds, pools and canals of South America dominated by Hydrocharitaceae with small opposite or verticillated leaves, of genera *Elodea*, *Egeria*, in particular, *Elodea callitrichoides*, *Elodea densa*, *Elodea potamogeton*, *Elodea ernstae*, *Egeria densa*, *Egeria naias*.
(Oberdorfer, 1960: 44, 148; Cabrera, 1964: 29, 30-34; Cabrera and Zardini, 1978: 61-63; Fjeldså and Krabbe, 1990: 22; Junk, 1993: 716; Carnevali, 1994: unit 26).

22.3212 Lacustrine submerged *Vallisneria* meadows

Rooted submerged communities of standing waters of tropical South America dominated by grass-like Hydrocharitaceae of genus *Vallisneria* (*Vallisneria spiralis*).
(Cabrera, 1964: 28, 31-32).

22.322 Lacustrine *Cabomba* communities
Rooted submerged communities of standing waters of warm-temperate and subtropical South America dominated by species of the showy-flowered Nymphaeaceae (or Cabombaceae) genus *Cabomba*, with fine, verticillated leaves, endemic to warm temperate regions of the Americas, in particular by *Cabomba australis* of southeastern Brazil, Uruguay, Paraguay, and northeastern Argentina.
(Cabrera, 1964: 29-30, 32-33; Cabrera and Zardini, 1978: 276-278; Carnevali, 1994; unit 26).

22.323 Lacustrine *Myriophyllum* beds
Rooted submerged communities of standing waters of South America dominated by Haloragaceae of genus *Myriophyllum*, in particular *Myriophyllum aquaticum* and *Myriophyllum elatinoides*.
(Oberdorfer, 1960: 44, 148; Cabrera, 1964: 34; Vervoorst, 1967: 154; Cabrera and Zardini, 1978: 453-454; Moore, 1983: 31, 151; Junk, 1993: 716; Carnevali, 1994: unit 26).

22.3231 Lacustrine *Myriophyllum elatinoides* beds
Rooted submerged communities of the Andes and of temperate South America, dominated by *Myriophyllum elatinoides* (*Myriophyllum quitense*), essential to the threatened Patagonian endemic grebe *Podiceps gallardoi*.
(Cabrera, 1958: 351; Cabrera, 1964: 34; Rumboll, 1974; Cabrera and Zardini, 1978: 453-454; Storer, 1982; Moore, 1983: 31, 151; Fjeldså, 1984, 1986a, 1986b; Fjeldså and Krabbe, 1990: 22; Junk, 1993: 716; Johnson and Serret, 1994; Chebez, 1994: 111-115).

22.3232 Lacustrine *Myriophyllum aquaticum* beds
Rooted submerged communities of standing waters of South America dominated by *Myriophyllum aquaticum* (*Myriophyllum brasiliense*).
(Cabrera, 1964: 34; Vervoorst, 1967: 154; Cabrera and Zardini, 1978: 453-454; Fjeldså and Krabbe, 1990: 22; Carnevali, 1994: unit 26).

22.324 Lacustrine fine-leaved pondweed beds
Rooted submerged communities of standing waters of South America dominated by species of linear-leaved *Potamogeton*, in particular, *Potamogeton strictus* (*Potamogeton pusillus*), *Potamogeton pectinatus* var. *striatus* (*Potamogeton striatus*), *Potamogeton gayi*, *Potamogeton berteroanus*, *Potamogeton uruguayensis*, *Potamogeton burkartii*, or by *Zannichellia palustris*.
(Cabrera, 1958: 332, 351; Oberdorfer, 1960: 148; Cabrera, 1964: 29; Vervoorst, 1967: 154-155; Cabrera and Zardini, 1978: 51-53; Moore, 1983: 31, 270; Fjeldså and Krabbe, 1990: 22; Junk, 1993: 715-716; Carnevali, 1994: unit 26).

22.325 Lacustrine broad-leaved pondweed beds
Rooted submerged communities dominated by species of broad, elliptical-leaved *Potamogeton*, in particular by *Potamogeton illinoensis* var. *ventanicolus* of the Sierra de la Ventana and the dunes of General Madariaga.
(Cabrera and Zardini, 1978: 53).

22.326 Lacustrine marestail beds
Formations dominated by *Hippuris vulgaris*, with immersed or partially emerged whorls of leaves, of still, clear, cold to temperate, nutrient-rich waters of Patagonia and the Andes.
(Cabrera, 1964: 34; Moore, 1983: 30-31, 151).

22.327 Lacustrine *Ranunculus* communities
Rooted submerged communities of lakes and ponds of southern South America and the Andes dominated by submerged, aquatic species of *Ranunculus*, in particular by *Ranunculus aquatilis*, with a very few floating leaves.
(Moore, 1983: 31, 72).

22.328 Lacustrine *Mayaca* communities
Rooted submerged communities of freshwater lakes and ponds of tropical South America formed by mats of Mayacaceae with linear or thread-like, spirally arranged leaves, creeping, sometimes floating or amphibious, in particular, *Mayaca fluviatilis* (*Mayaca kunthii*).
(Hutchinson, 1973: 701; Heywood, 1978: 279; Junk and Howard-Williams, 1984: 273).

22.329 Lacustrine *Ruppia* communities
Rooted submerged communities of fresh or slightly brackish lakes dominated by species of genus *Ruppia*, in particular, *Ruppia filifolia*, of Tierra del Fuego, temperate Pacific South America and Andean lakes, notably, Lake Titicaca.
(Löffler, 1968: 68; Moore, 1983: 31-32, 270; Fjeldså and Krabbe, 1990: 23).

22.32A Lacustrine *Lilaeopsis* submerged communities
Rooted submerged communities of freshwater or slightly brackish Andean lakes and pools dominated by species of genus *Lilaeopsis*, notably, Lake Titicaca, where they occur to a depth of about 1 metre.
(Löffler, 1968: 68; Fjeldså and Krabbe, 1990: 27; Junk, 1993: 716).

22.32B Lacustrine *Isoetes* communities
Rooted submerged communities of freshwater lakes formed by pteridophytes of genus *Isoetes*, characteristic, in particular, of temperate lakes and of high altitude lakes of the southern tropical Andes.
(Moore, 1983: 32, 47; Grassi, 1989: 27, 31).

22.32B1 Temperate lacustrine *Isoetes* communities
Rooted submerged communities of freshwater lakes of the temperate regions of South America formed by pteridophytes of genus *Isoetes*, in particular *Isoetes savatieri* of Tierra del Fuego, western Patagonia, the southern Andes, the Chilean Fjordland, and, locally, Valdivian and mediterranean Chile, usually deeply submerged.
(Moore, 1983: 32, 47).

22.32B2 Tropical Andean lacustrine *Isoetes* communities
Rooted submerged communities of genus *Isoetes* of lakes of the tropical high Andes, in particular of *Isoetes escondidensis* of Lago Escondido, at 3500 metres in the Tucuman Andes.
(Grassi, 1989: 27, 31).

22.33 Lacustrine rooted floating vegetation
Formations dominated by rooted aquatic plants with broad floating or floating and emergent leaves, often with a stratum of submerged species (*Ceratophyllum*, *Myriophyllum*, *Potamogeton*, *Egeria*, *Elodea*) and occasionally accompanied by free-floating species, characteristic of large, permanent water bodies.
(Koepcke, 1961: 132-133; Cabrera, 1964: 45-56; Cabrera and Zardini, 1978; Moore, 1983: 31-32; Junk and Howard-Williams, 1984; Schnell, 1987b: 234, 250-251; Denny, 1993: 16-25; Muñoz *et al.*, 1993: 22; Carnevali, 1994; Archibold, 1995: 361-366).

22.331 Lacustrine nymphea beds
Formations of *Nymphaea spp.*, in particular *Nymphaea amazonum*, of standing waters of tropical, subtropical and warm temperate South America.
(Koepcke, 1961: 133; Cabrera, 1964: 53; Cabrera and Zardini, 1978: 278; Junk and Howard-Williams, 1984: 272; Schnell, 1987b: 235, 250; Carnevali, 1994: unit 24).

22.332 Lacustrine *Victoria* beds
Formations of the giant-leaved *Victoria amazonica* (*Victoria regia*) or *Victoria cruziana*, of standing waters of tropical and subtropical South America.
(Cabrera, 1964: 53-55; Junk and Howard-Williams, 1984: 272; Schnell, 1987b: 250; Carnevali, 1994: unit 24).

22.333 Lacustrine nymphoides beds

Formations of *Nymphoides spp.*, in particular *Nymphoides indica* (*Nymphoides humboldtiana*), of standing waters of tropical, subtropical and warm temperate South America.
(Cabrera, 1964: 55; Cabrera and Zardini, 1978: 486; Junk and Howard-Williams, 1984: 273; Schnell, 1987b: 235; Carnevali, 1994: unit 24).

22.334 Lacustrine broad-leaved pondweed beds
Formations of standing waters of South America dominated by species of *Potamogeton* with broad floating leaves as well as fine immersed leaves, in particular, *Potamogeton ferrugineus*, *Potamogeton spirilliformis*, *Potamogeton linguatus*.
(Cabrera, 1964: 52-53; Cabrera and Zardini, 1978: 51; Moore, 1983: 31, 268).

22.335 Lacustrine water-poppy beds
Formations of floating leaved Limnocharitaceae of standing waters of tropical, subtropical and warm temperate South America, in particular of *Hydrocleis nymphoides* or species of genus *Limnocharis*.
(Cabrera, 1964: 53; Cabrera and Zardini, 1978: 59-60; Junk and Howard-Williams, 1984: 273; Schnell, 1987b: 250; Muñoz *et al.*, 1993: 22; Carnevali, 1994: unit 24).

22.336 Lacustrine rooted pontederiad beds
Floating-leaf formations of rooted Pontederiaceae, in particular *Heteranthera limosa* and *Pontederia subovata* (*Reussia subovata*), of standing waters of South America.
(Carnevali, 1994: unit 24).

22.34 Shallow water floating vegetation
Communities of aquatic or semiaquatic plants occupying shallow water ponds and pools, often with fluctuating waterlevels, and inundation zones, with stems and leaves floating on the water surface or appressed on wet mud surfaces
(Oberdorfer, 1960: 44, 194; Cabrera, 1964: 48-52; Cabrera and Zardini, 1978; Moore, 1983: 31-32; Junk and Howard-Williams, 1984: 273; Schnell, 1987b: 235-236, 250; Walter and Breckle, 1991c: 390, 392, 399).

22.341 *Ludwigia* communities
Shallow water and wet mud communities formed by floating or creeping species of genus *Ludwigia* (*Jussieua*), in particular *Ludwigia uruguayensis*, *Ludwigia peploides*, *Ludwigia sedoides*, in ponds and puddles of tropical, subtropical and warm temperate South America.
(Oberdorfer, 1960: 44, 194; Cabrera, 1964: 50-52; Cabrera and Zardini, 1978: 450-451; Moore, 1983: 31-32; Junk and Howard-Williams, 1984: 273; Schnell, 1987b: 235-236; Walter and Breckle, 1991c: 390, 392, 399).

22.342 *Alternanthera* communities
Shallow water and wet mud communities formed by floating or creeping *Alternanthera philoxeroides* on inundatable marshy sites of tropical, subtropical and warm temperate South America.
(Cabrera, 1964: 49-50; Cabrera and Zardini, 1978: 252; Walter and Breckle, 1991c: 390, 392, 399).

22.343 *Callitriche* communities
Shallow water and wet mud communities of temperate and tropical South America formed by floating or creeping species of genus *Callitriche*, in particular *Callitriche turfosa*, *Callitriche deflexa*, *Callitriche rimosa*, *Callitriche heterophylla*, *Callitriche oblongicarpa*, *Callitriche antarctica*, *Callitriche lechleri*.
(Cabrera, 1964: 50; Cabrera and Zardini, 1978: 388; Moore, 1983: 31-32, 198).

22.344 *Hydrocotyle* communities
Shallow water and wet mud communities of temperate and tropical South America formed by floating or creeping species of genus *Hydrocotyle*, in particular *Hydrocotyle ranunculoides*.
(Oberdorfer, 1960: 44; Cabrera, 1964: 52; Cabrera and Zardini, 1978: 465; Carnevali, 1994: unit 24; Walter and Breckle, 1991c: 390, 392, 399).

22.345 Scrophulariaceae shallow water communities

Shallow water and wet mud communities of temperate and tropical South America formed by floating or creeping Scrophulariaceae of genera *Mimulus* or *Bacopa*, in particular, *Mimulus glabratus*, *Bacopa tweedii*, *Bacopa munieri*.
(Cabrera, 1964: 52; Cabrera and Zardini, 1978: 562-563; Moore, 1983: 31-32; Junk and Howard-Williams, 1984: 273; Schnell, 1987b: 234, 250).

22.346 *Enhydra* shallow water communities
Shallow water and wet mud communities of warm temperate and tropical South America formed by floating or creeping composites of genus *Enhydra*, in particular, *Enhydra anagallis*.
(Cabrera, 1964: 52; Cabrera and Zardini, 1978: 654).

22.347 *Marsilea* shallow water communities
Shallow water communities of temperate and tropical South America formed by floating-leaved ferns of genus *Marsilea*, in particular, *Marsilea concinna*.
(Cabrera, 1964: 51-52; Cabrera and Zardini, 1978: 45).

22.35 Lacustrine submerged algae and moss carpets
Large algae and bryophyte carpets of lake bottoms of South America.
(Cabrera, 1964: 25-26; Vervoorst, 1967: 155; Junk, 1993: 716).

22.351 Submerged bryophyte carpets
Bryophyte carpets of lake bottoms of South America, in particular *Sciaronium* carpets of high Andean lakes, reaching a depth of 29 metres in Lake Titicaca.
(Junk, 1993: 716).

22.352 Submerged chandalier algae carpets
Charophyte algal carpets of the bottom of unpolluted lakes of South America, formed mostly by species of genera *Chara* and *Nitella*, capable of forming at depths up to 12 metres, in particular, in Lake Titicaca.
(Cabrera, 1958: 351; Cabrera, 1964: 25-26; Vervoorst, 1967: 155; Junk, 1993: 716).

22.353 Submerged green algae carpets
Algal carpets of the bottom of lakes of South America, formed by Chlorophyceae other than Charales, in particular by algae of genera *Ulothrix*, *Oedogonium*, *Conferva*, *Hydrodiction* or the Coniugales genera *Spirogyra*, *Zygnema*.
(Cabrera, 1964: 25-26; Corbetta, 1974: 67-75).

22.4 Lake muds, sands, shingles

Lake bottoms or lake shores temporarily exposed by artificial or natural fluctuations of the water level, often important as feeding grounds for migrating waders. Lacustrine beaches, formed by wind or wave action.
(Koepcke, 1961: 126, 134-137, 139).

22.41 Temperate lake muds, sands and shingles
Lake bottoms or lake shores of Tierra del Fuego, the temperate Andes, Patagonia, the Pampas, Magellanic, Valdivian and mediterranean Chile.
(Erize *et al.*, 1995: 131).

22.42 Tropical lake muds, sands and shingles
Lake bottoms or lake shores of lowland and montane tropical South America.
(Koepcke, 1961: 134-137).

22.43 High Andean tropical lake muds, sands and shingles
Lake bottoms or lake shores of the high tropical Andes, at altitudes ranging above 3800 metres, sometimes 3500 metres.
(Koepcke, 1961: 134-137).
22.44 Desert lake muds, sands and shingles

Lake bottoms or lake shores of the tropical and subtropical deserts of South America, in particular, of the Pacific deserts of Peru and Chile.
(Koepcke, 1961: 134-137).

22.5 Amphibious macrophyte communities

Macrophytic communities adapted to an alternance of emergence and complete submersion, colonizing lake bottoms or lake shores subjected to temporary exposure (22.2) and other periodically or occasionally inundated muddy, sandy or stony basins. They include communities of annuals developing during the exposure phase as well as communities of perennials susceptible of temporary total immersion. Communities of prostrate plants adapted to alternances of floating on shallow water and creeping on wet muds are listed under unit 22.3, as shallow water floating communities.
(Oberdorfer, 1960: 149-152, 73-74, 128-Table 11; Koepcke, 1961: 139; Schnell, 1987b: 104).

22.51 Temperate amphibious communities
Amphibious macrophytic communities colonizing lake bottoms or lake shores and other periodically or occasionally inundated muddy, sandy or stony basins of the nemoral, steppe, mediterranean, temperate high mountain, and cool lowland desert zones of South America, including Tierra del Fuego, the temperate Andes, Patagonia, the Pampas, Magellanic, Valdivian and mediterranean Chile.
(Oberdorfer, 1960: 149-152, 73-74, 128-Table 11; Gajardo, 1994: unit 4B88).

22.511 Temperate perennial amphibious communities
Communities of perennial vegetation submerged for part of the year in oligotrophic or mesotrophic lakes, ponds and pools of temperate South America. *Gratiola peruviana*, *Litorella australis*, *Plagiobotrys pratensis*, *Nieremberga minima*, *Senecio zosteraefolius*, *Eleocharis pachycarpa*, *Isoetes savatieri*, *Lilaeopsis hilli*, *Rumex magellanicus*, *Azorella trifoliolata*, *Pilularia mandonii* are characteristic of diverse formations.
(Hauman, 1926: 133-134, 138-139; Oberdorfer, 1960: 149-150, 74, 128-Table 11; Cabrera and Zardini, 1978: 45; Moore, 1983: 31-32, 182, 200-201; Gajardo, 1994: unit 4B8-4B88).

22.512 Temperate annual amphibious swards
Dwarf oligo-mesotrophic annual communities of recently emerged muds and sands of temperate South America characterized by the abundance of dwarf annual sedges, rushes, *Elatine spp.*, *Limosella spp.* *Juncus planifolius*, *Juncus stipulatus*, *Juncus bufonius*, *Scirpus inundatus*, *Limosella aquatica*, *Anagallis alternifolia*, *Oldenlandia uniflora*, *Elatine chilensis*, *Lilaea scilloides*, constitute diverse formations.
(Oberdorfer, 1960: 44-45, 75, 150-152; Cabrera, 1964: 29, 89-90; Cabrera and Zardini, 1978: 55-56; Moore, 1983: 31-32, 200-201; Gajardo, 1994: units 5A1-5A18, 5A2-5A18).

22.52 Lowland and montane tropical amphibious communities
Amphibious macrophytic communities colonizing lake bottoms or lake shores and other periodically or occasionally inundated basins of the lowlands, the low mountains and the sylvatic zones of the high mountains of tropical South America. Used in conjunction with unit 24.5 or its subunits, communities occupying the beaches and banks uncovered by receding waters of tropical South American rivers and streams.
(Junk, 1984a: 227; Adis, 1984: 249; Junk and Howard-Williams, 1984: 274; Tressens *et al.*, 1994: 25; Harley, 1995: 27).

22.521 Lowland tropical amphibious communities
Amphibious macrophytic communities colonizing lake bottoms or lake shores and other periodically or occasionally inundated basins of the lowlands of tropical South America. Used in conjunction with unit 24.5 or its subunits, communities occupying the beaches and banks uncovered by receding waters of tropical South American lowland rivers and streams.
(Morello and Adamoli, 1974: 95; Junk, 1984a: 227; Junk and Howard-Williams, 1984: 274; Tressens *et al.*, 1994: 25).

22.522 Montane tropical amphibious communities

Amphibious macrophytic communities colonizing lake bottoms or lake shores and other periodically or occasionally inundated basins of the extra-Andean mountains of tropical South America and of the sylvatic zone of the tropical Andes. Used in conjunction with unit 24.5 or its subunits, communities occupying the beaches and banks uncovered by receding waters of tropical South American montane rivers and streams.
(Harley, 1995: 27).

22.53 High Andean tropical amphibious communities
Amphibious macrophytic communities colonizing lake bottoms, lake shores and other periodically or occasionally inundated basins, in particular, fen pools, of the puna, superpuna and paramo zones of the high tropical Andes.
(Koepcke, 1961: 139; Schnell, 1987b: 104).

22.531 Paramo amphibious communities
Amphibious macrophytic communities colonizing lake bottoms, lake shores and other periodically or occasionally inundated basins, in particular, fen pools, of the paramo zone of the high tropical Andes, with *Elatine minima*, *Isoetes spp.*, *Pilularia spp.*, *Scirpus inundatus*.
(Schnell, 1987b: 104).

22.532 Puna amphibious communities
Amphibious macrophytic communities colonizing lake bottoms, lake shores and other periodically or occasionally inundated basins, in particular, fen pools, of the puna and superpuna zones of the high tropical Andes.
(Cabrera, 1958: 351; Koepcke, 1961: 139).

22.54 Desert amphibious communities
Amphibious macrophytic communities colonizing freshwater lake bottoms and shores or other occasionally inundated basins of the tropical and subtropical deserts of South America, in particular, of the Pacific deserts of Peru and Chile.
(Koepcke, 1961: 139).

22.6 Lacustrine emergent features

Permanently or usually emergent features of the bed or shores of permanent or temporary freshwater lakes or ponds.

22.61 Lacustrine islets
Permanently or usually emergent features of the bed of permanent or temporary freshwater lakes or ponds, supporting terrestrial communities (units 3, 4) that may comprise elements that are favoured by the lacustrine microclimate or the protection that complete isolation by water affords, as in the case of breeding birds.

22.62 Lake cliffs
Cliffs of lakeshores and lake islands, supporting terrestrial communities (units 3, 4, 6) that may comprise elements favoured by the lacustrine microclimate.

22.63 Lake ice
Icepacks and icefloes of southern South American lakes, in particular, of Lago Argentino on the periphery of the Moreno glacier and of Lake Onelli, in Los Glaciales National Park.
(Erize *et al.*, 1995: 200-204).

23. STANDING BRACKISH AND SALT WATER

Athalassal decidedly brackish, saline or hypersaline lakes, pools and ditches, their features, their associated pelagic and benthic communities, their beds of macrophytic submerged or offshore vegetation.

23.1 Permanent saltlakes

Athalassal, permanent or temporary, brackish, saline or hypersaline lakes, ponds, pools, or parts of such water bodies, in which water is permanently retained, although its level may fluctuate; their associated pelagic (units 23.11, 23.12, 23.13, 23.14) and benthic (unit 23.15) communities. The macrophytic, euhydrophytic based communities that colonize them are separately listed under 23.3. Features of the lake basin uncovered by low water such as gravel, sand, mud or rock banks and beaches are listed under unit 23.4, the macrophytic amphibious communities that may develop on them under unit 15. Permanently or almost permanently emerged features supporting terrestrial communities influenced by the presence of the water body are included in unit 23.6. The fringing belts or island rafts of rooted or floating tall emergent vegetation are listed under unit 53.
(Koepcke, 1961: 124; Bonetto and Di Persia, 1984: 542; Junk, 1993: 715-716).

23.11 Temperate saltlakes
Permanent athalassal brackish, saline or hypersaline lakes, ponds or pools of temperate South America. Their distribution includes Tierra del Fuego, the temperate Andes, Patagonia, the Pampas, Magellanic, Valdivian and mediterranean Chile.

23.111 Patagonian saltlakes
Permanent athalassal saline lakes, ponds, pools of the Patagonian desert and steppe zones, abundant, in particular, on the pre-Andean Patagonian plateaux.
(Bonetto and di Persia, 1984: 541-542; Fjeldså and Krabbe, 1990: 23; Johnson and Serret, 1994; Erize *et al.*, 1995: 131).

23.112 Magellanic saltlakes
Permanent athalassal saline lakes, ponds, pools of the deciduous and evergreen Magellanic forest zones of Tierra del Fuego, the Chilean Fjordland and the lower and middle slopes of the southern Andes of Chile and Argentina.

23.113 Temperate high Andean saltlakes
Permanent athalassal saline lakes, ponds, pools of the higher elevations of the temperate Andes.

23.114 Mediterraneo-Chilean saltlakes
Permanent athalassal brackish, saline or hypersaline lakes, ponds or pools of the mediterranean zone of Chile, in particular, laguna de Batuco, in the metropolitan Santiago area of the Central Valley of Chile, and other lagoons of the coast ranges between Coquimbo and Maulin and of the interior valley between Ovalle and Santiago, sometimes of high salinity.
(Gajardo, 1994: 51, 56).

23.115 Pampa saltlakes
Permanent athalassal brackish, saline or hypersaline lakes, ponds, pools of the Argentinian and Uruguayan Pampas.

23.12 Lowland and montane tropical saltlakes

Permanent athalassal brackish, saline or hypersaline lakes, ponds, pools of tropical South America, at altitudes below 3000 to 4000 metres, mostly characteristic of dry and subhumid tropics and subtropics, in particular, of the Chacoan region.
(Bonetto and Di Persia, 1984: 542).

23.13 High Andean tropical saltlakes
Brackish, saline or hypersaline lakes, ponds and tarns of the tropical Andes, at altitudes ranging above 3800 metres, sometimes 3500 metres, mostly characteristic of the puna.
(Koepcke, 1961: 124; Johnson, 1965: 156-175; Löffler, 1968: 65; Parker *et al.*, 1982: 21; Fjeldså and Krabbe, 1990: 23; Junk; 1993: 715-717).

23.14 Desert permanent saltlakes
Permanent athalassal brackish, saline or hypersaline lakes, ponds or pools of the subtropical deserts, in particular of the Peruvian-Chilean deserts and of the Monte.
(Morello, 1958: 27-28, 127; Koepcke, 1961: 124; Bonetto and Di Persia, 1984: 542).

23.15 Saltlake benthic communities
Benthic animal, green algal or lower algal communities of permanent athalassal brackish, saline or hypersaline lakes, ponds or pools; benthic communities developed in the wet phase of the cycle of temporary brackish, saline or hypersaline athalassal water bodies.
(Junk, 1993: 715-716).

23.151 Temperate saltlake benthic communities
Lake bottom animal, green algal or lower algal communities of permanent athalassal brackish, saline or hypersaline lakes and pools of temperate South America.

23.152 Tropical saltlake benthic communities
Lake bottom animal, green algal or lower algal communities of permanent athalassal brackish, saline or hypersaline lakes and pools of tropical lowland and montane South America.

23.153 High Andean tropical saltlake benthic communities
Lake bottom animal, green algal or lower algal communities of permanent athalassal brackish, saline or hypersaline lakes and pools of high elevations of the tropical Andes of South America.

23.154 Desert saltlake benthic communities
Lake bottom animal, green algal or lower algal communities of permanent athalassal brackish, saline or hypersaline lakes and pools of the tropical and subtropical deserts of South America.

23.2 Temporary saltlakes

Temporary athalassal brackish, saline or hypersaline water bodies and their associated pelagic and benthic communities. Drawdown resistant euhydrophyte communities are included in unit 23.3. Features of the lake bed, uncovered by low water or permanently emerging, such as gravels, sands, muds or rocks of the exposed lake bed, its beaches and islands, and the animal and microphyte communities they may support, are listed under unit 23.4. The macrophyte-based amphibious communities that may occupy them are listed under unit 15, fringing belts or island rafts of rooted or floating tall emergent vegetation under 53.

23.21 Temperate temporary saltlakes
Temporary athalassal brackish, saline or hypersaline water bodies of temperate South America. Their distribution includes Tierra del Fuego, the temperate Andes, Patagonia, the Pampas, Magellanic, Valdivian and mediterranean Chile.

23.211 Patagonian temporary saltlakes
Temporary athalassal brackish, saline or hypersaline water bodies of the Patagonian desert and steppe zones.

23.212 Magellanic temporary saltlakes
Temporary athalassal brackish, saline or hypersaline water bodies of the deciduous and evergreen Magellanic forest zones of Tierra del Fuego, the Chilean Fjordland and the lower and middle slopes of the southern Andes of Chile and Argentina.

23.213 Temperate high Andean temporary saltlakes
Temporary athalassal brackish, saline or hypersaline water bodies of the temperate Andes.

23.214 Mediterraneo-Chilean temporary saltlakes
Temporary athalassal brackish, saline or hypersaline water bodies of the mediterranean zone of Chile.

23.215 Pampa temporary saltlakes
Temporary athalassal brackish, saline or hypersaline water bodies of the Argentinian and Uruguayan Pampas.

23.22 Lowland and montane tropical temporary saltlakes
Temporary athalassal brackish, saline or hypersaline lakes, ponds, pools of tropical South America, at altitudes below 3000 to 4000 metres, mostly characteristic of dry and subhumid tropics and subtropics, in particular, of the Chacoan region.

23.23 High Andean tropical temporary saltlakes
Temporary athalassal brackish, saline or hypersaline water bodies of the high tropical Andes, at altitudes ranging above 3800 metres, sometimes 3500 metres.
(Koepcke, 1961: 124; Johnson, 1965: 156-175; Löffler, 1968: 65; Parker *et al.*, 1982: 21; Fjeldså and Krabbe, 1990: 23; Junk; 1993: 715-717).

23.24 Desert temporary saltlakes
Temporary athalassal brackish, saline or hypersaline water bodies of the tropical and subtropical deserts of South America.
(Morello, 1958: 27-28, 127).

23.25 Temporary saltlake benthic communities
Benthic communities developed in the wet phase of the cycle of temporary athalassal saline water bodies.
(Koepcke, 1961: 126-127).

23.3 Athalassal saline euhydrophyte communities

Communities of permanent or semipermanent saline lakes, ponds, pools or canals formed by free-floating, floating-leaved rooted, or submerged macrophytes and their associated zoocoenoses. Tall emergent-dominated formations, rooted in the substratum or constituting soil-retaining floating islands (embalsados), are excluded and listed in unit 53.

23.31 Athalassal saline free-floating communities
Communities of athalassal decidedly brackish or saline lakes, ponds and pools, formed by free-floating macrophytes.

23.32 Athalassal saline rooted submerged phanerogamic communities
Communities of athalassal brackish or saline lakes, ponds, pools or basins, formed by submerged macrophytes and their associated zoocoenoses, usually comprising species of genera *Ruppia*, *Zannichellia*, *Najas*, *Potamogeton*.
(Schnell, 1987b: 264).

23.33 Athalassal saline rooted floating communities
Communities of saline or decidedly brackish lakes, ponds and pools, formed by free-floating or floating-leaved rooted macrophytes.

23.34 Shallow water floating halophile communities
Communities of aquatic or semiaquatic plants occupying shallow saline water ponds and pools, often with fluctuating waterlevels, and inundation zones, with stems and leaves floating on the water surface or appressed on wet mud surfaces

23.35 Submerged halophile algae and moss carpets
Large algae and bryophyte carpets of athalassal brackish, saline or hypersaline lakes, ponds or pools, in particular *Chara* and *Nitella* formations.
(Schnell, 1987b: 264).

23.4 Saltlake muds, sands, shingles

Bottoms or shores of athalassal saline water bodies temporarily exposed by artificial or natural fluctuations of the water level, often covered with salt efflorescences.

23.41 Temperate saltlake muds, sands and shingles

Bottoms or shores of athalassal saline water bodies of Tierra del Fuego, the temperate Andes, Patagonia, the Pampas, Magellanic, Valdivian and mediterranean Chile.

23.42 Tropical saltlake muds, sands and shingles

Bottoms or shores of athalassal saline water bodies of lowland and montane tropical South America.

23.43 High Andean tropical saltlake muds, sands and shingles

Bottoms or shores of athalassal saline water bodies of the high tropical Andes, at altitudes ranging above 3800 metres, sometimes 3500 metres.

23.44 Desert saltlake muds, sands and shingles

Bottoms or shores of athalassal saline water bodies of the tropical and subtropical deserts of South America.

23.6 Saltlake emergent features

Permanently or usually emergent features of the bed or shores of permanent or temporary saltlakes.

23.61 Saltlake islets
Permanently or usually emergent features of the bed of permanent or temporary saltlakes, supporting terrestrial communities (units 3, 4) that may comprise elements that are favoured by the lacustrine microclimate or the protection that complete isolation by water affords, as in the case of breeding birds.

23.62 Saltlake cliffs
Cliffs of saltlake shores and islands, supporting terrestrial communities (units 3, 4, 6) that may comprise elements favoured by the lacustrine microclimate.

24. RUNNING WATER

All rivers and streams, permanent or temporary, fresh or saline, including rivers, streams, brooks, rivulets, rills, torrents, wadis or arroyos, waterfalls, cascades and rapids.

24.1 Permanent rivers and streams

Rivers, streams, brooks, rivulets, rills, torrents, waterfalls, cascades and rapids permanently carrying water, although its level may fluctuate widely, and their associated animal and microphytic pelagic and benthic communities. The euhydrophytic macrophyte communities that colonize them are separately listed under unit 24.3. Features of the river bed, uncovered by low water or permanently emerging, such as gravel, sand, mud or rock islands and bars, and the communities they support, are listed under units 24.4 and 24.5. The fringing belts of tall or short emergent vegetation are listed under unit 53, the riverside veils of tall herbs and creepers under units 37 or 3A, riverine arbustive and arborescent vegetation under units 44 or 4A.
(Koepcke, 1961: 128-132; Whitten and Brooks, 1972; Fittkau, 1976; Sioli, 1984a; Junk and Howard-Williams, 1984; Rai and Hill, 1984a, 1984b; Schnell, 1987b; Lowe-McConnell, 1987; Clark, 1990; Schubert, 1991; Leser, 1994; Archibold, 1995: 379-380).

24.11 Rivulets
Crenal streams, rivulets formed in and near the source area of streams, characterized by high stability of temperature, near the annual average of the ground-water table, developed mostly in mountain situations.
(Fittkau, 1976; Schubert, 1991; Leser, 1994: 261).

24.12 Brooks, creeks, streams, torrents
Upper and middle reaches of watercourses, characterized by limited width and usually by irregular flow speed producing a mosaic of lenitic and lotic microzones.
(Koepcke, 1961: 131-132; Fittkau, 1976; Schubert, 1991; Leser, 1994: 261).

24.121 Temperate brooks, creeks, streams, torrents
Upper and middle reaches of temperate watercourses, characteristic of hill and mountain regions of the Magellanic region, Patagonia, mediterranean Chile, the Pampas, the temperate Andes, the temperate and subtropical deserts, harbouring rhitral (epirhitral, metarhitral or hyporhitral) communities.
(Koepcke, 1961: 128-132; Schubert, 1991; Leser, 1994).

24.1211 Temperate higher stream reaches
Upper and middle reaches of temperate mountain streams of South America, characterized by turbulent, irregular flow, by diurnal and annual temperature variations higher than in the crenon, and by epirhitral and metarhitral biocoenoses largely dominated by Turbellaria, Ephemeroptera, Plecoptera, Trichoptera, Diptera, by Bryophyta and epilithic Bacillariophyta, Cyanophycaea, Rhodophyta and Chlorophyta algae, with few, specialized, immerged macrophytes (24.3). The unit corresponds to the "Trout zone" or "Salmonid zone" of western European icthyological classifications.
(Schubert, 1991; Leser, 1994).

24.1212 Temperate lower stream reaches
Lower reaches of temperate hill and montane streams of South America, often representing the middle course of rivers, harbouring hyporhitral communities. The unit corresponds to the "Grayling zone" of western European icthyological classifications.
(Schubert, 1991; Leser, 1994).

24.122 Tropical lowland and hill brooks, creeks, streams, torrents

Upper reaches of watercourses of tropical lowlands, hills, plateaux and low mountain ranges of South America, usually with a polymodal flooding pattern conditioned by local meteorological events, harbouring rhitral communities.
(Fittkau, 1976; Sioli, 1984a; Furch, 1984: 168-169; Géry, 1984; Lowe-McConnell, 1987: 143-145; Junk, 1993: 681-684; Archibold, 1995: 329-330).

24.1221 Sciaphile tropical streams
Streams within tropical forest, in a densely shaded environment, characterized by scarcity or absence of aquatic plants and a highly diversified fauna, comprising insects and often very small fishes, dependant on forest litter falling into the water.
(Fittkau, 1976; Sioli, 1984a).

24.12211 Whitewater sciaphile streams
Shaded streams of tropical forests carrying whitewaters, turbid waters of more or less ochraceous colour caused by the suspended mineral charge, with a transparency comprised between 0.10 and 0.5 metres, and generally with a pH of 6.2-7.2, mostly limited to pre-Andean regions and to hilly central Amazonia.
(Sioli, 1984a: 157-162; Furch, 1984: 168-169).

24.12212 Clearwater sciaphile streams
Shaded streams of tropical forests carrying clearwaters, more or less transparent waters of green to olive-green colour, with a transparency comprized between 1.10 and 4.3 metres, with diverse pH comprised between 4.5 and 7.8. They are most characteristic of South American tropical rain forest and semievergreen forest regions, in particular, of the upper parts of the Amazon, Parana and Orinoco basins on the crystalline Brazilian and Guianan shields. They are the habitat of the endangered merganser *Mergus octosetaceus* and otter *Pteronura brasiliensis*.
(Sioli, 1984a: 157-162; Furch, 1984: 168-169; Best, 1984: 377-378; Chebez, 1994: 128-132, 240-247).

24.12213 Blackwater sciaphile streams
Shaded streams of tropical forests carrying blackwaters, more or less transparent waters of olive-brown to coffee brown colour caused by suspended humic complexes nearly devoid of mineral charge, with a transparency comprised between 1.30 and 2.90 metres, originating from podzolised quartz soils, generally with a pH of 3.8-4.9, characteristic in particular of white-sand areas in the Amazonian basin.
(Sioli, 1984a: 157-162; Furch, 1984: 168-169).

24.12214 Alternating sciaphile streams
Shaded streams of tropical forests with water properties varying seasonally or in shorter time cycles between clearwater, whitewater and blackwater types.
(Sioli, 1984a: 157-162).

24.1222 Heliophile tropical streams
Upper reaches of tropical watercourses characterized by exposure of the water to sunlight.
(Fittkau, 1976; Sioli, 1984a: 157-162).

24.12221 Whitewater heliophile streams
Sunlit streams of tropical regions carrying whitewaters, turbid waters of more or less ochraceous colour caused by the suspended mineral charge.
(Sioli, 1984a: 157-162).

24.12222 Clearwater heliophile streams
Sunlit streams of tropical regions carrying clearwaters, more or less transparent waters of green to olive-green colour, characteristic, in particular, of Amazonian campos and of the cerrado region.
(Sioli, 1984a: 157-162).

24.12223 Blackwater heliophile streams
Sunlit streams of tropical regions carrying blackwaters, more or less transparent waters of olive-brown to coffee brown colour caused by suspended humic complexes nearly devoid of mineral charge, originating from podzolised quartz soils, characteristic in particular of white-sand areas.
(Sioli, 1984a: 157-162).

24.12224 Alternating heliophile streams
Sunlit streams of tropical regions with water properties varying seasonally or in shorter time cycles between clearwater, whitewater and blackwater types.
(Sioli, 1984a: 157-162).

24.123 Tropical mountain streams
Montane streams of the major mountain ranges of tropical South America, in particular, of the Andes and the Serra do Mar.
(Koepcke, 1961: 130-132; Lowe-McConnell, 1987: 145-148; Junk, 1993: 693-694).

24.1231 Tropical altimontane streams
Streams of the extrasylvatic zones of the high altitudes of the major mountain ranges of tropical South America.
(Koepcke, 1961: 131-132; Lowe-McConnell, 1987: 147-148).

24.12311 Altiplano streams
Streams of the paramo, subparamo, puna and prepuna zones of the tropical high Andes. They are the habitat of the toads of genus *Telmatobius*.
(Koepcke, 1961: 131-132).

24.12312 Tropical Andes glacier streams
Glacier-fed, small streams of the very high altitudes of the high tropical Andes, very cold and poor in nutrients, almost devoid of macrofauna.
(Koepcke, 1961: 132).

24.1232 Tropical mountain forest streams
Streams of the mountain forest belts of the major mountain ranges of tropical South America, in particular, of the Andes and the Serra do Mar. They constitute, on the eastern slopes of the Andes, south of the Andean bend, the habitat of the threatened dipper *Cinclus schulzi*; other characteristic bird species include the tiger-heron *Tigrisoma fasciatum*, the torrent duck *Merganetta armata*, the dipper *Cinclus leucocephalus*.
(Koepcke, 1961: 131-132; Lowe-McConnell, 1987: 145-147; Junk, 1993: 693-694; Chebez, 1994: 182-183).

24.12321 Small tropical mountain forest streams
Upper reaches of streams of the mountain forest belts of the major mountain ranges of tropical South America, in particular, of the Andes and the Serra do Mar, mostly narrow and shaded.
(Koepcke, 1961: 131-132).

24.12322 Large tropical mountain forest streams
Wider, partly heliophile streams of the mountain forest belts of the major mountain ranges of tropical South America, in particular, of the Andes and the Serra do Mar.
(Koepcke, 1961: 131-132).

24.13 Rivers
Lowland and plateau watercourses of South America, harbouring potamal biocoenoses, very similar, in the middle and lower reaches, to those of standing water.
(Schubert, 1991; Leser, 1994).

24.131 Temperate rivers
Temperate lowland watercourses of South America, with potamal biocoenoses. They are limited to the Patagonian faunal region which encompasses the Monte, Patagonia, the southern Andes, the Magellanic, Valdivian and mediterraneo-Chilean regions.
(Géry, 1969; Lowe-McConnell, 1987: 12, 123-125; Schubert, 1991; Leser, 1994).

24.1311 Temperate upper river reaches
Upper reaches of temperate and subtropical lowland (potamal) watercourses of South America, characterized by calmer flow, higher annual temperature variation and potamal biocoenoses comprising more standing water species, among them immerged macrophytes (24.3), than those of rhitral streams. The unit corresponds to the "Barbel zone" of western European icthyological classifications.

(Schubert, 1991; Leser, 1994).

24.1312 Temperate lower river reaches
Middle and lower reaches of temperate and subtropical lowland watercourses of South America, harbouring metapotamal and hypopotamal biocoenoses. The unit corresponds to the "Bream zone" of western European icthyological classifications.
(Schubert, 1991; Leser, 1994).

24.132 Tropical lowland and hill rivers
Middle and lower reaches of watercourses of tropical South America. They include rivers of the Amazon, Orinoco and Parana basins, in rain forest and semievergreen forest environments, usually with a monomodal flooding pattern synchronized with the alternance of dry and rainy seasons. They also comprise savanna floodplain and dry woodland rivers and smaller river systems in the tropical coastlands of the Pacific, the Atlantic and the Caribbean. They are subdivided in accordance with fish faunal regions, which appear well-marked in spite of anastomoses between the Amazon and the Orinoco (Casiquiare anastomosis) and, intermittently, between the Amazon and the Parana systems.
(Koepcke, 1961: 128-130; Fittkau, 1976; Sioli, 1984a; Furch, 1984: 167-169; Rai and Hill, 1984a; Best, 1984: 371-377, 381-386; Géry, 1984: 364-368, 369; Junk, 1984b: 444-449; Lowe-McConnell, 1987: 123-143; Junk, 1993: 681-684; Leser, 1994; Archibold, 1995: 329-330).

24.1321 Amazonian rivers
Middle and lower reaches of watercourses of the Amazon basin of tropical South America, mostly developed in rain forest and semievergreen forest environments, usually with a monomodal flooding pattern synchronized with the alternance of dry and rainy seasons. They constitute the habitat of, in particular, the threatened manatee *Trichechus inunguis* and river dolphins *Inia geoffrensis* and *Sotalia fluviatilis*. Besides the subdivision by water type adopted, distinctive faunistic regions can be recognized on the basis of fish assemblies, which include a number of species of local occurrence, specialized ecology or fragile and threatened status.
(Fittkau, 1976; Sioli, 1984a; Furch, 1984: 167-169; Rai and Hill, 1984a; Best, 1984: 371-377, 381-386; Géry, 1984: 364-368, 369; Junk, 1984b: 444-449; Lowe-McConnell, 1987: 123-143; Junk, 1993: 681-684; Leser, 1994; Archibold, 1995: 329-330).

24.13211 Whitewater rivers
Middle and lower reaches of Amazonian watercourses carrying whitewaters, turbid waters of more or less ochraceous colour caused by the suspended mineral charge, with a Secchi-disk transparency comprised between 0.10 and 0.5 metres, and generally with a pH of 6.2-7.2, characteristic of pre-Andean regions. The Rio Solimoes and the Rio Madeira are examples.
(Sioli, 1984a: 157-162; Leser, 1994).

24.13212 Clearwater rivers
Amazonian rivers carrying clearwaters, more or less transparent waters of green to olive-green colour, with a transparency comprized between 1.10 and 4.3 metres, with diverse pH comprised between 4.5 and 7.8, characteristic of Brazilian shield and Guianan shield fed rivers. The Rio Tapajos, the Rio Xingu are examples. Many rivers of the Parana and Uruguay system (unit 24.1323) share these characteristics.
(Sioli, 1984a: 157-162; Leser, 1994).

24.13213 Blackwater rivers
Middle and lower reaches of Amazonian streams carrying blackwaters, more or less transparent waters of olive-brown to coffee brown colour caused by suspended humic complexes nearly devoid of mineral charge, originating from podzolised quartz soils, with a transparency comprised between 1.30 and 2.90 metres, and generally with a pH of 3.8-4.9, characteristic of white-sand fed rivers. The Rio Negro, most of its right tributaries and the Rio Cururu are examples.
(Sioli, 1984a: 157-162; Leser, 1994).

24.13214 Alternating tropical rivers
Middle and lower reaches of Amazonian streams with water properties varying seasonally between clearwater, whitewater and blackwater types.
(Sioli, 1984a: 157-162).

24.1322 Orinocan rivers
Middle and lower reaches of watercourses of the Orinoco system developed both in rain forest and semievergreen forest environments, with conditions similar to those of Amazonian rivers, and in extensive savanna regions.
(Lowe-McConnell, 1987: 150-153; Junk, 1993: 681-684, 708-711).

24.1323 Guiano-Atlantic rivers
Middle and lower reaches of watercourses of the Guianas, constituting relatively short fluvial systems independent of the vast Amazonian and Orinocan complexes, developed mainly in rain forest environments, often with savanna and gallery conditions in the upper course, in part of the coastal plain, or in both.
(Schnell, 1987a: 253-269; Lowe-McConnell, 1987: 150-153; Junk, 1993: 681-684, 708-711).

24.1324 Paranean rivers
Middle and lower reaches of watercourses of the Parana, Paraguay and Uruguay system developed, in part in rain forest and semievergreen forest environments, in part in dry tropical woodland and savanna environments, usually with tropical gallery forests, and including the large inundatable Pantanal floodplain and the swamp-forming rivers of the Chaco.
(Lowe-McConnell, 1987: 123-125, 153-158; Junk, 1993: 681-682, 699-705).

24.1325 Magdalenean rivers
Middle and lower reaches of watercourses of the Magdalena river system in Caribbean South America, with a somewhat irregular but overall bimodal flooding pattern.
(Lowe-McConnell, 1987: 123-125; Junk, 1993: 681-682, 712-715).

24.1326 Trans-Andean tropical rivers
Middle and lower reaches of watercourses of Pacific Colombia, Ecuador and northern and central Peru.

(Koepcke, 1961: 128-130; Lowe-McConnell, 1987: 123-125).

24.1327 East Brazilian rivers
Middle and lower reaches of watercourses of the basins of the Parnaiba, the San Francisco, the Paraiba, the Jaqui, and smaller rivers of the caatinga and Atlantic forest coasts of Brazil, developed mostly in dry tropical woodland and savannas, with gallery forests.
(Lowe-McConnell, 1987: 123-125).

24.133 High-Andean rivers
Large, calm watercourses of the endoreic Lake Titicaca basin in the high Andes.
(Koepcke, 1961: 131).

24.134 Pacific desert rivers
Middle and lower courses of the rivers of the deserts of southern Peru and Chile, with an essentially Andean fish fauna.
(Koepcke, 1961: 130; Lowe-McConnell, 1987: 123-125).

24.14 Rivercourse features
Areas of abruptly changed gradient or width, generating discontinuities in the watercourse and harbouring distinctive communities.

24.141 Waterfalls
More or less vertical descent of a watercourse over irregularities of the streambed. Several specialized swifts of genera *Cypseloides* and *Streptoprocne*, of limited distribution, breed or roost behind them.
(Chantler and Driessens, 1995).

24.142 Mouthbays
Very wide expanses of water characteristic of the lowest stretches of Amazonian tributaries originating on the Brazilian or Guianan shields, developed between the hard substrate sections with their decantation zone and the confluent, constituting freshwater rias.
(Sioli, 1984a: 144-146; Furch, 1984: 169-172; Rai and Hill, 1984a)

24.143 Varzea lakes
Often shallow lagoons formed by floodwaters in the floodplain, sometimes very large in the high-water season, shrinking in the low-water period without drying up completely.
(Sioli, 1984a: 141, 146).

24.144 Low-water river pools
Pools left in river beds by the receding waters of temporary watercourses or strongly receding permanent watercourses, acting as refuges of river fauna, in particular, in the Pacific desert and subdesert regions, of fishes of genera *Bryconamericus*, *Lebiasina*, *Pygidium* and of the crustacean *Bithynis caementarius*.
(Koepcke, 1961: 127-128).

24.15 Saline streams and rivers
Watercourses of South America carrying saline or decidedly brackish waters. Other characteristics of saline watercourses can be noted by combination with other codes of unit 24.1.

24.2 Intermittent rivers and streams

Watercourses of which the flow is interrupted for part of the year, leaving a dry bed or pools, and their associated animal and microphytic pelagic and benthic communities; conditions during the period of flow can be indicated by transposition of the subdivisions of unit 24.1. Dry river bed communities and those of features of the river bed substrate, uncovered by low water or permanently emerging, are listed under units 24.4 and 24.5. Low-water period pool refuges are listed under 24.7. The fringing belts of tall or short emergent vegetation are listed under unit 53, the riverside veils of tall herbs and creepers under units 37 or 3A, riverine arbustive and arborescent vegetation under units 44, 3B or 4A.
(Koepcke, 1961: 127-132).

24.3 Euhydrophytic river vegetation

Communities of permanent or semipermanent streams, rivers and their inundation zones formed by free-floating, floating-leaved rooted, or submerged macrophytes and their associated epiphytic biocoenoses. Tall emergent-dominated formations, rooted in the substratum or constituting soil-free gramineous rafts (camalotales) or soil-retaining floating islands (embalsados) are excluded and listed in unit 53.
(Cabrera, 1964; Junk, 1984a: 226-228; Junk and Howard-Williams, 1984; Best, 1984: 375; Schnell, 1987b; Junk, 1993: 679-740; Carnevali, 1994; Tressens *et al.*, 1994; Calleja, 1994: 259-264; Huber, 1995: 159-160).

24.31 Free-floating riverine vegetation
Communities of macrophytes floating freely at the surface of watercourses, not rooted in the substrate and not rising or moderately rising above the water surface, together with their epiphytic fauna. Soil-free floating rafts dominated by low-growing pontederiads (*Eichhornia* and *Reussia* camalotales) are included, soil-free floating rafts and soil-retaining floating islands dominated by tall grass-like hydrophytes or helophytes (graminoid camalotales, embalsados, floating islands) are not, and are listed in 53.
(Cabrera, 1964; Junk, 1984a: 226-228; Junk and Howard-Williams, 1984; Best, 1984: 375; Junk, 1993: 679-740; Carnevali, 1994; Calleja, 1994: 259-264).

24.311 Riverine pontederiad rafts
Colonies of free-floating Pontederiaceae of watercourses of South America and their floodplains. Mixed formations of large aquatic grasses and pontederiads, forming large camalotales, are included separately in unit 53.4.
(Cabrera, 1964: 56-64; Cabrera and Zardini, 1978: 4, 181-183; Junk, 1984a: 226; Junk and Howard-Williams, 1984: 271-272; Best, 1984: 375; Carnevali, 1994: unit 25 *p.*; Calleja, 1994: 264).

24.3111 Riverine *Eichhornia* rafts
Flowing-water communities of camalotales-forming free-floating pontederiads of genus *Eichhornia*, widespread in tropical, subtropical and warm temperate parts of South America, forming in main river

channels as well as in floodplains. Part of the camalotales are included here; those that comprise a substantial stratum of tall emergents are listed in unit 53.
(Cabrera, 1964: 56-64; Cabrera and Zardini, 1978: 4, 181; Junk, 1984a: 226; Junk and Howard-Williams, 1984: 271-272; Best, 1984: 375; Calleja, 1994: 264).

24.31111 Riverine *Eichhornia crassipes* rafts
Flowing-water rafts of *Eichhornia crassipes*, abundant in all major watercourses of tropical, subtropical and warm temperate South America and their floodplains.
(Cabrera, 1964: 56-64; Cabrera and Zardini, 1978: 4, 181; Junk, 1984a: 226; Junk and Howard-Williams, 1984: 271; Best, 1984: 375; Schnell, 1987b: 250; Calleja, 1994: 264).

24.31112 Riverine *Eichhornia azurea* rafts
Flowing-water rafts of *Eichhornia azurea* of watercourses of tropical, subtropical and warm temperate South America and their floodplains, somewhat less abundant than those of *Eichhornia crassipes*, in particular, within the Amazon system, restricted, as main-channel communities, to the lower Amazon river and its tributaries.
(Cabrera, 1964: 58; Cabrera and Zardini, 1978: 4, 181; Junk and Howard-Williams, 1984: 271; Best, 1984: 375).

24.3112 Riverine *Pontederia* rafts
Flowing-water formations of free-floating pontederiads of genus *Pontederia* (*Reussia*), notably, *Pontederia rotundifolia*, of watercourses of tropical and subtropical South America and their floodplains.
(Cabrera, 1964: 58; Cabrera and Zardini, 1978: 4, 183; Junk and Howard-Williams, 1984: 271; Best, 1984: 375).

24.312 Riverine water lettuce beds
Colonies of the free-floating, rosette-forming *Pistia stratiotes* of calm-water zones and floodplains of watercourses of tropical and subtropical South America.
(Cabrera, 1964: 60-63; Cabrera and Zardini, 1978: 4, 171; Junk, 1984a: 226; Junk and Howard-Williams, 1984: 271; Best, 1984: 375; Schnell, 1987b: 250; Calleja, 1994: 259).

24.313 Riverine large fern rafts
Free-floating communities of watercourses of South America dominated by large ferns, in particular, of genus *Salvinia* or *Ceratopteris*.
(Cabrera, 1964: 60; Cabrera and Zardini, 1978: 45-46; Junk, 1984a: 226; Junk and Howard-Williams, 1984: 271; Best, 1984: 375).

24.3131 Riverine *Salvinia* rafts
Often dense and extensive mats of watercourses of South America and their floodplain dominated by free-floating ferns of genus *Salvinia*, in particular, *Salvinia auriculata*, *Salvinia rotundifolia*, *Salvinia herzogii*, *Salvinia sprucei*, *Salvinia minima*.
(Cabrera, 1964: 60; Cabrera and Zardini, 1978: 45-46; Junk, 1984a: 226; Junk and Howard-Williams, 1984: 271; Best, 1984: 375).

24.3132 Riverine *Ceratopteris* rafts
Floating communities of watercourses of tropical South America and their floodplains dominated by the robust parkerid fern *Ceratopteris pterioides*.
(Cabrera, 1964: 60; Junk, 1984a: 226; Junk and Howard-Williams, 1984: 271).

24.314 Riverine limnobium rafts
Freshwater formations of rivers of tropical South America and the Pampas, and of their inundation zones, dominated by the free-floating Hydrocharitaceae *Hydromystria laevigatum* (*Limnobium laevigatum*, *Hydromystria stolonifera*).
(Cabrera, 1964: 60; Cabrera and Zardini, 1978: 4, 60-61; Junk, 1984a: 226; Calleja, 1994: 263).

24.315 Riverine duckweed-azolla communities
Communities of rivers and streams of South America and of their inundation zone formed by small free-floating surface macrophytes, mostly duckweed of genera *Lemna*, *Spirodela*, *Wolffia*, *Wolffiella*, small ferns of genus *Azolla* or liverworts of genera *Riccia* and *Ricciocarpus*. They are limited to areas of slow current, in particular, in inundation zones and quiet parts of rivers.

(Cabrera, 1964; Cabrera and Zardini, 1978: 172-175; Junk, 1984a: 226; Junk and Howard-Williams, 1984: 271; Schnell, 1987b: 250; Huber, 1995: 159).

24.316 Riverine *Ceratophyllum* communities
Communities of watercourses of South America and their floodplains, dominated by the usually submerged, free-floating, *Ceratophyllum demersum*.
(Cabrera, 1964: 29-30, 32-33; Vervoorst, 1967: 154-155; Cabrera and Zardini, 1978: 278; Junk and Howard-Williams, 1984: 271).

24.317 Riverine free-floating *Utricularia* colonies
Immerged free-floating communities of rivers and streams of South America formed by *Utricularia spp.*, notably *Utricularia foliosa*, capable, in particular, of colonizing nutrient-poor blackwater river floodplains.
(Junk, 1984a: 226; Junk and Howard-Williams, 1984: 271-272; Best, 1984: 375; Junk, 1993: 688).

24.318 Riverine *Neptunia* communities
Communities of watercourses of tropical South America dominated by free-floating Fabaceae of genus *Neptunia*, in particular, communities of rain forest floodplains formed by *Neptunia oleracea*.
(Junk, 1984a: 226).

24.32 Rooted submerged tropical riverine vegetation
Underwater colonies of submerged, rooted, perennial phanerogams, with often emerging flower spikes, developing in streams and rivers of South America.
(Cabrera, 1964; Junk, 1984a: 226-228; Junk and Howard-Williams, 1984; Best, 1984: 375; Schnell, 1987b; Junk, 1993: 679-740; Carnevali, 1994; Tressens *et al.*, 1994; Calleja, 1994: 259-264; Huber, 1995: 159-160).

24.321 Riverine hydrocharid submerged communities
Rooted submerged communities dominated by Hydrocharitaceae, in particular, of genera *Elodea* and *Egeria* of watercourses of South America.
(Cabrera, 1964: 30-34; Cabrera and Zardini, 1978: 61-63; Junk and Howard-Williams, 1984: 272).

24.322 Riverine *Cabomba* beds
Rooted submerged communities of quiet, relatively shallow, flowing waters of warm-temperate and subtropical South America dominated by species of the showy-flowered Nymphaeaceae (or Cabombaceae) genus *Cabomba*, with fine, verticillated leaves, endemic to warm temperate regions of the Americas, in particular by *Cabomba australis* of southeastern Brazil, Uruguay, Paraguay, and northeastern Argentina, by *Cabomba schwarzii* of Amazonia, or by *Cabomba pihauyensis*, characteristic of rich aquatic waterplant beds in sunny creeks of savanna areas within the Amazonian basin.
(Cabrera, 1964: 29-30, 32-33; Cabrera and Zardini, 1978: 276-278; Junk and Howard-Williams, 1984: 272, 280).

24.323 Riverine *Myriophyllum* beds
Rooted submerged communities watercourses of South America dominated by Haloragaceae of genus *Myriophyllum*, in particular *Myriophyllum aquaticum* (*Myriophyllum brasiliense*) or *Myriophyllum elatinoides* (*Myriophyllum quitense*).
(Cabrera, 1964: 34; Vervoorst, 1967: 154; Cabrera and Zardini, 1978: 453-454; Moore, 1983: 31, 151).

24.324 Riverine fine-leaved pondweed beds
Rooted submerged communities of watercourses of South America dominated by species of linear-leaved *Potamogeton*, in particular, *Potamogeton pectinatus* var. *striatus*, *Potamogeton berteroanus*, *Potamogeton strictus* (*Potamogeton pusillus*), *Potamogeton burkartii* or by *Zannichellia palustris*.
(Cabrera, 1964: 29; Vervoorst, 1967: 154-155; Cabrera and Zardini, 1978: 51-53; Moore, 1983: 31, 268-270).

24.325 Riverine broad-leaved pondweed beds

Rooted submerged communities of South American watercourses dominated by species of broad, elliptical-leaved *Potamogeton*, in particular by *Potamogeton illinoensis* var. *ventanicolus* of arroyos of the Sierra de la Ventana.
(Cabrera and Zardini, 1978: 53).

24.326 Riverine marestail communities
Formations dominated by *Hippuris vulgaris* of slow-moving, clear, cold to temperate watercourses of Patagonia and the Andes.
(Cabrera, 1964: 34; Moore, 1983: 30-31, 151).

24.327 Riverine *Ranunculus* communities
Rooted submerged communities of slow watercourses of southern South America and the Andes dominated by submerged, aquatic species of *Ranunculus*, in particular by *Ranunculus aquatilis*, with a very few floating leaves.
(Moore, 1983: 31, 72).

24.328 Riverine *Mayaca* communities
Rooted submerged communities of streams and rivulets of tropical South America formed by mats of Mayacaceae, in particular, *Mayaca fluviatilis* (*Mayaca kunthii*).
(Hutchinson, 1973: 701; Heywood, 1978: 279; Giulietti and Wanderley, 1995: 724; Huber, 1995: 159).

24.329 Riverine eriocaulid beds
Communities of watercourses of tropical South America dominated by mostly immersed Eriocaulaceae, in particular, sparse communities of shady forest creeks and small rain forest rivers formed by *Syngonanthus anomalus* or *Tonina fluviatilis*, usually rooted but capable of growing after uprooting by the current, trapped in branches, and large, dense colonies of hairlike *Eriocaulon melanocephalum* of lowland and highland stony riverbeds of the Guiana shield.
(Junk and Howard-Williams, 1984: 272, 278-279; Huber, 1995: 159).

24.32A Riverine submerged araceid beds
Communities of watercourses of tropical South America dominated by mostly immersed Araceae, in particular, communities of *Jasarum steyermarkii*, endemic to blackwater rivers and small ponds of the Guiana shield, occurring between 1200 and 1300 metres in the Gran Sabana, down to 500 metres in the upper Mazaruni River of Guyana.
(Huber, 1995: 160).

24.33 Rooted floating tropical riverine vegetation
Communities of rivers, streams and their floodplain dominated by rooted aquatic plants with broad floating or floating and emergent leaves, often with a stratum of submerged species (*Ceratophyllum*, *Myriophyllum*, *Potamogeton*, *Egeria*, *Elodea*) and occasionally accompanied by free-floating species.
(Cabrera, 1964; Junk, 1984a: 226-228; Junk and Howard-Williams, 1984; Best, 1984: 375; Schnell, 1987b; Junk, 1993: 679-740; Carnevali, 1994; Tressens *et al.*, 1994; Calleja, 1994: 259-264).

24.331 Riverine nymphea beds
Formations of *Nymphaea spp.* of the watercourses of South America and their floodplains, constituted in particular by *Nymphaea amazonum*, of tropical, subtropical and warm temperate regions, and by *Nymphaea rudgeana* found both in shady forest and sunny savanna creeks of the Amazonian basin.
(Cabrera and Zardini, 1978: 278; Junk and Howard-Williams, 1984: 272; Best, 1984: 375).

24.332 Riverine *Victoria* beds
Formations of the giant-leaved *Victoria amazonica* (*Victoria regia*) or *Victoria cruziana*, of watercourses of tropical and subtropical South America and their floodplains.
(Cabrera, 1964: 53-55; Junk, 1984a: 226; Junk and Howard-Williams, 1984: 272; Schnell, 1987b: 234; Junk, 1993: 704).

24.333 Riverine nymphoides beds
Formations of *Nymphoides spp.*, in particular *Nymphoides indica* (*Nymphoides humboldtiana*), of tropical, subtropical and warm temperate rivers and creeks of South America.
(Cabrera, 1964: 55; Cabrera and Zardini, 1978: 486; Junk and Howard-Williams, 1984: 272).

24.334 Riverine broad-leaved pondweed beds
Formations of watercourses of South America dominated by species of *Potamogeton* with broad floating leaves as well as fine immersed leaves, in particular, *Potamogeton ferrugineus*, *Potamogeton linguatus*.
(Cabrera and Zardini, 1978: 51-53; Moore, 1983: 31, 268-270).

24.335 Riverine water-poppy beds
Communities of floating leaved Limnocharitaceae of calm, clear watercourses of tropical, subtropical and warm temperate South America, formed, in particular, by *Hydrocleis nymphoides* or species of genus *Limnocharis*.
(Cabrera and Zardini, 1978: 59-60; Calleja, 1994: 260).

24.34 Podostemaceid communities
Aquatic and sometimes semiaquatic tropical fast-river, rapids and waterfall rock communities dominated by Podostemaceae, represented in South America, in particular, on the Guianan and Brazilian shields, by genera *Marathrum*, *Tristicha*, *Oserya*, *Mourera*, *Apinagia*, *Rhyncholacis*, *Podostemon*, in particular. The family is remarkable for its heterogeneous, anomalous vegetative system, often moss-like, alga-like or lichen-like, and its ecological and phenological adaptation to flowing water, rocky substrates and the rhythm of riverine flood and low-water pattern.
(Cabrera, 1968: 42-45; Schnell, 1987a: 266, 269; Schnell, 1987b: 238-248; Junk and Howard-Williams, 1984: 273, 279; Tressens *et al.*, 1994: 24; Huber, 1995: 159).

24.341 Waterfall podostemaceid communities
Communities of Podostemaceae colonizing rocks of waterfalls of tropical South America.

24.3411 Guiano-Amazonian waterfall Podostemaceae communities
Communities of species of Podostemaceae occupying rocks of cascades of northern South America, in particular, carpets of *Apinagia longifolia* of Guianan waterfalls, formations of *Apinagia multibranchiata* or *Rhyncholacis penicillata* of waterfalls of the upper Caroni River in Venezuela.
(Schnell, 1987b: 247).

24.3412 Paranean waterfall Podostemaceae communities
Communities of Podostemaceae occupying rocks in cascades of the Parana river basin, in particular, the great waterfalls of the Iguazu, with *Podostemon aguirensis*, *Podostemon comata*, *Podostemon glaziovianum*, *Podostemon schenckii*, *Podostemon warmingii*, *Podostemon atrichus*.
(Cabrera, 1968: 44; Tressens *et al.*, 1994: 24).

24.342 Rapids podostemaceid communities
Communities of Podostemaceae occupying rocks splashed and washed by the swift, turburlent waters of tropical South American river rapids.
(Cabrera, 1968: 42-45; Schnell, 1987b: 238-248; Tressens *et al.*, 1994: 24).

24.3421 Guiano-Amazonian rapids Podostemaceae communities
Communities of Podostemaceae, in particular, *Apinagia staheliana*, *Rhyncholacis hydrocichorium*, *Moureria fluviatilis*, of rocks splashed and washed by waters of rapids of the river systems of northern South America.
(Schnell, 1987b: 247).

24.34211 Guianan *Apinagia-Rhyncholacis* rapids communities
Communities of *Apinagia staheliana* and *Rhyncholacis hydrocichorium* of northern South America, in particular, of the Guianan region, installed on emergent rocks of rapids beaten by swift water currents.
(Schnell, 1987b: 247).

24.34212 Guianan *Mourera* rapids communities
Communities, often carpet-forming, of the spectacular, tall-spiked *Mourera fluviatilis* on rock sills and upper course rapids of river systems of the Guianan region.
(Schnell, 1987a: 266, 269; Schnell, 1987b: 245, 247).

24.3422 Paranean rapids Podostemaceae communities
Communities of Podostemaceae of splashed and washed rocks of rapids of the Parana, Iguazu, Uruguay and Apipe river systems, in particular, colonies of *Apinagia yguazuensis* of the Iguazu, and of

several species of *Podostemon*, including *Podostemon uruguensis*, of the former Salto Grande rapids of the Uruguay.
(Cabrera, 1968: 44-45; Tressens *et al.*, 1994: 24).

24.343 Submerged pavement podostemaceid communities
Communities of Podostemaceae of rivers of tropical South America colonizing submerged, near-surface, subhorizontal flat rocks and rock pavements.
(Schnell, 1987b: 247-248; Cabrera, 1968: 44-45).

24.3431 Guiano-Amazonian submerged pavement *Podostemaceae* communities
Communities of Podostemaceae of rivers of northern tropical South America colonizing submerged, near-surface, subhorizontal flat rocks and rock pavements.
(Schnell, 1987b: 247-248).

24.34311 Guianan fast-water pavement Podostemaceae communities
Communities of Podostemaceae of Guianan rivers colonizing flat, nearly horizontal, pavements submitted to swift currents, in particular, communities of *Tristicha trifaria*, *Oserya minima* and various species of genus *Apinagia*.
(Schnell, 1987b: 247).

24.34312 Guianan calm-water pavement Podostemaceae communities
Communities of Podostemaceae of Guianan river systems occupying subhorizontal rock pavements bathed by waters with reduced current speed, in particular, communities of *Marathrum capillaceum*.
(Schnell, 1987b: 247-248).

24.3432 Paranean immersed pavement Podostemaceae communities
Communities of Podostemaceae of the Parana-Uruguay river system, colonizing constantly-bathed near-surface rocks, with the carpeting moss-like *Tristicha trifaria*.
(Cabrera, 1968: 44-45; Tressens *et al.*, 1994: 24).

24.344 River-bottom podostemaceid communities
Submerged communities of Podostemaceae colonizing rocks at the bottom of rivers of tropical South America .
(Cabrera, 1968: 42-45; Schnell, 1987b: 238-248).

24.3441 Guiano-Amazonian rock bottoms Podostemaceae communities
Submerged communities of Podostemaceae of river-bottom rocks of river systems of northern South America, formed, in particular, by carpets of *Apinagia flexuosa*.
(Schnell, 1987b: 248).

24.3442 Paranean rock bottoms Podostemaceae communities
Submerged communities of Podostemaceae of river-bottom rocks of the Parana-Uruguay river system, constituted, in particular, by colonies of *Mourera aspera* or *Apinagia yguazuensis*.
(Cabrera, 1968: 44).

24.35 Riverine submerged charophyte beds
Beds of charophytes submerged in watercourses of South America, in particular, beds of *Nitella opaca* of arroyos of the Pampa.
(Vervoorst, 1967: 155).

24.4 Riverbed shingles, sands, muds and rocks

Features of the riverbeds uncovered by low water or permanently emerging, such as gravel, sand, mud or rock islands and bars. The specialized macrophytic amphibious communities that may develop on them are listed separately under unit 24.5. The terrestrial communities and tall fringing vegetation belts that may also be supported by them are indicated by codes from units 15, 3 or 4 and from unit 53.
(Koepcke, 1961: 134-136; Junk, 1984a: 227).

24.41 Riverbed rocks, pavements and blocks
Hard rock features permanently emerging from, or temporarily uncovered by, watercourses.

(Koepcke, 1961: 134).

24.42 River gravels
River bed deposits of small stones uncovered by low water or permanently emerging, including gravel banks, bars, beaches or islands.
(Koepcke, 1961: 134-135).

24.43 River sands
Sand deposits in riverbeds uncovered by low water or permanently emerging, including sand banks, bars, beaches or islands. Sand beaches of the Amazon system are the nesting sites of river turtles of genus *Podocnemis*, in particular of the very large, colonial, *Podocnemis expansa*.
(Koepcke, 1961: 136; Sioli, 1984a: 148, 151; Best, 1984: 386-391).

24.44 River muds
Alluvial muds exposed by stream level fluctuations.
(Koepcke, 1961: 135-137).

24.5 Semiaquatic river vegetation

Low or sparse assemblies of amphibious, semiaquatic or paludicolous herbaceous macrophytes colonizing features of the riverbeds uncovered by low water or permanently emerging, such as gravel, sand, mud or rock banks, bars and beaches.
(Koepcke, 1961: 134-136; Junk, 1984a: 227; Adis, 1984: 249; Junk and Howard-Williams, 1984: 274; Tressens *et al.*, 1994: 24-27).

24.51 River rocks semiaquatic vegetation
Communities of grasses, sedges or nongramineous herbaceous plants, dependant on moisture from spray and intermittent immersion, developed on or among drenched rocks of riverbeds, rapids and waterfalls, including both rocks periodically covered by waterfalls and vertical or horizontal flat rock surfaces splashed and sprayed by waterfalls or rapids.
(Tressens *et al.*, 1994: 24-27).

24.511 River rocks semiaquatic grass swards
Formations of Poaceae and other gramineous herbs on rocks of riverbeds, rapids and waterfalls, in particular, partially submerged swards of the endemic *Paspalum lilloi* of rocks of the Iguazu Falls area.

(Renvoize, 1988: 48; Tressens *et al.*, 1994: 24).

24.512 River rocks semiaquatic forb communities
Formations of herbaceous nongramineous plants developed on and between rocks of riverbeds, rapids and waterfalls, in particular, communities colonizing continuously showered rocks of Iguazu Falls, with *Oxalis debilis*, *Hypoxis decumbens*, *Sinningia sellowii*.
(Tressens *et al.*, 1994: 24).

24.513 Waterfall-spray pavement communities
Formations of plants, often diverse and species-rich, occupying subhorizontal rock pavements, terraces or platforms bathed by spray from waterfalls, in particular, vegetation colonizing the terraces of the Salto San Martin of Iguazu Falls composed of Scrophulariaceae (*Stemodia hyptoides*), Guttiferae (*Hypericum brasiliense*), Lythraceae (*Cuphea fruticosa*), composites (*Jaegeria hirta*, *Acmella serratifolia*), euphorbs (*Phyllanthus caroliniensis*), umbellifers *Eryngium pandanifolium*, grasses (*Paspalum conspersum*, *Paspalum urvillei*, *Setaria geniculata*), Cyperaceae (*Fimbristylis autumnalis*, *Lipocarpha sellowiana*, *Rhynchospora tenuis*), bromeliads (*Dyckia distachya*), terrestrial orchids.
(Tressens *et al.*, 1994: 25-26).

24.52 River gravels semiaquatic vegetation
Pioneer assemblies colonizing gravel banks, bars and beaches of rivers and streams of temperate and tropical South America. Codes from unit 22.5 can be used to further define communities.

24.53 River sand banks semiaquatic vegetation

Pioneer assemblies colonizing sand banks, bars and beaches of rivers and streams of temperate and tropical South America. Codes from units 22.5, 22.34, 15.3, 15.4, 15.5 can be used to further define communities.
(Junk, 1984a: 227; Adis, 1984: 249; Junk and Howard-Williams, 1984: 274; Tressens *et al.*, 1994: 24-27).

24.54 River muds semiaquatic vegetation
Pioneer assemblies colonizing mud banks, bars and beaches of rivers and streams of temperate and tropical South America. Codes from units 22.5, 22.34, 15.3, 15.4, 15.5 can be used to further define communities.
(Junk, 1984a: 227; Adis, 1984: 249; Junk and Howard-Williams, 1984: 274; Tressens *et al.*, 1994: 24-27).

24.56 Wadi communities
Specialized communities of the beds of intermittent watercourses of desert and near-desert regions, in particular of the Monte and the Chaco, where *Argemone mexicana* and *Nicotiana glauca* are characteristic.
(Morello, 1958: 124).

24.6 Riverine emergent features

Permanently or usually emergent features of the bed or shores of permanent or temporary flowing water courses.

24.61 Riverine islets
Permanently or usually emergent features of the bed of permanent or temporary flowing water courses, supporting terrestrial communities (units 3, 4) that may comprise elements that are favoured by the riverine microclimate or the protection that isolation by water affords.

24.62 Riverine cliffs
Cliffs of river banks and river islands, supporting terrestrial communities (units 3, 4, 6) that may comprise elements favoured by the riverine microclimate.
(Koepcke, 1961: 134; Sioli, 1984a: 141-142; McQueen and McQueen, 1993).

3 . SCRUB AND GRASSLAND

Shrub-, grass- or forb-dominated communities constituting either zonal climax communities under non-desert climates unsuitable for forest, or zoogenic or anthropogenic, regressive or progressive, transitional stages in forest successions on well-drained, seasonally inundatable or poorly drained but non-marshy soils. Included are deciduous, ericaceous, sclerophyllous or lauriphyllous shrub communities of subantarctic, temperate, mediterranean, tropical, equatorial and high mountain climates, steppes, alpine and other orogenous grasslands, secondary dry, mesophile or humid grasslands and forblands of subantarctic, temperate, mediterranean, tropical and equatorial climates.

31. TEMPERATE HEATH AND SCRUB

Shrub communities of nemoral affinities. They include winter-deciduous scrubs or brushes of the subarctic, subantarctic, nemoral, steppe, warm-temperate humid and mediterranean zones, ericoïd or coniferous scrubs of the subarctic, subantarctic, nemoral, steppe and warm-temperate humid zones and scrubs, heaths, cushion-heaths or brushes of the cold, extrasylvatic or supradesertic altitude belts of subantarctic, nemoral, mediterranean and subtropical high mountains. In South America, Magellanic and Juan Fernandez heaths, southern Andean cushion heaths, dwarf-shrub heaths and feldmark, Magellanic and Valdivian deciduous thickets and Magellanic dwarf conifer heaths belong to this unit.
(Hueck and Seibert, 1972: units 81 *p.*, 82 *p.*, 84 *p.*, 64-65 *p.*, 75-80 *p.*; Hueck, 1978; Moore, 1983; Walter and Breckle, 1991b, 1991c; Gajardo, 1994: regions 8, 7, 6, 5, 4, 2B; Daniele and Natenzon, 1994: regions 10, 17).

31.1 Magellanic wet heaths

Communities of the cool-temperate zone of South America dominated by ericoid-leaved shrubs developed on waterlogged peat, under conditions of extreme pluviosity, strong winds and low temperatures, characteristic of the Chilean archipelagoes. *Empetrum rubrum* is their main constituent.
(Moore, 1979: 491-494; Pisano, 1983; Gajardo, 1994: region 7C).

31.11 *Empetrum* dwarf wet heaths
Dwarf heaths of the lowlands of southern South America, in the deciduous or evergreen *Nothofagus* forest zone, and in the Magellanic moorland zone, formed by a more or less continuous canopy of prostrate shrubs, often less than 20 cm high, including the usually dominant *Empetrum rubrum*, together with *Pernettya pumila*, *Myrteola nummularia*, *Berberis ilicifolia*, *Chiliotrichium diffusum*, *Desfontainia spinosa*, over a dense cushion of bryophytes, including mosses and sphagnum. They may grade into or form a mosaic with blanket bogs of unit 52 and raised bogs of unit 51.
(Pisano, 1971b: 110; Moore, 1979: 491-494; Moore, 1983: 27; Pisano, 1983: 309-310; Gajardo, 1994: units 7C121, 7C132, 7C133, 7C134, 7C136, *p.*).

31.111 South Magellanic *Empetrum* dwarf wet heaths
Dwarf *Empetrum rubrum*-dominated, humid, peaty, oceanic heaths of Magellanic Tierra del Fuego and the southern Chilean archipelago, developed in the deciduous or evergreen *Nothofagus* forest zone and the Magellanic moorland zone.
(Pisano, 1971b: 110; Moore, 1979: 491-494; Moore, 1983: 27; Pisano, 1983: 309-310; Gajardo, 1994: units 7C132, 7C133, 7C134, 7C136, *p.*).

31.1111 *Bolax gummifera-Pernettya pumila* wet heaths
Dwarf humid, peaty, oceanic heaths of Magellanic Tierra del Fuego, extreme southwestern Patagonia, and the southern Chilean fjordland north to 50° S, developed in the deciduous or evergreen *Nothofagus* forest zone and the Magellanic moorland zone, with the usually dominant *Empetrum rubrum*, *Bolax gummifera*, *Pernettya pumila*, *Abrotenella emarginata*, *Azorella lycopodioides*, *Drapetes muscosus*, *Luzula alopecurus*.
(Gajardo, 1994: units 6B10-7C132, 7B8-7C132, 7B9-7C132, 7C13-7C132, 7C14-7C132, *p.*).

31.1112 *Empetrum-Sphagnum* wet heaths
Dwarf *Empetrum rubrum*-dominated, humid, peaty, oceanic heaths of Magellanic Tierra del Fuego, extreme southwestern Patagonia, and the southern Chilean fjordland north to 50° S, developed mostly in the Magellanic moorland zone and in the Magellanic deciduous forest zone, with *Berberis ilicifolia*, *Chiliotrichium diffusum*, *Sphagnum magellanicum*, *Pernettya mucronata*, *Myrteola nummularia*.

(Pisano, 1971b: 110; Moore, 1979: 491-494; Moore, 1983: 27; Pisano, 1983: 309-310; Gajardo, 1994: units 6B10-7C133, 7C13-7C133, *p.*).

31.1113 *Empetrum-Bolax caespitosa* wet heaths
Dwarf *Empetrum rubrum*-dominated, humid, peaty, oceanic heaths of Magellanic Tierra del Fuego and the southern Chilean fjordland north to 50° S, developed mostly in the Magellanic moorland zone and in the southernmost Magellanic evergreen forest zone, with *Bolax ceaspitosa*, *Abrotanella emarginata*, *Azorella lycopodioides*, *Drapetes muscosus*, *Marsippospermum grandiflorum*, *Pernettya pumila*, *Azorella selago*, *Colobanthus subulatus*, *Escallonia serrata*, *Festuca magellanica*, *Gunnera magellanica*, *Luzula alopecurus*, *Pernettya mucronata*, *Senecio darwinii*.
(Gajardo, 1994: units 7B9-7C134, 7C13-7C134, 7C14-7C134, *p.*).

31.1114 *Empetrum-Marsippospermum* wet heaths
Dwarf *Empetrum rubrum*-dominated, humid, peaty, oceanic heaths of Magellanic Tierra del Fuego and the southern Chilean archipelago north to 50° S, developed mostly in the Magellanic moorland zone, with *Marsippospermum grandiflorum*, *Berberis ilicifolia*, *Myrteola nummularia*, *Chiliotrichium diffusum*, *Luzuriaga marginata*, *Senecio acanthifolius*, *Blechnum penna-marina*.
(Gajardo, 1994: units 7C13-7C136, 7C14-7C136, *p.*).

31.112 Messier *Empetrum* wet heaths
Dwarf, humid, peaty, oceanic heaths of the Chilean archipelago islands bordering Canal Messier, of Isla Wellington, of the shores of the Golfo de Peñas, and of the peninsula de Taitao, with rare outliers in the montane zone of adjacent hills, with *Empetrum rubrum*, *Oreobolus obtusangulus*, *Donatia fascicularis*, *Astelia pumila*, *Myrteola nummularia*, *Perezia magellanica*.
(Gajardo, 1994: units 6B8-7C121, 7C12-7C121, *p.*).

31.12 *Empetrum* tall wet heaths
Taller heaths of the lowlands of southern South America, characteristic of sheltered stations, of woodland edges, of seashores receiving runoff from the interior, dominated by *Empetrum rubrum* associated with various shrubs of medium height and with small tree-ferns.
(Moore, 1983; Pisano, 1983: 310; Gajardo, 1994: unit 7C13-7C133 *p.*).

31.121 *Empetrum-Pernettya mucronata* wet heaths
Tall wet heaths of southern South America formed by *Empetrum rubrum* and *Pernettya mucronata*, often with *Chiliotrichum diffusum*, *Berberis ilicifolia*, developing in particular as a transition between the wetter facies of Fuego-Patagonian deciduous forests, and bogs or wet grasslands. The species may include *Marsippospermum grandiflorum*, *Nothofagus betuloides*, *Sphagnum magellanicum*, *Caltha dionaefolia*, *Luzuriaga marginata*, *Myrteola nummularis*, *Philesia magellanica*, *Senecio acanthifolius*, *Blechnum penna-marina*, *Lebetanthus myrsinites*, and occasionally *Pilgerodendron uvifera*.
(Moore, 1979: 491-494; Moore, 1983: 27; Gajardo, 1994: 6B10-7C133, 7C13-7C133 *p.*).

31.122 *Empetrum-Tepualia* wet heaths
Tall wet heaths of southern South America formed by *Empetrum rubrum* and *Tepualia stipularis*, characteristic of the Chilean Fjordland between the Straits of Magellan and Isla Wellington.
(Moore, 1979: 494).

31.123 *Empetrum-Escallonia* wet heaths
Tall wet heaths of southern South America formed by *Empetrum rubrum* and *Escallonia serrata*, forming along the interface between forest and wet grasslands.
(Pisano, 1971b: 111; Moore, 1983: 142).

31.2 Fuego-Patagonian dry heaths

Mesophile or xerophile heaths on mineral, usually siliceous, podsolic soils in moist oceanic and suboceanic climates of the plains and low mountains of the Magellanic, Andino-Patagonian and Valdivian regions.
(Oberdorfer, 1960: 154-158; Moore, 1979, 1983; Pisano, 1983; Gajardo, 1994: regions 4C, 5A).

31.21 Patagonian heaths
Heaths of the Patagonian steppe zone of Tierra del Fuego.
(Moore, 1983).

31.211 Patagonian *Empetrum* dry heaths
Heaths of northern Tierra del Fuego and the southern mainland, developed locally in the steppe zone over acid, permeable, often rather shallow soils, dominated by *Empetrum rubrum*, accompanied by *Azorella caespitosa*, *Baccharis magellanica*, *Colobanthus subulatus*, *Luzula chilensis*, *Nassauvia darwinii*, *Perezia recurvata*, and by species shared with the adjacent steppes, in particular, *Arjona patagonica*, *Armeria maritima*, *Festuca gracillima*, *Oxalis enneaphylla*, *Poa alopecurus*. They are related to the Magellanic *Empetrum* wet heaths of unit 31.1, but, developed under a regime of much lower precipitations, they differ both physiognomically and physically.
(Moore, 1979: 489-490; Moore, 1983: 26).

31.212 Patagonian *Nardophyllum* dry heaths
Low cushion heaths of coastal gravels of the Patagonian steppe zone of the Strait of Magellan region, dominated by the dwarf ericoid composite *Nardophyllum bryoides*, associated with *Berberis empetrifolia*, *Euphorbia collina*, *Lepidophyllum cupressiforme*, *Oxalis enneaphylla* and *Suaeda argentinensis*.
(Moore, 1983: 25).

31.22 Magellanic dry heaths
Heaths of the deciduous and evergreen Magellanic forest zones, developed on relatively well-drained soils.
(Moore, 1983).

31.221 Magellanic *Empetrum-Bolax* dry heaths
Dwarf shrub heaths of the deciduous *Nothofagus* forest zone of southern South America, developed on shallow, well-drained soils, particularly in cold air sinks and frost pockets, dominated by *Empetrum rubrum* and *Bolax gummifera*, with *Abrotanella emarginata*, *Azorella lycopodioides*, *Drapetes muscosus*, *Festuca magellanica*, *Lycopodium magellanicum*, *Myrteola nummularia*, *Nanodea muscosa*, *Pernettya pumila*.
(Moore, 1983: 27).

31.222 Magellanic *Empetrum-Pernettya* dry heaths
Heaths of the deciduous or evergreen *Nothofagus* forest zone of southern South America, often very open, developed on relatively well-drained soils, in particular on granitic moraines and substrates recently liberated by ice, formed by *Empetrum rubrum* and *Pernettya mucronata*, with *Nassauvia magellanica*, *Escallonia serrata*, *Embothrium coccineum*.
(Pisano, 1971b: 115-116; Dimitri, 1972, 1977).

31.23 Valdivian dry heaths
Mesophile or xerophile heaths developed on mineral soils, in particular, dry, base-poor volcanic and dry, sandy soils, in moist oceanic and suboceanic climates of the plains and low mountains of southern mainland Chile and Chiloe Island.
(Oberdorfer, 1960: 154-158; Gajardo, 1994: regions 4C, 5A).

31.231 Valdivian *Pernettya myrtilloides* dry heaths
Fairly open heaths of the Lake region of southern Chile, characteristic of the coastal Valdivian forest zone, of the interior pre-Andean Lake laurel forest region and of the Andean lauriphyllous forest zone, dominated by *Pernettya myrtilloides* (*Pernettya poeppigii*), with *Baccharis obovata*, *Agrostis leptotricha*, *Lomatia hirsuta*, *Myoschilos oblongata*, *Gevuina avellana*, *Racomitrium hypnoides*.
(Oberdorfer, 1960: 155-157; Gajardo, 1994: units 4C10-5A24, 5A1-5A24, 5A2-5A24).

31.2311 Lowland *Pernettya myrtilloides* heaths
Pernettya myrtilloides heaths of low altitudes (50-100 metres) of the Lake region of southern Chile, co-dominated by *Pernettya myrtilloides* (*Pernettya poeppigii*), *Baccharis obovata* and *Ugni molinae*, usually with abundant *Racomitrium hypnoides*.
(Oberdorfer, 1960: 155-157; Gajardo, 1994: units 4C10-5A24, 5A1-5A24, 5A2-5A24).

31.2312 Highland *Pernettya myrtilloides* heaths
Pernettya myrtilloides heaths of the 750-800 metre level of the Lake region of southern Chile, with *Myrteola leucomyrtillus*.
(Oberdorfer, 1960: 156-157).

31.232 Valdivian *Pernettya mucronata* dry heaths
Usually dense, heaths of Chiloe and the pre-Andean zone of the Chilean Lake District dominated by *Pernettya mucronata* var. *angustifolia*, with *Blechnum penna-marina*, *Agrostis tenuis*, *Berberis darwinii*, *Gaultheria phyllyreaefolia*, *Ugni candollei*, characteristic of woodland edges, roadsides, abandoned pastures, dry buttes of peat bogs and, also, of rocky ground at moderate altitudes.
(Oberdorfer, 1960: 156, 157-158; Gajardo, 1994: units 5A3-5A42, 5A4-5A42).

31.3 Juan Fernandez heaths

Open shrublands and fern fields of the higher altitudes of the oceanic Juan Fernandez archipelago.
(Skottsberg, 1953a: 913-917, 942-944, 945-948; Murphy, 1936: 255-256; Cabrera and Willink, 1980: 104; Gajardo, 1994: 5B6-5B63).

31.31 Masafueran alpine heaths
Relict heaths of subantarctic affinities, of the high, suprasylvatic zone of the oceanic Juan Fernandez archipelago, limited to altitudes above 1100 metres on the lofty, 1650 metres high, Mas Afuera, and of very restricted extent, formed by *Empetrum rubrum*, *Rubus geoides*, *Pernettya rigida*, *Myrteola nummularia*, *Ugni selkirkii*, accompanied by *Acaena masafuerana*, *Drimys confertifolia*, *Lagenophora hariotii*, *Nertera granadensis*, *Uncinia tenuis*, *Lycopodium magellanicum*.
(Skottsberg, 1953a: 945-948; Murphy, 1936: 255-256; Cabrera and Willink, 1980: 104; Gajardo, 1994: 5B6-5B63).

31.32 Masafueran subalpine fern-grass heaths
Heaths of the lower extrasylvatic zone of Mas Afuera, developed in the altitudinal range of 700-1100 metres, dominated by the ferns *Dicksonia externa*, *Lophosoria quadripinnata*, *Blechnum auriculatum*, *Blechnum chilense*, *Gleichenia quadripartita*, often accompanied by *Pernettya rigida* and an abundance of grasses.
(Skottsberg, 1953a: 942-944; Murphy, 1936: 255-256; Cabrera and Willink, 1980: 104; Gajardo, 1994: 5B6-5B63).

31.33 Masatierran *Pernettya* heaths
Shrublands of exposed ridges of Mas a Tierra, mostly developed on shallow stony soils, formed by *Pernettya rigida*, *Escallonia callcottiae*, *Robinsonia gayana*, *Blechnum cycadifolium*, *Ugni selkirkii*, usually dominated by the Ericaceae *Pernettya rigida*, sometimes by the Myrtaceae *Ugni selkirkii*.
(Skottsberg, 1953a: 913-917).

31.4 Southern Andean dwarf shrub heaths

Dwarf shrub heaths of the alpine, extrasylvatic, zone of the southern Andes, developed on the margins of rock screes and other well-drained sites in the same belt as the cushion heaths of unit 31.61, dominated by the ericoid *Empetrum rubrum* or, more rarely, by *Pernettya pumila* and *Myrteola nummularia*; *Cystopteris fragilis* and *Senecio darwinii* are characteristic.
(Oberdorfer, 1960: 146, 156-157; Cabrera and Willink, 1980: 86; Moore, 1983: 30).

31.5 Magellanic dwarf conifer heaths

Heaths of the Magelllanic region dominated by shrubby conifers, in particular by dwarf shrubby ecotypes of the otherwise arborescent cypress *Pilgerodendron uvifera* or by the creeping podocarp *Dacrydium fonckii*.

(Pisano, 1983: 310-311; Rushforth, 1987).

31.51 *Pilgerodendron* dwarf heaths
Low heaths dominated by microphanerophytic *Pilgerodendron uvifera* forming a dense cover, usually not more than 30 cm in height, developed on thin peaty soils over rocky substrates in the Magellanic moorland region, mostly in association with phanerogamic cushion-plant mires. The basal layer is usually formed by loose cushions of liverworts and mosses and by caespitose phanerogams, including *Abrotanella linearifolia*, *Astelia pumila*, *Bolax caespitosa*, *Caltha appendiculata*, *Caltha dioneaefolia*, *Donatia fascicularis*, *Oreobolus obtusangulus*, *Phyllachne uliginosa*, *Tapeinia pumila*. Dwarfed shrubs, *Berberis ilicifolia*, *Desfontainia spinosa*, *Empetrum rubrum*, form a subshrubby layer. Other common companions include *Acaena pumila*, *Carex microglochin*, *Perezia magellanica*, *Senecio trifurcatus*.
(Pisano, 1983: 310; Moore, 1983: 28-29).

31.52 *Dacrydium fonckii* creeping heaths
Very dense mat-heaths of the Magellanic region formed by the subligneous dwarf decumbent podocarp *Dacrydium fonckii*, developed in flat or coastal areas on periodically flooded sites or in places where the permanent water table is near the surfaces. Common associates include *Empetrum rubrum*, *Berberis ilicifolia* and relatively tall bunch-growing graminoids, in particular, *Carpha alpina* var. *schoenoides*, *Festuca subantarctica*, *Marsippospermum grandiflorum*, *Rostkovia magellanica*, *Schoenus andinus*, *Schoenus antarcticus*.
(Pisano, 1983: 310-311).

31.521 Cushion-plant *Dacrydium* heaths
Creeping *Dacrydium fonckii* heaths of the Magellanic region, formed over a continuous substratum of loose cushions of liverworts characteristic of cushion-plant bogs, mostly in areas receiving between 2500 and 3000 mm of rain per year.
(Pisano, 1983: 310-311).

31.522 Sphagnum *Dacrydium* heaths
Creeping *Dacrydium fonckii* heaths of the Magellanic region, formed over a continuous *Sphagnum magellanicum* mat, mostly in areas receiving between 1000 and 2000 mm of rain per year. *Nothofagus betuloides* and *Berberis buxifolia* may participate in the shrub layer.
(Pisano, 1983: 310-311).

31.6 Southern Andean cushion-heaths

Closed or moderately open formations of the alpine, extrasylvatic zone of Tierra del Fuego and the mainland temperate Andean system, north to the mediterranean Andes of Chile and the Cuyo Andes of Argentina, characterized by the predominance of dwarf shrubs and herbs growing in hemispherical cushions.
(Hauman, 1926: 152-157; Roig, 1982: 62-67; Moore, 1983: 30; Pisano, 1983: 320; Walter and Breckle, 1991c: 394; Gajardo, 1994: regions 2B11, 6A11, 7C11, 7C13, 7C14, 8A1).

31.61 Fuego-Magellanic montane cushion-heaths
Cushion-heaths of the alpine, extrasylvatic zone of Tierra del Fuego and the southern mainland Andes, north to the northern limits of the Magellanic tundra complex and the main Magellanic deciduous and evergreen *Nothofagus* forests, at about 45° S, developed at or above timberline.
(Hauman, 1926: 154-156; Hueck and Seibert, 1972: unit 82 *p.*; Pisano, 1983; Moore, 1983: 30; Gajardo, 1994: regions 7C11, 7C13, 7C14).

31.611 Timberline southern Andean *Bolax* cushion-heaths
Closed cushion-heaths of the alpine, extrasylvatic zone of Tierra del Fuego and the southernmost mainland Andes, developed at, or immediately above, timberline, formed by large cushions of, in particular, *Bolax spp.*
(Hauman, 1926: 154-156; Moore, 1983: 30; Gajardo, 1994: regions 7C11, 7C13, 7C14).

31.6111 Southern Andean *Bolax gummifera* cushion-heaths
Cushion-heath of the alpine zone of Tierra del Fuego and the southernmost mainland developed at and just above the timberline, dominated by cushions of *Bolax gummifera* which may attain one metre in height, associated with cushion-forming *Abrotanella emarginata*, *Azorella lycopodiodes*, *Colobanthus subulatus* and *Drapetes muscosus*, accompanied by shrubs of *Empetrum rubrum* and a few other species, such as *Acaena magellanica*, *Festuca contracta*, *Gamochaeta spiciformis*, *Luzula alopecurus*, *Pernettya pumila*, *Stipa rariflora*. *Saxifragodes albowiana* and *Tetrachondra patagonica* are restricted to these communities. *Drapetes muscosus* may be dominant or codominant in some communities.
(Pisano, 1971b: 115; Moore, 1983: 30; Gajardo, 1994: units 7C13-7C132 *p.*, 7C14-7C132 *p.*).

31.6112 Southern Andean *Bolax caespitosa* cushion-heaths
Cushion-heath communities of the southern Andes, developed at and near timberline in wetter sites than the communities of 31.6111, characterized by the presence of cushions of *Bolax caespitosa*, *Caltha appendiculata*, *Caltha dioneifolia* and *Plantago barbata*.
(Moore, 1983: 30).

31.612 Open southern Andean cushion-heaths
Open cushion-heaths of the alpine, extrasylvatic zone of Tierra del Fuego and the southernmost mainland Andes, forming either above the closed *Bolax* cushion-heaths of 31.611 and constituting the transition between them and the even more open and higher-located feldmark communities of 31.7, or occupying lower altitude stations edaphically unsuited for the closed heaths of 31.611.
(Moore, 1983: 30).

31.6121 Upper southern Andean cushion-heaths
Low, open cushion-heaths of the high southern Andes, above the timberline *Bolax* communities of 31.611, with a greater prominence of the smaller and lower cushions of *Armeria maritima*, *Azorella selago*, *Cerastium arvense*, *Draba magellanica*, *Leucheria hahnii*, *Onuris alismatifolia*, *Perezia magellanica* and *Trisetum spicatum*, and a lesser importance of *Bolax gummifera*.
(Moore, 1983: 30).

31.6122 Southern Andean *Saxifragella* cushion-heaths
Open, impoverished communities of the upper altitudinal reaches of the southern Andean cushion-heaths, formed by scattered cushions of *Saxifragella bicuspidata*, sometimes accompanied by *Azorella selago* and *Cerastium arvense*.
(Moore, 1983: 30).

31.6123 Southern Andean *Viola* cushion-heaths
Open cushion-heaths of gravelly seepage areas in the southern Andean suprasylvatic heath belt, with *Viola tridentata* and *Koenigia islandica*.
(Moore, 1983: 30).

31.6124 Sliding clay cushion-heaths
Communities of southern Andean, in particular Fuegian, steep slopes with deep clay soils destablized by wind or trampling by guanaco or sheep constituted by a reduced cortège of species characteristic of open cushion-heaths, in particular *Calandrinia caespitosa*, *Oxalis enneaphylla*, *Nassauvia pygmaea* and *Senecio alloeophyllus*. *Phaiophleps biflora* ssp. *lykholmi* and *Tristagma nivalis* are nearly restricted to these formations.
(Moore, 1983: 30).

31.62 Central temperate Andean cushion-heaths
Cushion-heaths of the high Andean phytogeographical province, occupying the high altitudes of the northern section of the Patagonian Andes, between about 45° and 36°-38° S.
(Hueck and Seibert, 1972: unit 82 *p.*; Gajardo, 1994: regions 6A1, 6A3, 8A1).

31.621 High Andean *Caltha-Berberis* cushion-heaths
Cushion-heaths of the high Andean phytogeographical province of the Cordillera del Viento Andes of Neuquen, Bio-Bio, La Araucania, Los Lagos, at latitudes comprised between about 36° S and 39° S, with *Berberis empetrifolia*, *Caltha appendiculata* accompanied by *Cardamine glacialis*, *Oursia*

racemosa, *Ranunculus peduncularis*, *Senecio fistulosa*, with *Azorella lycopodioides*, *Calceolaria foliosa*, *Epilobium nivale*, *Escallonia alpina*, *Gamocarpha poeppigii*, *Hypochaeris acaulis*, *Nassauvia aculeata*, *Nassauvia lagascae* (*Nassauvia revoluta*), *Plantago barbata*, *Tristagma nivale*, *Viola cotyledon*.
(Gajardo, 1994: units 6A1-6A11, 6A3-6A11).

31.622 High Andean *Adesmia-Azorella* cushion-heaths
Cushion-heaths of the high Andean phytogeographical province of the Andes of Aisen, Chubut and northern Santa Cruz, at latitudes comprised between about 40° S and 47° S, with *Adesmia longipes*, *Azorella incisa*, *Perezia pedicullariaefolia*, *Senecio julietii*, *Nassauvia lagascae* (*Nassauvia revoluta*), *Nassauvia ramosissima*, *Lucilia frigida*.
(Gajardo, 1994: units 6B6-8A14, 8A1-8A14).

31.63 Northern temperate Andean cushion-heaths
Cushion-heaths of the high Andean phytogeographical province of the mediterranean Andes of Chile and the Cuyo Andes of Argentina, in southern Coquimbo, Valparaiso, Santiago, Maulin, northern Neuquen, San Juan, Mendoza, at latitudes between 31° S and 36°-38° S.
(Walter, 1968: 178, 185; Ducoing, 1973: 56; Cabrera and Willink, 1980: 86; Roig, 1982: 62-67; Walter and Breckle, 1991c: 143; Gajardo, 1994: units 2B112, 2B111, 2B114).

31.631 High mediterranean Andean *Laretia* heaths
Cushion-heaths of the high Andean phytogeographical province of southern Coquimbo, Valparaiso, Santiago, Maulin, San Juan, Mendoza, at latitudes comprised between 31° S and 36° S, mostly constituted by cushion-forming Apiaceae of genera *Azorella*, *Pozoa* and *Laretia*, in particular, *Laretia compacta* or the vulnerable *Laretia acaulis*, and by the Fabaceae *Anarthrophyllum andicola*.
(Walter, 1968: 178, 185; Ducoing, 1973: 54-56; Walter and Breckle, 1991c: 143; Gajardo, 1994: units 2B10-2B112, 2B11-2B112, 2B12-2B112; Coig *et al.*, 1994: 120).

31.632 Cuyo-mediterranean high-slope cushion-heaths
Sparse, discontinuous communities of low, generally spiny, cushion-forming shrubs, occupying the upper level of Andean thorny heaths in the mediterranean Andes of Chile, the Cuyo Andes of Argentina and the Chilean coast range, between 31° S and 36°-38° S.
(Ducoing, 1973: 54-55; Roig, 1982: 62-67; Gajardo, 1994: unit 2B111).

31.6321 Western Andean high-slope *Mulinum-Chuquiraga* cushion-heaths
Communities of low, generally spiny, cushion-forming shrubs and numerous summer-flowering herbs of the mid and high slopes of the northern temperate Andes and of the high slopes of the Chilean coast range, between 31° and 35° S, with *Mulinum spinosum* and *Chuquiraga oppositifolia*, accompanied by *Berberis empetrifolia*, *Tetraglochin alatum*, *Anarthrophyllum andicola*, *Acaena splendens*, *Carex setifolia*, *Gayophytum humile*, *Laretia acaulis*, *Mutisia rosea*, *Viviania mariifolia*, and occasionally *Calandrina affinis*, *Stipa lachnophylla*, *Tropaeolum polyphyllum*.
(Ducoing, 1973: 54-55; Gajardo, 1994: units 2B10-2B111, 2B11-2B111, 4A1-2B111).

31.6322 Cuyo Andes high-slope cushion-heaths
Sparse, discontinuous communities of low, generally spiny, cushion-forming shrubs, occupying the upper level of Andean thorny heaths in the Cuyo Andes of Argentina, at altitudes mostly above 3000 metres, with *Chuquiraga oppositifolia*, *Adesmia obovata*, *Adesmia schneideri*, *Adesmia subterranea*, *Mulinum ovalleanum*, *Mulinum echegarayii*, *Oxalis bryoides*.
(Roig, 1982: 62-64).

31.633 Cuyo-mediterranean middle-slope heaths
Communities of low, spiny, often cushion-forming shrubs, occupying the lower level of Andean thorny heaths in the mediterranean Andes of Chile, the Cuyo Andes of Argentina and the Cuyo precordillera, between 31° S and 36°-38° S.
(Roig, 1982: 62-67; Gajardo, 1994: unit 2B114).

31.6331 Western Andean *Chuquiraga-Valenzuelia* cushion-heaths
Cushion-heaths of the lower part of the high Andean level of the northern temperate Andes, between 31° and 36°S, with *Chuquiraga oppositifolia* and *Valenzuelia trinervis*, accompanied by *Oxalis adenophylla*, *Pozoa coriacea*, *Acaena leptocantha*, *Adesmia gracilis*, *Berberis empetrifolia*,

Calceolaria biflora, *Ephedra andina*, *Euphorbia collina*, *Festuca acanthophylla*, *Proustia cuneifolia*, *Senecio patagonicus*.
(Gajardo, 1994: unit 2B11-2B114, 2B12-2B114, 4A2-2B114).

31.6332 Cuyo Andes cordilleran middle-slope heaths
Communities of low, spiny, often cushion-forming shrubs occupying the lower level of Andean thorny heaths in the Cuyo Andes of Argentina, dominated by *Tetraglochin alatum*, *Nassauvia axillaris*, *Mulinum spinosum*, *Adesmia pinifolia*, *Adesmia horrida*, *Adesmia remyana* or *Chuquiraga ruscifolia*.
(Roig, 1982: 62-64).

31.6333 Cuyo Andes precordilleran heaths
Communities of low, spiny, often cushion-forming shrubs of the middle and high slopes of the Cuyo precordillera, dominated, in particular, by *Colliguaja integerrima*, *Adesmia uspallatensis* or *Nassauvia axillaris*.
(Roig, 1982: 64-67).

31.7 Fuego-Andean feldmark

Very open formations of the uppermost vegetation belt of the alpine, extrasylvatic zone of Tierra del Fuego and the southern mainland north to the northern limits of the deciduous and evergreen southern temperate *Nothofagus* forests, at about 45° S. The ground is mostly bare talus deposits devoid of higher plants. The vegetation is formed mostly by sparse, scattered dwarf cushion-plants and dense *Usnea* lichen communities. *Moschopsis rosulata* var. *globosa* and *Nassauvia lagascae* are specialized for this habitat; *Nassauvia pygmaea*, *Nassauvia latissima*, *Saxifraga magellanica*, *Senecio humifusus* may enter in the composition of the communities.
(Moore, 1983: 31).

31.8 Valdivio-Magellanic deciduous thickets

Winter deciduous scrubs or thickets of the southern forest zones of South America.
(Oberdorfer, 1960: 122-133, 136-143).

31.81 Valdivio-Magellanic *Fuchsia* thickets
Brushes, sometimes tall or even very tall, of forest margins and forest clearings of the southern forest zones of South America, in particular, of the mixed evergreen-deciduous Magellanic forests, the *Nothofagus betuloides-Drymis* coastal forests and the southern Chilean mixed *Nothofagus obliqua* deciduous forests, dominated by the deciduous *Fuchsia magellanica*, with *Ribes magellanicum* and *Pernettya mucronata*, sometimes locally codominant, *Chiliotrichum diffusum*, *Aristotelia chilensis*, often important, and many shrubs from the coastal mixed forest and herbs such as *Cardamine geraniifolia*, *Ranunculus biternatus*.
(Oberdorfer, 1960: 130-132; Moore, 1983: 28, 154; Schmaltz, 1991: 566; Gajardo, 1994: units 4B8-5A25, 5A1-5A25, 5A2-5A25, 5A3-5A25, 7A5-5A25).

31.82 Deciduous *Nothofagus* scrubs
Shrub formations of *Nothofagus pumilio* or *Nothofagus antarctica*, occupying exposed areas or situated towards the upper limit of the altitude range of the species, within the southern Andean, Fuego-Patagonian and montane Valdivian forest zones. There is often, with increasing altitude or exposure, a continuous cline from tall forest through low forest (unit 41.3), tall scrub and elfin forest, to prostrate scrub.
(Oberdorfer, 1960: 142-143; Moore, 1983: 26-27; Ramirez *et al.*, 1985a; Gajardo, 1994: units 6B8-6B81, 6B8-6B61, 6B8-6B91, 6B6-6A82, 6B9-6B94 *p.*, 6B10-6B81, 7B7-7B72, 7B7-6B94, 7B8-7B85, 7B9-7C111, 7C11-7111, 7C12-7B72, 7C14-7B84).

31.821 *Nothofagus antarctica* deciduous scrubs

Shrub formations of *Nothofagus antarctica* of exposed sites and upper limits of altitudinal woodland occurrence in Fuegia, Patagonia, the Chilean Fjordland, the southern Andes and the coast ranges of Valdivian Chile.
(Moore, 1983: 26-27; Ramirez *et al.*, 1985a; Gajardo, 1994: units 6A4-6B81 *p.*, 6B8-6B81, 6B9-6B94 *p.*, 6B10-6B81, 7B7-7B72, 7B7-6B94, 7B8-7B85, 7B9-7C111, 7C11-7C111, 7C12-7B72, 7C14-7B85).

31.8211 Southern Andean *Nothofagus antarctica* deciduous scrubs
Shrub formations of *Nothofagus antarctica* with *Berberis buxifolia*, *Azorella caespitosa*, *Pernettya pumila* of upper limits of altitudinal woodland occurrence in the Patagonian cordilleras.
(Moore, 1983: 26-27; Ramirez *et al.*, 1985a: 56-57; Gajardo, 1994: units 6B8-6B81, 6B10-6B81).

31.8212 Archipelagic *Nothofagus antarctica* deciduous scrubs
Shrub formations of *Nothofagus antarctica* with *Escallonia serrata*, *Berberis ilicifolia*, and sometimes *Nothofagus betuloides* and *Lebetanthus myrsinites*, of the southern Chilean Fjordland and western Tierra del Fuego.
(Moore, 1983: 26-27; Gajardo, 1994: units 7B7-7B72, 7B8-7B85, 7C12-7B72, 7C14-7B85).

31.8213 Peri-glacial *Nothofagus antarctica* deciduous scrubs
Shrub formations of *Nothofagus antarctica*, with *Gunnera magellanica* characteristic of humid soils in the periphery of glaciers and on recently deglaciated soils of the extreme southern Andes of Patagonia, Tierra del Fuego and the Navarino archipelago.
(Moore, 1983: 26-27; Gajardo, 1994: units 7B9-7C111, 7C11-7C111).

31.8214 Patagonian *Nothofagus antarctica* deciduous scrubs
Brush formations of *Nothofagus antarctica* with *Berberis buxifolia*, *Blechnum penna-marina*, *Fragaria chilensis*, *Geranium berterianum*, *Holcus lanatus*, *Osmorhiza chilensis*, *Ovidia andina*, *Ribes magellanicum* or with *Baccharis patagonica*, *Festuca pallescens*, *Acaena splendens* of the transition between Magellanic woodland and Patagonian steppes, of stony alluvions of large rivers and sandy streamside soils, often very altered by pastoral activity.
(Moore, 1983: 26-27; Gajardo, 1994: units 6B9-6B94 *p.*, 8A1-6B96 *p.*).

31.8215 Coast range *Nothofagus antarctica* scrubs
Shrub formations of *Nothofagus antarctica* of exposed sites and upper limits of altitudinal woodland occurrence in the coast ranges of Valdivian Chile, in particular, the Cordillera Nahuelbuta and the Cordillera Pelada.
(Ramirez *et al.*, 1985a: 59; Gajardo, 1994: unit 6A4-6B81 *p.*).

31.822 *Nothofagus pumilio* deciduous scrubs
Shrub formations of *Nothofagus pumilio* of the Patagonian cordilleras of Tierra del Fuego and the southern mainland Andes north to about 40° S latitude, occupying exposed areas at the upper altitudinal limit of deciduous Magellanic woods, with *Ribes cucullatum*, or, on more humid slopes, *Drimys winteri* var. *andina*, and sometimes, in somewhat less exposed situations, mixed with *Nothofagus betuloides*. They grade into low forest and forest of *Nothofagus pumilio* (unit 41.31).
(Moore, 1983: 26-27; Gajardo, 1994: units 6B6-"6A82" = 6B82, 6B8-"6B81" = 6B82, 6B8-6B61, 6B8-6B91 *p.*).

32. EVERGREEN SCLEROPHYLLOUS SCRUB

Shrub communities of humid mediterranean affinities. They include broad-leaved evergreen sclerophyllous or lauriphyllous shrub communities of the mediterranean, warm-temperate humid, and sometimes, nemoral, steppe or subantarctic, zones, as well as ericoid or coniferous scrubs of the mediterranean zone. They are particularly widespread in temperate South America, occurring in the mid-Chilean xerophytic (mediterranean) forest zone and in the Valdivian forest and warm-temperate deciduous forest zones, but also in the Magellanic deciduous, Magellanic evergreen and southern Andean conifer forest zones, in the Patagonian cold steppe zone, in the summer-wet warm-temperate Pampa steppe zone and in the approaches of the Atacama Desert.
(Oberdorfer, 1960; Hueck and Seibert, 1972: units 73-80 *p.*, 62-65 *p.*; Ducoing, 1973: 57-69; Hueck, 1978; Cabrera and Willink, 1980; di Castri, 1981; Rundel, 1981; Margaris, 1981; Moore, 1983; Walter and Breckle, 1991b, 1991c; Gajardo, 1994; Daniele and Natenzon, 1994: regions 1, 10, 11, 17).

32.1 Mediterraneo-Chilean evergreen sclerophyllous scrub

Broad-leaved sclerophyllous or lauriphyllous evergreen scrubs of the mediterranean zone of central Chile, extending from 30° S to nearly 38° S.
(Schmithüsen, 1956; Oberdorfer, 1960: 6, 7-64; Hueck and Seibert, 1972: units 73-74 *p.*; Ducoing, 1973: 57-60; Rundel, 1981: 175-201; Gajardo, 1994: regions 3A, 3B, 3C, 4A, 4B).

32.11 Central Chilean matorrals
Evergreen or evergreen and drought-deciduous shrub formations of the eumediterranean region of inland Chile, extending between the Elqui river at 30° S and the Bio-Bio river around 37° S, represented by varied communities occupying the slopes of the coast range, the foothills of the western Andean cordilleras and, locally, the central valley, replacing sclerophyllous forest.
(Ducoing, 1973: 57-61, 68; Rundel, 1981: 181; Arroyo *et al.*, 1994: 54-55; Fuentes *et al.*, 1995: 188, 191; Gajardo, 1994: units 3C105, 3C111 *p.*, 3C112 *p.*, 3C113, 3C114 *p.*, 3C122, 3C124).

32.111 *Quillaja* matorrals
Shrub communities of the mediterranean zone of Chile dominated by shrub or arborescent growth forms of *Lithrea caustica* and *Quillaja saponaria*, accompanied by many evergreen sclerophyllous shrubs, in particular, *Colliguaja odorifera*, *Cryptocarya alba*, *Escallonia pulverulenta*, *Kageneckia oblonga*, *Schinus polygamus*, stem-photosynthetic, drought-deciduous, mostly spiny or spinescent shrubs, among which *Ephedra andina* and the Rhamnaceae *Colletia spinosissima*, *Retanilla ephedra*, *Talguenia quinquenervia*, *Trevoa trinervis*, low deciduous malacophyllous shrubs and subshrubs, including *Baccharis linearis*, *Baccharis rosmarinifolius*, *Flourensia thurifera*, *Gochnatia fascicularis*, *Podanthus mitiaui*, *Satureja gilliesii*, *Teucrium bicolor*, the large woody deciduous shrubs *Proustia cuneifolia*, *Proustia cinerea* and a field layer, well-developed in mature undisturbed communities, rich in perennials, including abundant geophytes, especially of Amaryllidaceae, Liliaceae and Iridaceae, ferns of genera *Adiantum*, *Blechnum*, *Notholaena*, *Pellaea* and creeping or trailing species of genera such as *Dioscorea*, *Tropaeolum*, *Mutisia*, *Valerianella*; native annuals are relatively unimportant under the matorral.
(Rundel, 1981: 181-182; Gajardo, 1994: units 3C111 *p.*, 3C112 *p.*).

32.1111 *Lithrea-Quillaja* matorrals
Shrub communities of the mediterranean sub-Andean hills and coast range mainly of Santiago and O'Higgins formed by *Lithrea caustica*, *Quillaja saponaria*, *Pasithaea coerulea*.
(Rundel, 1981: 181-182; Gajardo, 1994: units 2B10-3C111, 3C11-3C111 *p.*, 4A1-3C111).

32.1112 *Quillaja-Colliguaja* matorrals

Shrub communities of the mediterranean sub-Andean slopes of Santiago and O'Higgins, developed on rocky slopes, in high valleys, at generally higher altitudes than unit 32.1111, richer in drought-deciduous, stem-photosynthetic species, formed by *Quillaja saponaria*, *Colliguaja odorifera*, *Adesmia arborea*, *Porlieria chilensis*.
(Gajardo, 1994: units 2B10-3C112, 3C11-3C112 *p.*).

32.112 Mesic *Cryptocarya* matorrals
Shrub communities of the mediterranean sub-Andean slopes of Santiago and O'Higgins, characteristic of more mesic stations than those occupied by the communities of unit 32.111, characterized by the prominence of *Cryptocarya alba*.
(Gajardo, 1994: units 3C113, 3C114, *p.*).

32.1121 *Cryptocarya-Quillaja* matorrals
Shrub communities of mesic south-facing slopes and valleys of the mediterranean sub-Andean hills of Santiago and O'Higgins, formed by *Cryptocarya alba*, *Quillaja saponaria*, *Trevoa trinervis*.
(Gajardo, 1994: units 3B7-3C113, 3C11-3C113, *p.*).

32.1122 *Cryptocarya-Lithrea* matorrals
Shrub communities of mesic slopes of the mediterranean sub-Andean hills of Santiago and O'Higgins, formed by *Cryptocarya alba*, *Lithrea caustica*, *Pasithaea coerulea*.
(Gajardo, 1994: unit 3C11-3C114 *p.*).

32.113 Southern mediterraneo-Chilean matorrals
Xerophyllous evergreen shrub communities of the sub-Andean slopes, central valley and coastal range of the southern part of the mediterranean zone of central Chile, in southern O'Higgins, Maule and Bio-Bio.
(Gajardo, 1994: units 3C122, 3C124).

32.1131 Southern *Lithrea-Azara* matorrals
Shrub communities of the sub-Andean slopes, central valley and coastal range of the southern part of the mediterranean zone of central Chile, in southern O'Higgins, Maule, Bio-Bio and La Araucania, formed by *Lithrea caustica*, *Azara integrifolia*, *Peumus boldus*, *Quillaja saponaria*, *Baccharis linearis*, *Escallonia pulverulenta*.
(Gajardo, 1994: units 3C12-3C122, 3C13-3C122, 3C14-3C122, 4A2-3C122, 4A3-3C122, 4A4-3C122, 4B5-3C122, 4B7-3C122).

32.1132 *Colliguaja salicifolia* matorrals
Shrub communities of the sub-Andean slopes and central valley of the southern part of the mediterranean zone of central Chile, in southern O'Higgins, Maule and extreme northern Bio-Bio, formed by *Colliguaja salicifolia*, sometimes in pure populations, otherwise accompanied by *Colletia spinosa*, *Baccharis rhomboidalis*, *Azara integrifolia*, *Lomatia hirsuta*, characteristic of the transition zone between eumediterranean and montane matorrals.
(Rundel, 1981: 186; Gajardo, 1994: units 3C12-3C124, 4A4-3C124).

32.114 *Lithrea-Peumus* matorrals
Shrub communities of the coast range of mediterranean central Chile in Valparaiso, Santiago, O'Higgins, Maule and northern Bio-Bio, extending locally in the sub-Andean region of southern O'Higgins, Maule and extreme northern Bio-Bio, formed by *Lithrea caustica*, *Peumus boldus*, *Quillaja saponaria*, *Trevoa trinervis*, *Nassella chilensis*, *Satureja gilliesii*, *Cryptocarya alba*.
(Gajardo, 1994: units 3B7-3C105, 3B8-3C105, 3B9-3C105, 3C10-3C105, 3C12-3C105, 3C13-3C105).

32.115 *Lithrea-Colliguaja* northern transition matorrals
Xerophyllous shrub communities, rich in annual species, of the northern extreme of interior mediterranean Chile, between 30° S and nearly 32° S, formed by *Lithrea caustica*, *Colliguaja odorifera*, *Adesmia tenella*, *Erodium maschatum*, *Erodium cicutarium*.
(Gajardo, 1994: unit 3A2-3A26).

32.12 Mediterraneo-Chilean coastal evergreen matorrals

Evergreen matorrals of the coastal terraces of the mediterranean zone of Chile, west of the coastal cordillera.
(Ducoing, 1973: 69; Rundel, 1981: 181, 185-186; Arroyo *et al.*, 1994: 55; Gajardo, 1994: units 3A31, 3A32, 3A41, 3A42).

32.121 Southern mediterraneo-Chilean coastal matorrals
Evergreen shrub communities occupying the coastal terraces of the southern part of the mediterranean zone of central Chile, from the Rapel to the Bio-Bio and west of the coastal range, under a regime of higher precipitation than that characteristic of the northern drought-deciduous coastal matorrals, dominated by Anacardiaceae, in particular, *Lithrea caustica*, *Schinus crenatus*, *Schinus dependens*, *Schinus latifolius*, *Schinus pollyphyllus*.
(Ducoing, 1973: 69).

32.122 Northern mediterraneo-Chilean evergreen coastal matorrals
Evergreen shrub formations of the northern part of the mediterranean zone of central Chile, occupying sites below 300 metres within the vicinity of the coast and on coastal bluffs and terraces, composed of representatives of typical matorral communities, but less rich in species, extending from the rio Rapel, at about 34° S, northward to around 30° S, intermingling with the drought-deciduous communities of unit 33 which replace them progressively, so that they become increasingly rare and limited to favourable stations northwards.
(Rundel, 1981: 185; Gajardo, 1994: units 3A31, 3A32, 3A41, 3A42).

32.1221 Central Chilean coastal *Lithrea* matorrals
Xerophyllous tall shrub or subarborescent communities, rich in annual species, occupying lower slopes and ravine bottoms of coastal areas of northern mediterranean Chile between 29°30' S and 32° S, formed of *Lithrea caustica* with *Pleocarphus revolutus*, *Porlieria chilensis*, *Erodium cicutarium*, *Encelia tomentosa*.
(Rundel, 1981: 185; Gajardo, 1994: units 3A1-3A32, 3A3-3A32).

32.1222 Central Chilean coastal *Azara-Schinus* matorrals
Shrub communities occupying sheltered places of coastal terraces of northern mediterranean Chile between 29°30' S and 32° 30' S, formed of *Azara celastrina*, *Schinus latifolius*, *Cryptocarya alba*, *Escallonia revoluta*, *Bahia ambrosioides*, *Eupatorium salvia*, *Baccharis concava*.
(Rundel, 1981: 185; Gajardo, 1994: units 3A1-3A31, 3A3-3A31, 3A4-3A31).

32.1223 Coastal *Peumus-Podanthus* matorrals
Widespread arborescent matorrals or tall shrublands comprised of *Peumus boldus*, *Podanthus mitiqui*, *Eupatorium salvia*, *Quillaja saponaria*, *Flourensia thurifera*, *Lobelia salicifolia*, *Muehlenbeckia hastulata*, *Cryptocarya alba* occupying coastal and interior sectors of western Chile between 31° 30' S and nearly 33° S latitude, particularly developed in ravines and on south-facing slopes.
(Rundel, 1981: 185; Gajardo, 1994: unit 3A4-3A41).

32.1224 Central Chilean coastal *Lucama* matorrals
Local scrubs of the central Chilean coasts dominated by the vulnerable evergreen sclerophyll *Pouteria splendens* (*Lucama valparadisea*), with *Lepechina salviae*, *Baccharis concava*, *Eupatrium salvia*, *Podanthus mitiqui*, *Bahia ambrosioides*, *Escallonia pulverulenta*, *Fuchsia lycioides*, *Lithrea caustica*, *Puya venusta*, characteristic of the coastal cliffs and coastal localities of southern Coquimbo and extreme northern Valparaiso, with a very few outposts in central Valparaiso.
(Oberdorfer, 1960: 16-17, 23; Rundel, 1981: 185; Gajardo, 1994: 3A4-3A42, 3C10-3A42; Coig *et al.*, 1994: 120).

32.13 Successional matorral shrublands
Shrub formations of the mediterranean zone of Chile, characteristic of slopes and hills of the coast range, constituting phases of reestablishment of the *Quillaja-Lithrea* matorral subsequent to disturbance, formed by *Acacia caven*, *Cestrum parqui*, *Lobelia salicifolia*, *Muehlenbeckia hastulata*, *Podanthus mitiqui*, *Psoralea glandulosa*, *Satureja gilliesii* or *Trevoa trinervis*.
(Oberdorfer, 1960: 33-39; Rundel, 1981: 183; Gajardo, 1994: units 3B71, 3B72, 3B74, 3B82, 3A25).

32.131 *Trevoa* successional matorrals

Closed, dense shrub communities dominated by or rich in *Trevoa trinervis*, generally of secondary origin, characteristic of the inner slopes and hills of the coastal cordillera and, locally, of the central valley of mediterranean central Chile.
(Gajardo, 1994: units 3B71, 3B72, 3B74).

32.1311 *Trevoa-Colliguaja* successional matorrals
Very dense, spiny, shrub communities dominated by *Trevoa trinervis* and *Colliguaja odorifera* accompanied by *Lithrea caustica*, with *Baccharis paniculata* and an herb layer rich in annual and perennial species, of the slopes and hills of the coastal cordillera of Chile between about 32° S and 35° S.
(Oberdorfer, 1960: 36-37; Gajardo, 1994: units 3B5-3B71, 3B7-3B71, 3B8-3B71, 3C10-3B71).

32.1312 *Peumus-Trevoa* successional matorrals
Tall, dense shrub communities dominated by *Trevoa trinervis* and *Peumus boldus*, accompanied by *Lithrea caustica*, *Baccharis paniculata*, *Avena barbata*, *Hypochaeris glabra*, *Trifolium glomeratum*, *Briza minor*, *Clarkia tenella*, *Eupatorium salvia*, of the inner slopes and hills of the coastal cordillera of mediterranean central Chile between about 32° S and 35° S.
(Gajardo, 1994: unit 3B7-3B72, 3C10-3B72).

32.1313 *Acacia-Lithrea* successional matorrals
Secondary shrub communities formed by *Acacia caven*, *Lithrea caustica*, *Leucheria rosea*, *Pasithaea coerulea*, *Trisetum chromastachyum*, *Trevoa trinervis*, *Quillaja saponaria* occupying disturbed areas of stony foothills and elevated unirrigated localities of the Chilean central valley between about 33° S and 34° 30'S.
(Oberdorfer, 1960: 37; Gajardo, 1994: unit 3B7-3B74, 3C11-3B74, 3C12-3B74).

32.132 *Baccharis-Plantago* successional matorrals
Species-poor shrub communities dominated by *Baccharis linearis* and *Plantago hispidula* accompanied by *Briza minor*, *Vulpia megalura*, *Agrostis tenuis*, *Bromus hordeaceus*, constituting, colonizing abandoned dry-farming lands as a primary stage in the development of post-cultivation secondary vegetation in the coast range of mediterranean Chile between about 33° 30' and 35° S.
(Gajardo, 1994: unit 3B8-3B82).

32.133 *Gutierrezia-Atriplex* successional matorrals
Shrub communities dominated by *Gutierrezia resinosa* and *Atriplex semibaccata*, with *Heliotropium stenophyllum*, *Lycium chilense*, *Marrubium vulgare*, constituting an early successional stage of the development of secondary vegetation of abandoned fields on level terrain or slopes in the coast range of mediterranean Chile between nearly 29° S and 31° 30' S.
(Gajardo, 1994: units 3A2-3A25, 3A1-3A25, 3A3-3A25).

32.14 Mediterraneo-Chilean *Fabiana* sand heaths
Scrubs of the southern part of the mediterranean zone of Chile and its transition to the Valdivian zone dominated by the ericoid shrub *Fabiana imbricata*, characteristic of sandy ground (arenales) of the southern part of the central valley, in central Bio-Bio, often covering very large surfaces.
(Ducoing, 1973: 69; Hueck, 1978: 376; Gajardo, 1994: unit 3C14-3C141 *p*).

32.15 Mediterraneo-Chilean espinal matorrals
Mixed matorrals of the mediterranean zone of Chile, formed by the association of evergreen and drought-deciduous shrubs and shrubby, often relatively dense, stands of the drought-deciduous *Acacia caven*, characteristic mostly of the lower slopes of the Chilean Central Valley, from the Limari river southward to the Laja river, at the contact with the valley floor *Acacia caven* woodland or savanna below, and with the central Chilean matorral above. *Colletia spinosa*, *Porlieria hygrometra*, *Proustia pungens*, *Schinus dependens* are among the characteristic shrubs.
(Ducoing, 1973: 64-65; Hueck, 1978: 376; Rundel, 1981: 187-188; Arroyo *et al.*, 1994: 54; Fuentes *et al.*, 1995: 188; Gajardo, 1994: units 3B52, 3B53, 3B54, 3B58 *p.*).

32.151 *Acacia-Flourensia* espinal matorrals
Open shrub formations dominated by *Acacia caven* and *Flourensia thurifera* with *Adesmia tenella*, *Pectocarya dimorpha*, *Erodium cicutarium*, *Gutierrezia resinosa*, *Happlopappus chrysanthemifolius* of

level areas or gentle slopes of the Chilean coast range, and of the northern mediterraneo-Chilean interior, between about 30° and 33° S.
(Gajardo, 1994: units 3A2-3B52, 3B5-3B52).

32.152 *Colliguaja-Adesmia* espinal matorrals
Shrub communities, possibly representing degradation stages of *Quillaja* woods, dominated by *Colliguaja odorifera* and *Adesmia arborea* with *Alonsoa meridionalis*, *Proustia cinerea*, *Quillaja saponaria*, *Lobelia polyphylla*, *Haplopappus pristiphyllus*, *Vulpia megalura*, of high south-facing slopes of the Chilean coast range between about 31° 30' S and 33° S.
(Gajardo, 1994: units 3A2-3B53, 3B5-3B53).

32.153 *Colliguaja-Proustia* espinal matorrals
Shrub communities dominated by *Colliguaja odorifera* and *Proustia cinerea*, with *Adesmia arborea*, *Ephedra andina*, *Nassella chilensis*, *Notholaena mollis*, *Pasithaea coerulea*, *Stipa plumosa*, *Erodium cicutarium*, *Trichocereus chilensis*, *Porlieria chilensis*, of high slopes and rocky summits above 1000 metres of the Chilean coast range between about 30° S and 33° 30' S.
(Gajardo, 1994: units 3A2-3B54, 3B5-3B54).

32.154 *Quillaja-Porlieria* espinal matorrals
Clustered shrub communities dominated by *Quillaja saponaria* and *Porlieria chilensis* accompanied by *Colliguaja odorifera*, *Proustia cuneifolia*, *Kageneckia oblonga* with scattered tall trees and vernal grasslands forming in open areas, of gentle slopes at middle elevations of the Chilean coast range between about 31° 30' S and 33° S.
(Gajardo, 1994: unit 3B5-3B58 *p.*).

32.2 Valdivian evergreen scrubs

Evergreen scrubs and thickets of the Valdivian lauriphyllous forest and the mediterraneo-Valdivian transition deciduous forest zones of Chile, between about 35° and 47° S, with extensions into the extreme south of the mediterranean zone, and sometimes with an admixture of drought-deciduous shrubs.
(Oberdorfer, 1960: 122-130; Hueck and Seibert, 1972: units 78 *p.*, 75 *p.*; Ducoing, 1973: 71-86; Gajardo, 1994: regions 4B, 4C, 5A).

32.21 Valdivian *Corynabutilon-Aristotelia* matorrals
Generally tall, dense evergreen scrubs and thickets of the Valdivian lauriphyllous forest and the mediterraneo-Valdivian transition deciduous forest zones of Chile constituted of *Corynabutilon vitifolium*, *Aristotelia chilensis*, *Baccharis sphaerocephala*, *Buddleia globosa*.
(Gajardo, 1994: units 4C10-5A16, 5A1-5A16, 5A3-5A16).

32.22 Valdivian *Berberis-Rhaphithamnus* matorrals
Often dense evergreen scrubs and thickets of the Valdivian lauriphyllous forest and the mediterraneo-Valdivian transition deciduous forest zones of Chile constituted of *Berberis buxifolia*, *Rhaphithamnus spinosus*, *Aristotelia chilensis*, *Berberis darwinii*.
(Gajardo, 1994: units 5A1-5A17, 5A3-5A17).

32.23 Valdivian *Aristotelia-Baccharis* scrubs
Open shrub communities dominated by *Aristotelia chilensis* of burned areas of lower altitudes of the Valdivian forest zone of the Chilean coast range, with *Baccharis racemosa*, *Muehlenheckia thamnifolia*, *Rubus ulmifolius*, *Berberis buxifolia*, *Berberis darwinii*.
(Gajardo, 1994: units 4B6-4B64, 4B8-4B64, 4C9-4B64, 4C10-4B64, 5A1-4B64).

32.24 Valdivian *Aristotelia* ruderal scrubs
Evergreen scrubs and thickets of the Valdivian lauriphyllous forest and the mediterraneo-Valdivian transition deciduous forest zones of Chile constituted mainly by introduced invasive species associated with a few native shrubs, among which *Aristotelia chilensis* is usually well represented. *Cytisus monspessulanus*, *Sarothamnus scoparius*, *Rubus ulmifolius*, *Ulex europaeus* are the main introduced

dominants; besides *Aristotelia chilensis*, *Baccharis racemosa*, *Muehlenheckia thamnifolia*, *Berberis darwinii*, *Berberis buxifolia* may be important native elements.
(Gajardo, 1994: units 4A3-4B52, 4B5-4B52, 3C14-4B66, 4B6-4B66, 4C10-4B64, 4B8-4B84, 5A3-4B84).

32.25 Eastern Andean Valdivian scrubs
Evergreen scrubs of the eastern Andean enclaves of the Valdivian rain forests, in the Nahuel Huapi region and, mostly, the Lago Puelo basin of the Argentinian Andes, in particular, formations of *Guevina avellana* colonizing burned areas.
(Dimitri, 1972, 1977).

32.3 Juan Fernandez lauriphyllous scrubs

Lauriphyllous scrubs and matorrals of the Juan Fernandez archipelago, formed by species of the lauriphyllous forests, characteristic, in particular, of the base of cliffs rising from the forest, of rock ledges and of ravine walls, as well as of areas of degradation of the lauriphyllous forests.
(Skottsberg, 1953a: 910-913, 938-942; Gajardo, 1994: region 5B).

32.31 Mas a Tierra lauriphyllous scrubs
Lauriphyllous scrubs and matorrals of Mas a Tierra in the Juan Fernandez archipelago, characteristic, in particular, of the base of cliffs rising from the forest, matorral degradation and regeneration stages of the *Nothomyrcia-Drimys* lauriphyllous forests of low and middle slopes or of the *Cuminia-Azara*-rich lauriphyllous forests of the middle and high slopes. The small tree fern *Blechnum cycadifolium* and small rosette trees may be prominent.
(Skottsberg, 1953a: 910-913; Gajardo, 1994: units 5B5-5B51 *p.*, 5B5-5B52 *p.*).

32.32 Mas Afuera lauriphyllous scrubs
Lauriphyllous scrubs and matorrals of Mas Afuera, in the Juan Fernandez archipelago, characteristic, in particular, of ravine walls, matorral degradation and regeneration stages of the *Fagara-Myrceugenia* lauriphyllous forests of low and middle slopes. Shrubby *Myrceugenia schulzi* is often the main constituent, the uncommon *Sophora masafuerana* and *Sophora fernandeziana* are usually present.
(Skottsberg, 1953a: 938-942; Gajardo, 1994: unit 5B-5B61 *p.*).

32.4 Andino-mediterranean evergreen scrubs

Evergreen or mixed evergreen-drought-deciduous, sclerophyllous or lauriphyllous, matorrals of mediterranean, near-mediterranean, mediterraneo-montane or Valdivio-mediterranean winter-wet regime areas of the Andean system and their transition to Patagonian steppes and semideserts, distributed on the western slopes of the mediterranean Andes, in the Andean mixed *Nothofagus*-lauriphyllous evergreen forest, conifer forest and northern deciduous forest zones, in the western Patagonian sub-Andean steppe zone and its transition to forest belts.
(Hueck and Seibert, 1972: units 78 *p.*, 75 *p.*, 76 *p.*, 77 *p.*, 80 *p.*, 82 *p.*; Dimitri, 1972, 1977; Ducoing, 1973: 68, 83-84; Gajardo, 1994: regions 2B, 6A, 6B7, 6B9 *p.*, 6B10, 8A; Daniele and Natenzon, 1994: regions 9, 10 *p.*).

32.41 Mediterraneo-Chilean montane matorrals
Matorrals of the 1200-1500 metre level of the Andean Cordillera of central Chile, between about 31°S and 35°S, characteristic, in particular, of the valleys of large rivers, with rare outposts in the coast range, composed of open to moderately dense stands of low, evergreen shrubs, the taller species including *Valenzuelia trinervis*, *Kageneckia angustifolia* and *Colliguaja integerrima* related to species of the matorrals of lower altitudes but with narrower, more xeromorphic leaves, and low spiny shrubs, in particular, *Chuquiraga oppositifolia*, *Mulinum spinosum*, *Ribes nubigenum*, *Tetraglochin alatum*, *Berberis spp.*; moister sites are occupied by large woody matorral shrubs.
(Rundel, 1981: 181, 186-187; Arroyo *et al.*, 1994: 54; Quintanilla, 1987: 23-25; Gajardo, 1994: region 2B; Fuentes *et al.*, 1995: 188).

32.411 Western pre-Andean *Colliguaja* scrub
Low dense sclerophyllous shrub communities occupying rocky alluvions and colluvions of slopes of the western Andes of Coquimbo, Valparaiso, Santiago and O'Higgins, between 31° and 34° 30'S, with a few stations on the higher slopes of the coast range, comprised of *Colliguaja integerrima*, *Gymnophyton isatidicarpum*, *Tetraglochin alatum*, *Erigeron berteroanus*, *Mulinum spinosum*, *Valenzuelia trinervis*, *Valeriana glauca*, *Acaena splendens*, *Ephedra andina*, *Viviania mariifolia*.
(Gajardo, 1994: units 2B10-2B102, 4A1-2B102).

32.412 Pre-Andean *Kageneckia* scrub
High matorrals of the central Chilean Andes of Coquimbo, Valparaiso, Santiago and O'Higgins, between about 31°S and 35°S latitude, with rare outposts in the coast range, composed of *Kageneckia angustifolia*, *Valenzuelia trinervis*, *Acaena pinnatifida* with, in particular, *Acaena splendens*, *Mulinum spinosum*, *Colliguaja saponaria*, *Tetraglochin alatum*, *Viviania mariifolia*, *Colliguaja integerrima*.
(Oberdorfer, 1960: 37-39; Rundel, 1981: 186-187; Gajardo, 1994: units 2B10-2B101, 4A1-2B101, 4A2-2B101).

32.413 Western Andean *Fabiana-Ephedra* heaths
Widespread, floristically rich shrub communities of the mid-slopes of the Andes in Coquimbo, Valparaiso, Santiago and O'Higgins, between about 29° 30' S and 34° 30' S, extending north in the high steppes of the Cordillera de Doña Ana, usually occupying sandy or alluvial substrates, with *Fabiana imbricata*, *Ephedra andina*, *Stipa pogonathera*, *Viviania mariifolia*, *Adesmia spinosissima*, *Alstroemeria venustula*, *Anarthrophyllum andicola*, *Argylia potentillaefolia*, *Baccharis confertifolia*, *Chuquiraga oppositifolia*, *Gymnophyton robustum*, *Jaborosa caulescens*, *Menonvillea cuneata*, *Nardophyllum scoparium*, *Oreopolus palmae*, *Reyesia parviflora*, *Senecio erineus*.
(Gajardo, 1994: 2B8-2B91, 2B9-2B91, 2B10-2B91).

32.42 Andino-Patagonian scrubs
Evergreen or mixed evergreen-drought-deciduous, sclerophyllous or lauriphyllous matorrals the eastern slopes of the Andes, characteristic of near-mediterranean or mediterraneo-montane regimes of moderate pluviosity with a pronounced winter maximum in the *Austrocedrus chilensis* and *Araucaria araucana* forest zones, their ecotone with the Patagonian steppes and semideserts and the edges of the Monte, with limited penetration in the evergreen *Nothofagus dombeyi* forest zone.
(Hueck and Seibert, 1972: units 77 *p.*, 76 *p.*, 79 *p.*, 82 *p.*; Dimitri, 1972, 1977; Gajardo, 1994: regions 6A, 6B7, 6B9, 6B10, 8A; Daniele and Natenzon, 1994: regions 9, 10 *p.*).

32.421 Andino-Patagonian *Berberis* scrub
Evergreen scrubs of the Andino-Patagonian region dominated by low or medium-tall, usually spiny, species of genus *Berberis*, widespread in particular in the eastern part of the Andino-Patagonian woodland zone and adjacent arid Patagonian steppes.
(Dimitri, 1972: 72, 117; Dimitri, 1977: 4, 36; Moore, 1983: 66).

32.4211 Andino-Patagonian *Berberis darwinii* scrub
Evergreen scrubs of the Andino-Patagonian region dominated by the often tall, spiny *Berberis darwinii*, abundant in the eastern part of the Andino-Patagonian woodland zone and adjacent arid Patagonian steppes, from Neuquen to Chubut.
(Dimitri, 1972: 72, 117; Dimitri, 1977: 4, 41).

32.4212 Andino-Patagonian *Berberis linearifolia* scrub
Local medium-tall evergreen scrubs of the Andino-Patagonian region dominated by the spiny *Berberis linearifolia*, characteristic of the basin of the Rio Manso Superior, in areas influenced by cattle.
(Dimitri, 1972: 72, 117; Dimitri, 1977: 4, 43).

32.4213 Andino-Patagonian *Berberis buxifolia* scrub
Evergreen shrub communities dominated by the medium-tall *Berberis buxifolia* (*Berberis heterophylla*), characteristic of southern Andino-Patagonian deciduous and, locally, evergreen forests, forming, in particular, extensive matorrals in the region of Lago Argentino.
(Dimitri, 1977: 4, 42; Moore, 1983: 66).

32.4214 Andino-Patagonian low *Berberis* scrub

Evergreen scrubs of the Andino-Patagonian region dominated by low, spiny, species of genus *Berberis*.
(Dimitri, 1972: 72, 117; Dimitri, 1977: 4, 41).

32.4215 Andino-Patagonian *Berberis pearcei* scrub
Evergreen shrub communities dominated by the almost non-spiny *Berberis pearcei*, a close associate of *Notophagus pumilio*, characteristic of the northern parts of the Fuego-Patagonian deciduous forest zone, in particular in the regions of Lanin and Nahuel Huapi.
(Dimitri, 1972: 72; Dimitri, 1977: 4, 44).

32.422 Andino-Patagonian pre-steppic scrubs
Scrubs of the ecotone between the Andino-Patagonian conifer and deciduous forest zones and the Patagonian sub-Andean steppes, or of enclaves within the steppes, formed by evergreen or mixed evergreen-drought-deciduous shrubs.
(Dimitri, 1972, 1977; Gajardo, 1994: regions 6A, 6B9, 8A).

32.4221 Andino-Patagonian retamoid brushes
Evergreen scrubs of the Andino-Patagonian region dominated by broom-like shrubs, in particular, *Diostea juncea*, abundant in zones degraded by grazing, notably in the region of transition from woodland to steppe.
(Dimitri, 1972, 1977).

32.4222 Andino-Patagonian *Baccharis patagonica* scrubs
Evergreen scrubs of the extreme western Patagonian sub-Andean steppes and the adjacent deciduous forest zone, the basin of the upper Bio-Bio, the high Andean steppes of the Cordilleras de la Araucania, dominated by *Baccharis patagonica* accompanied by bunch-grasses of genus *Stipa* or by *Acaena splendens*.
(Gajardo, 1994: units 8A11, 8A15).

32.42221 Andino-Patagonian *Baccharis-Stipa* scrubs
Evergreen scrubs of the extreme western Patagonian sub-Andean steppes, extending in the basin of the upper Bio-Bio and to the high Andean steppes of the Cordilleras de la Araucania, dominated by low, quasi-prostrate *Baccharis patagonica* accompanied by bunch-grasses *Stipa neaei*, *Stipa speciosa*, *Stipa duriuscula*, with *Senecio bracteolatus*, *Ribes cucullatum*, *Poa scaberula*.
(Gajardo, 1994: units 6A1-8A11, 6A2-8A11, 6A5-8A11, 8A1-8A11).

32.42222 Andino-Patagonian *Acaena-Baccharis* scrubs
Evergreen scrubs of the extreme western Patagonian sub-Andean steppes and the adjacent deciduous forest zone dominated by *Acaena splendens* and *Baccharis patagonica*, with *Acaena pinnatifida*, *Mulinum spinosum*, *Fragaria chiloensis*, *Anemone multifida*, *Viola maculata*, *Rumex acetosella*.
(Gajardo, 1994: units 6B9-8A15, 8A1-8A15).

32.4223 Andino-Patagonian *Colliguaja-Mulinum* scrubs
Open evergreen scrubs of the extreme western Patagonian sub-Andean steppes, in particular, of the shores of Lago General Carrera, dominated by *Colliguaja integerrima*, *Mulinum spinosum*, *Senecio neaei*, *Acaena pinnatifida*, *Adesmia boronioides*, *Erodium cicutarium*, *Stipa brevipes*, *Vulpia dertonensis*.
(Gajardo, 1994: unit 8A-8A16).

32.4224 Andino-Patagonian *Adesmia-Senecio* scrubs
Very local evergreen scrubs occupying rocky slopes near watercourses of the extreme western Patagonian sub-Andean steppes, with *Adesmia boronioides*, *Senecio neaei*, *Baccharis obovata*, *Berberis buxifolia*, *Discaria serratifolia*, *Schinus patagonicus*, *Geranium berterianum*, *Calceolaria biflora*, *Cerastrum arvense*.
(Gajardo, 1994: unit 8A-8A17).

32.423 Andino-Patagonian tall brushes
Evergreen scrubs of the Andino-Patagonian region dominated by usually tall, large broad-leaved or compound-leaved, unarmed shrubs.

(Dimitri, 1972, 1977).

32.4231 Andino-Patagonian *Aristotelia maqui* scrub
Evergreen scrubs of the Andino-Patagonian region dominated by *Aristotelia maqui*, abundant in the eastern semixerophytic woodland zone, and often forming dense communities.
(Dimitri, 1972: 117; Dimitri, 1977: 4, 52).

32.4232 Andino-Patagonian *Lomatia hirsuta* brush
Evergreen brushes of *Lomatia hirsuta*, bush or small tree, common in the eastern part of the Andino-Patagonian forest zones and in their ecotone with the Patagonian steppe region.
(Dimitri, 1972: 74-75, 117; Dimitri, 1977: 5, 31; Gajardo, 1994: unit 6B9-7B63 *p.*; Erize *et al.*, 1995: 173).

32.4233 Andino-Patagonian *Maytenus boaria* scrub
Evergreen matorrals of the eastern belts of the Andino-Patagonian forest region dominated by *Maytenus boaria*.
(Dimitri, 1972: 75, 117; Dimitri, 1977: 5, 33; Erize *et al.*, 1995: 173).

32.4234 Andino-Patagonian *Embothrium coccineum* scrub
Evergreen shrub communities, sometimes tall, dominated by *Embothrium coccineum*, widespread in the Andino-Patagonian region from Neuquen to Tierra del Fuego, though particularly characteristic of the Fuego-Patagonian deciduous forest zone, entering, in stations of favourable conditions, the western Patagonian sub-Andean steppes.
(Dimitri, 1972: 74, 117; Dimitri, 1977: 4, 39; Gajardo, 1994: units 6B9-6B95, 8A1-6B95; Erize *et al.*, 1995: 173, 177).

32.4235 Andino-Patagonian *Gaultheria-Pernettya* thickets
Evergreen shrub communities of the Andino-Patagonian forest zone dominated by the tall *Gaultheria phyllireaefolia* and *Pernettya mucronata*.
(Dimitri, 1972: 117; Dimitri, 1977: 4, 59).

32.424 Eastern Andean *Fabiana* heaths
Matorrals dominated by the scale-leaved *Fabiana imbricata* of the Andino-Patagonian forest zone on the Argentine side, mainly extreme western Neuquen and Rio Negro provinces, occupying dry places or recolonization after forest fires.
(Walter, 1968: 203-204; Dimitri, 1972: 109-110, 117; Dimitri, 1977: 4, 61).

32.5 Magellanic sclerophyllous scrub

Broad-leaved sclerophyllous or lauriphyllous evergreen scrubs of the Magellanic broad-leaved evergreen forest zone and Magellanic moorland zone of Tierra del Fuego, the Chilean Fjordland and the southern Andes, the southern deciduous forest zones of the Chilean Fjordland and southern Fuego-Patagonia, the Fuego-Patagonian steppe zone, developed under cold, humid temperate climates without pronounced summer minimum in pluviosity.
(Hueck and Seibert, 1972: units 65, 79, 80 *p.*; Dimitri, 1972, 1977; Moore, 1983; Gajardo, 1994: regions 6B6, 6B8, 6B9 *p.*, 7, 8B; Daniele and Natenzon, 1994: region 10 *p.*, 17).

32.51 Magellanic evergreen forest zone scrub
Broad-leaved sclerophyllous or lauriphyllous evergreen scrubs characteristic of the Magellanic evergreen forest zone, its clearings and edges.
(Moore, 1983: 29).

32.511 Magellanic *Nothofagus betuloides* scrub
Evergreen *Nothofagus betuloides* scrubs developing in exposed areas or towards the upper limits of the altitudinal range of Magellanic evergreen forests.
(Moore, 1983: 28-29; Gajardo, 1994: units 7A2-7B62 *p.*, 7A5-7B62 *p*, *7B6-7B62 p.*, 7B8-7B84, 7B9-7B91 *p.*, 7C10-7B91 *p.*, 7C12-7B91 *p.*).

32.512 Maritime *Nothofagus nitida* scrub
Tall or arborescent matorral of Chiloe Island, the Chonos archipelago, the outer capes and islands of the Taitao peninsula and, locally, the Canal Messier archipelagoes, dominated by *Nothofagus nitida* and *Tepualia stipularis*, with *Podocarpus nubigena*, *Drimys winteri*, *Lomatia ferruginea*, *Weinmannia trichosperman*, *Desfontainia spinosa*, *Embothrium coccineum*.
(Gajardo, 1994: units 5A3-5A32, 7A4-7A42 = 5A32, 7C10-5A32, 7C12-5A32).

32.513 Magellanic *Hebe* scrub
Dense, one-metre high shrub communities dominated by *Hebe elliptica*, sparsely distributed on Staten Island and in the Chilean archipelago from Cape Horn to 45° 53'S. latitude, inhabiting cliffs and rocks of coastal areas in more exposed situations than the *Fuchsia* scrub (unit 31.81); other shrubs may participate in the formation, including *Berberis ilicifolia*, *Empetrum rubrum*, *Escallonia serrata*, *Lebetanthus myrsinites*, *Nothofagus betuloides*, *Pernettya mucronata*, with a rather poor herb layer.
(Moore, 1983: 28-29, 203, 207).

32.52 Magellanic moorland evergreen scrubs
Shrub communities of the Magellanic moorland zone of southwestern Tierra del Fuego, southern islands, the southern Chilean archipelago and adjacent peninsulas, formed under conditions of high precipitation and wind, occupying rock crevices and better drained prominences, formed principally by *Nothofagus betuloides*, *Berberis ilicifolia*, *Desfontainia spinosa*, *Philesia magellanica*, accompanied by *Chiliotrichum diffusum*, *Drimys winteri*, *Embothrium coccineum*, *Empetrum rubrum*, *Escallonia serrata*, *Nothofagus antarctica*, *Tepualia stipularis*. The formations are mostly open, comprised of spaced shrubs and dwarfed or prostrate individuals of taller species; they may be closed when wind shelter and greater soil fertility permit looser development of crowns, or, conversely, when extreme wind sculpts the crowns into a low, dense intermingled cover. *Nothofagus betuloides* is the most common dominant. *Escallonia serrata* is very prominent on thin soil rocky sites, *Desfontainia spinosa* in more fertile localities, or, together with *Berberis ilicifolia*, on thicker peat accumulations. *Tepualia stipularis* may be a local dominant in parts of the western sections of the region, north of the Strait of Magellan. These scrublands grade into both the limited forest patches and the more prevalent blanket bog communities (unit 52) of the region.
(Moore, 1983: 29; Pisano, 1983: 311-312 *p.*; Walter and Breckle, 1986; Gajardo, 1994: units 7C13-7C135, 7C14-7B84, 7B9-7C135, 7B9-7B91, 7C11-7B91, 7C12-7B91, 7C13-6B83 = 7B83, 7C14-7B82, *p.*).

32.53 Southern deciduous forest zone scrub
Broad-leaved sclerophyllous or lauriphyllous evergreen scrubs of the deciduous forest zone of the Fuego-Patagonian region, occupying cleared areas, openings and forest edges, often also represented in similar locations within the adjacent mixed or evergreen forest zones.
(Moore, 1983: 26-27).

32.531 Southern *Chiliotrichum-Berberis* scrub
Evergreen shrub communities of the Fuego-Patagonian deciduous forest zone dominated by *Chiliotrichum diffusum* and *Berberis buxifolia* (*Berberis cuneata*, *Berberis microphylla*), often with a prominence of *Ribes magellanicum*, shrubby *Maytenus magellanica*, *Embothrium coccineum* or *Pernettya mucronata*.
(Pisano, 1971b; Moore, 1983: 26-27).

32.532 Southern *Pernettya mucronata* scrubs
Evergreen scrubs of the Fuego-Patagonian deciduous forest zone dominated by *Pernettya mucronata*, often accompanied by *Empetrum rubrum*, *Chiliotrichum diffusum* or *Berberis ilicifolia*, characteristic of bog-woodland ecotones, at places grading into the heaths of units 31.12 or 31.22.
(Moore, 1983: 27).

32.533 Southern *Pernettya-Chiliotrichum* scrub
Evergreen scrubs of the Fuego-Patagonian deciduous and mixed deciduous-evergreen forest zones, characteristic of rocky and stony outcrops and woodland clearings, dominated by *Pernettya mucronata* and *Chiliotrichum diffusum*, with *Maytenus disticha*, *Acaena pinnatifolia*, *Acaena ovalifolia*, *Baccharis*

obovata, *Berberis buxifolia*, *Blechnum penna-marina*, *Embothrium coccineum*, *Fragaria chiloensis*, *Taraxacum officinale*
(Gajardo, 1994: units 6B9-6B92, 7B7-6B92, 7C11-6B92, *p.*).

32.54 Fuego-Patagonian sclerophyllous scrubs
Broad-leaved sclerophyllous evergreen scrubs of the Patagonian steppe zone of Tierra del Fuego, Magellanic Chile and southern Santa Cruz.
(Moore, 1983; Gajardo, 1994: region 8B; Daniele and Natenzon, 1994: region 17).

32.541 Fuego-Patagonian *Lepidophyllum* scrubs
Shrub communities of the Fuego-Patagonian steppe region, distributed on coastal sands of northern Tierra del Fuego, the Straits of Magellan and continental Patagonia north to 48°S, sometimes also on inland sands of the same regions, notably between Bahia Inutil and Bahia San Sebastian, dominated by the composite *Lepidophyllum cupressiforme*, 0.5-1.4 m high, accompanied by *Berberis buxifolia* and *Senecio patagonicus* in the upper canopy and by *Acaena pinnatifida*, (*Acaena platyacantha*), *Acaena sericea*, *Berberis empetrifolia*, *Boopis australis*, *Descurainia antarctica*, *Jaborosa magellanica*, *Oxalis enneaphylla*, *Phacelia secunda* (*Phacelia pinnatifida*), *Valeriana carnosa*, *Festuca gracilima*, *Festuca magellanica* in lower layers. The community grades into the *Festuca gracillima* steppes as well as into saline grasslands.
(Moore, 1983: 25-26; Gajardo, 1994: unit 8B2-8B25).

32.542 Fuego-Patagonian *Chiliotrichum* scrubs
Scrub communities of the southern part of the Patagonian steppe zone, dominated by the composite *Chiliotrichum diffusum* (fachine), characteristic of areas where annual rainfall approaches 350 mm, constituting an ecotonal community between the *Festuca gracillima* steppes and the southern forests. The accompanying cortège comprises moist grassland elements as well as species characteristic of sheltered forest margins. Components include *Gentianella magellanica*, *Acaena ovalifolia*, *Acaena magellanica*, *Adenocaulon chilense*, *Anemone multifida*, *Geum magellanicum*, *Primula magellanica*, *Cerastium arvense*, *Aster vahlii*, *Baccharis patagonica*, *Calceolaria biflora*, *Cotula scariosa*, *Schizeilena ranuculus*, *Viola magellanica*, *Hierochloe redolens*, *Phleum alpinum*.
(Moore, 1983: 25-26; Gajardo, 1994: unit 8B2-8B24).

32.6 Pampean sclerophyllous scrub

Broad-leaved sclerophyllous or lauriphyllous evergreen scrubs of temperate affinities of the warm temperate steppe zone of the Rio de la Plata region of northeastern Argentina and southern Uruguay. The region is a transition zone between tropical and temperate floras and faunas. The grasslands are usually, and probably correctly, treated as temperate steppes; they have been included in unit 34 (34.1). The woodlands are of clear Paranean or Chacoan affinities; they have been included in units 4B and 4A (4B.6, 4A.3). The shrublands offer a more complex spectrum. Some, particularly in the northern part of the region, include many tropical genera or species and are best included in 3B (3B.25). The communities listed here are, on the contrary, similar in physiognomy to Andino-Patagonian or mediterraneo-Chilean scrubs and are dominated by species of southern affinities or by Pampean endemic species.
(Cabrera and Zardini, 1978: 2, 7; Cabrera and Willink, 1980: 81, 82; Hueck and Seibert, 1981: unit 63 *p.*; Soriano *et al.*, 1992: 381, 385, 386; Muñoz *et al.*, 1993: 22, 27-28; Narosky and Di Giacomo, 1993: 14; Burkart *et al.*, 1994: 3, 21; Daniele and Natenzon, 1994: regions 1, 11).

32.61 Pampean steppe evergreen scrubs
Broad-leaved sclerophyllous or lauriphyllous evergreen scrubs forming locally in the climax *Bothriochloa-Stipa-Piptochaetium-Aristida* steppes of the Pampas regions of Argentina and southern Uruguay, characteristic in particular of the rolling Pampa, the inland Pampa and the southern Uruguayan Campos.
(Cabrera and Zardini, 1978: 2; Hueck and Seibert, 1981: unit 63 *p.*; Soriano *et al.*, 1992: 381, 385, 386; Muñoz *et al.*, 1993: 22; Burkart *et al.*, 1994: 3, 21).

32.611 Humid pampa steppe scrubs
Evergreen scrubs of the climax steppes of the humid, eastern Pampas regions of Argentina and southern Uruguay, characteristic in particular of the rolling Pampa and the southern Uruguayan Campos, constituted mainly by composites of genera *Baccharis*, *Eupatorium* (*Eupatorium*

buniifolium), *Pterocaulon* (*Pterocaulon cordobense*), *Vernonia* (*Vernonia rubricaulis*) with a few species of other families, in particular, Rosaceae (*Margyricarpus pinnatus*), Lythraceae (*Heimia salicifolia*).
(Cabrera and Zardini, 1978: 2, 638, 640; Hueck and Seibert, 1981: unit 63 *p.*; Soriano *et al.*, 1992: 381, 386; Muñoz *et al.*, 1993: 22; Burkart *et al.*, 1994: 3).

32.6111 Humid Pampa *Baccharis* steppe scrubs
Evergreen scrubs of the climax steppes of the humid, eastern Pampas regions of Argentina and southern Uruguay, characteristic in particular of the rolling Pampa and the southern Uruguayan Campos, constituted mainly by composites of genus *Baccharis* (*Baccharis trimera*, *Baccharis articulata*, *Baccharis notosergila*, *Baccharis coridifolia*).
(Cabrera and Zardini, 1978: 2, 638, 640; Hueck and Seibert, 1981: unit 63 *p.*; Soriano *et al.*, 1992: 381, 386; Muñoz *et al.*, 1993: 22; Burkart *et al.*, 1994: 3).

32.6112 Pampa *Eupatorium* steppe scrubs
Evergreen scrubs of the climax steppes of the humid, eastern Pampas regions of Argentina and southern Uruguay dominated by *Eupatorium buniifolium*, characteristic in particular of southern Uruguay, where it covered extensive surfaces, and still constitutes large thickets.
(Gore and Gepp, 1978: 25; Muñoz *et al.*, 1993: 28).

32.612 Semiarid pampa steppe scrubs
Evergreen scrubs of the climax steppes of the semiarid, western Pampas regions of Argentina, characteristic of the inland Pampa, constituted mainly by composites of genera *Baccharis* (*Baccharis articulata*, *Baccharis coridifolia*, *Baccharis artemisioides*, *Baccharis ulicina*, *Baccharis crispa*), *Hyalis* (*Hyalis argentea*), *Thelesperma* (*Thelesperma megapotamicum*) and the tall aphyllous shrub *Discaria longispina*.
(Cano and Movia, 1967: 35; Cabrera and Zardini, 1978; Hueck and Seibert, 1981: unit 63 *p.*; Soriano *et al.*, 1992: 385; Burkart *et al.*, 1994: 21).

32.62 Eastern Pampean hill evergreen scrubs
Broad-leaved sclerophyllous or lauriphyllous evergreen or mixed evergreen and drought-deciduous scrubs of mountains, hills and rocky elevations of the Pampas region of South America, in particular, the Sierras of Olavarria, Tandil, Balcarce and la Ventana in the southern Pampas of Argentina, and the serranias of southern Uruguay in the departments of Lavalleja, Maldonado, Rocha and San Jose.
(Cabrera and Zardini, 1978: 7; Cabrera and Willink, 1980: 81, 82; Hueck and Seibert, 1981: unit 63 *p.*; Soriano *et al.*, 1992: 385, 386; Muñoz *et al.*, 1993: 27-28; Narosky and Di Giacomo, 1993: 14; Erize *et al.*, 1995: 102).

32.621 Pampean *Colletia-Dodonaea* thickets
Usually tall brush dominated by the deciduous, spiny *Colletia paradoxa* and the evergreen *Dodonaea viscosa* accompanied by shrubs of genera *Baccharis* (notably *Baccharis articulata*, *Baccharis coridifolia*), *Buddleia*, *Cestrum*, *Vernonia* and *Discaria*, and various grasses, occupying deep, well-aerated soils of the sierras of Balcarce and Mar del Plata and of the serannias of southern Uruguay.
(Cabrera and Zardini, 1978: 7, 395-396, 400-401; Cabrera and Willink, 1980: 82; Soriano *et al.*, 1992: 385; Muñoz *et al.*, 1993: 27, 90-91, 100-101; Narosky and Di Giacomo, 1993: 14; Erize *et al.*, 1995: 102).

32.622 Eastern Pampean hill slope scrubs
Broad-leaved sclerophyllous or lauriphyllous evergreen scrubs of rocky outcrops, hills and lower slopes of the sierras of the Argentinian Pampas and southern Uruguayan Campos regions.
(Cabrera and Zardini, 1978: 7; Cabrera and Willink, 1980: 81, 82; Hueck and Seibert, 1981: unit 63 *p.*; Soriano *et al.*, 1992: 385, 386; Muñoz *et al.*, 1993: 27-28).

32.6221 *Baccharis tandilensis* scrubs
Low scrubs dominated by the very branched, densely leafy endemic *Baccharis tandilensis*, often with a participation of numerous other shrub and gramineous species, occupying slopes of the hills of the sierras of Tandil, Balcarce and Mar del Plata.
(Cabrera and Zardini, 1978: 7, 640; Cabrera and Willink, 1980: 82; Soriano *et al.*, 1992: 385).

32.6222 Eastern Pampean hill *Eupatorium* scrubs
Low scrubs, often extensive, dominated by *Eupatorium buniifolium* of the Sierra de Tandil and the serranias of southern Uruguay.
(Soriano *et al.*, 1992: 385; Muñoz *et al.*, 1993: 28).

32.6223 Southern Uruguayan mixed scrubs
Matorrals of the serranias of southern Uruguay constituted by *Baccharis spp.* (notably *Baccharis trimera*, *Baccharis crispa*), *Eupatorium buniifolium*, *Heterothalamus alienus*, *Colletia paradoxa*, *Eupatorium brevipetiolatum*, and, occupying more rocky areas, numerous ferns and cacti of, in particular, genera *Wigginsia*, *Echinopsis*, *Gymnocalycium*, *Opuntia*, and *Cereus peruvianus*.
(Cabrera and Willink, 1980: 81, 82; Muñoz *et al.*, 1993: 26-28).

32.6224 *Heterothalamus alienus* matorrals
Evergreen scrubs and thickets dominated by *Heterothalamus alienus* of the serranias of eastern and northeastern Uruguay, in Lavalleja, Maldonado and Tacuarembo.
(Cabrera and Willink, 1980: 81, 82; Muñoz *et al.*, 1993: 28, 134-135).

32.623 Eastern Pampean hill summital scrubs
Scrubs of the high windswept slopes and summital plateaux of the sierras of the Pampa, at altitudes above 500 metres, comparatively undisturbed compared to the surrounding lowlands and harbouring several Pampean endemics, formed by the prostrate shrubs *Mimosa rocae*, *Mimosa tandilensis*, the endemic *Plantago bismarckii*, *Adesmia pampeana* and *Senecio ventanensis*, the Andino-Patagonian *Mulinum spinosum*, the austral *Gaultheria phylariaefolia* and numerous ferns.
(Cabrera and Zardini, 1978: 7; Cabrera and Willink, 1980: 81, 82; Hueck and Seibert, 1981: unit 63 *p.*; Soriano *et al.*, 1992: 385, 386; Muñoz *et al.*, 1993: 27-28; Erize *et al.*, 1995: 102).

32.6231 Pampean hill *Mimosa rocae* summital scrub
Woody carpets of dwarf, stunted, *Mimosa rocae* on stony ground of the sierras of Buenos Aires and Uruguay.
(Cabrera and Willink, 1980: 82; Soriano *et al.*, 1992: 385).

32.6232 Pampean hill *Mimosa tandilensis* summital scrub
Formations of prostrate shrubs of *Mimosa tandilensis* of stony substrates of the sierras of Buenos Aires and Uruguay.
(Cabrera and Zardini, 1978: 320; Cabrera and Willink, 1980: 82).

32.6233 Pampean hill *Plantago-Senecio* summital scrub
Scrubs of the sierras of the southern Pampa region, in particular, Ventana, Tandil and Balarce, formed by the shrubby endemics *Plantago bismarkii* or *Senecio ventanensis*.
(Cabrera and Zardini, 1978: 579, 680; Cabrera and Willink, 1980: 82; Soriano *et al.*, 1992: 385; Erize *et al.*, 1995: 102).

32.6234 Pampean hill *Adesmia pampeana* summital scrub
Scrubs of the Sierras de la Ventana formed by the endemic *Adesmia pampeana*.
(Cabrera and Willink, 1980: 82; Soriano *et al.*, 1992: 385; Erize *et al.*, 1995: 102).

32.6235 Pampean hill *Gaultheria* summital scrub
Scrubs of the sierras of the southern Pampa region formed by the austral *Gaultheria phylariaefolia*.
(Cabrera and Willink, 1980: 82; Soriano *et al.*, 1992: 385).

32.63 Pampean dune evergreen scrubs
Evergreen scrubs of the interior dunes of the Pampa region, in particular *Hyalis argentea* formations of the dunes of the inland Pampa, *Dodonaea viscosa* formations of the dunes of the Parana delta and Uruguay.
(Cano and Movia, 1967: 35; Cabrera and Zardini, 1978: 395-396; Cabrera and Willink, 1980: 81; Muñoz *et al.*, 1993: 100-101; Burkart *et al.*, 1994: 21).

32.7 Southern temperate bamboo thickets

Thickets of the Valdivian forest zone, and, to a lesser extent, of the Magellanic evergreen, Magellanic deciduous and broad-leaved sclerophyllous forest zones, dominated by bamboos of genus *Chusquea*.
(Walter, 1968: 195-204; Dimitri, 1972, 1977; Veblen *et al.*, 1983: 22-23; Gajardo, 1994: regions 3, 4, 5, 6, 7).

32.71 Southern temperate erect bamboo thickets
Thickets of the southern broad-leaved forest zones of South America dominated by erect, unbranched bamboos of genus *Chusquea*.
(Veblen *et al.*, 1983: 22-23).

32.711 *Chusquea culeou* bamboo thickets
Thickets, often tall, up to 7 metres, of the Valdivian rain forests and the Magellanic zone of Chile and, locally, of Argentina, dominated by *Chusquea culeou*.
(Dimitri, 1972, 1977; Veblen *et al.*, 1983: 22-23; Gajardo, 1994: 7B6-7B64, 7B72-7B64).

32.7111 Valdivian *Chusquea culeou* thickets
Tall bamboo thickets dominated by *Chusquea culeou* colonizing open areas of the Valdivian forest zone and adjacent deciduous *Nothofagus* and conifer montane forests; they are abundant, in particular, between 500 and 900 metres in the Lake district; they are the main cover of disturbed or burned sites.
(Dimitri, 1972: 72, 117; Dimitri, 1977: 3, 4, 38; Veblen *et al.*, 1983: 14, 22-23; Schmaltz, 1991: 569-572).

32.7112 Magellanic *Chusquea-Berberis* thickets
Open-canopied thickets of high slopes and very altered parts of the Magellanic evergreen forest zone of Chile formed by *Chusquea culeou* and *Berberis serrato-dentata* with *Fuchsia magellanica*, *Ribes magellanica*, characteristic of pre-Andean interior zones of the Chilean Fjordland from 43° S to 48° S.
(Gajardo, 1994: 7B6-7B64, 7B7-7B64).

32.712 *Chusquea tenuiflora* bamboo thickets
Thickets, up to two to three metres high, of the evergreen, deciduous and mixed evergreen-deciduous *Nothofagus dombeyi*, *Nothofagus betuloides*, *Nothofagus pumilio* forests of southern South America dominated by *Chusquea tenuiflora*, forming mostly just below timberline, at 900-1200 metres.
(Veblen *et al.*, 1983: 15, 22-23; Schmaltz, 1991: 575).

32.713 *Chusquea nigricans* bamboo thickets
Thickets of the Valdivian forest zone of Chile typical of poorly drained basins and frost pockets, also sometimes of above-timberline areas, at altitudes between 900 and 1300 metres, dominated by *Chusquea nigricans*.
(Veblen *et al.*, 1983: 22).

32.714 *Chusquea cumingii* thickets
Seemingly pure, dense, bamboo thickets occuping stations above 100 metres, between about 33° S to 35° S latitude, within the deciduous forest zone of the middle Chilean Andes, the xeric forest zone of the coast range and reduced, favoured localities of more xeric adjacent regions. They are dominated by *Chusquea cumingii*, often accompanied by *Lithrea caustica*, *Mulinum ulicinum*, *Triptilion spinosum*, *Erodium bothrys*, the terrestrial orchid *Chloraea disoides*.
(Oberdorfer, 1960: 24; Rundel, 1981: 187, 196; Gajardo, 1994: 4A1-4A12, 3C10-4A12=4A13, 3C11-4A12=4A13, 3C13-4A12=4A13).

32.72 Southern temperate climbing bamboo thickets
Thickets of the Valdivian rain forest zone dominated by climbing, multi-branched bamboos of genus *Chusquea*.
(Veblen *et al.*, 1983: 22-23).

32.721 *Chusquea quila* bamboo thickets

Thickets of the Valdivian rain forest zone and adjacent deciduous forest zones dominated by the climbing bamboo *Chusquea quila*, often with *Fuchsia magellanica*, *Azara lanceolata*, *Ribes valdivianum*, *Acaena ovalifolia*, *Embothrium coccineum*, *Hydrangea serratifolia*, *Laurelia philippiana*, *Nothofagus betuloides*, occupying well-drained sites at altitudes between sea level and 600 metres, frequently colonizing clearings of forests subject to timber exploitation and pasture margins.
(Veblen *et al.*, 1983: 12-13, 22-23; Schmaltz, 1991: 567, 568; Gajardo, 1994: 5A3-5A33, 7A5-5A33, 7B6-5A33).

32.722 *Chusquea uliginosa* bamboo thickets
Thickets of the Valdivian rain forest zone dominated by the climbing bamboo *Chusquea uliginosa*, occupying poorly drained substrates at altitudes of sea level to 350 metres.
(Veblen *et al.*, 1983: 22).

33. MEDITERRANEAN DROUGHT-DECIDUOUS SCRUBS

Scrubs of arid mediterranean affinities, dominated by drought-deciduous xerophytic shrubs or subshrubs, often cushion-forming, thorny or malacophyllous, developed in the coastal regions of the mediterranean zone and sometimes in the transition area between mediterranean and tropical desert zones. They include the phryganas and bathas of the Mediterranean basin and the coastal sagebrushes of California. In South America, coastal matorrals of the northern part of the mediterranean zone of Chile are characteristic of this unit. Similar formations occur in xeric localities within the Central Valley, the coastal mountains and the Andean foothills. Drought-deciduous scrubs of the transition zone between mediterranean climate forest regions and the Patagonian semideserts and steppes and of isolated xeric hill ranges in the warm humid temperate Pampa region also fit within this habitat class.
(di Castri, 1981; Quézel, 1981; Rundel, 1981; Hanes, 1981; Margaris, 1981; Arroyo *et al.*, 1994: 54-55; Fuentes *et al.*, 1995: 188; Gajardo, 1994: regions 3, 6, 8, *p*).

33.1 Chilean xero-coastal matorrals

Scrubs of arid mediterranean affinities, dominated by drought-deciduous xerophytic shrubs or subshrubs, developed in the coastal regions of the northern part of the mediterranean zone of Chile, from the Rio Rapel at 34° S to the Rio Elqui at 30° S, under a precipitation gradient of 449 mm to 127 mm in annual means and a corresponding shift of life-form dominance from south to north, with reduction of sclerophyllous and woody deciduous plants and increase in succulents coinciding with increasing aridity. They grade northwards, at least from the Rio Limari on, into deserts and semideserts, southwards, from 32° 50' on, into the mediterranean evergreen matorrals of unit 32.
(Rundel, 1981; Quintanilla, 1984: units A2, B7; Quintanilla, 1987: 12-14; Arroyo *et al.*, 1994: 54-55; Fuentes *et al.*, 1995: 188; Gajardo, 1994: units 3A11, 3A12, 3A33, 3A35, 3A37).

33.11 Shrubby xero-coastal matorrals
Drought-deciduous scrubs of the coastal regions of the northern part of the mediterranean zone of Chile dominated by small malacophyllous shrubs or taller woody deciduous shrubs, often accompanied by evergreen shrubs, notably *Lithrea caustica*, *Schinus polygamus* and *Schinus latifolia*, and by succulents, particularly *Trichocereus litoralis*.
(Rundel, 1981: 185; Quintanilla, 1987: 12-14).

33.111 *Bahia-Baccharis* coastal scrubs
Drought-deciduous scrubs of the coastal terraces of mediterranean Chile dominated by small malacophyllous shrubs, among which *Bahia ambrosioides* is usually the commonest, followed by *Baccharis concava*, *Baccharis linearis*, *Eupatorium glechonophyllum*, *Eupatorium salvia*, *Lepechinea salviae*, *Podanthus mitiqui*. Larger shrubs, in particular, *Fuchsia lycioides* and succulents, notably *Puya chilensis*, are often part of the communities.
(Rundel, 1981: 185; Quintanilla, 1987: 12; Gajardo, 1994: unit 3A3-3A33, 3A4-3A33, 3C10-3A33).

33.112 Fray Jorge xero-coastal scrubs
Dense scrub of the Fray Jorge hills, adjacent to *Aextoxicon punctatum* woodland, constituted by *Baccharis concava*, accompanied by *Ribes punctatum*, *Erigeron berteroanum*, *Puya chilensis*, *Bahia ambrosioides*, *Fuchsia lycioides*.
(Gajardo, 1994: unit 3A3-3A35).

33.113 *Adesmia-Cassia* scrubs
Widely distributed drought-deciduous scrubs, sometimes very dense, of coastal terraces, slopes and plains near the ocean, mostly of sandy substrates, with *Adesmia microphylla*, which may predominate, *Cassia coquimbensis*, *Bahia ambrosioides*, *Flourensia thurifera*, *Proustia cuneifolia*, *Bromus*

berterianus, *Fuchsia lycioides*, *Puya chilensis*, *Trichocereus coquimbanus*, and occasionally *Lobelia polyphylla*, *Ophryosporus triangularis*, *Plantago hispidula*, *Pleocarphus revolutus*, *Porlieria chilensis*, *Stipa plumosa*.
(Quintanilla, 1987: 12; Gajardo, 1994: units 3A1-3A11, 3A3-3A11, 3A4-3A11).

33.114 *Heliotropium-Fuchsia* scrubs
Low, open drought-deciduous scrubs, mostly of level coastal terraces, in which vernal herbs predominate, constituted by *Fuchsia lycioides*, *Heliotropium stenophyllum*, *Oxalis gigantea*, *Adesmia tenella*, *Bromus berterianus*, *Plantago hispidula*, *Erodium cicutarium*, *Gutierezia resinosa*, *Helenium aromaticum*, *Moscharia pinnatifida*, and occasionally, *Erodium malachoides*, *Flourensia thurifera*, *Koeleria phleoides*.
(Rundel, 1981: 185-186; Quintanilla, 1987: 12; Gajardo, 1994: unit 3A1-3A12).

33.115 *Reichea-Trichocereus* scrubs
Rare, local, communities of the coastal cliffs of Coquimbo, characterized by the presence of the relict endangered Myrtaceae *Reichea coquimbensis*, with *Trichocereus coquimbana*, *Nolana paradoxa*, *Loasa urmenetae*, *Calandrinia grandiflora*, *Sicyos bryonaefolius*, *Heliotropium stenophyllum*, *Oxalis gigantea*, *Trichocereus coquimbanus*, *Cristaria glaucophylla*, *Junellia selaginoides*.
(Gajardo, 1994: unit 3A1-3A13; Coig *et al.*, 1994: 121).

33.116 Coastal *Flourensia* scrubs
Fairly tall drought-deciduous scrubs of the coastal terraces and ocean-influenced slopes of coastal ranges of mediterranean Chile dominated by *Flourensia thurifera* with *Heliotropium stenophyllum*, *Colliguaja odorifera*, *Proustia cuneifolia*, *Puya chilensis*.
(Gajardo, 1994: units 3A1-3A21, 3A3-3A21, 3A4-3A21).

33.12 Succulent coastal matorrals
Scrubs of the coastal regions of the northern part of the mediterranean zone of Chile dominated by succulents or stem-succulents, in particular *Oxalis bridgesii*, *Carica chilensis*, cacti, in particular, *Neoporteria spp.*, *Equinocactus supertextus*, *Trichocereus chilensis*, *Trichocereus litoralis*, *Trichocereus coquimbanus*, bromeliads *Puya venusta*, *Puya chilensis*, *Puya beteroniana*, of which many are regional endemics.
(Ducoing, 1973: 62-63; Rundel, 1981: 185-186; Quintanilla, 1987: 12, 14; Hoffmann, 1989: 42-45; Gajardo, 1994: units 3A33 *p.*, 3A37).

33.121 *Heliotropium*-succulent coastal matorrals
Scrubs of the coastal regions of the northern part of the mediterranean zone of Chile formed by *Heliotropium stenophyllum*, *Flourensia thurifera*, and several regional endemic succulents or stem-succulents, including *Oxalis bridgesii*, *Carica chilensis*, cacti, in particular, of genus *Neoporteria*, and the bromeliad *Puya venusta*.
(Rundel, 1981: 185-186).

33.122 *Oxalis gigantea* coastal matorrals
Scrubs of the coastal regions of the northern part of the mediterranean zone of Chile dominated by the stem-succulent shrub *Oxalis gigantea* and malacophyllous shrubs and subshrubs, including the endemic *Heliotropium stenophyllum* in particular of coastal terraces, with a scattering of the woody deciduous trees *Adesmia arborea* and *Fuchsia lycioides*, and succulents, notably *Puya chilensis*, *Trichocereus skottsbergii*, known in particular from Puerto Oscuro in central Coquimbo province.
(Rundel, 1981: 185-186).

33.123 Cactus coastal matorrals
Scrubs of the coastal regions of the northern part of the mediterranean zone of Chile dominated by large or medium large cacti, for the most part regional endemics of very limited range.
(Britton and Rose, 1937b; Ducoing, 1973: 62; Rundel, 1981: 185-186; Hoffmann, 1989: 42-45).

33.1231 *Eulychnia castanea* coastal matorrals
Scrubs of the coastal regions of the northern part of the mediterranean zone of Chile, around 32° S, restricted to wind-swept coastal bluffs, constituted by the mound-forming *Eulychnia castanea*.
(Rundel, 1981: 185-186; Hoffmann, 1989: 42, 140-141).

33.1232 *Trichocereus litoralis* coastal matorrals
Scrubs of the coastal regions of the northern part of the mediterranean zone of Chile dominated by *Trichocereus litoralis*.
(Rundel, 1981: 185; Hoffmann, 1989: 45, 88-89).

33.1233 Columnar cactus-*Heliotropium* transition matorrals
Scrubs of the coastal regions of the extreme northern part of the mediterranean zone of Chile, in the zone of transition to semidesert and desert communities, dominated by the large semiarborescent cacti *Trichocereus coquimbanus* and *Eulychnia breviflora* (*Eulychnia spinibarbis*) accompanied by *Copiapoa coquimbana*, *Puya coquimbensis* and *Heliotropum stenophyllum*.
(Rundel, 1981: 185-186; Hoffmann, 1989: 42, 44, 86, 108-111, 138-139).

33.124 *Puya* coastal matorrals
Scrubs of coastal terraces and rocky slopes of mediterranean Chile dominated by the large rosettes of the bromeliads *Puya chilensis*, the vulnerable *Puya venusta* or *Puya berteroniana*.
(Quintanilla, 1987: 12, 14; Gajardo, 1994: units 3A3-3A33, 3A4-3A33, 3C10-3A33, 3A3-3A37, 3C10-3A37, 3C10-3B73; Coig *et al.*, 1994: 120).

33.125 *Neoporteria* coastal matorrals
Scrubs of the coastal regions of the northern part of the mediterranean zone of Chile dominated by cacti of genus *Neoporteria*, in particular, *Neoporteria jussieui*, *Neoporteria wagenknechtii*, *Neoporteria horrida*, *Neoporteria curvispina*.
(Hoffmann, 1989: 42, 45, 182-187, 174-175, 190-193, 198-203).

33.2 Chilean xeric slope matorrals

Open shrub formations of the mediterranean zone of Chile installed on xeric north-facing slopes, dominated by succulents and soft-leaved drought-deciduous shrubs, with a highly variable participation of sclerophyllous shrubs *Lithrea caustica*, *Colliguaya odorifera*, *Adesmia arborea*, and grasses, *Piptochaetium panicoides*, *Nasella exserta*.
(Rundel, 1981; Arroyo *et al.*, 1994: 54-55; Fuentes *et al.*, 1995: 188; Gajardo, 1994: units 3A21, 3A24, 3B56, 3B510, 3B73, 3C115, 3C123).

33.21 *Puya* xeric slope matorrals
Open communities of dry, north-facing slopes of the mediterranean zone of Chile dominated by, or rich in, *Puya spp.*.
(Rundel, 1981: 183-184; Arroyo *et al.*, 1994: 54-55; Gajardo, 1994: units 3B510, 3B73, 3C115).

33.211 *Puya berteroniana* xeric slope matorrals
Inland xeric slope open scrubs of mediterranean Chile dominated by, or rich in, *Puya berteroniana*, mostly characteristic of moderate elevations; the succulent bromeliads are often accompanied by other succulents such as *Trichocereus chilensis* and malacophyllous or sclerophyllous shrubs, in particular, *Adesmia arboria*. *Colliguaja odorifera*, *Colletia spinosa*.
(Rundel, 1981: 183; Gajardo, 1994: units 3B5-3B510, 3C11-3B510, 2B10-3B73, 3B5-3B73, 3B7-3B73).

33.212 *Puya violacea* xeric slope matorrals
Inland xeric slope open scrubs of mediterranean Chile dominated by, or rich in, *Puya coerulea* (*Puya violacea*), on steep rocky substrates where its abundance can impart a blue-grey cast to entire slopes. Accompanying shrubs include, in particular, *Colleguaja odorifera*, *Lithrea caustica*, *Quillaja saponaria*, *Trevoa trinervis*.
(Rundel, 1981: 183-184; Gajardo, 1994: unit 3C11-3C115, 4A1-3C115).

33.22 *Flourensia* xeric slope matorrals

Open communities of lower elevations of dry, north-facing slopes of the mediterranean zone of Chile dominated by the malacophyllous shrub *Flourensia thurifera* with *Puya berteroniana* and *Trichocereus chilensis* and the absence of an herb layer; *Bridgesia incisiifolia* is often important in situations near the coast north of Santiago.
(Rundel, 1981: 184; Fuentes *et al.*, 1995: 188; Gajardo, 1994: units 3A21, 3A24, 3B56).

33.221 *Flourensia-Heliotropium* matorrals
Inland xeric slope brushes of mediterranean Chile dominated by *Flourensia thurifera* with *Heliotropium stenophyllum*, *Colliguaja odorifera*, *Proustia cuneifolia*.
(Gajardo, 1994: units 3A2-3A21, 3B5-3A21).

33.222 *Bridgesia-Flourensia* matorrals
Xeric brushes of dry, rocky upper slopes of mediterranean Chile dominated by *Bridgesia incisaefolia* and *Flourensia thurifera*, *Notholaena mollis*, *Adesmia microphylla*, *Cordia decandra*, *Opuntia ovata*, *Trichocereus coquimbanus*.
(Gajardo, 1994: units 3A2-3A24, 3B5-3A24).

33.223 *Flourensia-Colliguaja* matorrals
Scanty, transitional, xeric slope brushes of inland mediterranean Chile dominated by *Flourensia thurifera* and *Colliguaja odorifera* with *Porlieria chilensis*, *Baccharis paniculata*, *Trevoa trinervis*, *Quillaja saponaria*.
(Gajardo, 1994: unit 3B5-3B56).

33.23 *Fabiana barriosii-Junellia* matorrals
Xeric brushes of dry, rocky slopes of mediterranean Chile dominated by *Fabiana barriosii*, *Junellia selaginoides*, *Haplopappus angustifolius*, *Adesmia tenella*, *Plantago hispidula*.
(Gajardo, 1994: units 3A1-3A22, 3A2-3A22).

33.24 Mediterraneo-Chilean xeric cactus slopes
Communities of interior slopes of the mediterranean zone of Chile dominated by cacti, in particular, *Neoporteria eriosyzoides*, *Neoporteria clavata*, *Neoporteria nidus*, *Neoporteria simulans*, *Eulychnia acida*, *Copiapoa coquimbana*, species of genera *Trichocereus* (*Echinopsis*) and *Opuntia*, and *Eriosyce sandillon* of Andean slopes.
(Hoffmann, 1989: 42, 110-111, 134-135, 148-149, 188-189).

33.3 Andino-Patagonian drought-deciduous scrubs

Drought-deciduous scrubs of the Andino-Patagonian region characteristic of the transition zone between dry Andino-Patagonian woodland belts and the adjacent arid Patagonian steppes and semideserts, of xeric north-facing slopes in the western Andean montane sclerophyllous woodland zone and of dry interior basins of the temperate Andes.
(Dimitri, 1972, 1977; Gajardo, 1994: regions 3C, 4A, 6A).

33.31 Andino-Patagonian presteppic *Colletia* scrub
Drought-deciduous scrubs of the eastern ecotone between the Andino-Patagonian woodland zone and the Patagonian steppe, dominated by *Colletia spinosissima*, abundant in the fringe of the Patagonian steppe.
(Dimitri, 1972: 117; Dimitri, 1977: 4, 51).

33.32 Western Andean *Colletia-Baccharis* scrub
Facies and subcommunities of the *Lithrea-Quillaja* and related matorrals, rich in stem-photosynthetic, drought-deciduous, usually spiny shrubs, in particular, pre-Andean spiny scrubs developed in the piedmont of the Andes, at 600-1300 metres, in the provinces of Santiago and Aconcagua, dominated by *Colletia spinosissima*, with *Schinus dependens*, *Colliguaja odorifera*, *Cestrum parqui*, *Azara petiolari*.
(Ducoing, 1973: 67-68; Rundel, 1981: 182; Gajardo, 1994: units 3C12-3C123, 4A2-3C123).

33.33 Andino-Patagonian *Chacaya-Discaria* brush

Drought-deciduous scrubs of the eastern ecotone between the Andino-Patagonian woodland zone and the Patagonian steppe, and of the Cuyo Andes, dominated by the tall, spiny Rhamnaceae *Discaria serratifolia* or *Chacaya trinervis*, the latter endemic to Argentina.
(Morello, 1958: 91, 123; Dimitri, 1972: 117; Dimitri, 1977: 4, 51-52; Roig, 1982: 63; Erize *et al.*, 1995: 173).

33.331 Andino-Patagonian *Discaria* scrub
Drought-deciduous scrubs of the eastern ecotone between the Andino-Patagonian woodland zone and the Patagonian steppe, dominated by *Discaria serratifolia*.
(Dimitri, 1972: 117; Dimitri, 1977: 4, 51-52).

33.332 Eastern Andean *Chacaya* woodland
Drought-deciduous scrubs or thickets formed by the sometimes very tall, up to four metres, Argentinian endemic *Chacaya trinervis*, characteristic of river valleys in the ecotone between Andino-Patagonian forests and Patagonian steppes, locally also of river terraces with near-surface phreatic water in valleys of the Cuyo Andes and of Monte streambeds.
(Morello, 1958: 91, 123; Dimitri, 1972: 117; Dimitri, 1977: 4, 51-52; Roig, 1982: 63; Erize *et al.*, 1995: 173).

33.34 Andino-Patagonian *Discaria*-*Colletia* scrub
Drought-deciduous scrubs of the western slope of the temperate Andes dominated by spiny Rhamnaceae, the tall *Discaria serratifolia* and the lower *Colletia spinosa*, characteristic of the dry inner Andean basin of the upper rio Bio-Bio, exposed to climatic conditions similar to those of Patagonia, extending to nearby high Andean steppes.
(Gajardo, 1994: units 6A1-6A52, 6A5-6A52).

33.4 Pampean drought-deciduous scrubs

Drought-deciduous scrubs of isolated rocky mountains, hills, outcrops and dunes of the Pampa region of northern Argentina and southern Uruguay.

33.41 Pampean sierra drought-deciduous scrubs
Drought-deciduous scrubs of mountains, hills and rocky elevations of the Pampas region of South America, in particular, the Sierras of Olavarria, Tandil, Balcarce and la Ventana in the southern Pampas of Argentina, and the serranias of southern Uruguay in the departments of Lavalleja, Maldonado, Rocha and San Jose.

33.411 Pampean *Discaria*-*Wedelia* scrubs
Shrub stands of the deciduous *Discaria longispina* (*Discaria americana*) and and the suffrutescent *Wedelia buphthalmiflora* of the southern Pampean ranges, in particular, the Sierra de la Ventana.
(Cabrera and Zardini, 1978: 658, 400; Soriano *et al.*, 1992: 385; Narosky and Di Giacomo, 1993: 14; Erize *et al.*, 1995: 102).

33.412 Pampean sierra *Mulinum spinosum* summital scrub
Scrubs of the sierras of the southern Pampa region formed by *Mulinum spinosum*, an Andino-Patagonian element.
(Cabrera and Willink, 1980: 82; Soriano *et al.*, 1992: 385).

33.42 Pampean dune drought-deciduous scrubs
Drought-deciduous scrubs of the interior dunes of the Pampa region, in particular, *Discaria longispina*-*Margyricarpus pinnatus* formations of the interior dunes of the flooding Pampa, *Colletia paradoxa* formations of sands of Uruguay.
(Vervoorst, 1967: 158-159; Cabrera and Willink, 1980: 81; Muñoz *et al.*, 1993: 90-91; Burkart *et al.*, 1994: 21).

34. TEMPERATE STEPPES AND DRY THERMOPHILOUS GRASSLANDS

Primary and secondary steppes, formations dominated by medium or tall perennnial tuft-forming grasses or suffrutescents, with lacunar ground cover, together with their associated therophyte communities; typical formations, with two periods of dormancy, in large part climactic, are characteristic of a steppe belt in continental mid-latitudes, with irradiations in the nemoral zone; physiognomically similar formations, although perhaps largely anthropogenic, and mostly with a single period of dormancy, are widespread in the transition zones that form on the temperate side of the subtropical deserts. In South America, the main temperate steppe regions are the Pampas and the Patagonian steppe. More local formations occur in the transition zone between the Atacama Desert and the mid-Chilean xerophytic (mediterranean) region, as well as within the mediterranean zone itself. By extension, 34 may also include dry thermophilous, mostly zoogenous, grasslands and thermophile forest fringe formations of the lowland, hill and montane altitudinal levels of the nemoral and mediterranean zones.
(Hueck and Seibert, 1972: units 62, 63 *p.*, 64-67 *p.*; Schnell, 1987b: 46-47, 44; Rieley and Page, 1990: 40; Coupland, 1992d; Soriano *et al.*, 1992; Daniele and Natenzon, 1994: regions 1, 8, 9, 11, 12, 17).

34.1 Rio de la Plata grasslands

Warm temperate, subhumid grasslands of eastern South America situated around the Rio de la Plata and the lower reaches of the Parana and the Uruguay rivers between 30° S and 38° S, bounded by Argentine Mesopotamian parkland and Espinal xerophytic forest to the northwest, and by Espinal and Monte shrublands along the western and southern margins, grading to the north and northwest into the more subtropical primary or secondary grasslands of the northern campos, the northern Espinal and the Chaco (3A.7). They constitute two major entities, the Argentinian pampas, or pampas proper, on loessic substrates west of the Rio de la Plata and the Rio Uruguay, and the Uruguayan pampas, or southern campos, on more varied substrates, to the east of these rivers.
(Vervoorst, 1967; Walter, 1968: 680-704; Burkart, 1975; Walter and Breckle, 1991c: 385-399; Coupland, 1992d: 364; Soriano *et al.*, 1992; Muñoz *et al.*, 1993: 22; Daniele and Natenzon, 1994: regions 1, 11).

34.11 *Stipa* pampas
Steppic grasslands of the central and eastern parts of the Argentinian pampas and of the southern Uruguayan pampas, dominated by usually medium-tall grasses that include a strong representation of genus *Stipa*, forming the climax, zonal, undisturbed cover in most of the region.
(Vervoorst, 1967: 96-118; Walter, 1968: 680-704; Cabrera and Zardini, 1978; Cabrera and Willink, 1980: 80, 81; Soriano *et al.*, 1992; Burkart *et al.*, 1994: 2).

34.111 Pluri-dominant *Stipa* pampas
Steppes of fertile soils of the central and eastern parts of the Argentinian pampas and of the southern part of the Uruguayan pampas, dominated by a varied cortège of species of genera *Stipa*, *Piptochaetium* and *Aristida* ("flechillas"), usually multistratum or, under grazing, bistratum.
(Vervoorst, 1967: 96-109; Walter, 1968: 680-704; Cabrera and Zardini, 1978: 2; Cabrera and Willink, 1980: 80, 81; Soriano *et al.*, 1992; Burkart *et al.*, 1994: 2).

34.1111 Species-rich rolling pampas
Grasslands of fertile soils of the northern section of the Argentinian pampas, lying between the Rio de la Plata and the Rio Paraná to the northeast, the Rio Salado to the southwest, and the Rio Matanza to the southeast, on gently undulating plains, well drained by a network of river valleys constituting part of the la Plata-Paraná watershed, formed under a mild-winter climate with a varying annual rainfall that imparts to them the aspect of a prairie in humid years and of a pseudo-steppe in dry years. Because

of intensive agricultural practices, seminatural and natural stands have become rare. Such stands are rich in sharp-leaved and tuft-forming grasses of genera *Stipa*, *Piptochaetium* and *Aristida* and are dominated by *Bothriochlora laguriodes*, *Stipa neesiana*, *Piptochaetium montevidense*, *Aristida murina*, *Stipa papposa*, accompanied by *Paspalum dilatatum*, *Piptochaetium bicolor*, *Briza brizoides*, *Melica brasiliana* and, less abundantly, by *Stipa hyalina*, *Danthonia montevidensis*, *Panicum bergii*, *Briza subaristata*, *Schizachyrium intermedium*, *Setaria geniculata*, *Paspalum notatum*, *Eragrostis lugens*, *Poa bonariensis*, *Agrostis montevidensis*, *Bromus unioloides*; associated broad-leaved herbs and sedges include *Phyla canescens*, *Carex bonariensis*, *Berroa gnaphalioides*, *Hypochoeris spp.*, *Oxalis spp.*, *Adesmia bicolor*, *Tragia geraniifolia*, *Conyza blackei*, *Conyza bonariensis*; the vernal aspect is marked by *Chevreulia sarmentosa*, *Facelis retusa*, *Polygala australis*, *Micropsis spathulata*.
(Walter, 1968: 686-704; Cabrera and Zardini, 1978: 2; Cabrera and Willink, 1980: 81; Soriano *et al.*, 1992: 371-372, 381-382; Burkart *et al.*, 1994: 2).

34.1112 Species-rich flooding pampas
Grasslands of the eastern section of the Argentinian pampas, developed in the Rio Salado and Rio Laprida basins, occupying flat lowlands with endoreic or areic drainage, relieved by low dorsal ranges and crescent-shaped ridges on the eastern side of natural ponds, by fixed sand dunes and shell deposits, otherwise subjected to extensive and lengthy flooding during periods of abundant precipitation occurring at long pluriannual intervals. Dominant grasses include *Bothriochloa laguroides*, *Paspalum dilatatum*, *Briza subaristata*, shared with the rolling pampas, as well as species characteristic of the region, among which *Sporobolus indicus*, *Stipa papposa*, *Stipa formicarum*, *Stipa philippii*, *Aristida murina*, *Danthonia montevidensis*, *Paspalidium paludivagum*, *Distichlis scoparia*, *Chaetotropis elongata*, *Paspalum vaginatum*, *Stenotaphrum secundatum*.
(Vervoorst, 1967: 96-109; Walter, 1968: 686-704; Cabrera and Willink, 1980: 81; Soriano *et al.*, 1992: 373-374, 382-384; Burkart *et al.*, 1994: 2).

34.1113 Species-rich *Stipa-Piptochaetum* southern pampas
Natural or near-natural grasslands of the southernmost sector of the Argentinian pampas, including the Sierra de Tandil and the Sierra de la Ventana, their piedmonts and the moderately sloping Atlantic coastal plain to the south of them, well drained by a fluvial network, dominated by *Stipa neesiana*, *Stipa clarazii*, *Stipa trichotoma*, *Stipa tenuis*, *Piptochaetum napostaense*, *Piptochaetum lejopodum*, *Poa ligularis* with an abundance of *Stipa ambigua*, *Stipa candata*, *Stipa filiculmis*, *Stipa tenuissima*, *Piptochaetum chaetophorum*, *Piptochaetum cabrerae*, *Piptochaetum montevidense*, *Melica macra*, *Briza subaristata*, *Bouteloua megapotamica*.
(Walter, 1968: 686-704; Cabrera and Willink, 1980: 81; Soriano *et al.*, 1992: 374, 385).

34.1114 Southern campo *Stipa* pampas
Grasslands of the southern section of the Uruguayan pampas, or southern campos, extending between the Rio Yi and the Atlantic and Rio de la Plata coasts, in gently rolling plains well-drained by gallery-forest lined rivers; regional characteristics include small depressions on granitic beds, frequent rock outcrops, especially in the west, and hills in the southern part; the natural or near-natural grassland communities, similar to those of the Argentinian rolling pampa, very reduced as a result of grazing practices, comprise, in particular, *Stipa neesiana*, *Stipa hyalina*, *Stipa megapotamica*, *Stipa philippii*, *Paspalum dilatatum*, *Paspalum notatum*, *Setaria geniculata*, *Poa lanigera*, *Poa bonariensis*, *Agenium villosum*, *Leptocoryphium lanatum*, *Bromus unioloides*, *Deyeuxia viridiflavescens*.
(Cabrera and Willink, 1980: 80; Soriano *et al.*, 1992: 386).

34.112 Single-dominant *Stipa* pampas
Steppes of the central and eastern parts of the Argentinian pampas and of the southern part of the Uruguayan pampas, less species-rich than those of 34.111, dominated by a single tussock-forming medium-tall *Stipa* species.
(Vervoorst, 1967: 114-118; Walter, 1968: 680-704; Cabrera and Zardini, 1978; Soriano *et al.*, 1992).

34.1121 *Stipa charruana* pampas
Stipa charruana-dominated grasslands of the eastern part of the rolling pampa of Argentina and of the southern Uruguayan pampa, where they probably formerly occupied deep fertile soils, and still occur in tall vigorous formations ("maciegas") on soils of medium fertility.
(Soriano *et al.*, 1992: 381, 386).

34.1122 *Stipa brachychaeta* pampas
Stipa brachychaeta-dominated grasslands of the northwestern part of the Argentinian rolling pampa, mostly limited to relict stands on mounds along rivercourse channels, and of the southern pampa, in particular of areas that never have been cultivated.
(Walter, 1968: 701-703; Soriano *et al.*, 1992: 374, 381, 385).

34.1123 *Stipa trichotoma* pampas
Natural or near-natural grasslands dominated by tussocks of *Stipa trichotoma*, characteristic, in the Argentinian southern pampas and southwestern flooding pampas, of lower, moister ground than those of 34.1122.
(Walter, 1968: 701-704; Soriano *et al.*, 1992: 374, 382, 385).
34.1124 *Stipa papposa* pampas
Stipa papposa-dominated steppes of the flooding pampa, very low and rather open, characteristic of comparatively dry, humic-gley, unfertile soils, often located between climax multispecific *Stipa* steppes and salt grasslands, relatively species-poor.
(Vervoorst, 1967: 114-118; Walter, 1968: 680-704; Cabrera and Zardini, 1978; Soriano *et al.*, 1992).

34.12 Inland pampas
Grasslands of the western and central sections of the Argentinian pampas, west of the Rio Salado and Laprida basins and the Sierra de Ventana, occupying very extensive flat plains, in large part transformed by intensive agricultural activity, composed of two distinctive subregions, eastern and western. The western sector, comprising San Luis province, is very undulating, with thick aeolian sand deposits and fixed sand dunes permitting a rapid passage of water into the underlying soil; halophyte-inhabited ponds form in palaeo-depressions but there are no river systems; climax grasslands apparently remain, dominated in particular by *Sorghastrum pellitum*, *Elyonurus muticus*, *Aristida spegazzini*, *Bothriochloa springfieldii*, *Chloris retusa*, *Eragrostis lugens*, *Poa ligularis*, *Poa lanuginosa*, *Schizachyrium plumigerum*, *Stipa brachychaeta*, *Stipa trichotoma* and, in disturbed sites, *Aristida inversa*, *Digitaria californica*, *Piptochoetium napostaense*, *Sporobolus cryptandrus*; broad-leaved herbs include *Glandularia hookeriana*, showy flowered *Macrosiphonia petrae*, *Relbunium richardianum*, *Stevia satureiaefolia*. The eastern sector is very flat, punctuated with knolls, has well drained sandy soil, extensive marshes at the terminus of Rio Cuarto and Rio Quintoi, and natural salty ponds formed in relation to the slope of subsurface impervious layers; this sector is entirely modified by agricultural activies and natural or seminatural dry grasslands are apparently no longer extant.
(Walter, 1968: 686-704; Cabrera and Willink, 1980: 81; Soriano *et al.*, 1992: 373-374, 384-385; Burkart *et al.*, 1994: 21).

34.13 Mesopotamic pampas
Grasslands of the Uruguay-Parana interfluve of southern Entre Rios, north to Diamonte, Gualeguay, Concepcion and Colon, developed on loessic or more clayey sediments, over mostly rolling or hilly terrain drained by a network of gallery-forest lined rivers, characterized by an abundance of species of subtropical grass genera, notably *Axonopus*, *Paspalum*, *Digitaria*, *Schizachyrium* and *Bothriochloa* and comparative paucity of *Piptochoetium*, *Poa* and *Stipa* compared to more southern pampa grasslands, and a dominance of *Stipa neesiana*, *Stipa tenuissima* and *Eragrostis cilianensis*, accompanied by *Briza subaristata*, *Melica brasiliana*, *Paspalum dilatatum*, *Paspalum picatulum*, *Panicum bergii*, *Panicum milioides*, *Sporobolus indicus*, *Schizachyrium intermedium*, *Axonopus compressus*, *Bothriochloa laguroides*, *Bothriochloa barbinodis*, *Deyeuxia viridiflavescens*, *Setaria fiebrigi*, *Setaria vaginata*, *Aristida murina*, *Bromus unioloides*, *Chloris ciliata*, *Chloris capensis*, accompanied by a broad-leaved herb cortège similar to that of other pampa grasslands.
(Burkart, 1969: map 1; Cabrera and Willink, 1980: 80; Soriano *et al.*, 1992: 374, 385-386; Burkart *et al.*, 1994: 3; Daniele and Natenzon, 1994: unit 1).

34.14 Short-grass pampa steppes and grasslands
Grasslands of highlands, poor soils and intensively grazed areas within the pampa region, dominated by grasses of low stature.
(Cabrera and Willink, 1980: 82; Soriano *et al.*, 1992: 374, 385, 386; Burkart *et al.*, 1994: 21).

34.141 Southern pampa highland steppes

Grasslands of the southern Argentinian pampas, situated above 500 metres on rocky or sandy substrates, rich in endemic grasses including *Festuca ventanicola*, *Festuca pampeana*, *Stipa juncoides*.
(Cabrera and Willink, 1980: 82; Soriano *et al.*, 1992: 374, 385).

34.142 Blanqueal pampas
Sparse grasslands of "blanqueales" (whitish lands), characteristic, in particular, of the southern Uruguayan pampas, of the mesopotamic pampas, of the Argentinian rolling pampas and their ecotone with the flooding pampas, formed by *Eleusine tristachya*, *Sporobolus pyramidatus*, *Chloris berroi*, *Chloris ciliata*, *Bouteloua megapotamica* and broad-leaved herbs.
(Soriano *et al.*, 1992: 386).

34.143 Short-grass pampa meadows
Grasslands of the southern Uruguayan pampas subjected to intense grazing, transformed into a short, 10-cm high, sward dominated by *Poa lanigera*, *Danthonia montevidensis*, *Piptochaetum spp.*, *Melica spp.*, *Trifolium polymorphum*, *Carex bonariensis* and many introduced plants, including *Lolium multiflorum*.
(Soriano *et al.*, 1992: 386).

34.144 Pampa dune and sand steppes
Psammophile grasslands of mobile or fixed dunes and other sandy substrates of the Pampa region of northern Argentina and southern Uruguay.
(Cabrera and Willink, 1980: 81; Burkart *et al.*, 1994: 21).

34.1441 Eastern pampean sand steppes
Psammophile grasslands of mobile or fixed dunes and other sandy substrates of the rolling, flooding and southern Pampa regions of Argentina and of the southern campos of Uruguay, with *Elionurus muticus*, *Poa lanuginosa*, *Panicum racemosum*, *Senecio crassiflorus*.
(Cabrera and Willink, 1980: 81).

34.1442 Western pampean dune grasslands
Psammophile grasslands of the extensive dune systems of the western, inland, Pampa region of Argentina, with *Panicum urvilleanum*, *Poa ligularis*, *Sporobolus rigens*, *Stipa eriostachya*.
(Cabrera and Willink, 1980: 81; Burkart *et al.*, 1994: 21).

34.14421 Western pampean fixed dune grasslands
Psammophile grasslands of fixed or somewhat active dunes of the western, inland, Pampa region of Argentina, with *Stipa eriostachya*.
(Burkart *et al.*, 1994: 21).

34.14422 Western pampean mobile dune grasslands
Psammophile grasslands of very unstable dunes of the western, inland, Pampa region of Argentina, with *Panicum urvilleanum*, *Poa ligularis*, *Sporobolus rigens*.
(Cabrera and Willink, 1980: 81; Burkart *et al.*, 1994: 21).

34.15 Rocky slope *Paspalum* pampas
Grasslands of the southern Argentinian pampas, installed on rocky sites and hills, dominated by *Paspalum quadrifarium*, part of a singular vegetation considered by some authors to constitute a distinct phytogeographic district.
(Parodi, 1947; Walter, 1968: 702-703; Cabrera and Zardini, 1978: 5; Soriano *et al.*, 1992: 385).

34.16 Rocky slope *Eryngium* pampas
Steppes of the southern Argentinian pampas, installed on rocky sites and hills dominated by tall Apiaceae, mostly graminoid or bromeliadoid, of genus *Eryngium*, including *Eryngium eburneum*, *Eryngium paniculatum*, *Eryngium horridum*, *Eryngium serra*, *Eryngium elegans*, part of the distinctive southern pampa hill vegetation complex.
(Parodi, 1947; Cabrera and Zardini, 1978: 459-461; Soriano *et al.*, 1992: 385).

34.17 Subalkaline rolling pampas

Steppes of slightly alkaline soils of the Argentinian rolling pampa comprising salt-tolerant species that are not narrow halophytes, such as *Sporobolus pyramidatus*, *Sporobolus indicus*, *Schedonnardus paniculatus*, *Stipa papposa*, *Bouteloua megapotamica* with *Jaborosa runcinata*, *Solanum meloncilla*, and with a reduced presence of less salt-tolerant species of unit 34.111.
(Soriano *et al.*, 1992: 382).

34.2 Patagonian steppes and semidesert grasslands

Steppic grasslands of the steppe zone of southern South America, extending in a narrow strip along the eastern foothills of the Andes from about 36° S to about 52° S latitude and across the continent from about 52° S to 54° S, separating the deserts and semideserts of Patagonia (72.1) from the temperate deciduous forests and temperate broad-leaved forests of the southern Andes and southern Tierra del Fuego, or from high Andean communities; steppic grasslands enclaved within the semidesert zone of Patagonia, in particular, within the western semideserts (72.14) and the San Jorge semideserts (72.13).
(Moore, 1983; Soriano, 1982; Soriano *et al.*, 1983; Coupland, 1992d: 364-365; Daniele and Natenzon, 1994: regions 8 *p.*, 9, 17; Burkart *et al.*, 1994: 16-17, 29-30).

34.21 Sub-Andean steppes and semidesert grasslands
Steppic grasslands of the eastern foothills and piedmont of the Andes and southern mainland Patagonia, bordering and, in part, interdigitating with, the deserts and semideserts of Patagonia that lie to the east and north of them, in particular, those of the southern part of the Occidental District and those of the Santacruzian subdistrict.
(Walter, 1968: 714-715; Soriano *et al.*, 1983: 441-442; Walter and Box, 1983i: 433; Quintanilla, 1989: 11-13; Walter and Breckle, 1991c: 412; Coupland, 1992d: 364-365; Daniele and Natenzon, 1994: regions 9, 17 *p.*; Burkart *et al.*, 1994: 16-17, 29-30).

34.211 Sub-Andean *Festuca pallescens* steppes
Steppic grasslands of the eastern foothills and piedmont of the Andes and southern mainland Patagonia dominated by *Festuca pallescens*, constituting the main vegetation type of the sub-Andean steppe belt.
(Walter, 1968: 715; Soriano *et al.*, 1983: 441, 444, 450; Coupland, 1992d: 364-365; Gajardo, 1994: units 8A1-8A12, 8A1-8A13 *p.*; Burkart *et al.*, 1994: 30).

34.212 Sub-Andean *Stipa* steppes and semidesert grasslands
Xeric open steppes and semidessert grasslands dominated by low-tussock *Stipa spp.* of the eastern foothills and piedmont of the Andes, generally occupying lower altitude and drier localities than the *Festuca* steppes of 34.211. *Stipa humilis* and *Stipa speciosa* are the most frequent dominants, together or separately; *Stipa chrysophylla*, *Stipa ibari*, *Stipa psylantha*, *Stipa neaei*, *Stipa subplumosa*, *Stipa sorianoi* may accompany them or locally dominate; *Bromus macranthus*, *Hordeum comosum*, *Poa ligularis*, *Festuca argentina* may participate in the steppe formation.
(Walter, 1968: 714; Quintanilla, 1973; Quintanilla, 1974: 60; Soriano *et al.*, 1983: 442; Walter and Breckle, 1991b: 412; Coupland, 1992d: 364-365; Gajardo, 1994: unit 8A1-8A11 *p.*; Burkart *et al.*, 1994: 16-17).

34.22 Middle Patagonian semidesert grasslands
Steppic grasslands forming locally under favourable edaphic or microclimatic conditions within the Patagonian semidesert regions.
(Soriano *et al.*, 1983: 444-445, 452; Walter and Breckle, 1991c: 413; Coupland, 1992d: 364-365; Daniele and Natenzon, 1994: region 8 *p.*; Burkart *et al.*, 1994: 15).

34.221 San Jorge semidesert grasslands
Steppic grasslands of the upper Del Castillo Plateau south of Pico Salamanca, adjacent to the Gulf of San Jorge, formed by *Festuca pallescens*, *Festuca argentina* and *Poa ligularis*, with *Stipa humilis*, *Stipa speciosa*, forming a mosaic with the dwarf scrub semideserts of unit 72.13.
(Soriano *et al.*, 1983: 452; Walter and Breckle, 1991c: 413; Coupland, 1992d: 365).

34.222 Western Patagonian semidesert fescue grasslands
Festuca pallescens-dominated steppic grasslands forming in the western Patagonian semideserts on the margins of valleys occupied by hygrophilous grasslands ("mallines") or hygro-halophile communities.

(Soriano *et al.*, 1983: 444, 445; Coupland, 1992d: 365).

34.23 Southern Patagonian steppes
Cold steppes of the Fuegian District of southern Patagonia, occupying the steppic region of Tierra del Fuego and the southern part of the Patagonian mainland, south of the sub-Andean steppes and the Santacruzian semideserts, with both of which they merge.
(Walter, 1968: 717; Moore, 1983: 24-25; Soriano *et al.*, 1983: 450; Quintanilla, 1989: 19; Coupland, 1992d: 364-365; Gajardo, 1994: region 8B *p.*; Daniele and Natenzon, 1994: region 17; Burkart *et al.*, 1994: 29-30).

34.231 *Festuca gracillima* steppe
Steppic grasslands of Tierra del Fuego and Magellanic southern mainland Patagonia dominated by *Festuca gracillima*, accompanied by, or locally codominant with, *Agropyron fuegianum*, *Agrostis flavidula*, *Festuca magellanica*, *Poa alopecurus* ssp. *alopecurus* and *Trisetum spicatum*; *Acaena pinnatifida*, *Armeria maritima*, *Calceolaria uniflora*, *Cerastium arvense*, *Draba magellanica*, *Erigeron myosotis*, *Leucheria hahni*, *Leucheria purpurea*, *Luzula alopecurus*, *Phaiophleps biflorus*, *Senecio magellanicus*, *Silene magellanica*, *Sisyrinchium patagonicum*, *Taraxicum gilliesii*, *Vicia bijuga*, *Viola maculata* are characteristic of the community.
(Walter, 1968: 717; Moore, 1983: 24; Soriano *et al.*, 1983: 444, 450; Coupland, 1992d: 364-365; Gajardo, 1994: unit 8B2-8B21; Burkart *et al.*, 1994: 30).

34.232 *Festuca pyrogea* steppe
Steppic grasslands of northern Isla Grande, drier than those of 34.231, with a prominence of *Festuca magellanica* (*Festuca pyrogea*), *Phacelia secunda* and *Valeriana carnosa*, accompanied by *Stipa chrysophylla* and *Rytidosperma virescens*.
(Moore, 1983: 24, 276).

34.233 *Festuca gracillima-Stipa humilis* steppes
Steppic grasslands of Tierra del Fuego and Magellanic southern mainland Patagonia codominated by *Festuca gracillima* and *Stipa humilis*, accompanied by *Festuca magellanica*, *Stipa brevipes*, *Acaena pinnatifida*, *Acaena platyacantha*, *Calceolaria uniflora*, widespread, in particular in areas of higher moisture than those occupied by 34.231.
(Gajardo, 1994: unit 8B2-8B22).

34.3 Mediterraneo-Chilean steppes

Dry grasslands of the mesomorphic, or mediterranean, zone of Chile, extending between the Elqui river, at 30° S, and the Bio Bio river, at 37° S.
(Ducoing, 1973: 61-65; Gajardo, 1994: regions 3, 4, 5).

34.31 Mediterraneo-Chilean arid coastal steppes
Sparse grasslands, forb meadows and annual communities, with often exuberant spring growth, of the northern part of the mediterranean climate zone of Chile and of its transition to the subtropical desert zone, limited to the coastal plains, terraces and hills of the western flank of the coastal cordillera, developed between the Limari at 29° S and La Ligua at 32° 30' S, more locally to the Rapel at 34° S, sparsely to the Lontue at 35° S, interdigitating and intergrading with drought-deciduous and succulent scrubs of unit 33 and sometimes with evergreen scrubs of unit 32.
(Ducoing, 1973: 61-63; Gajardo, 1994: regions 3A1, 3A3, 3A4, 3B8, 3C10, 3C13).

34.311 Mediterraneo-Chilean coastal Nolanaceae communities
Open communities of the coastal terraces, plains and hills of the mediterranean zone of Chile and its transition to the subtropical desert zone, with exuberant spring growth, dominated by annual species of Nolanaceae.
(Ducoing, 1973: 61-63; Quintanilla, 1987: 16; Gajardo, 1994: units 3A14, 3A44 *p.*).

34.3111 Northern mediterraneo-Chilean Nolanaceae communities
Annual communities of the coastal terraces and rocky slopes of northern mediterranean Chile, distributed between the Limari and the Choapa, dominated by annual species of genus *Nolana*,

including *Nolana paradoxa*, *Nolana rupicola*, *Nolana rupestris* or *Alona* (*Alona filifolia*), accompanied by cacti and bromeliads.
(Ducoing, 1973: 61-63; Quintanilla, 1987: 16; Gajardo, 1994: units 3A1-3A14, 3A3-3A14).

34.3112 Southern mediterraneo-Chilean Nolanaceae communities
Annual communities of the coastal terraces and rocky slopes of mediterranean Chile, distributed between the Choapa and the Lontue dominated by *Nolana paradoxa*. Many or most of these communities are sea-cliff communities listed under unit 18.
(Ducoing, 1973: 61-63; Quintanilla, 1987: 16; Gajardo, 1994: units 3A4-3A44, 3B8-3A44, 3C10-3A44, 3C13-3A44, *p.*).

34.312 Mediterraneo-Chilean coastal meadows
Forb meadows of the coastal terraces and hills of mediterranean Chile, between the Limari and La Ligua.
(Quintanilla, 1987: 12; Gajardo, 1994: units 3A34, 3A36, 3A43).

34.3121 Mediterraneo-Chilean *Helenium-Sagina* meadows
Forb meadows of plains and gentle slopes of western Chile between 30° 30' S and 31° 30' S composed of *Helenium gramaticum*, *Nolana humifusa*, *Sagina apetala*.
(Gajardo, 1994: unit 3A3-3A34).

34.3122 Mediterraneo-Chilean *Adesmia-Erodium* meadows
Forb meadows of the coastal terraces and coastal slopes of mediterranean Chile, widespread between the Limari and La Ligua, in particular, on post cultural land, formed by *Adesmia tenella*, *Erodium sicutarium*, *Helenium aromaticum*.
(Gajardo, 1994: units 3A1-3A36, 3A3-3A36, 3A4-3A36).

34.313 Mediterraneo-Chilean *Piptochaetium-Haplopappus* steppes
Tufted grasslands of the coastal terraces and slopes of mediterranean Chile, common between the Choapa and La Ligua, constituted by *Piptochaetium montevidense*, *Haplopappus rosulatus*, *Pectocarya dimorpha*, *Fortunatia biflora*.
(Gajardo, 1994: unit 3A4-3A43).

34.32 Mediterraneo-Chilean inland grasslands
Grasslands of mediterranean Chile characteristic of the central valley, extending to the coast range and the lower slope of the Andes, constituting, in particular, the grassland element of *Acacia caven* open woodland, parkland or savanna.
(Ducoing, 1973: 64-65; Gajardo, 1994: regions 3A, 3B).

34.321 Mediterraneo-Chilean espinal *Stipa* steppes
Dry grasslands of the Chilean *Acacia caven* savanna ("estepa de espino"), situated from the Limari river southward to the Laja river, characteristic of the Chilean central valley, extending westwards through the coastal cordillera to the sea and eastwards into longitudinal valleys of the Andes, constituted largely of low grasses of the genera *Stipa*, *Festuca*, *Nacella*, *Bromus*, *Trisetum*, *Melica*, in particular, *Stipa plumosa*, *Nasella chilensis*, *Trisetum phleoides*, comprising an abundance of vernal annuals and numerous forbs, including many showy-flowered species such as of Onagraceae, *Oxalis* (*Oxalis mallobolla*, *Oxalis rosea*), *Anemone decapetala*, *Alonsoa incisifolia*, *Calceolaria nudicaulis*, *Verbena corymbosa*.
(Ducoing, 1973: 64-65; Quintanilla, 1974: 51; Gajardo, 1994: units 3B5-3B54, 3B6-3B62, 3B9-3B81, 3B9-3C105, *p.*).

34.322 Mediterraneo-Chilean *Avena-Erodium* grasslands
Post-cultural grasslands of mediterranean Chile formed by *Avena barbata*, *Vulpia megalura*, *Koeleria phleoides*.
(Gajardo, 1994: units 3A1-3B64, 3A3-3B64, 3A4-3B64, 3B5-3B64, 3B6-3B64, 3B8-3B64).

34.33 Mediterraneo-Valdivian grasslands
Dry, steppic grasslands of the Valdivian forest region and the southern mediterranean deciduous forest region of Chile.

(Gajardo, 1994: regions 4B, 4C, 5A).

34.331 Maulinian grasslands
Species-rich grasslands of the Maulin district of Chile, developed on the slopes of the coastal Cordillera, between 35° S and 37° 20' S in the region of transition between central Chilean and subantarctic floristic provinces. Included is the *Aster vahlii* community of eroded gentle slopes.
(Cabrera and Willink, 1980: 98; Gajardo, 1994: regions 4A3, 4B5, unit 4B5-4B54).

34.332 Mediterraneo-Valdivian *Avena-Rumex* grasslands
Grasslands of the deciduous woodland zones of the plains and pre-Andes of Frontera and the Lake District, and of the lauriphyllous forest zone of Chiloe, developed on eroded soils and post-cultural land, composed mostly of ruderals and introduced species, with *Avena fatua*, *Agrostis tenuis*, *Rumex acetosella*, or with *Echium vulgare*.
(Gajardo, 1994: units 4B6-4B63, 4B8-4B63, 4C10-4B63, 5A3-4B63, 4B6-4B65, 4B7-4B65).

34.34 Mediterraneo-Andean transition grasslands
Grasslands of the slopes of the Andes of Chile and, locally, of the coastal cordillera, composed of indigenous species of *Andropogon*, *Bromus*, *Calamagrostis*, *Deyeuxia*, *Distichlis*, *Eragrostis*, *Poa*, *Sporobolus*, with representatives of genera *Agrostis*, *Bouteloua*, *Elyonurus*, *Festuca*, *Muhlenbergia*, *Panicum*, *Pappophorum*, *Paspalum*, *Stipa*.
(Roseveare, 1948; Coupland, 1992d: 364; Gajardo, 1994: unit 4A1-2B113).

34.4 Juan Fernandez grasslands

Native grasslands of the lower, drier, altitudes of the Juan Fernandez Islands, dominated by *Stipa laevissima* and *Stipa neesiana*, accompanied by grasses of genera *Nassella* and *Piptochaetum* and by sedges, today much transformed.
(Skottsberg, 1953a: 919-921, 948-949; Cabrera and Willink, 1980: 104; Gajardo, 1994; region 5B).

34.41 Mas a Tierra *Stipa* steppes
Grasslands of Mas a Tierra dominated by *Stipa neesiana* and *Polypogon chilense*, with *Machaerina scirpoidea*, *Ochagavia elegans*, *Acaena ovalifolia*, *Nicotiana cordifolia*.
(Gajardo, 1994; unit 5B5-5B53).

34.42 Mas Afuera *Stipa* steppes
Grasslands of Mas Afuera dominated by *Stipa laevissima* and *Stipa neesiana*, with *Polypogon chilense*, *Acaena ovalifolia*.
(Gajardo, 1994; region 5B6-5B62).

35. DRY SILICEOUS GRASSLANDS

Short, mostly secondary, grasslands and therophyte communities colonizing acidic, well-drained soils of the lowland, hill and montane levels of the nemoral, subantarctic, mediterranean and warm-temperate humid zones. In South America they are limited to restricted azonal communities of the Magellanic deciduous and evergreen forest zones.

35.1 Magellanic dry Poa fuegiana grasslands

Dry or mesic grasslands of the deciduous and evergreen Magellanic forest zones, occupying small surfaces on relatively well-drained sandy or gravelly soils, formed by cespitose grasses including *Poa alopecurus* ssp. *fuegiana* and dwarf chamaephytes.
(Pisano, 1971b; Gajardo, 1994: regions 6, 7).

35.11 *Poa fuegiana-Agropyron magellanicum* grasslands
Dry or mesic, relatively dense, grasslands of the deciduous and evergreen Magellanic forest zones, formed by cespitose grasses with a small admixture of dwarf shrubs, occupying sandy or gravelly soils of fluvio-glacial deposits, often between the forest edge or its shrubby mantle and the high-water mark, or extending below it on coastal beaches, in which case communities are listed under 16.2112, dominated by *Poa alopecurus* ssp. *fuegiana* and *Agropyron magellanicum*, with *Festuca erecta*, *Phleum alpinum*, *Deschampsia flexuosa*, *Trisetum spicatum*, *Plantago maritima*, *Plantago barbata*, *Aster vahlii*, *Primula farinosa* ssp. *magellanica*, *Colobanthus quitensis*, *Azorella filamentosa*, *Cerastium arvense*, *Armeria macloviana* (*Armeria chilensis*, *Armeria andina*, *Armeria elongata*, *Armeria maritima*).
(Pisano, 1971b: 106, 109-110, 123, 125).

35.12 *Poa fuegiana-Baccharis-Senecio* grasslands
Open to very open pioneer communities formed by cespitose grasses with numerous chamaephytes on granitic moraines and substrates recently exposed by ice in the deciduous and evergreen Magellanic forest zones, with *Poa alopecurus* ssp. *fuegiana*, *Baccharis nivalis*, *Senecio cunneatus*.
(Pisano, 1971b: 115, 125).

35.2 Magellanic dry fescue grasslands

Dry grasslands occupying forest, scrub or heath clearings, open scrubs, coastal sands, gravels and rocks within the evergreen or deciduous *Nothofagus* forest zones of Tierra del Fuego and southern South America, dominated by *Festuca gracillima*, *Festuca magellanica* (*Festuca pyrogea*), *Festuca cirrosa* (*Festuca erecta*).
(Moore, 1983: 276).

36. TEMPERATE ALTI-ANDEAN GRASSLANDS

Primary and secondary grass- or sedge-dominated formations of the alpine and subalpine levels of the subantarctic and temperate Andes, north to the mediterranean Andes of Chile and the Cuyo Andes of Argentina.
(Oberdorfer, 1960: 143-146; Hueck and Seibert, 1972: units 81 *p.*, 82 *p.*; Roig, 1982: 62-67; Daniele and Natenzon, 1994: region 10).

36.1 Fuego-Andean alpine meadows

Streamside and seep communities of small forbs and grasses of the alpine, extrasylvatic level of the Patagonian Andes, at elevations generally above 500-600 metres.
(Moore, 1983: 31).

36.11 Fuego-Andean *Abrotanella* meadows
Matlike grasslands of the extra-sylvatic zone of the subantarctic Andes situated along stream margins or seepage areas, often derived from glaciers and slow-melting snow-patches, formed of *Abrotanella linearifolia*, *Caltha appendiculata* and *Plantago barbata*, with *Acaena antarctica, Acaena tenera*, *Caltha sagittata*, *Lagenifera nudicaulis*, *Ourisia fuegiana*, *Oxalis magellanica*, *Poa alopecurus* ssp. *fuegiana*, *Primula magellanica*, *Tapeinia obscura* and *Viola commersonii*.
(Moore, 1983: 31).

36.12 Fuego-Andean *Cardamine* meadows
Seep and streamside grasslands of the alpine level of the subantarctic Andes, developed on rocky substrates and coarse soils, with *Cardamine glacialis*, *Epilobium australe*, *Hamadryas magellanica*, *Nassauvia magellanica*.
(Moore, 1983: 31).

36.13 Fuego-Andean *Agrostis* meadows
Grasslands of the alpine, extrasylvatic level of the subantarctic Andes developed on marshy ground along sheltered streams and in seepage areas with impeded drainage, constituted by *Agrostis magellanica*, *Carex banksii*, *Carex magellanica*, *Carpha alpina*, *Cortaderia pilosa*, *Deschampsia atropurpurea*, *Rostkovia magellanica*, *Schoenus antarcticus*, *Uncinia kingii*, *Uncinia lechleri* and bryophytes. These communities may grade into *Sphagnum* bogs.
(Moore, 1983: 31).

36.2 Northern temperate alti-Andean grasslands

Grasslands of the alpine, extrasylvatic level of the mediterranean Andes of Chile, and the Cuyo Andes of Argentina, at latitudes comprised between 27°-28° S and 36°-38° S, in regions of mainly winter precipitation becoming progressively more abundant from north to south.
(Roig, 1982: 61-67; Gajardo, 1994: regions 2B8, 2B11, 2B12; Erize *et al.*, 1995: 163).

36.21 Northern temperate alti-Andean *Stipa* steppes
Dry grasslands of the alti-Andean level of the mediterranean Andes of Chile and of the Cuyo Andes of Argentina, at latitudes comprised between 27°-28° S and 36°-38° S, dominated by grasses of genus *Stipa*.
(Roig, 1982: 61-67, 70-71; Gajardo, 1994: regions 2B8, 2B11, 2B12).

36.211 *Stipa chrysophylla* mediterraneo-Andean steppes
Very dry *Stipa chrysophylla*-dominated grasslands of the alti-Andean level of the Cuyo Andes, of the Cuyo precordillera, of the Chilean Cordillera de Doña Ana and of the northern part of the Cordillera de Santiago. The accompanying cortège includes, in central Chile, *Adesmia remyana*, *Adesmia gayana*, *Calandrinia picta*, *Chaetanthera acerosa*, *Viola montagnei*, *Adesmia subterranea*, *Azorella*

madreporica, *Christaria andicola*, *Chaetanthera minuta*, *Gayophytum humile*, *Mentzelia pinnatifida*, *Oreopolus macranthus*, *Phacelia cumingii*, *Viviania marifolia*, and, in the Cuyo, *Senecio tricephalus*, *Oreopolus glacialis*, *Menonvillea spathulata*.
(Roig, 1982: 63-64, 66; Gajardo, 1994: unit 2B8-2B81, 2B11-2B81; Erize *et al.*, 1995: 163).

36.212 *Stipa lachnophylla* alti-Andean steppes
Steppic grasslands of the alti-Andean level of the northern temperate Andes, in particular, formations of the Cordillera de Santiago dominated by *Stipa lachnophylla*, with *Mulinum spinosum*, *Chuquiraga oppositifolia*, *Acaena splendens*, *Anarthrophyllum andicola*, *Tropeolum polyphyllum*.
(Gajardo, 1994: unit 2B11-2B113).

36.213 Temperate alti-Andean *Stipa speciosa*-*S. frigida* steppes
Very xeric grasslands of the alti-Andean level of the Cuyo Andes of Argentina dominated by *Stipa speciosa* and *Stipa frigida*, with *Adesmia nanolignea*.
(Roig, 1982: 61-67, 70-71).

36.214 Cuyo precordillera *Stipa* steppes
Dry grasslands of the alti-Andean level of the Cuyo precordillera, developed at altitudes mostly above 2500 metres, dominated by grasses of genus *Stipa*. *Stipa andina*, *Stipa speciosa*, *Stipa eriostachya*, *Stipa scirpea*, *Stipa vaginata*, *Stipa semperiana*, *Stipa ruiz*, *Stipa ameghinoi*, *Stipa tenuissima*, *Stipa paramilloensis* constitute, in single dominance or multiple dominance combinations, an array of formations of varied distribution or ecology.
(Roig, 1982: 61-67, 70-71).

36.22 Northern temperate alti-Andean vegas
Humid meadows of the alpine, extrasylvatic level of the mediterranean Andes characterized by the dominance of the endemic Argentine and Chilean Juncaceae *Patosia clandestina*.
(Gajardo, 1994: units 2B115, 2B121).

36.221 Central Chilean alti-Andean vegas
Humid meadows of the highest levels of the Andes of central Chile, in the Cordillera de Santiago and the Cordillera de Doña Ana, with *Juncus balticus* and *Patosia clandestina* accompanied by *Eleocharis albibracteata*, *Calamagrostis fulva*, *Calamagrostis rigescens*, *Carex gayana*, *Draba tenuis*, *Gentiana prostrata*, *Hordeum comosum*, *Xychloe andina*, *Plantago barbata*, *Poa holciformis*, *Trifolium polymorphum*, occasionally *Astragalus bustillosii*, *Mimulus depressus*, *Nastanthus caespitosus*.
(Gajardo, 1994: units 2B8-2B115, 2B11-2B115).

36.222 Maule alti-Andean vegas
Humid meadows of the highest levels of the Maule Andes, between about 35° and 37°S, in a region where the crestline of the chain is lower than in the north by some 1500 metres and communities are intermediate in floristic composition between the southern dry alti-Andean steppes and the formations of higher latitudes with higher precipitations and longer snow cover. The vega communities, harbouring relictual periglacial tundra elements, are constituted by *Patosia clandestina* and *Pernettya pumila* accompanied by *Juncus balticus*, *Gentiana prostrata*, *Plantago barbata*, *Nastanthus caespitosus* commonly *Calandrinia rupestris*, *Caltha appendiculata*, *Gayophytum humile*, *Hypochaeris acaulis*, *Mimulus lutens*, *Nastanthus scapiger*, *Ourisia alpina*, *Perezia lyrata*.
(Gajardo, 1994: unit 2B121).

36.23 Northern temperate Andean *Poa holciformis* grasslands
Mesic steppes of less sunny exposures of the Cuyo Andes of Argentina dominated by *Poa holciformis*.
(Roig, 1982: 63).

37. TEMPERATE HUMID GRASSLANDS AND TALL HERB COMMUNITIES

Wet meadows and large herb communities of the subantarctic, nemoral, warm-temperate humid, steppic and mediterranean zones of South America.

37.1 Pampean humid grasslands

Communities of flooded depressions and upper river banks of the Pampa region dominated by species of sedges, rushes, low or medium grasses of genera *Panicum* and *Paspalum*, robust tussock-forming or rhizomatous grasses, or tall Apiaceae of genus *Eryngium*.
(Vervoorst, 1967: 96-109; Walter, 1968: 680-704; Cabrera and Zardini, 1978: 5-7; Walter and Breckle, 1991c: 390, 392, 397, 398-399; Soriano *et al.*, 1992: 382-383, 385, 386, 387; Muñoz *et al.*, 1993: 25).

37.11 Pampean *Cyperus*-*Juncus* humid grasslands
Communities of flooded depressions of the Pampas, in particular, of the flooding pampas and the southern campos, dominated by species of *Cyperus* and *Juncus*, notably *Cyperus reflexus*, *Cyperus reflexus* var. *fraternus*, *Cyperus laetus* ssp. *oostachyus*, *Juncus microcephalus* var. *intermedius*, *Juncus microcephalus* var. *floribundus*, with, among others, *Carex bonariensis*, *Carex phalaroides*.
(Vervoorst, 1967: 119-126; Soriano *et al.*, 1992: 386).

37.12 Pampean *Panicum*-*Paspalum* humid grasslands
Grasslands of flooded depressions and upper river banks of the Pampas, in particular, of the flooding pampas, the shores of the Plata and the southern campos, dominated by low or medium species of *Panicum* and *Paspalum*.
(Vervoorst, 1967: 119-126; Cabrera and Zardini, 1978: 5; Soriano *et al.*, 1992: 382-383).

37.121 Plata riverbank *Paspalum*-*Panicum* grasslands
Low, dense, humid grasslands of the banks of the rio Plata, occupying sandy substrates inundated only during the highest floods, dominated by *Paspalum vaginatum* and *Panicum decipiens*, with other grasses and broad-leaved herbs.
(Cabrera and Zardini, 1978: 5).

37.122 Pampas depression *Panicum*-*Paspalum* grasslands
Communities of flooded depressions of the Pampas, in particular, of the flooding pampas and the southern campos, generally on clayey soils, dominated by low or medium species of *Panicum* and *Paspalum*, in particular, *Panicum milioides*, *Panicum gouini*, *Panicum sabulorum*, *Paspalum vaginatum*, *Paspalum distichum*, with *Paspalidium paludivagum*, *Stipa formicarum*, *Stipa bavioensis*, *Polypogon elongatus*, *Stenotaphrum secundatum*, *Gaudinia fragilis*, *Amphibromus scabrivalvis*, *Leersia hexandra*, *Agrostis hurgensii*, *Phalaris angusta*, *Glyceria multiflora*, *Deveuxia viridiflavescens*, Cyperaceae, Juncaceae and broad-leaved herbs.
(Vervoorst, 1967: 119-126; Soriano *et al.*, 1992: 382-383).

37.123 Pampean *Panicum prionitis* humid grasslands
Dense, rhizomatous grasslands occupying hydromorphic soils of the pampas, in particular of the southern Uruguayan pampas and the delta of the Parana.
(Cabrera and Zardini, 1978: 142; Walter and Breckle, 1991c: 399; Muñoz *et al.*, 1993: 25).

37.13 Pampean tall humid grasslands
Very tall grasslands dominated by robust tussock-forming or rhizomatous Poaceae, occupying hydromorphic soils of the pampas.

37.131 Pampean *Cortaderia* humid grasslands

Grasslands occupying hydromorphic soils of the pampas, in particular of the southern Uruguayan pampas and the southern pampa of Argentina, dominated by tussocks of the tall *Cortaderia selloana* (pampas grass), harbouring the small Apiaceae *Diposis saniculaefolia* and *Notiosciadium pampicola*.
(Walter and Breckle, 1991c: 398; Soriano *et al.*, 1992: 385-386; Muñoz *et al.*, 1993: 25).

37.132 Moist *Paspalum quadrifarium* pampas
Steppic grasslands of lowlying, moist areas of the rolling, flooding and southern Argentinian pampas, and, formerly at least, of the southern Uruguayan pampas, dominated by *Paspalum quadrifarium*.
(Vervoorst, 1967: 109-114; Walter, 1968: 699, 702-703; Cabrera and Zardini, 1978: 139; Soriano *et al.*, 1992: 382, 383, 386).

37.133 Pampean *Gynerium* humid grasslands
Grasslands of lowlying, moist areas of the southern Uruguayan campos dominated by *Gynerium argenteum*
(Muñoz *et al.*, 1993: 25).

37.14 Moist *Eryngium* pampas
Steppes of lowlying, periodically inundatable, areas of the pampa region, in particular, of the rolling and flooding Argentinian pampas, dominated by the very tall *Eryngium eburneum*, in pure stands or accompanied by *Eryngium serra*, *Eryngium elegans*, *Eryngium pandanifolium*, *Eryngium cabrerae*, *Apium leptophyllum*, *Gerardia communis*, *Castilleja communis*.
(Walter, 1968: 699; Cabrera and Zardini, 1978: 5, 459-461).

37.2 Andino-Patagonian humid grasslands

Humid grasslands of cool temperate regions of South America, including the steppes, semideserts and deserts of Patagonia, the Magellanic, Valdivian and low Andean evergreen and deciduous forest and scrub zones.

37.21 Western Patagonian mallines
Hygrophilous grasslands (mallines) occupying relatively broad valley bottoms and slopeside springs of the eastern foothills and piedmont of the Andes, within the Patagonian sub-Andean steppes and the western Patagonian semideserts, constituted of abundant *Juncus* species and sedges and grasses, including *Carex nebularum*, *Carex gayana*, *Carex argentina*, *Carex andina*, *Hordeum comosum*, *Poa annua*, *Agrostis pyrogea*, *Polypogon australis*, *Deschampsia antarctica*, *Koeleria mendocinensis*; *Colobanthus subulatus*, *Colobanthus crassifolius*, *Potentilla anserina*, *Vicia megellanica*, *Acaena magellanica*, *Azorella trifurcata*, *Plantago australis* ssp. *cumingiana*, *Gnaphalium pratense* participate in the densest, least disturbed mallines.
(Soriano *et al.*, 1983: 443; Walter and Breckle, 1991c: 412).

37.22 Southern Patagonian humid meadows
Oasis-like communities of sedges, grasses and forbs (vegas) occupying wet sites, such as along valleys and watercourses and in depressions, of southern Patagonia, often limited in extent, with a clay horizon below the surface, with various grasses and herbs dominant or predominating, usually with *Acaena magellanica*, *Anagallis alternifolia*, *Azorella caespitosa*, *Blechnum penna-marina*, *Caltha sagittata*, *Gentianella magellanica*, *Pratia longiflora*, *Calceolaria biflora*.
(Moore, 1983: 24-25; Soriano *et al.*, 1983: 443; Walter and Breckle, 1991c: 412; Coupland, 1992d: 365; Gajardo, 1994: unit 8B2-8B23).

37.221 Southern Patagonian humid grassy meadows
Humid grasslands of the Patagonian deserts, semideserts and steppes dominated by Poaceae or Juncaceae species, in particular, *Alopecurus magellanicus*, *Deschampsia antarctia*, *Deschampsia kingii*, *Deschampsia elegantula*, *Hierochloe redolens*, *Hordeum comosum*, *Agrostis pyrogea*, *Koeleria spp.*, *Trisetum spp.* (*Trisetum spicatum*), *Puccinellia magellanica*, *Juncus scheuchzerioides*.
(Moore, 1983: 24-25; Coupland, 1992d: 365; Gajardo, 1994: unit 8B2-8B23 *p.*).

37.222 Southern Patagonian humid sedge meadows

Humid grasslands of the Patagonian deserts, semideserts and steppes dominated by, or rich in, sedges, notably, *Carex acaulis*, *Carex curta*, *Carex darwinii*, *Carex subantarctica*.
(Moore, 1983: 24-25; Coupland, 1992d: 365; Gajardo, 1994: unit 8B2-8B23 *p.*).

37.23 Magellanic humid grasslands
Wet grasslands of the evergreen and deciduous forest and scrub zones of lowlands and hills of southernmost South America, developed on peaty or sandy ground, dominated by grasses or rushes.
(Moore, 1968, 1983; Pisano, 1971b: 110).

37.231 Magellanic evergreen forest humid grasslands
Humid grasslands of the southern evergreen *Nothofagus* forest zone, generally of limited extent, occupying forest openings and woodland margins particularly where there is some lateral water movement, near streams or by the sea, with *Poa alopecurus* ssp. *fuegiana*, *Poa robusta*, *Hierochloe redolens*, *Carex banksii*, *Deschampsia kingii*, *Cardamine glacialis*, *Senecio smithii*.
(Moore, 1983: 29).

37.232 Magellanic deciduous forest humid grasslands
Humid grasslands of the southern evergreen *Nothofagus* forest zone, occupying flatter areas where ground water approaches the surface, notably in parts of some river valleys, similar to grasslands of adjacent steppe areas, but with a species cortège characterized by, in particular, *Carex magellanica*, *Carex microglochin*, *Geum magellanicum*, *Senecio acanthifolius* and *Uncinia lechleriana*.
(Moore, 1983: 27).

37.233 Magellanic *Marsippospermum* humid grasslands
Grasslands of the Magellanic region, of wet sands and peaty substrates, in association with *Empetrum rubrum* dwarf wet heaths, dominated by *Marsippospermum grandiflorum*, characteristic, in particular, of periglacial scrub and heath zones.
(Pisano, 1971b: 110; Moore, 1983: 319; Gajardo, 1994: region 7C11).

37.24 Valdivian humid grasslands
Humid grasslands of the Valdivian forest zone with *Juncus procerus*, *Lotus corniculatus*, *Holcus lanatus*, *Agrostis tenuis*, *Dactylis glomerata*, *Trifolium repens*.
(Oberdorfer, 1960: 175-177; Gajardo, 1994: units 4B8-4B89, 5A1-4B89, 5A2-4B89, 5A3-4B89, 7A5-4B89).

37.25 Eastern Patagonian humid grasslands
Communities of sedges, grasses and forbs occupying wet sites, such as valley bottoms, within the Patagonian central and San Jorge Gulf deserts, characteristic, in particular, of the latter, with *Eleocharis albibracteata*, *Poa ligularis*, *Poa annua*, *Plagiobotrys calandrinioides*, *Myosurus apetalus*, *Veronica peregrina*, *Plantago myosurus*.
(Soriano *et al.*, 1983: 452).

37.26 Andino-Patagonian *Juncus scheuchzerioides* humid grasslands
Wet grasslands of the Magellanic region dominated by *Juncus scheuchzerioides*, forming most often on humid sands.
(Moore, 1968: 17, 18; Moore, 1983: 321-322).

37.27 Andino-Pacific forb communities
Hygrophile communities and woodland fringes of the Andino-Patagonian region and the Juan Fernandez Islands dominated by broad-leaved herbaceous plants.
(Murphy, 1936: 257; Pisano, 1971b: 116; Dimitri, 1972: 117; Dimitri, 1977: 5; Moore, 1983: 24-25; Erize *et al.*, 1995: 173).

37.271 Andino-Pacific *Gunnera* communities
Hygrophile communities of the Andino-Patagonian region and the Juan Fernandez Islands dominated by, or rich in, broad-leaved herbaceous plants of genus *Gunnera*.
(Murphy, 1936: 257; Pisano, 1971b: 116; Dimitri, 1972: 117; Dimitri, 1977: 5; Moore, 1983: 24-25).

37.2711 Andino-Patagonian *Gunnera magellanica* humid meadows

Humid meadows of the Andino-Patagonian region dominated by, or rich in, broad-leaved herbaceous plants, in particular, *Gunnera magellanica*, *Samolus spathulatus*, accompanied by *Acaena magellanica*, *Caltha sagittata*, *Aster vahlii*, *Blechnum penna-marina*.
(Pisano, 1971b: 116; Dimitri, 1972: 117; Dimitri, 1977: 5; Moore, 1983: 24-25).

37.2712 Andino-Patagonian *Gunnera chilensis* communities
Communities of very humid sites of the northern Andino-Patagonian region dominated by the very large leaved *Gunnera chilensis*.
(Dimitri, 1972: 117; Dimitri, 1977: 5, 94).

37.2713 Juan Fernandez *Gunnera* communities
Communities of the Juan Fernandez Islands dominated by very large leaved species of *Gunnera*, in particular, communities of very humid sites of the ravines of Mas a Tierra dominated by *Gunnera peltata*, of the highlands of Mas a Tierra dominated by *Gunnera bracteata*, and of canyons, higher slopes and high altitude shallow ravines of Mas Afuera dominated by *Gunnera masafuerae*.
(Skottsberg, 1922b: 147-151; Murphy, 1936: 257; Skottsberg, 1953a: 917-919, 940-942).

37.272 Andino-Pacific *Alstroemeria* fringes
Tall-herb woodland fringes of the Andino-Patagonian and Valdivian regions dominated by or rich in the Amaryllidaceae *Alstroemeria aurantiaca*, characteristic, in particular, of the ecotone between northern Andino-Patagonian forests and sub-Andean Patagonian steppes.
(Dimitri, 1977: 82; Moore, 1983: 24-25; Erize *et al.*, 1995: 173).

38. TEMPERATE MESOPHILE GRASSLANDS

Lowland and montane mesophile pastures and hay meadows of the subantarctic, nemoral, steppe, warm-temperate humid and mediterranean woodland zones of South America. Few or no native graminoid communities have formed on fertile soils at the expense of the southern South American forests and steppes under the effect of anthropogenic or zoogenic processes. Most of the nonsteppic mesophile pastures and hay meadows are exotic grasslands correctly placed in unit 8. A few may harbour a sufficient diversity of indigenous elements to be better listed in unit 38. The subdivisions have been introduced to harbour them.

38.1 Valdivian mesophile grasslands

Mesophile pastures and hay meadows of the Valdivian forest zone rich in indigenous species, in particular, native-species rich stands of the *Holcus-Agrostis* and *Sisymbrium-Dactylis* meadows.
(Oberdorfer, 1960: 164-175; Gajardo, 1994: units 4B8-4B85, 5A1-4B85, 5A3-4B85, 4B8-4B86, 5A1-4B86, 5A3-4B86).

38.2 Nemoral mesophile grasslands

Mesophile pastures and hay meadows of the Magellanic evergreen and deciduous forest zones rich in indigenous species, in particular, native-species rich stands of the *Taraxacum-Holcus* and *Holcus-Trifolium* meadows.
(Coupland, 1992d: 365; Gajardo, 1994: units 6B9-6B93, 7B6-7B65, 7B7-7B65).

3A. LOWLAND TROPICAL GRASSLANDS

Savanna grasslands, tropical seasonally flooded grasslands, tropical permanently flooded grasslands and tropical steppes, communities dominated by mostly tall grasses or grasslike species of tropical regions. They include all grasslands of lowland tropical South America, south to the Chaco, the Espinal, the Mesopotamian savannas and the northern Uruguayo-Brazilian campos, as well as the humid grasslands of the Monte.
(Koepcke, 1961: 139-140, 203-205; Schnell, 1971, 1987a, 1987b; Hueck and Seibert, 1972: units 1-15 *p.*, 23-24 *p.*, 28-32 *p.*, 33-44 *p.*, 46-50 *p.*, 52 *p.*, 54-61; Cabrera and Willink, 1980; Sarmiento, 1983; Huber and Alarcon, 1988; Rieley and Page, 1990; Coupland, 1992d; Burkart *et al.*, 1994; Daniele and Natenzon, 1994: regions 2, 3, 4, 5, 6, 7, 12; Carnevali, 1994; Archibold, 1995: 60, 64; Huber, 1995: 138-140).

3A.1 Northern South American tropical grasslands

Savanna grasslands, tropical seasonally flooded grasslands and tropical permanently flooded grasslands of the Orinoco basin and of the lowlands and coastal basins of Caribbean South America.
(Hueck and Seibert, 1972, 1981: units 59, 60, 61; Cabrera and Willink, 1980: 63-64; Sarmiento, 1983: 253-264; Schnell, 1987a: 419-437; Huber and Alarcon, 1988: units 11, 12, 18, 19, 22, 25, 26, 28, 29, 30, 31, 32, 36, 38, 45, 46, 47, 67, 68, 69, 77; Coupland, 1992d: 364; Huber, 1995: units 70, 71, 72, 73, 74, 75, 76).

3A.11 Colombo-Venezuelan llanos grasslands
Savanna grasslands, tropical seasonally flooded grasslands, tropical permanently flooded grasslands and tropical steppes of the sedimentary Orinoco basin, constituents of a vast and varied, mostly seasonal, partly hyperseasonal, savanna complex developed in Colombia and Venezuela, between the Andes and the Caribbean Cordilleras, in the west and north, and the Guianan shield, in the east and south, north of the Amazonian rain forest zone, under an alternatedly dry and wet tropical climate, with annual rainfall between 1000 and 2200 millimetres and one or two to five or six dry months.
(Hueck and Seibert, 1972, 1981: units 59, 60; Cabrera and Willink, 1980: 63-64; Medina and Sarmiento, 1981; Sarmiento, 1983: 253-263; Schnell, 1987a: 419-437; Huber and Alarcon, 1988: units 18, 19, 22, 25, 26, 28, 29, 30, 31, 32, 36, 38, 45, 67, 68, 69, 76, 77; Coupland, 1992d: 364; Huber, 1995: units 70, 71, 72, 73, 74, 75, 76; Archibold, 1995: 64).

3A.111 Andean piedmont llanos grasslands
Grasslands of the alluvial fans and alluvial terraces of the Andean piedmont of Colombia and Venezuela, for the most part seasonal, dominated by hard tussock grasses and sedges.
(Sarmiento, 1983: 254-257; Schnell, 1987a: 419-437; Huber and Alarcon, 1988: units 18, 19).

3A.1111 Andean piedmont seasonal llanos grasslands
Noninundatable grasslands of the alluvial fans and alluvial terraces of the Andean piedmont of Colombia and Venezuela, mostly developed on stony slopes.
(Sarmiento, 1983: 254-257; Schnell, 1987a: 419-437; Huber and Alarcon, 1988: unit 18).

3A.11111 Venezuelan Andean piedmont seasonal grasslands
Noninundatable grasslands of the Andean piedmont of Venezuela dominated by *Trachypogon plumosus* and *Axonopus canescens*.
(Sarmiento, 1983: 254-257; Huber and Alarcon, 1988: unit 18).

3A.11112 Colombian Andean piedmont seasonal grasslands
Noninundatable grasslands of the Andean piedmont of Colombia dominated by *Trachypogon vestitus*, *Trachypogon ligularis*, *Axonopus purpusii* or *Paspalum pectinatum*.

(Sarmiento, 1983: 255).

3A.1112 Andean piedmont hyperseasonal llanos grasslands
Hyperseasonal grasslands of low-lying ground of the Andean piedmont of Colombia and Venezuela, waterlogged during the rainy season.
(Sarmiento, 1983: 254-257; Huber and Alarcon, 1988: unit 19).

3A.11121 Venezuelan Andean piedmont hyperseasonal grasslands
Hyperseasonal grasslands of the Andean piedmont of Venezuela.
(Sarmiento, 1983: 254-257; Huber and Alarcon, 1988: unit 19).

3A.11122 Colombian Andean piedmont hyperseasonal grasslands
Hyperseasonal grasslands of the Andean piedmont of Colombia dominated by *Leptocoryphium lanatum*.
(Sarmiento, 1983: 255).

3A.112 Colombian-Venezuelan high plain grasslands
Grasslands of the high plains or mesas of the llanos savanna complex, developed on remnants of a formerly continuous tableland now composed of low plateaux deeply dissected by rivers, with a gently undulating surface or hilly relief, isolated mesas protected from erosion by hard lateritic layers and river terraces, occupying the Meta-Guaviare interfluve in Colombia, the piedmont of the Guianan shield and the central and eastern llanos of Venezuela.
(Sarmiento, 1983: 257-259; Schnell, 1987a: 419-437; Huber and Alarcon, 1988: units 22, 36, 38, 67, 68, 69, 76, 77; Huber, 1995: units 71, 72, 73, 74, 75, 76).

3A.1121 Colombian high plain grasslands
Grasslands of the high plains or mesas of the llanos savanna complex of Colombia, in the Meta-Guaviare interfluve, dominated by the sedge *Fimbristylis junciformis* (*Bulbostylis junciformis*) and the grasses *Leptocoryphium lanatum*, *Paspalum spp.*, *Trachypogon ligularis*, *Trachypogon vestitus*, *Trachypogon plumosus*.
(Sarmiento, 1983: 259, 261).

3A.1122 Central Venezuelan high plain grasslands
Grasslands of the high plains or mesas of central Venezuela, dense, about one metre tall, dominated by *Trachypogon plumosus*, *Axonopus aureus*, *Andropogon spp.*, *Panicum spp.*, *Leptocoryphium lanatum*, *Rhynchospora spp.*, *Fimbristylis spp.*.
(Sarmiento, 1983: 257-259; Huber and Alarcon, 1988: unit 22).

3A.1123 Eastern Venezuelan high plain grasslands
Grasslands of the high plains or mesas of eastern Venezuela, dominated by *Trachypogon plumosus*, *Trachypogon vestitus*, *Axonopus canescans*, *Axonopus spp.*, *Andropogon spp.*, *Leptocoryphium lanatum*, *Rhynchospora spp.*, *Fimbristylis paradoxa*.
(Sarmiento, 1983: 257; Huber and Alarcon, 1988: units 36, 38).

3A.1124 Guianan shield piedmont high plain grasslands
Grasslands of the high plains or mesas of the llanos savanna complex of the piedmont of the Guianan shield of Venezuela, mostly dominated by grasses of genus *Trachypogon*.
(Sarmiento, 1983: 259; Huber and Alarcon, 1988: units 67, 68, 69, 76, 77; Huber, 1995: 140-142, units 71, 72, 74, 75, 76).

3A.11241 Guianan shield piedmont seasonal grasslands
Seasonal grasslands of the high plains or mesas of the piedmont of the Guianan shield of Venezuela, dense, dominated by *Trachypogon plumosus*, *Axonopus canescans*, *Andropogon spp.*, *Aristida tincta*, *Aristida setifolia*, *Rhynchospora spp.*, *Fimbristylis spp.*.
(Sarmiento, 1983: 259; Huber and Alarcon, 1988: units 67, 68, 76; Huber, 1995: 140-142, units 71, 75).

3A.11242 Guianan shield piedmont hyperseasonal grasslands
Hyperseasonal grasslands of the high plains or mesas of the piedmont of the Guianan shield of Venezuela, mostly low and sparse, dominated by *Panicum caricoides*, *Panicum orinocanum*, *Panicum*

micranthum, *Paspalum plicatulum*, *Mesosetum rottboellioides* and sedges (*Rhynchospora spp.*, *Fimbristylis spp.*).
(Sarmiento, 1983: 259; Huber and Alarcon, 1988: units 69, 77; Huber, 1995: 140-142, units 72, 74, 76).

3A.113 Colombian-Venezuelan alluvial plain grasslands
Grasslands of the depression occupying the central part of the llanos, between the Andean piedmont and the high plains of the Guianan piedmont and of central Venezuela.
(Sarmiento, 1983: 259-262; Schnell, 1987a: 419-437; Huber and Alarcon, 1988: units 25, 26, 28, 29, 30).

3A.1131 Llanos alluvial plain seasonal grasslands
Seasonal grasslands occupying higher banks and levees within the depression of the central part of the llanos, dominated by *Axonopus purpusii* and *Paspalum plicatulum* or by *Sporobolus indicus* and *Imperata implicata*.
(Sarmiento, 1983: 259-262; Huber and Alarcon, 1988: unit 25 *p.*, 30 *p.*).

3A.1132 Llanos alluvial plain hyperseasonal grasslands
Hyperseasonal grasslands constituting the dominant community of the depression occupying the central part of the llanos of Colombia and Venezuela, between the Andean piedmont and the high plains of the Guianan piedmont and of central Venezuela, dominated by grasses of genera *Andropogon* and *Mesosetum*.
(Sarmiento, 1983: 259-262; Huber and Alarcon, 1988: units 25 *p.*, 30 *p.*).

3A.1133 Llanos alluvial plain estero grasslands
Grasslands occupying esteros or permanent swamps of the depression of the central part of the llanos of Venezuela, submitted to prolonged inundation under one metre or more of water during the rainy season, dense, tall, dominated by *Hymenachne amplexicolis*, *Leersia hexandra*, with *Luziola spruceana*, *Sorghastrum parviflorum*.
(Sarmiento, 1983: 259-262; Huber and Alarcon, 1988: units 26, 28, 30 *p.*).

3A.1134 Llanos alluvial riverine overflow grasslands
Grasslands of the central depression of the llanos of Colombia and Venezuela occupying land submitted to annual flooding by the overflow of rivers and streams, dense, up to two metres tall, dominated by *Paspalum fasciculatum*.
(Sarmiento, 1983: 259-262; Huber and Alarcon, 1988: unit 29).

3A.114 Colombian-Venezuelan aeolian plain grasslands
Grasslands of the aeolian landscape of the Meta and Cinaruco basins of Meta, Casanare, Arauca and southern Apure, with extensions eastwards in the high plains, constituted by dunes, interdunal depressions and silty plains.
(Sarmiento, 1983: 262-263; Schnell, 1987a: 419-437; Huber and Alarcon, 1988: units 31, 32).

3A.1141 Colombian-Venezuelan aeolian plain dune grasslands
Dry seasonal grasslands of the dunes of the aeolian plains of the Meta and Cinaruco basins, dominated by *Trachypogon ligularis* or *Trachypogon plumosus*, and by *Paspalum carinatum*.
(Sarmiento, 1983: 262-263; Huber and Alarcon, 1988: units 31 *p.*, 32).

3A.1142 Colombian-Venezuelan aeolian plain hyperseasonal grasslands
Hyperseasonal grasslands of interdunal depressions and silty plains of the aeolian plains of the Meta and Cinaruco basins, dominated by *Mesosetum spp. Paratheria prostrata* and *Axonopus affinis*.
(Sarmiento, 1983: 262-263; Huber and Alarcon, 1988: units 31 *p.*).

3A.115 Orinoco delta grasslands
Seasonally flooded grasslands of the upper and middle Orinoco delta, dominated by *Leersia hexandra* and *Imperata brasiliensis*.
(Huber and Alarcon, 1988: unit 45; Huber, 1995: unit 70).

3A.12 Caribbean grasslands
Savanna grasslands, tropical seasonally flooded grasslands, tropical permanently flooded grasslands and tropical steppes of isolated seasonal and hyperseasonal, savanna complexes of the Caribbean coasts, coastal basins and coastal low mountain slopes of northern South America, developed in the Rio Atrato basin and the middle Magdalena valley of Colombia, in the basin of Lake Maracaibo and on the coastal chains of Venezuela, on Trinidad.
(Hueck and Seibert, 1972, 1981: units 61, 60 *p.*; Sarmiento, 1983: 263-264; Huber and Alarcon, 1988: units 11, 12, 101, 104).

3A.121 Magdalena-Atrato grasslands
Savanna grasslands, tropical seasonally flooded grasslands, tropical permanently flooded grasslands and tropical steppes of the isolated seasonal and hyperseasonal savannas of the Rio Atrato basin and the middle Magdalena valley of Colombia.
(Hueck and Seibert, 1972, 1981: unit 61; Hueck, 1978: 143; Sarmiento, 1983: 263).

3A.122 Maracaibo grasslands
Savanna grasslands, tropical seasonally flooded grasslands, tropical permanently flooded grasslands and tropical steppes of isolated seasonal and hyperseasonal savannas of the basin of Lake Maracaibo, in Venezuela.
(Hueck and Seibert, 1972, 1981: unit 59 *p.*; Sarmiento, 1983: 263; Huber and Alarcon, 1988: units 11, 12).

3A.123 Caribbean cordillera grasslands
Grasslands of the savannas of the coastal chains of Venezuela, developed in the Serrania del Litoral at altitudes comprised between 800 and 1200 metres, on the southern slopes of the Avila range and between 40 and 600 metres in the valleys of Aragua, also widespread in the Serrania del Interior, with *Trachipogon plumosus*, *Axonopus pulcher*, *Andropogon selloanus*, *Sporobolus cubensis*. Some of them are strongly ruderalized.
(Sarmiento, 1983: 264; Huber and Alarcon, 1988: units 101, 104).

3A.124 Trinidad grasslands
Hyperseasonal savanna grasslands of Trinidad, in the Aripo Savanna, southeast of Arima, dominated by the grass *Paspalum pulchellum* and the sedge *Lagenocarpus tremulus*, harbouring, in particular, the insectivorous *Drosera capillaris* and *Utricularia spp.*.
(ffrench, 1976: 15; Sarmiento, 1983: 263).

3A.2 Guianan plateau grasslands

Savanna grasslands, tropical seasonally flooded grasslands, tropical permanently flooded grasslands and upland tropical forb meadows of the South American Guianan shield plateau in Venezuela, Guyana, Surinam, French Guiana and northeastern Brazil. They comprise two large ensembles, enclaved within northeastern Amazonian rain forest regions. A western ensemble is formed of the Gran Sabana of Venezuela, the savannas of the Pakairama Range foothills in northern Brazil, southeastern Venezuela and eastern central Guiana, the savannas of the upper Rio Branco basin of Brazil, the savannas of the Kanuku Mountains and upper Rupuni basin in southern Guyana. An eastern ensemble is centered on the Acari-Tumucumaque-Lombarda ranges and their spurs in southern Surinam and southern French Guiana. Smaller grassland regions prolong the western ensemble westwards in Venezuela.
(Hueck and Seibert, 1972, 1981: unit 57; Hueck, 1978: 83-84, 439; Cabrera and Willink, 1980: 67-69; Sarmiento, 1983: 264-267; Schnell, 1987a: 408-411; Huber and Alarcon, 1988: units 118, 119, 120, 121, 125, 129, 137, 142 *p.*, 146; Coupland, 1992d: 364; Huber, 1995: 147, 149-156, units 79, 80, 81, 82, 83, 84, 88, 89, 92, 96).

3A.21 Guianan plateau seasonal and semiseasonal grasslands
Noninundatable savanna grasslands of the South American Guianan shield plateau in Venezuela, Guyana, Surinam, French Guiana and northeastern Brazil, seasonal or semiseasonal, developed under tropical climates with a dry season of altitudinally variable length.

(Sarmiento, 1983: 265-267; Huber and Alarcon, 1988: units 118, 120, 121, 125, 137, 146; Huber, 1995: units 73, 79, 81, 82, 83, 84).

3A.211 Western Guianan plateau grasslands
Noninundatable savanna grasslands of the western part of the Guianan shield, forming an extensive ensemble in the Gran Sabana of Venezuela, the savannas of the Pakairama Range foothills in northern Brazil, southeastern Venezuela and eastern central Guyana, the savannas of the upper Rio Branco basin of Brazil, the savannas of the Kanuku Mountains and upper Rupuni basin in southern Guyana.
(Sarmiento, 1983: 265-267; Huber and Alarcon, 1988: units 118, 120 *p.*, 121, 125; Huber, 1995: units 73, 79, 81).

3A.2111 Western Guianan plateau upland grasslands
Noninundatable savanna grasslands of the middle altitudes, at levels around 900-1200 metres, of the western part of the Guianan shield, in southeastern Venezuela, northern Brazil, eastern central and southern Guyana, mostly developed on white sands, semiseasonal, with a short rainless season, dominated by grasses of genera *Axonopus*, *Panicum*, *Trachypogon*, *Echinolaena* and sedges of genera *Rhynchospora*, *Fimbristylis*, *Scleria*, in particular, *Axonopus pruinosus*, *Axonopus kaietukensis*, *Trachypogon plumosus*, *Echinolaena inflexa*, *Rhynchospora globosa*, *Fimbristylis paradoxa*, *Fimbristylis capillaris*, *Scleria cyperina*.
(Sarmiento, 1983: 265-267; Huber and Alarcon, 1988: units 118, 120, 121; Huber, 1995: units 79, 81).

3A.2112 Guianan tableland seasonal grasslands
Noninundatable seasonal savanna grasslands of the lower altitudes, at levels around 100-500 metres, of the western part of the Guianan shield, in southeastern Venezuela, northern Brazil, eastern central and southern Guyana, developed on lower tablelands, alluvial fans, upper river terraces, dominated by *Trachypogon plumosus*, with *Aristida tincta*, *Aristida setifolia*, *Axonopus canescans*, *Echinolaena inflexa*, *Leptocoryphium lanatum*, *Fimbristylis paradoxa*.
(Sarmiento, 1983: 267; Huber and Alarcon, 1988: unit 125; Huber, 1995: 141, unit 73).

3A.212 Parima-Guanay upland grasslands
Noninundatable savanna grasslands of the middle altitudes, at levels of 300-1000 metres, of isolated ranges of the westernmost part of the Guianan shield plateau in Venezuela, in particular, of the Sierra Parima and of the Cerro Guanay-Serrania del Santo ensemble, dominated by *Trachypogon plumosus*, *Axonopus canescens*, *Axonopus chrysites*, *Axonopus anceps*, *Panicum rudgei*, *Echinolaena inflexa*, *Paspalum lanciflorum*, *Rhynchospora barbata*, *Fimbristylis lanata*, *Fimbristylis capillaris*, *Scleria hirtella*, *Scleria bracteata*.
(Sarmiento, 1983: 265-267; Huber and Alarcon, 1988: units 137, 146; Huber, 1995: units 82, 83, 84).

3A.213 Eastern Guianan plateau grasslands
Noninundatable savanna grasslands of the eastern part of the South American Guianan shield plateau, developed around the Acari, Tumucumaque and Lombarda ranges of southeastern Guyana, southern Surinam and southwestern French Guiana, and of adjacent extreme northern Brazil.
(Hueck, 1978: 47-48; Sarmiento, 1983: 265-267).

3A.22 Guianan plateau hyperseasonal grasslands
Seasonally flooded savanna grasslands of river flats of the South American Guianan shield plateau in Venezuela, Guyana, Surinam, French Guiana and northeastern Brazil, with *Andropogon selloanus*, *Andropogon bicornis*, *Paspalum pulchellum*, *Paspalum densum*, *Paspalum millegrana*, *Panicum laxum*, *Sporobolus cubensis*, *Hypogynium virgatum* and sedges of genera *Rhynchospora* and *Fimbristylis*.
(Sarmiento, 1983: 267; Huber and Alarcon, 1988: unit 119; Huber, 1995: unit 80).

3A.23 Guianan upland forb meadows
Broad-leaved herb communities of uplands of the South American Guianan shield plateau in Venezuela, Guyana, Surinam, French Guiana and northeastern Brazil, developed, in large mountain systems, at generally lower altitudes than the highland and high tepui forb meadows of unit 3C.313. They occur, in particular, on the Gran Sabana plateaux, on the summit plateau of Cerro Guaiquinima, on the upland plateaux of interior Cerro Paru, on the lower summits of the tepuis of southern Amazonas. They are generally dominated by Rapataceae of genera *Stegolepis* or *Saxofridericia*.

(Sarmiento, 1983: 265; Huber and Alarcon, 1988: units 120 *p.*, 129, 142 *p.*, 150 *p.*; Huber, 1995: 150-156, units 88, 89, 92, 96).

3A.231 Gran Sabana upland forb meadows
Broad-leaved herb communities of uplands of the Gran Sabana plateaux of Venezuela, mostly dominated by the Rapataceae *Stegolepis ptaripuiensis* and *Stegolepis angustata*.
(Huber and Alarcon, 1988: unit 120 *p.*; Huber, 1995: 150, unit 88).

3A.232 Cerro Guaiquinima upland forb communities
Broad-leaved herb communities of uplands of the summital plateau of isolated Cerro Guaiquinima, in northern Bolivar, mostly dominated by the Rapataceae *Stegolepis squarrosa*.
(Huber and Alarcon, 1988: unit 129; Huber, 1995: 152, unit 89).

3A.233 Cerro Paru upland forb meadows
Broad-leaved herb communities of upland plateaux of interior Cerro Paru, in northern Venezuelan Amazonas, mostly dominated by the Rapataceae *Saxofridericia grandis*.
(Huber and Alarcon, 1988: unit 142 *p.*; Huber, 1995: 154, unit 92).

3A.234 Cerro Vinilla upland forb meadows
Broad-leaved herb communities of uplands of the lower summits of the tepuis of southern Venezuelan Amazonas, in particular, of Cerro Vinilla, at about 750 metres, where they are dominated by the Rapataceae *Saxofridericia spongiosa*.
(Huber and Alarcon, 1988: unit 150 *p.*; Huber, 1995: 155-156, unit 96).

3A.3 Guianan coastal grasslands

Savanna grasslands, tropical seasonally flooded grasslands and tropical permanently flooded grasslands of the coastal lowlands of northern South America in Guyana, Surinam, French Guiana and Amapa, occupying a narrow, discontinuous belt between the littoral swamps and the interior rain forest, developed on alluvial deposits, mostly coarse sands, under an annual rainfall of 2000-3000 milimetres and two to four relatively dry months.
(Hueck and Seibert, 1972, 1981: unit 50; Hueck, 1978: 83; Sarmiento, 1983: 267-269; Schnell, 1987a: 438-443).

3A.31 Guianan coastal semiseasonal grasslands
Well-drained dry or mesophile grasslands of the coastal lowlands of Guyana, Surinam, French Guiana and Amapa, mostly dominated by *Trachypogon plumosus* and *Leptocoryphium lanatum*.
(Sarmiento, 1983: 267-269).

3A.311 Guianan coastal white sand semiseasonal grasslands
Well-drained dry or mesophile grasslands of white sands of the coastal lowlands of Guyana, Surinam, French Guiana and Amapa, ecologically and floristically related to the white sand grasslands of the Amazon basin.
(Sarmiento, 1983: 267-269).

3A.312 Guianan coastal red soil semiseasonal grasslands
Well-drained savanna grasslands of red, more or less lateritic soils of the coastal lowlands of Guyana, Surinam, French Guiana and Amapa, ecologically and floristically related to the grasslands of the llanos and of the Guinan shield.
(Sarmiento, 1983: 267-269).

3A.32 Guianan coastal hyperseasonal grasslands
Seasonally flooded grasslands and permanently flooded grasslands of the coastal lowlands of Guyana, Surinam, French Guiana and Amapa, with *Andropogon spp.*, *Paspalum spp.*, in particular, *Paspalum pulchellum*, *Panicum stenodes*.
(Sarmiento, 1983: 267-269).

3A.4 Amazonian grasslands

Enclave grasslands and forb meadows of the Amazonian rain forest zone in the Amazonian basin and the southern, upper, Orinocan basin, distributed, in particular, on Ilha de Marajo, in the Rio Madeira-Rio Purus region, in the Rio Tocantins-Rio Gurupi region, in western Amazonia and in the Orinoco-Amazon interfluve region.
(Hueck and Seibert, 1972, 1981: units 1, 3, 4, 5, 8, 11, 14, 57 *p.*; Hueck, 1978: 43-44, 48-49, 54; Medina and Sarmiento, 1981: 632; Sarmiento, 1983: 269-271; Schnell, 1987a: 233-241; Huber and Alarcon, 1988: units 55, 56, 57; Huber, 1995: units 77, 78, 87; Archibold, 1995: 64-65).

3A.41 Amazonian semiseasonal grasslands
Noninundatable grasslands of openings within the Amazonian rain forest zone of the Amazonian and Orinocan basins, mostly developed on red soils, dense, fairly similar to llanos or Guianan shield seasonal grasslands, with *Trachypogon plumosus*, *Axonopus canescens*, *Panicum cervicatum*, *Mesosetum rottboellioides*, *Echinolaena inflexa*, sedges of genera *Rhynchospora*, *Fimbristylis*, *Scleria*, together with many forbs.
(Sarmiento, 1983: 269-271; Huber and Alarcon, 1988: unit 55; Huber, 1995: 143, unit 77).

3A.42 Amazonian hyperseasonal grasslands
Seasonally flooded grasslands of periodically waterlogged alluvial plains of the Amazonian rain forest zone of the Amazonian and upper Orinocan basins, with *Sorghastrum setosum*, *Panicum tricholaenoides*, *Echinolaena inflexa*, *Andropogon spp.*, sedges and forbs of families Rapataceae, Xyridaceae, Eriocaulaceae, Bromeliaceae, Orchidaceae.
(Sarmiento, 1983: 269-271; Huber and Alarcon, 1988: unit 56; Huber, 1995: 143-144, unit 78).

3A.43 Amazonian swamp grasslands
Grasslands of seasonal swamps of the varzea floodplains of the Amazonian basin rain forest zone dominated by tall grasses and sedges, including *Panicum fasciculatum*, *Echinochloa polystachya*, *Oryza perennis*, in large part floating and referable to unit 53.4.
(Sarmiento, 1983: 269-271; Junk, 1984a: 221, 227; Schnell, 1987a: 234).

3A.44 Amazonian white sands forb meadows and grasslands
Forb meadows and grasslands of white sands of the Amazonian and upper Orinocan basin rain forest zone, particularly prevalent in the upper Orinoco and Rio Negro river basins, highly varied in physiognomy, from low and sparse to dense and one metre tall, as well as in floristic composition, extremely rich in endemics, usually dominated by broad-leaved forbs, sometimes by sedges, rarely by grasses. The commonest dominants are Rapataceae of genus *Schoenocephalium* (*Schoenocephalium cucullatum*, *Schoenocephalium teretifolium*, *Schoenocephalium martianum*). Other frequent Rapataceae include species of genera *Monotrema*, *Cephalostemon*, and the endemic *Guacamaya superba*. Xyridaceae (*Xyris*, *Abolboda*), Eriocaulaceae (*Syngonanthus*, *Paepalanthus*, *Eriocaulon*), Cyperaceae (*Fimbristylis*, *Rhynchospora*, *Lagenocarpus*) are numerous. Grasses are represented by genera *Panicum*, *Axonopus* and by the bambusoid *Steyermarkochloa angustifolia*.
(Sarmiento, 1983: 269-271; Huber and Alarcon, 1988: unit 57; Huber, 1995: 148-149, unit 87).

3A.5 Brazilian shield savanna grasslands

Savanna grasslands, tropical seasonally flooded grasslands and tropical permanently flooded grasslands of the Brazilian shield, distributed principally in the Cerrados region of Mato Grosso, Mato Grosso do Sul, Rondonia, Goias, Minas Gerais, Tocantins, southeastern Para, southern Maranhao, western Bahia, extending northeastwards into the Caatinga region and eastwards into Paranean uplands, constituting the most extensive savanna grassland in South America, dominated by grasses of genera *Andropogon*, *Aristida*, *Paspalum* and *Trachypogon*.
(Hueck and Seibert, 1972: units 46, 48, 49, 55 *p.*, 56 *p.*; Cabrera and Willink, 1980: 56-60; Loureiro *et al.*, 1982; Sarmiento, 1983: 247-253; Renvoize, 1984: 3; Schnell, 1987a: 326-396; Schnell, 1987b: 20-21; Lewis, 1987: 6-9, plate 1; Coupland, 1992d: 364; Harley, 1995: 15-20; Archibold, 1995: 63-64).

3A.51 Cerrado seasonal grasslands
Noninundatable grasslands of the Brazilian shield constituting the most widespread grassland element of the cerrados, developed mostly on plateaux and hilltops, associated with a variable quantity of ligneous constituents to form the cerrado savannas of unit 96.5, floristicically rich and diverse. Grasses of genera *Andropogon*, *Axonopus*, *Ichnanthus*, *Paspalum*, *Aristida*, *Trachypogon*, *Panicum*, *Paratheria tristachya* are the main dominants, accompanyed by *Echinolaena inflexa*, *Leptocoryphium lanatum*, *Elyonurus latifolius*, sedges, forbs and subshrubs.
(Hueck and Seibert, 1972: units 46, 48, 49, 55 *p.*, 56 *p.*; Cabrera and Willink, 1980: 56-60; Loureiro *et al.*, 1982: 340, 343; Sarmiento, 1983: 247-253; Schnell, 1987a: 326-396; Schnell, 1987b: 20-21; Coupland, 1992d: 364; Harley, 1995: 18; Archibold, 1995: 63-64).

3A.52 Cerrado hyperseasonal and swamp grasslands
Seasonally flooded grasslands of the cerrado regions of the Brazilian shield, developed on poorly drained soils, mostly of valley sides, dispersed throughout the Brazilian shield region, although commoner in the transition zone to the Pantanal, constituting hyperseasonal grasslands where subjected to an alternance of waterlogging and severe drought, esteros or swamp grasslands where inundated for most of the year, submitted to short and relatively unpronounced droughts. They are mostly dominated by grasses, with a large representation of sedges and of broad-leaved forbs of families Commelinaceea, Costaceae, Eriocaulaceae, Heliconiae, Iridaceae, Rapataceae, Xyridaceae.
(Loureiro *et al.*, 1982: 344; Sarmiento, 1983: 247-253).

3A.6 Pantanal-Mojos savanna grasslands

Savanna grasslands, tropical seasonally flooded grasslands and tropical permanently flooded grasslands of the southwestern periphery of the Brazilian shield, distributed principally in the Mojos region of northeastern Bolivia and in the Pantanal area of western Mato Grosso and Mato Grosso do Sul and of extreme eastern Bolivia and northeastern Paraguay.
(Herzog, 1923: 110-129; Hueck and Seibert, 1972: units 47, 58; Loureiro *et al.*, 1982: 344; Sarmiento, 1983: 271-273; Schnell, 1987a: 397-399; Archibold, 1995: 65).

3A.61 Gran Pantanal grasslands
Savanna grasslands, tropical seasonally flooded grasslands and tropical permanently flooded grasslands of the Pantanal area of western Mato Grosso and Mato Grosso do Sul and of extreme eastern Bolivia and northeastern Paraguay, developed in a region of transition between the cerrado of the adjacent Brazilian shield and the Chaco. Seasonally flooded grasslands, with variable length of inundation, are the most prevalent grassland types in the Pantanal; uninundatable savanna grasslands are relatively rare.
(Hueck and Seibert, 1972: unit 58; Loureiro *et al.*, 1982: 344; Sarmiento, 1983: 271-272; Archibold, 1995: 65).

3A.611 Gran Pantanal seasonal grasslands
Noninundatable savanna grasslands of the Pantanal, uncommon, limited to interfluves, very similar, in floral composition, physiognomy and association with woody elements, to cerrado seasonal grasslands.

(Loureiro *et al.*, 1982; Sarmiento, 1983: 271-272).

3A.612 Gran Pantanal hyperseasonal grasslands
Seasonally flooded grasslands of the Pantanal subjected to an alternance of waterlogging and severe drought, mostly dominated by *Sorghastrum agrostoides*.
(Sarmiento, 1983: 271-272; Archibold, 1995: 65).

3A.613 Gran Pantanal swamp grasslands
Flooded grasslands of the Pantanal inundated for most of the year, submitted to short and relatively unpronounced droughts, dominated by tall grasses, mostly of genera *Paspalum* and *Panicum*.
(Sarmiento, 1983: 271-272; Archibold, 1995: 65).

3A.62 Mojos grasslands
Savanna grasslands, tropical seasonally flooded grasslands and tropical permanently flooded grasslands of the Mojos region of northeastern Bolivia, developed in a region of transition between the Amazon basin communities, the cerrado of the Brazilian shield and the Chaco, with isolated outposts enclaved in forest areas of the Madre de Dios, Beni, Mamore system, including the Pampa del Heath in the Rio Heath valley of extreme eastern Peru. Seasonally flooded grasslands are the most prevalent grassland types in the Mojos.
(Herzog, 1923: 110-129; Hueck and Seibert, 1972: unit 47; Parker *et al.*, 1982: 16; Sarmiento, 1983: 272-273; Schnell, 1987a: 397-399; Foster *et al.*, 1994: 65-74).

3A.621 Mojos seasonal grasslands
Noninundatable savanna grasslands of the Mojos, with *Andropogon lateralis*, *Andropogon agrostoides*, *Paspalum attenuatum*, *Paspalum chrisites*, *Panicum boliviense*, *Aristida boliviana*.
(Herzog, 1923: 114, 123-124; Sarmiento, 1983: 272-273; Schnell, 1987a: 398).

3A.622 Mojos hyperseasonal grasslands
Seasonally flooded grasslands of the Mojos subjected to an alternance of waterlogging and severe drought, mostly dominated by grasses of genera *Leersia*, *Panicum*, *Paspalum*, where flooding lasts for 5-10 months, or *Sporobolus*, *Axonopus*, *Andropogon*, *Trichachne*, with shorter flooding periods.
(Herzog, 1923: 124; Sarmiento, 1983: 272-273).

3A.623 Mojos swamp grasslands
Flooded grasslands of the Mojos, inundated for most of the year, submitted to short and relatively unpronounced droughts, dominated by tall grasses and sedges, with abundant forbs.
(Herzog, 1923: 81; Sarmiento, 1983: 272-273).

3A.7 Subtropical savanna grasslands

Mesic, hygrophile and inundatable grasslands of northern Argentina, southern Paraguay, southern Brazil and northern Uruguay, characteristic of the humid Chaco, the semiarid Chaco, the northern Espinal, the northern Campos, extending, on humid soils, into the arid Chaco, the Monte and the pre-Puna, developed under megathermic climate conditions, intermediate between tropical grasslands and warm humid temperate Pampa grasslands with a predominant tropical element; they are formed of tall or medium-tall grasses, generally cespitose, conferring to them a tall steppe physiognomy; mesic, hygrophile and inundatable variants are often dominated by the same graminoid species with varying forb, short grass and frutescent cortèges.
(Morello, 1958; Martinez-Crovetto, 1963; Ragonese and Castiglioni, 1968; Morello *et al.*, 1971; Hueck and Seibert, 1972: units 35, 37, 54, 63, *p.*; Morello and Adamoli, 1974; Burkart, 1975; Cabrera and Willink, 1980: 60-62, 69-70; Lewis and Pire, 1981; Soriano *et al.*, 1992; Muñoz *et al.*, 1993; Burkart *et al.*, 1994: 4-15, 22-23; Daniele and Natenzon, 1994: regions 2, 3, 4, 5, 6, 7, 12; Carnevali, 1994).

3A.71 Subtropical mesic savanna grasslands
Mesic grasslands of well-drained to excessively drained soils of the Chaco, the northern Espinal and the northern Campos of northeastern Argentina, southern Paraguay, southern Brazil and northern Uruguay.
(Ragonese and Castiglioni, 1968; Morello and Adamoli, 1974; Lewis and Pire, 1981; Soriano *et al.*, 1992; Muñoz *et al.*, 1993; Burkart *et al.*, 1994: 4-15; Carnevali, 1994: 274-275, 278, 279, 280-281).

3A.711 Subtropical tall steppic mesic grasslands
Mesic steppic pastizal grasslands of well-drained to excessively drained soils of the Chaco, the northern Espinal and the northern Campos of northeastern Argentina, southern Paraguay, southern Brazil and northern Uruguay dominated by tall cespitose grasses.
(Carnevali, 1994: 17).

3A.7111 Mesic *Elyonurus* grasslands
Open steppic two- or three-tiered grasslands of medium height dominated by *Elyonurus muticus*, comprised of grasses, often with shrubs and suffrutescents, with, in particular, *Baccharis coridifolia*,

Vernonia chamaedrys, *Eryngium horridum*, *Heimia salicifolia*, *Senecio grisebachii*, *Sporobolus indicus*, *Schizachyrium microstachyum*, *Sorghastrum agrostoides* in the upper layer, *Cnidoscolus loasoides*, *Rhynchosia corylifolia* in the intermediate layer and *Paspalum notatum*, *Axonopus spp.*, *Plantago spp.* in the lower layer, occupying gently rolling hills with well-drained soils of the Chaco, the Espinal and the northern Campos.
(Ragonese and Castiglioni, 1968: 145, 151; Morello and Adamoli, 1974: 94; Lewis and Pire, 1981: 20, 25-26; Burkart *et al.*, 1994: 6, 12; Carnevali, 1994: units 1, 44b, 49).

3A.7112 Mesic *Aristida jubata* grasslands
Steppic fairly open *Aristida jubata*-dominated grasslands of medium height occupying well-drained often sandy or lateritic soils of elevated areas, hills and eroded plateaux of the Parana-Uruguay plain. In well conserved formations, now very rare, the large dense tufts of *Aristida jubata* are the main constituents with only a small participation by a few other species including dispersed emergent shrubs; the regularly grazed formations, widespread, are characteristically more species-rich, often with scattered shrubs and suffrutescents such as *Schinus weinmanniaefolius*, *Senecio brasilianis*, *Vernonia chamaedrys*, *Baccharis coridifolia*, *Eryngium horridum* in a sparse upper layer, *Aristida jubata* predominating in the intermediate layer with a presence of a few other Poaceae species and lower strata of short stoloniferous grasses, perennial and annual herbs.
(Carnevali, 1994: unit 50).

3A.7113 Mesic *Andropogon* grasslands
Tall grasslands dominated by *Andropogon lateralis* on relatively well-drained, often sandy, reddish or stony soils of gentle slopes, elevations and hills of the humid Chaco, the northern Espinal and the Parana-Uruguay interfluve campos, with *Paspalum notatum*, *Axanopus affinis*, *Axanopus compressus*, *Schizachyrium microstachyum*, *Desmodium incanum* with a lesser participation of other grass, rush, cyperaceous and forb species and few shrubs, among which *Baccharis coridifolia*, *Vernonia chamaedrys*, *Eryngium horridum*, *Senecio grisebachii* are the most frequent. These formations are closed when undisturbed, a condition rarely found at present; they are characteristically less tall and discontinuous with openings between groups of grass tufts under grazing.
(Carnevali, 1994: units 2, 40a, 52).

3A.7114 Mesic *Sorghastrum* grasslands
Tall, open, steppic, well-drained grasslands of the northern Campos and the Chaco dominated by grasses of genus *Sorghastrum*, in particular, *Sorghastrum nutans* or *Sorghastrum agrostoides*.
(Ragonese and Castiglioni, 1968: 148; Carnevali, 1994: units 51, 53).

3A.7115 Subtropical *Erianthus trinii* grasslands
Grasslands of the central and northern sections of the Uruguayo-Brazilian pampas dominated by the tall *Erianthus trinii*, emerging from a lower stratum of *Axonopus compressus*, *Paspalum notatum* and *Paspalum plicatulum*, accompanied by *Piptochaetium stipoides* and *Sporobolus aeneus*.
(Soriano *et al.*, 1992: 387).

3A.7116 Mesic *Leptochloa chloridiformis* grasslands
Mesic steppic pastizal grasslands of well-drained soils of the Chaco, most characteristic of the southern Chaco, dominated by fairly tall, robust, *Leptochloa cloridiformis*.
(Ragonese and Castiglioni, 1968: 148; Lewis and Pire, 1981: 20, 33, 35).

3A.712 Subtropical mesic meadow grasslands
Mesic short, carpeting, pradera grasslands of well-drained soils of the Chaco, the northern Espinal, the Paranean region and the northern Campos of northeastern Argentina, southern Paraguay, southern Brazil and northern Uruguay.
(Carnevali, 1994: 17).

3A.7121 Mesic *Paspalum notatum* grasslands
Meadow grasslands of the Chaco, the Espinal and the extreme northern part of the Brazilian pampas, north of the Ibicui and Vacacai rivers, dominated by *Paspalum notatum*, resulting from the transformation of natural savanna grasslands by intense grazing and recurrent fires, often species-poor, low and open, with scattered tall grasses and shrubs.
(Soriano *et al.*, 1992: 387; Carnevali, 1994: units 3, 40b).

3A.7122 Mesic *Axonopus-Paspalum* grasslands
Meadow grasslands of the northern Campos formed by a fairly closed, low stratum of *Axonopus compressus* and *Paspalum notatum* with emergent robust forbs, subshrubs and grasses.
(Carnevali, 1994: unit 54).

3A.72 Subtropical humid savanna grasslands
Grasslands of hydromorphic, poorly drained, soils of the Chaco, the northern Espinal, the Paranean region and the northern Campos of northeastern Argentina, southern Paraguay, southern Brazil and northern Uruguay.
(Ragonese and Castiglioni, 1968; Morello and Adamoli, 1974; Lewis and Pire, 1981; Soriano *et al.*, 1992; Muñoz *et al.*, 1993; Burkart *et al.*, 1994: 4-15; Carnevali, 1994: 275, 278, 279, 281).

3A.721 Tall steppic humid subtropical grasslands
Pastizal grasslands of hydromorphic, poorly drained, soils of the Chaco, the northern Espinal, the Paranean region and the northern Campos of northeastern Argentina, southern Paraguay, southern Brazil and northern Uruguay dominated by tall cespitose grasses.
(Carnevali, 1994: 17, 275, 278, 279, 281).

3A.7211 Humid *Elyonurus* grasslands
Hygrophile grasslands dominated by *Elyonurus muticus* with *Paspalum notgatum*, *Axonopus affinis*, accompanied by *Centella hirtella* and *Hydrocotyle bonariensis*, and a great abundance in the middle and lower strata of sedges, notably of genera *Cyperus*, *Bulbostylis*, *Rhynchospora*, *Fimbristylis*, of the Chaco and the northern Espinal, occupying, in particular, sands and dunes of riverine origin.
(Morello and Adamoli, 1974: 94; Carnevali, 1994: 33-35, 143, 156-159, 161-164, units 4, 44a).

3A.7212 Humid *Andropogon* grasslands
Tall, hygrophile grasslands of the humid Chaco, the northern Espinal and the Paranean region, dominated by *Andropogon lateralis*, with *Axonopus affinis*, *Axonopus compressus*, *Paspalum notatum*, *Sorghastrum agrostoides*, *Sporobolus indicus*. It constitutes the most widespread humid grassland of the region, and also the most typical, capable of reaching a height of about two metres, often, particularly in the Paranean region, dotted by ant or termite hills.
(Carnevali, 1994: units 5, 41a, 55).

3A.7213 Humid *Sorghastrum* grasslands
Tall, hygrophile grasslands of the Chaco and the Paranean region, dominated by *Sorghastrum agrostoides*, often in almost pure, dense stands, allowing little undergrowth except mosses and nostoc algae.
(Morello and Adamoli, 1974: 94; Carnevali, 1994: units 6, 56).

3A.7214 *Aristida venustula* hyperseasonal grasslands
Short, open steppe grassland of the ñandubay district of the northern Espinal, notably on shallow soils over poorly drained substrates, dominated by *Aristida venustula* accompanied by *Paspalum notatum*, *Evolvulus spp.*, *Rhinchospora praecinta*; a very sparse, taller stratum is composed of *Sporobolus indicus* with, in particular, *Schizachyrium spicatum*, *Eragrostis lugens*.
(Carnevali, 1994: unit 43).

3A.722 Humid subtropical meadow grasslands
Short, carpeting pradera grasslands of hydromorphic, poorly drained, soils of the Chaco, the northern Espinal and the northern Campos of northeastern Argentina, southern Paraguay, southern Brazil and northern Uruguay.
(Carnevali, 1994: 17, 275, 278, 279, 281).

3A.7221 Humid and perhumid *Paspalum* meadow grasslands
Short, carpeting pradera grasslands of poorly drained, humid or very humid to somewhat inundatable soils of the Chaco and the northern Espinal of northeastern Argentina, southern Paraguay, southern Brazil and northern Uruguay dominated by grasses of genus *Paspalum*.

3A.72211 Humid *Paspalum* meadow grasslands

Low to medium pradera grasslands of poorly drained soils of the Chaco and the northern Espinal dominated by *Paspalum notatum*, *Paspalum almum*, *Paspalum distichum* or sometimes *Paspalum acuminatum* with an admixture of *Axonopus affinis*, *Axonopus compressus* or *Axonopus argentinus*.
(Morello and Adamoli, 1974: 95; Carnevali, 1994: units 7c, 7d, 41b).

3A.72212 Perhumid *Paspalum* meadow grasslands
Very humid to somewhat inundatable low pradera grasslands of hydromorphic soils of the periphery of waterbodies of the Chaco dominated by *Paspalum acuminatum*, *Paspalum lividum* or *Paspalum alcalinum*, sometimes with *Paspalum almum* or *Paspalum notatum*.
(Morello and Adamoli, 1974: 95; Carnevali, 1994: unit 8).

3A.7222 Humid *Axonopus* meadow grasslands
Short, carpeting pradera grasslands of hydromorphic, poorly drained, soils of the humid Chaco, the northern Campos and the bañados of the Espinal of northeastern Argentina, southern Paraguay, southern Brazil and northern Uruguay dominated by grasses of genus *Axonopus* (*Axonopus compressus*, *Axonopus affinis*, *Axonopus argentinus*) with *Paspalum almum*, *Paspalum notatum*.
(Carnevali, 1994: units 7a, 7b, 42 *p.*, 58).

3A.723 Subtropical malezal grasslands
Hyperseasonal savanna grasslands of the Chaco, the Espinal and the northern Campos with a reticulate microrelief formed of the juxtaposition of flat-topped, more or less polygonal, columns or pedestals supporting cespitose or carpeting grasslands and intervening erosion channels or rills harbouring a seasonal succession of aquatic, paludal and terrestrial communities. They are usually subjected to prolonged inundation, of the order of six months per year.
(Soriano *et al.*, 1992: 387; Carnevali, 1994: 47-49).

3A.7231 Malezal tall cespitose grasslands
Malezal grasslands of the Chaco, the Espinal and the northern Campos in which the columns or pedestals support steppe-like formations of tall cespitose grasses.
(Carnevali, 1994: 47-49).

3A.72311 Malezal *Andropogon* grasslands
Malezal grasslands of the humid Chaco, the Espinal, the northern Campos, dominated by *Andropogon lateralis*, accompanied on the pedestals by *Sorghastrum agrostoides*, *Schizachyrium microstachyum*, *Hypogynium virgatum*, *Paspalum spp.* and, in a lower stratum, *Axonopus affinis*, *Axonopus compressus*, *Panicum milioides*; the erosion channels carry, in particular, *Luziola peruviana*, *Eleocharis nodulosa*, *Eleocharis fistulosa*, *Eleocharis contracta*, *Eleocharis bonariensis*, *Ludwigia peploides*, *Nymphoides indica*; accompanying forbs, occurring either on the pedestals or in the rills include *Cuphea glutinosa*, *Polygala molluginifolia* and *Hydrocotyle bonariensis*.
(Soriano *et al.*, 1992: 387; Carnevali, 1994: units 10, 47, 59).

3A.72312 Malezal *Sorghastrum* grasslands
Malezal grasslands of the humid Chaco dominated by tall *Sorghastrum agrostoides*, with *Andropogon lateralis*, *Schizachyrium microstachyum* and, in the lower stratum, *Axonopus affinis*, *Axonopus compressus*, *Rhynchospora tenuis*, *Rhynchospora luzuliformis*.
(Carnevali, 1994: unit 11).

3A.72313 Malezal *Paspalum durifolium* grasslands
Malezal grasslands of the humid Chaco and northern Campos dominated by tall *Paspalum durifolium* with *Andropogon lateralis*, *Rhynchospora corymbosa*, *Sorghastrum agrostoides* and, in the lower stratum, *Axonopus affinis*, *Axonopus compressus*, *Panicum laxum*, *Rhynchospora emaciata*, *Rhynchospora tenuis*, *Rhynchospora barrosiana*.
(Carnevali, 1994: units 12, 60).

3A.7232 Malezal carpeting grasslands
Malezal grasslands with pedestals supporting carpeting grasslands of short rhizomatous or stoloniferous grasses, dominated by *Axonopus compressus*, *Axonopus affinis* or *Paspalum notatum*.
(Carnevali, 1994: units 13, 61).

3A.73 Subtropical swamp grasslands
Grasslands of semipermanently or permanently waterlogged soils, with prolonged seasonal inundation, of the Chaco, the northern Espinal, the northern Campos, the Monte, of northern Argentina, southern Paraguay, southern Brazil and northern Uruguay.
(Morello, 1958; Ragonese and Castiglioni, 1968; Morello *et al.*, 1971; Morello and Adamoli, 1974; Lewis and Pire, 1981; Soriano *et al.*, 1992; Muñoz *et al.*, 1993; Burkart *et al.*, 1994: 4-15, 22-23; Carnevali, 1994: 275-276, 278, 279-280, 281).

3A.731 Subtropical pajonal grasslands
Swamp grasslands og the Chaco, the northern Campos, the northern Espinal and the Monte dominated by tall or medium tall cespitose bunchgrasses, mostly tall, robust, species of genera *Paspalum* and *Panicum*.
(Morello, 1958; Ragonese and Castiglioni, 1968; Morello *et al.*, 1971: 48; Morello and Adamoli, 1974; Lewis and Pire, 1981; Soriano *et al.*, 1992; Muñoz *et al.*, 1993; Burkart *et al.*, 1994: 4-15, 22-23; Carnevali, 1994: 17).

3A.7311 Subtropical *Panicum* pajonales
Dense hygrophile grasslands of the Chaco, the northern Espinal, the northern Campos and the Monte overwhelmingly dominated by tall to very tall, robust species of genus *Panicum*.
(Carnevali, 1994: units 16, 17, 48 *p.*, 64, 65).

3A.73111 *Panicum grumosum-rivulare* pajonales
Tall, dense, hygrophile grasslands of the Chaco, the northern Espinal and the northern Campos dominated by the robust *Panicum grumosum* and *Panicum rivulare*, with a lesser presence of *Paspalum yaguaronense*, *Paspalum intermedium*, *Paspalum ovale*, *Paspalum urvillei*.
(Morello and Adamoli, 1974: 94; Carnevali, 1994: units 16, 48 *p.*, 64).

3A.73112 *Panicum prionitis* pajonales
Tall, dense, hygrophile grasslands of the Chaco, the northern Espinal and the northern Campos dominated by the robust *Panicum prionitis*, accompanied by other very tall, robust grasses, in particular, *Paspalum haumanii*, *Panicum tricholaenoides*, *Paspalum conspersum*, *Setraria friebrigii*.
(Morello and Adamoli, 1974: 94; Soriano *et al.*, 1992: 387; Muñoz *et al.*, 1993: 25; Carnevali, 1994: units 17, 48 *p.*, 65).

3A.73113 *Panicum chloroleucum* pajonales
Dense hygrophile grasslands of the Monte dominated by *Panicum chloroleucum*.
(Morello, 1958: 119).

3A.7312 Subtropical *Paspalum* pajonales
Swamp grasslands og the Chaco, the northern Campos and the northern Espinal dominated by tall or medium tall cespitose bunchgrasses of genus *Paspalum*.
(Soriano *et al.*, 1992: 387; Carnevali, 1994: units 14, 63, 66).

3A.73121 *Paspalum durifolium* pajonales
Tall, hygrophile grasslands of the humid Chaco, the northern Espinal and the northern Campos dominated by *Paspalum durifolium* with an admixture of *Rhynchospora corymbosa*, *Paspalum intermedium*, *Hypogynium virgatum*, *Andropogon lateralis* or *Rhytachne subgibbosa*.
(Carnevali, 1994: units 14, 48 *p.*, 63).

3A.73122 *Paspalum guaraniticum* pajonales
Tall, hygrophile grasslands of the northern Campos dominated by *Paspalum guaraniticum* with an admixture of *Rhynchospora corymbosa*, *Paspalum intermedium*, *Hypogynium virgatum*, *Andropogon lateralis* or *Rhytachne subgibbosa*.
(Carnevali, 1994: unit 66).

3A.73123 Uruguayo-Brazilian *Paspalum exaltatum* pajonales
Tall wet grasslands of soils subjected to extended flooding of the northern Uruguayo-Brazilian Campos dominated by the locally characteristic *Paspalum exaltatum*.
(Soriano *et al.*, 1992: 387).

3A.73124 Subtropical *Paspalum quadrifarium* pajonales
Grasslands of humid soils of valleys of the northern Uruguayo-Brazilian Campos dominated by the very tall *Paspalum quadrifarium*, accompanied by *Rottboellia selloana*, *Eriochloa punctata*, *Eragrostis bahiensis*, *Stipa philippii*, *Phalaris platensis* and the forbs *Eryngium echinatum*, *Verbena litoralis*, *Sisyrinchium spp.*.
(Soriano *et al.*, 1992: 387).

3A.73125 *Paspalum rufum* pajonales
Tall wet grasslands of soils subjected to extended flooding of the northern Uruguayo-Brazilian Campos and the northern Chaco dominated by *Paspalum rufum*.
(Morello *et al.*, 1971: 48; Morello and Adamoli, 1974: 94; Soriano *et al.*, 1992: 387).

3A.73126 *Paspalum haumani* pajonales
Tall wet grasslands of soils subjected to extended flooding of the northern Campos and the Chaco dominated by the extremely tall *Paspalum haumani*.
(Soriano *et al.*, 1992: 387; Carnevali, 1994: 59).

3A.73127 Subtropical *Paspalum fasciculatum* pajonales
Dense hygrophile grasslands of the northern Chaco dominated by the tall to very tall, robust, markedly tropical, *Paspalum fasciculatum*.
(Ragonese and Castiglioni, 1968: 148).

3A.73128 *Paspalum intermedium* pajonales
Dense hygrophile grasslands of the Chaco dominated by the tall to very tall, robust Chaco near-endemic *Paspalum intermedium*.
(Ragonese and Castiglioni, 1968: 148; Morello and Adamoli, 1974: 94).

3A.732 Subtropical *Luziola* and *Eleocharis* swamp grasslands
Grasslands rich in sedges of semipermanently flooded terrains of shallow depressions, poorly drained plains, basins, channels and lagoon complexes of the Chaco, the northern Campos and the summital plateaux of tabular hills of the northern Espinal.
(Carnevali, 1994: units 9, 42 *p.*, 62).

3A.7321 *Eleocharis* hygrophile grasslands
Swamp grasslands of the humid Chaco, the northern Campos with a more or less dense, 0.5-1 metre tall, stratum of *Eleocharis nodulosa*, *Eleocharis fistulosa*, *Luziola peruviana*, *Leersia hexandra* and a taller, very sparse stratum of *Rhynchospora corymbosa*, *Rhynchospora pringlei*.
(Carnevali, 1994: units 9, 62).

3A.7322 *Luziola* hygrophile grasslands
Swamp grasslands of the Chaco and the northern Campos dominated by *Luziola peruviana*, with *Eleocharis nodulosa*, *Rhynchospora pringlei*, *Eleocharis bonariensis*, *Eragrostris bahiensis*.
(Morello *et al.*, 1971: 49; Morello and Adamoli, 1974: 95; Carnevali, 1994: unit 9 var. 2).

3A.7323 Hilltop hygrophile grasslands
Low to medium, more or less dense, swamp grasslands of basins of the summital plateaux of tabular hills of the northern Espinal, dominated by species of *Eleocharis* (*Eleocharis nodosa*, *Eleocharis elegans*, *Eleocharis contracta*) accompanied by *Luziola leiocarpa*, *Panicum milioides*, *Rottboellia selloana*, with *Aster squamatus*, *Eregerostis bahiensis*, *Chloris polydactyla* and tufts of *Paspalum plicatulum*.
(Carnevali, 1994: unit 42 *p.*).

3A.733 *Rhynchospora-Axonopus* swamp grasslands
Swamp grasslands of the northern Campos, more or less dense, dominated by low to medium species of *Rhynchospora* (*Rhynchospora pringlei*, *Rhynchospora barrosiana*, *Rhynchospora tenuis*, *Rhynchospora globosa*, *Rhynchospora emaciata*) and *Axonopsis compressus*, accompanied by sparser, emergent, *Andropogon lateralis*.
(Carnevali, 1994: unit 57).

3A.8 Pacific tropical grasslands

Savanna grasslands, tropical seasonally flooded grasslands, tropical permanently flooded grasslands and tropical permanent steppes of the Pacific lowlands and pre-Andean slopes of tropical South America, including perennial grasslands of the transition regions between Pacific evergreen or semievergreen rain forest regions and Pacific coastal deserts and humid grasslands of the vicinity of the lower course and mouth of rivers of the desert zone of Peru. Ephemeral annual grasslands and forblands of desert zones, dependant on annual or irregular rains, very prevalent in northern Peru, where they constitute the grassy component of savannas, are excluded and listed under unit 74.34.
(Koepcke, 1954: 44-45; Koepcke, 1961: 139-140, 196-199, 203-205; Hueck and Seibert, 1972, 1981: units 33 *p.*).

3A.9 Oceanic tropical grasslands

Grasslands of tropical affinities of oceanic islands of the subtropical and tropical Atlantic and Pacific waters of South America.
(Skottsberg, 1922a: 63-76; Skottsberg, 1928: 492-495, 496-498).

3A.91 Polynesian oceanic grasslands
Grasslands of Easter Island, of Polynesian affinities, forming the main plant community on the island, distributed in particular in the coastal lava plains, on the volcano slopes and in the craters, dominated by *Sporobolus elongatus*, *Axonopus paschalis*, *Cyperus brevifolius* (*Kyllinga brevifolia*), *Stipa horridula*, *Paspalum scrobiculatum* or *Eragrostis elongata*.
(Skottsberg, 1922a: 63-76; Skottsberg, 1928: 492-495, 496-498).

3A.911 Easter Island *Sporobolus* grasslands
Grasslands of the coastal lava plains of Easter Island and of inside slopes of Easter Island craters, dominated by *Sporobolus elongatus*, sometimes associated with *Paspalum scrobiculatum*, which may locally co-dominate or even dominate.
(Skottsberg, 1922a: 63-76; Skottsberg, 1928: 494-495, 497, 498).

3A.912 Eastern Islands low slope *Sporobolus-Eragrostis* grasslands
Grasslands of the lower slopes of Easter Island, below 300 metres, dominated by the Polynesian *Eragrostis elongata* and *Sporobolus elongatus*.
(Skottsberg, 1922a: 63-76; Skottsberg, 1928: 497).

3A.913 Easter Islands high slope *Axonopus-Cyperus* grasslands
Grasslands of the higher slopes of Easter Island, at 300-400 metres, dominated by the endemic grass *Axonopus paschalis* with the tropical sedge *Cyperus brevifolius* (*Kyllinga brevifolia*).
(Skottsberg, 1922a: 63-76; Skottsberg, 1928: 497).

3A.914 Easter Island *Stipa* grasslands
Grasslands of the higher slopes of Easter Island, limited to a few stations on the western slope of mount Katiki, dominated by the endemic feathergrass *Stipa horridula*.
(Skottsberg, 1922a: 64; Skottsberg, 1928: 497).

3A.915 Easter Island *Cyperus* humid grasslands

Humid grasslands of the crater depression of Maunga Katiki, on Easter Island, developed on moist sandy soils, dominated by *Cyperus brevifolius* (*Kyllinga brevifolia*) with *Axonopus paschalis* and *Agrostis retrofracta*.
(Skottsberg, 1928: 498).

3A.92 Eastern Pacific islands tropical grasslands
Grasslands of the subtropical and tropical oceanic islands of the eastern Pacific, in particular, of the Galapagos Islands.

3A.93 Atlantic islands tropical grasslands
Grasslands of the subtropical and tropical oceanic islands of the South American waters of the Atlantic.

3B. TROPICAL SHRUBLANDS

Communities dominated by deciduous or evergreen shrubs associated with tropical and subtropical forests or lowland tropical savannas. They include all dry-land nonsaline shrublands of lowland tropical nondesert South America, as well as shrubs and thickets associated with mountain forests of unit 49 below the main timberline, riverine and inundatable thickets and scrubs associated with wet and moist forests of units 46, 47, 48 and 4A, wetland, nonsaline scrubs of dry woodland (unit 4B), savanna grasslands (unit 3A) and tropical or subtropical deserts (units 73, 74), scrubs and thickets of tropical affinities invading the transition zone between tropical woodland and desert regions or the warm temperate grassland regions enclaved in tropical and subtropical biomes.
(Koepcke, 1961: 141-142, 145-147, 154, 160, 165, 195-196; Hueck and Seibert, 1972, 1981; Hueck, 1978: 43-44, 47-48, 54; Daniele and Natenzon, 1994: regions 1, 2, 3, 4, 5, 6, 7, 11, 12, 13).

3B.1 Tropical rain forest mantles and regrowth

Communities dominated by deciduous or evergreen shrubs, subshrubs, small trees, canes, tall herbs forming a fringe on the edge of lowland tropical South American evergreen or semievergreen rain forest (units 46, 47, 48, 4A) stands or occupying their clearings.
(Hueck, 1978: 146).

3B.11 Tropical evergreen forest mantles and regrowth
Communities dominated by deciduous or evergreen shrubs, subshrubs, small trees, canes, tall herbs forming a fringe on the edge of tropical South American evergreen rain forest stands or occupying their clearings.
(Hueck, 1978: 146, 148).

3B.111 Tropical evergreen forest dry land mantles and regrowth
Communities dominated by deciduous or evergreen shrubs, subshrubs, small trees, canes, tall herbs forming a fringe on dry land edges of tropical South American terra firme rain forest stands or occupying their clearings.
(Hueck, 1978: 146).

3B.112 Tropical evergreen forest riverine mantles and regrowth
Communities dominated by deciduous or evergreen shrubs, subshrubs, small trees, canes, tall herbs forming a fringe on the riverside edge of tropical South American rain forest stands or occupying clearings of inundatable varzea or igapo forests.
(Hueck, 1978: 146).

3B.1121 Amazonian riverine thickets
Riverine shrub or tall shrub-dominated formations of permanently or seasonally inundated banks and floodplains of rivers of the Amazonian basin and adjacent northern South America.
(Ridgely and Tudor, 1989: 19; Schnell, 1987a: 237-238; Huber and Alarcon, 1988: unit 52).

3B.11211 Amazonian whitewater riverine thickets
Riverine shrub or tall shrub-dominated formations of permanently or seasonally inundated banks and floodplains of whitewater rivers of the Amazonian basin and adjacent northern South America, comprising a series of temporarily successional communities composed by canes of genus *Gynerium*, and tall shrubs or small trees of *Salix humboldtiana*, *Tessaria integrifolia* and of genus *Cecropia*, grading into varzea forest of unit 4A.
(Ridgely and Tudor, 1989: 19; Schnell, 1987a: 237-238).

3B.11212 Amazonian blackwater riverine thickets
Riverine tall shrub- and small tree-dominated formations of permanently or seasonally inundated banks and floodplains of blackwater rivers of the Amazonian basin and adjacent northern South America, grading into, or forming the fringe of igapo forest of unit 4A.
(Schnell, 1987a: 237-238; Huber and Alarcon, 1988: unit 52; Huber, 1995: 66).

3B.1122 Atlantic tropical evergreen forest riverine mantles
Communities dominated by deciduous or evergreen shrubs, subshrubs, small trees, canes, tall herbs forming a fringe on the riverside edge of Atlantic tropical South American evergreen rain forest stands.

3B.1123 Pacific tropical evergreen forest riverine mantles
Communities dominated by deciduous or evergreen shrubs, subshrubs, small trees, canes, tall herbs forming a fringe on the riverside edge of Pacific tropical South American rain forest stands.

3B.12 Tropical semievergreen forest mantles and regrowth
Communities dominated by deciduous or evergreen shrubs, subshrubs, small trees, canes, tall herbs forming a fringe on the edge of tropical South American semievergreen rain forest stands or occupying their clearings.
(Tressens &, 1994: 27, 29).

3B.121 Tropical semievergreen forest dry land mantles and regrowth
Communities dominated by deciduous or evergreen shrubs, subshrubs, small trees, canes, tall herbs forming a fringe on dry land edges of tropical or subtropical South American semievergreen rain forest stands or occupying their clearings.

3B.122 Tropical semievergreen forest riverine mantles
Communities dominated by deciduous or evergreen shrubs, subshrubs, small trees, canes, tall herbs forming a fringe on riverine edges of tropical or subtropical South American semievergreen rain forest stands.

3B.1221 Paranean semievergreen forest riverine thickets
Riverine shrub or tall shrub-dominated formations of permanently or seasonally inundated banks and floodplains of rivers of the Parana-Paraguay-Uruguay system, developed within the Paranean semievergreen forest zone or in association with riverine forests that prolong them.
(Tressens &, 1994: 27, 29).

3B.1222 Northern tropical semievergreen forest riverine mantles
Communities dominated by deciduous or evergreen shrubs, subshrubs, small trees, canes, tall herbs forming a fringe on riverine edges of northern South American and northern Amazonian semievergreen rain forests and riverine forests.

3B.2 Tropical xerophytic shrublands and savanna shrublands

Dry-land, nonsaline communities dominated by deciduous or evergreen shrubs associated with tropical and subtropical dry woodland (unit 4B) and seasonal, hyperseasonal or subseasonal savanna grasslands (unit 3A); dry-land scrubs and thickets of tropical affinities invading the transition zone between dry tropical woodland and desert regions or the warm temperate grassland regions enclaved in tropical and subtropical biomes.

3B.21 Caribbeo-Orinocan sclerophyllous scrubs
Dry-land, nonsaline, nondesert, shrublands of northern South America, in the Caribbean lowlands, the southern Caribbean islands and the Orinoco basin, associated with dry tropical woodland or with llanos seasonal and hyperseasonal savanna grasslands.
(Hueck and Seibert, 1972: units 41, 42, 59, 60; Caldera, 1985: 42; Huber and Alarcon, 1988: units 22, 38, 61).

3B.22 Southern tropical sclerophyllous scrubs

Dry-land, nonsaline shrublands of the Brazilian shield and its southwestern peripheral depressions associated with dry tropical woodland or with seasonal and hyperseasonal savanna grasslands.
(Hueck and Seibert, 1972, 1981: units 43, 44, 46, 47, 58; Sarmiento, 1983: 246-253).

3B.221 Caatinga scrub
Scrubs of the northeastern Brazilian shield, in the caatinga region, formed mostly by drought-deciduous shrubs, accompanied by cacti and terrestrial bromeliads. The species cortège usually includes a high representation of genera *Caesalpinia*, *Aspidosperma*, *Croton*, *Mimosa* and, in the ground layer, bromeliads of genera *Neoglazovia* and *Bromelia*.
(Hueck and Seibert, 1972, 1981: units 43, 44; Hueck, 1978: 319-340; Schnell, 1987b: 5-22; Walter and Breckle, 1991b: 120, 139, 206-207; Sampaio, 1995: 47, 49-50, 53).

3B.2211 Caatinga dense scrub
Moderately dry, fairly dense, shrubby caatinga formations dominated by woody, branching, largely drought-deciduous shrubs of genera *Caesalpinia*, *Aspidosperma*, *Jatropha*, constituting the dominant formation of plateau areas.
(Hueck, 1978: 319-340; Schnell, 1987b: 5-22; Lewis, 1987; Walter and Breckle, 1991b: 120, 139, 206-207; Sampaio, 1995: 47, 50).

3B.2212 Upland caatinga scrub
Scrubs and thickets of elevated areas within the caatinga region, relatively dense, developed in conditions of higher humidity than those of the surrounding plateau.
(Hueck, 1978: 325).

3B.2213 Caatinga open scrub
Dry open caatinga scrub, rich in succulents, formed by groups of shrubs, or sometimes isolated shrubs, of genera *Mimosa*, *Caesalpinia*, *Aspidosperma*, with cacti of genus *Pilosocereus* and grasses of genus *Aristida*.
(Hueck, 1978: 319-340; Schnell, 1987b: 5-22; Walter and Breckle, 1991b: 120, 139, 206-207; Sampaio, 1995: 47, 50).

3B.222 Cerrado scrub
Shrublands of the Cerrado region of the Brazilian shield associated with dry tropical woodland or with seasonal and hyperseasonal savanna grasslands.
(Walter and Breckle, 1991b: 120, 137-140).

3B.23 Guiano-Amazonian sclerophyllous scrubs
Dry-land, nonsaline shrublands of the Amazonian basin and of the Guianan shield associated with dry tropical woodland, with white sand woodland or with seasonal and hyperseasonal savanna grasslands.
(Hueck and Seibert, 1972, 1981: unit 15; Hueck, 1978: 57, 62-67, 82-86).

3B.231 Guianan dry scrub
Dry-land, nonsaline shrublands of the Guianan shield and its piedmont associated with dry tropical woodland or with seasonal and hyperseasonal savanna grasslands.
(Huber and Alarcon, 1988; Huber, 1995: 141, unit 71).

3B.232 Amazonian white sand thickets
Dry-land, nonsaline shrublands of the Amazonian basin associated with white sand woodland or white sand grasslands, formed by shrubs of, in particular, genera *Byrsonima*, *Clusia*, *Couepia*, *Humiria*, *Ilex*, *Macrolobium*, *Myrcia*, *Ouratea*, *Pagamea*, *Protium*, *Retiniphyllum*, *Gaylussacia* (*Gaylussacia amazonica*) and acaulous palms, associated with *Dimorphandra vernicosa*, and with *Dimorphandra campinarum*, *Eperua campestris*, *Hirtella ulei*, *Hirtella punctillata*, *Leucothoe duckei*, *Peltogyne campestris*, *Swartzia arenicola*, *Sauvagesia duckei* and *Sphagnum spp.*.
(Schnell, 1987a: 236-237; Huber and Alarcon, 1988: unit 54; Huber, 1995: 136-137, units 64, 65).

3B.2321 Dry Amazonian campinas
Scrubs and dune-like elevations of white sands constituted by small-shrub islands separated by patches of bare sand, generally rich in lichens of genus *Cladonia*.
(Schnell, 1987a: 236-237; Huber and Alarcon, 1988: unit 54; Huber, 1995: 136, unit 64).

3B.2322 Humid Amazonian campinas
Scrubs of low mounds and ridges of seasonally flooded white sand areas constituted by *Burmannia spp.*, *Schizaea spp.*, *Utricularia spp.*, Eriocaulaceae and Xyridaceae.
(Schnell, 1987a: 236-237; Huber, 1995: 137, unit 65).

3B.24 Andino-Pacific sclerophyllous scrubs
Dry-land, nonsaline shrublands of the tropical Pacific lowlands of continental South America, in the transition zone between tropical forests and coastal deserts, of the Pacific tropical islands, and of dry interior valleys of the tropical Andes, associated with dry tropical woodland or with seasonal and hyperseasonal savanna grasslands.

3B.241 Pacific tropical scrubs
Shrublands of the tropical Pacific lowlands of continental South America, in the transition zone between tropical forests and coastal deserts, and of the Pacific tropical islands, associated with dry tropical woodland or with seasonal and hyperseasonal savanna grasslands.
(Koepcke, 1961: 141-142, 145-147, 154, 160, 165, 195-196; Wiggins and Porter, 1971: 19-22; Hueck and Seibert, 1972: unit 33).

3B.2411 Pacific coastal sclerophyllous scrubs
Shrublands of the tropical Pacific lowlands of continental South America, in the transition zone between tropical forests and coastal deserts, associated with dry tropical woodland or with seasonal and hyperseasonal savanna grasslands.
(Koepcke, 1961: 141-142, 145-147, 154, 160, 165, 195-196; Hueck and Seibert, 1972: unit 33).

3B.2412 Galapagan dry scrub
Dense scrubs and thickets of the arid zone and transition zone of the tropical Pacific Galapagos Islands, forming a transition between more open, desert communities of the arid zone and open or closed dry tropical woodland of the transition zone and of favourable locations within the arid zone.
(Wiggins and Porter, 1971: 19-22).

3B.242 Inner Andean tropical scrubs
Shrublands of dry interior valleys of the tropical Andes, associated with dry tropical woodland or with seasonal and hyperseasonal savanna grasslands.

3B.25 Chacoan tropical and subtropical scrubs
Dry-land, nonsaline or weakly saline shrublands of the Chaco and its regions of influence associated with dry tropical woodland, with seasonal and hyperseasonal savanna grasslands or extending into warm-humid temperate grasslands regions. They include tropical shrublands of the Chaco proper and its transition regions towards the Monte, the Pantanal or the Pampas, including the Espinal, as well as shrublands of Chacoan affinities of the warm-humid temperate Pampa grassland region. Pampa grasslands are usually, and probably correctly, treated as temperate steppes; they have been included in unit 34 (34.1). The woodlands are of clear Paranean or Chacoan affinities; they have been included in units 4B and 4A (4B.6, 4A.3). The shrublands offer a more complex spectrum. Some, particularly in the northern part of the region, include many tropical genera or species and may be included in 3B.25. A few communities, similar in physiognomy to Andino-Patagonian or mediterraneo-Chilean scrubs and dominated by species of southern affinities or by Pampean endemic species have been included in unit 32.6. Chacoan scrubs harbour a number of Chacoan endemic species, in particular, among mammals, the cavy *Pediolagus salinicola* and several species of tuco-tucos of genus *Ctenomys*.
(Morello, 1958; Ragonese and Castiglioni, 1968; Morello and Adamoli, 1974; Hueck and Seibert, 1972, 1981: units 34, 35, 36, 37, 38, 40 *p.*, 45; Hueck, 1978; Cabrera and Willink, 1980; Lewis and Pire, 1981; Schnell, 1987b; Walter and Breckle, 1991b: 120; Redford and Eisenberg, 1992; Burkart &, 1994; Carnevali, 1994; Ceballos, 1995).

3B.251 Chacoan fruticose scrubs
Dry-land, nonsaline or weakly saline nondesert scrubs and thickets of the Chaco and its regions of influence, including the regions of transition of the Chaco to the Monte, the Pantanal, the Mojos or the Pampas, the Espinal and the Pampa dominated by dicotyledonous, branched, woody shrubs of Chacoan affinities.

(Morello, 1958; Ragonese and Castiglioni, 1968; Morello and Adamoli, 1974; Hueck, 1978; Cabrera and Willink, 1980; Lewis and Pire, 1981; Schnell, 1987b; Burkart &, 1994; Carnevali, 1994)

3B.2511 Chacoan leguminous thorn scrub
Dry-land, nonsaline or weakly saline nondesert scrubs and thickets of the Chaco and its regions of influence dominated by thorny shrubs of genera *Acacia* or *Prosopis*, notably *Acacia caven*, *Prosopis algarrobilla*, *Prosopis nigra*.
(Morello, 1958; Ragonese and Castiglioni, 1968; Morello and Adamoli, 1974: 117, 119; Hueck, 1978; Cabrera and Willink, 1980; Lewis and Pire, 1981; Schnell, 1987b; Burkart &, 1994; Carnevali, 1994)

3B.2512 Chacoan Asteraceae scrub
Dry-land, nonsaline or weakly saline nondesert scrubs and thickets of the Chaco and its regions of influence dominated by composite shrubs of, in particular, genera *Baccharis* or *Heterothalamus*.
(Ragonese and Castiglioni, 1968: 154; Morello and Adamoli, 1974: 118).

3B.25121 Chacoan *Baccharis notosergila* scrub
Scrubs and thickets of the Chaco and its regions of influence dominated by *Baccharis notosergila*, characteristic, in particular, of the outer rim of basins.
(Morello and Adamoli, 1974: 118).

3B.25122 Chacoan *Heterothalamus* scrub
Scrubs and thickets of the western Chaco dominated by *Heterothalamus allionis*, characteristic of the slopes of the Sierras Pampeanas.
(Ragonese and Castiglioni, 1968: 154).

3B.252 Chacoan palm scrub
Dry-land, nonsaline or weakly saline nondesert scrubs and thickets of the Chaco and its regions of influence, including the regions of transition of the Chaco to the Monte, the Pantanal, the Mojos or the Pampas, the Espinal and the Pampa dominated by shrubby palms.
(Ragonese and Castiglioni, 1968; Morello and Adamoli, 1974; Hueck, 1978; Cabrera and Willink, 1980; Lewis and Pire, 1981; Schnell, 1987b; Burkart &, 1994; Carnevali, 1994)

3B.2521 *Butia paraguayensis* palm scrub
Rare relict *Butia paraguayensis* palm scrubs of the humid Chaco and the northern Campos, in particular, of riverine dunes of the Parana in the extreme eastern humid Chaco and of hills of the northern Uruguayan campos.
(Muñoz &, 1993: 28; Carnevali, 1994: unit 27b, 162-163).

3B.2522 *Trithrinax* palm scrub
Scrubs of the Chaco and its regions of influence, including the regions of transition of the Chaco to the Monte, the Pantanal, the Mojos or the Pampas dominated by shrubby palms of genus *Trithrinax*.
(Morello and Adamoli, 1974: 46; Muñoz &, 1993: 29).

3B.25221 *Trithrinax campestris* palm scrub
Scrubs of the southern Chaco and its regions of influence, including the regions of transition of the Chaco to the Monte, the Uruguayan campos, along the Rio Uruguay, or the Pampas dominated by the subtropical shrubby palm *Trithrinax campestris*.
(Morello and Adamoli, 1974: 46; Muñoz &, 1993: 29).

3B.25222 *Trithrinax biflabellata* palm scrub
Scrubs of the northern Chaco, in Formosa, northern Chaco and southern Paraguay, and, very locally, of the northern campos, dominated by the tropical shrubby palm *Trithrinax biflabellata*.
(Morello and Adamoli, 1974: 46; Muñoz &, 1993: 29).

3B.253 Chacoan succulent scrubs
Dry-land, nonsaline or weakly saline nondesert scrubs and thickets of the Chaco and its regions of influence, including the regions of transition of the Chaco to the Monte, the Pantanal, the Mojos or the Pampas, the Espinal and the Pampa dominated by succulents, mostly cacti.

(Morello, 1958; Ragonese and Castiglioni, 1968; Morello and Adamoli, 1974; Hueck, 1978; Cabrera and Willink, 1980; Lewis and Pire, 1981; Schnell, 1987b; Burkart &, 1994; Carnevali, 1994)

3B.3 Montane tropical thickets

Communities dominated by deciduous or evergreen shrubs associated with tropical mountain forests of unit 49 below the main timberline.

3B.31 Tropical Andean montane thickets
Scrubs and thickets associated with lower montane rain forests, upper montane rain forests, cloud forests, montane deciduous woodland, montane conifer woodland of the tropical Andes.
(Hueck and Seibert, 1972: units 17-19, 20-22).

3B.311 Southern Andean tropical montane thickets
Communities dominated by deciduous or evergreen shrubs of tropical or subtropical evergreen, semievergreen or semideciduous montane and cloud forests of the eastern flank of the southern tropical Andes, extending from the Andean bend in Bolivia, at about 18°S latitude, to Tucuman, at about 28°S, at altitudes above 500-600 metres.
(Herzog, 1923: 129-139; Hueck and Seibert, 1972, 1981: units 17, 20 *p.*; Erize &, 1995: 49, 56).

3B.312 Central Andean montane thickets
Communities dominated by deciduous or evergreen shrubs of tropical or subtropical moist and wet forest zones of lower slopes of the central tropical Andes, in particular, relatively open humid scrub formations in the valleys of the lower montane forest of the Eastern Peruvian slope of the Andes, with shrubs of genera *Piper* and *Sanchezia*, among others, more or less isolated trees comprising Bombacaceae, *Cecropia spp.*, *Erythrina spp.*, *Sapium spp*. and *Triplaris spp.*, palms of genera *Bactris*, *Euterpe* and *Iriartea* and vines such as *Mucuna*.
(Koepcke, 1961: 141-142, 145-147, 154, 160, 165, 195-196; Schnell, 1987a, 1987b).

3B.313 Northern Andean montane thickets
Communities dominated by deciduous or evergreen shrubs of tropical or subtropical moist and wet forest zones of lower slopes of the northern tropical Andes.
(Huber and Alarcon, 1988: unit 84).

3B.32 Brazilian Atlantic montane thickets
Scrubs and thickets associated with lower montane rain forests, upper montane rain forests, cloud forests and montane conifer woodland of the Serra do Mar and its associated ridges and plateaux of southern Brazil and northern Argentina.
(Hueck and Seibert, 1972: units 25, 32; Sick and Teixeira, 1979; Snow, 1982).

3B.33 Guianan montane thickets
Scrubs and thickets associated with lower montane rain forests, upper montane rain forests, cloud forests, montane palm forests of the mountains of the Guiana Highlands, in particular, of the Tepuis of southern Venezuela, western Guyana, southeastern Colombia and northern Brazil.
(Hueck and Seibert, 1972: unit 27; Henderson, 1995: 13).

3B.34 Southern Caribbean montane thickets
Scrubs and thickets associated with montane forests of low, small, isolated mountain ranges of northern Colombia, continental Venezuela and the southern Lesser Antillean islands, occurring, in particular, in the Serrania de Macuira in Guajira, in the Peninsula de Paraguana, and nearby Sierra de San Luis, the central Cordillera de la Costa of Venezuela, the Cordillera de Caripe, the Paria peninsula, Margarita Island and Trinidad.
(Huber and Alarcon, 1988: units 93, 94, 95, 98, 99, 103, 107, 108, 109, 111; Prance, 1989: 115-117; Walter and Breckle, 1991a: 205-206, 211-213).

3B.35 Peri-Amazonian montane thickets
Scrubs and thickets associated with montane forests of isolated ranges of the periphery of the Amazonian rain forest region, including those of interior mountains of the Brazilian shield.

(Hueck and Seibert, 1972: unit 16; Prance, 1989: 115-117).

3B.36 Oceanic cloud forest thickets
Scrubs and thickets associated with montane cloud forests of oceanic islands, in particular, thickets of the *Scalesia* cloud forest belt of the Galapagos archipelago, developed at altitudes extending from 180-200 metres to 400-550 metres.
(Wiggins and Porter, 1971: 22-24; Schnell, 1987b: 229; Walter and Breckle, 1991b: 266).

3B.37 Montane bamboo thickets
Montane bamboo woodland of the Andes, the Serra do Mar and its associated plateaux and ridges, the Guianan mountains and other isolated mountain ranges of South America, formed by species of genera *Chusquea* or *Merostachys*.

3B.371 Tropical Andean *Chusquea* thickets
Montane bamboo woodland and thickets of the high levels of the tropical Andes dominated by species of genus *Chusquea*, occurring in clearings of cloud forests, notably of *Podocarpus* forests, and, locally, in extrasylvatic areas, in particular, in the paramo of the Colombian Andes where the constituting species is *Chusquea weberbaueri*.
(Hueck, 1978; Schnell, 1987b: 101).

3B.372 Atlantic montane *Merostachys* thickets
Tall, 5-10 metre high thickets formed by *Merostachys multiramea* in the environment of the *Araucaria angustifolia* forests of southern Brazil and northern Argentina.
(Schnell, 1987a: 297, 301).

3B.4 Tropical and subtropical hygrophile scrubs

Scrubs and thickets of tropical affinities of nonsaline wet or inundatable land associated with dry tropical or subtropical woodland (unit 4B), savanna grasslands (unit 3A) and tropical or subtropical deserts (units 73, 74), dominated by deciduous or evergreen shrubs, tall shrubs or subshrubs, distributed, in South America, south to the southern limits of the Pacific coastal deserts, of the low slopes of the tropical Andes, and of the tropical or subtropical Monte desert, including the Pampa and Espinal, regions of co-occurrence of warm temperate grasslands and of predominantly tropical woodlands and scrublands.

3B.41 Northern tropical hygrophile scrubs
Scrubs and thickets of nonsaline wet or inundatable land associated with dry tropical or subtropical woodland (unit 4B), savanna grasslands (unit 3A) and tropical or subtropical deserts (units 73, 74), dominated by deciduous or evergreen shrubs, tall shrubs or subshrubs of the Caribbean and Orinocan northern peri-Amazonian regions of South America.

3B.42 Southern tropical and subtropical hygrophile scrubs
Scrubs and thickets of tropical affinities of nonsaline wet or inundatable land associated with dry tropical or subtropical woodland (unit 4B), savanna grasslands (unit 3A) and tropical or subtropical deserts (units 73, 74), dominated by deciduous or evergreen shrubs, tall shrubs or subshrubs of the Brazilian shield, its southwestern borderlands, the Chaco and its regions of influence, south to the Monte deserts and semideserts, the Espinal and the Pampa.

3B.421 Southern tropical and subtropical hygrophile shrublands
Scrubs and thickets of tropical affinities of nonsaline wet or inundatable land of the Brazilian shield, its southwestern borderlands, the Chaco and its regions of influence, south to the Monte deserts and semideserts, the Espinal and the Pampa, dominated by deciduous or evergreen shrubs or tall shrubs.

3B.4211 Tropical and subtropical *Solanum* swamp scrubs
Swamp scrubs (duraznillales, varillales, varillares) of the tropical and subtropical regions of South America dominated by shrubs of genus *Solanum*, in particular, formations of *Solanum glaucophyllum* of southern Brazil, Paraguay, Uruguay and northeastern Argentina, characteristic of depressions

subjected to inundation under fairly deep waters, up to one metre, in the humid Chaco, the Campos and the northern Pampas.
(Vervoorst, 1967: 180-181; Cabrera and Zardini, 1978: 5, 545; Carnevali, 1994: units 9 var. 1 *p.*, 62).

3B.4212 Tropical and subtropical *Baccharis* swamp scrubs
Swamp scrubs (chilcales) of the Brazilian shield, its southwestern borderlands, the Chaco and its regions of influence, south to the Monte deserts and semideserts, the Espinal and the Pampa, dominated by shrubs of genus *Baccharis*, in particular *Baccharis salicifolia* or *Baccharis punctulata*.
(Morello, 1958: 123; Ragonese and Castiglioni, 1968: 151; Cabrera and Zardini, 1978: 640; Erize &, 1995: 83).

3B.4213 Southern subtropical *Acacia macracantha* scrub
Scrubs and thickets (tuscales) of Chaco rivers dominated by *Acacia macracantha*.
(Ragonese and Castiglioni, 1968: 154; Erize &, 1995: 83).

3B.422 Southern tropical hygrophile subshrub communities
Scrubs and thickets of tropical affinities of nonsaline wet or inundatable land of the Brazilian shield, its southwestern borderlands, the Chaco and its regions of influence, south to the Monte deserts and semideserts, the Espinal and the Pampa, dominated by subshrubs, in particular, mandiyurales formed by *Ipomoea malvaioides* in the humid Chaco and the northern Campos.
(Carnevali, 1994: units 9 var. 1 *p.*, 62).

3B.43 Pacific tropical and subtropical hygrophile scrubs
Scrubs and thickets of nonsaline wet or inundatable land associated with dry tropical or subtropical woodland (unit 4B), savanna grasslands (unit 3A) and tropical or subtropical deserts (units 73, 74), dominated by deciduous or evergreen shrubs, tall shrubs or subshrubs of the Pacific coastal deserts and their northern fringes and of the Pacific tropical islands.

3C. TROPICAL AND SUBTROPICAL HIGH-MONTANE COMMUNITIES

Suprasylvatic or extrasylvatic nondesert formations of the very high altitudes of high tropical mountains, composed of tall tussock-forming grasses, rosette plants and arborescent scapeous phanerophytes, cushion plants and sclerophyllous shrubs. In South America they include Andean non-woodland, non-desert communities, in particular, the paramo communities, the steppic grasslands of the alti-Andean zone, of the moist Puna, of enclaves within the dry puna and of the eastern slopes, the alti-Andean cushion heaths and shrublands, the alti-Andean and puna wetland communities, as well as summital communities of isolated continental ranges, notably the Serra do Mar, the Serra do Espinhaço system, the Goias Planalto mountains and the Mato Grosso Planalto mountains, all on the Brazilian shield, the mountains of the Guianan shield, the mountains of the Caribbean coast and the mountains of tropical oceanic islands. The major life forms, grasslands, rosette communities, shrublands, cushion heaths may constitute relatively homogeneous formations or compose mosaics at various scales; the latter arrangement is particularly prevalent in the paramos, where wetland and dry land communities are also often intimately integrated. To a lesser extent, combination of life forms, in particular, cushion heaths and grasslands, is also characteristic of some alti-Andean communities.
(Koepcke, 1961: 179-192; Lauer, 1968; Troll, 1968; Cabrera, 1968; Cuatrecasas, 1968; Czajka, 1968; Birot, 1970: 92-110, Fig. 34; Schnell, 1971: 788-797; Hueck and Seibert, 1972: units 16 *p.*, 20-22 *p.*, 25 *p.*, 27 *p.*, 53, 82 *p.*, 83, 84 *p.*; Cabrera and Willink, 1980: 66-67, 84-89; Schnell, 1987b: 75-146; Rieley and Page, 1990; Walter and Breckle, 1991b: 71-85; Daniele and Natenzon, 1994: regions 14, 15, 16; Smith, 1994).

3C.1 Andean tropical high mountain communities

Suprasylvatic or extrasylvatic nondesert formations of the very high altitudes of the tropical Andes, north of the mediterranean Andes of Chile and the Cuyo Andes of Argentina, composed of tall tussock-forming grasses, rosette and cushion plants, sclerophyllous shrubs and arborescent scapeous phanerophytes; humid grasslands of tropical high Andean deserts.
(Koepcke, 1961: 179-192; Troll, 1968; Cabrera, 1968; Cuatrecasas, 1968; Czajka, 1968; Birot, 1970: 92-110, Fig. 34; Schnell, 1971: 788-797; Hueck and Seibert, 1972: units 20-22 *p.*, 82 *p.*, 83, 84 *p.*; Müller, 1976; Vuilleumier and Ewert, 1978: 53-63; Cabrera and Willink, 1980: 66-67, 84-87; Veillon, 1985b: 34; Vareschi, 1985: 40; Schnell, 1987b: 75-146; Rieley and Page, 1990; Walter and Breckle, 1991b: 71-85; Daniele and Natenzon, 1994: regions 14, 15; Archibold, 1995: 297-298).

3C.11 Giant rosette and wooly candle plant communities
Suprasylvatic or extrasylvatic nondesert formations of the very high altitudes of the northern and, more sparingly, southern tropical Andes, composed of rosette plants or arborescent scapeous phanerophytes.

(Cuatrecasas, 1954a, 1954b; Koepcke, 1961: 179-192; Troll, 1968; Cabrera, 1968; Cuatrecasas, 1968; Schnell, 1971: 788-797; Vuilleumier and Ewert, 1978: 53-63; Cabrera and Willink, 1980: 66-67; Schnell, 1987b: 75-146; Rieley and Page, 1990; Walter and Breckle, 1991b: 71-85; Smith, 1994; Meinzer &, 1994; Pfitsch, 1994; Keeley &, 1994; Miller, 1994; Berry and Calvo, 1994; Archibold, 1995: 297-298).

3C.111 Paramo *Espeletia* communities
Formations of the paramo and superparamo dominated by large rosette or caulirosette, sometimes high-stemmed Asteraceae of genus *Espeletia s.l.*, accompanied by a mosaic of tussocks or carpets of grasses of genera *Calamagrostis*, *Festuca*, *Stipa*, *Deyeuxia*, *Muehlenbeckia*, of cushions of the rush *Distichia muscoides*, of *Sphagnum*, of *Azorella*, of *Paepalanthus*, of *Plantago rigida*, of dwarf shrubs and ericoid shrubs of genera *Gaultheria*, *Hypericum*, *Loricaria*, *Pernettya* and *Vaccinium*, of small trees, in particular, *Diplostephium revolutum*, *Valeriana arborea*, *Gynoxys paramuna*, *Senecio vaccinioides*, *Miconia summa*, *Polylepis boyacensis*.
(Cuatrecasas, 1954b; Troll, 1968; Cuatrecasas, 1968; Schnell, 1971: 788-797; Vuilleumier and Ewert, 1978: 53-63; Cabrera and Willink, 1980: 66-67; Vareschi, 1985: 40; Schnell, 1987b: 96-98; Rieley and Page, 1990; Walter and Breckle, 1991b: 71-85; Smith, 1994; Meinzer &, 1994; Berry and Calvo, 1994; Archibold, 1995: 298).

3C.1111 Eastern Colombian paramo *Espeletia* communities

Espeletia communities of the paramos and superparamos of the Eastern Cordillera of Colombia and the Tama range of Venezuela, constituting the largest semicontinuous ensemble of paramos in the Andes, with, in particular, *Espeletia hartwegiana*, *Espeletia grandiflora*, *Espeletia conglomerata*, *Espeletia bogotensis*, *Espeletia argentea*, *Espeletia cayetana*, *Espeletia corymbosa*.
(Cuatrecasas, 1954b; Hueck, 1960; Vuilleumier and Ewert, 1978: 53-63; Schnell, 1987b: 99-106; Walter and Breckle, 1991b: 71-85).

3C.1112 Ecuadorian *Espeletia* communities
Espeletia communities of the paramos and superparamos of the main Andes of extreme southern Colombia and of Ecuador, south to the Sierra de Langanati at 2° S, at the southern limit of the genus.
(Cuatrecasas, 1954b; Cuatrecasas, 1968: 182; Hueck and Seibert, 1981: unit 83 *p.*; Walter and Breckle, 1991b: 71-85).

3C.1113 Western Colombian *Espeletia* paramo communities
Espeletia communities of the paramos and superparamos of the Cordillera Central and Cordillera Occidental of Colombia, relatively small and very disjunctly distributed, in particular in the Nevado de Huila-Pan de Azucar complex, the Nevado de Tolima ensemble and the northern Paramillo massif.
(Cuatrecasas, 1954b; Cuatrecasas, 1968: 182; Hueck and Seibert, 1981: unit 83 *p.*; Leitch, 1990: 201, 203-208; Walter and Breckle, 1991b: 71-85; Wege and Long, 1995: 136, 141, 149, 150-151).

3C.1114 Merida paramo *Espeletia* communities
Espeletia communities of the paramos and superparamos of the Cordillera de Merida of Venezuela, formed by, in particular, the stem-rosette *Espeletia moritziana*, *Espeletia schultzii*, *Espeletia spicata*, *Espeletia timotensis*, the stemmless rosette *Espeletia angustifolia*, *Espeletia lindenii*, the low branched rosette *Espeletia atropupurea*, *Espeletia semiglobulata*, the tuberous rosette *Espeletia batata*, *Espeletia floccosa*, and, in the subparamo, at the forest limit, the branched tree *Espeletia badilloi* and *Espeletia neerifolia*. They harbour many endemics, among them, the wren *Cistothorus meridae*.
(Cuatrecasas, 1954b; Hueck, 1960; Vuilleumier and Ewert, 1978: 53-63; Veillon, 1985b: 34; Vareschi, 1985: 40; Schnell, 1987b: 106-109; Huber and Alarcon, 1988: unit 90; Ridgely and Tudor, 1989: 89; Walter and Breckle, 1991b: 71-85; Berry and Calvo, 1994: 230-233).

3C.11141 Merida *Espeletia schultzii* paramo
Espeletia communities of the lower paramos of the Cordillera de Merida, dominated by the low-stemmed *Espeletia schultzii*, with *Hypericum brathys*, *Alchemilla spp.* and, locally, colonies of *Espeletia floccosa*.
(Schnell, 1987b: 106, 108, 109).

3C.11142 Merida *Espeletia timotensis* paramo
Espeletia communities of the middle altitudes of the paramos of the Cordillera de Merida, dominated by the high-stemmed *Espeletia timotensis* with *Espeletia lutescens*, *Espeletia spicata*, *Hypericum brathys* and cushions of the grass *Aciachne pulvinata* and of *Arenaria spp.*.
(Schnell, 1987b: 107-108).

3C.11143 Merida *Espeletia moritziana* paramo
Espeletia communities of the higher altitudes of the paramos of the Cordillera de Merida, dominated by the fairly high-stemmed *Espeletia moritziana*, and sometimes by *Espeletia semiglobata*, accompanied by scarce grasses and lichens, *Lupinus spp.*, *Malvastrum spp.*, *Senecio imbricatifolia*, *Senecio formosus*, on often fairly bare, rocky or stony substrates.
(Schnell, 1987b: 107, 109).

3C.1115 Perija-Santa Marta *Espeletia* communities
Espeletia communities of the paramos and superparamos of the Sierra de Perija, on the Colombo-Venezuelan border of the Maracaibo basin, and of the Nevada de Santa Marta of Colombia, constituting the northwesternmost spurs and outposts of the eastern Andes of Colombia and Venezuela, with, in particular, *Espeletia tillettii*, *Espeletia perijaensis*, endemic to the Sierra de Perija.
(Cuatrecasas, 1954b; Hueck, 1960; Hueck and Seibert, 1981: unit 83 *p.*; Huber and Alarcon, 1988: unit 83; Walter and Breckle, 1991b: 71-85).

3C.112 *Puya* giant rosette communities
Formations of the paramo, the superparamo or the humid puna dominated by large rosette or caulirosette bromeliads of genus *Puya*.

(Koepcke, 1961: 180-183, 188; Cuatrecasas, 1968; Troll, 1968: 43-44; Schnell, 1987b: 82-109; Smith, 1994: 3; Miller, 1994: 197; Archibold, 1995: 298).

3C.1121 Paramo *Puya* communities
Formations of the paramo and superparamo dominated by large rosette or caulirosette bromeliads of genus *Puya*, in particular *Puya venezuelana* and *Puya aristiguietae* of Venezuela, *Puya cuatrecasii* of Colombia, *Puya clava-herculis* and *Puya hamata* of Ecuador.
(Cuatrecasas, 1968; Schnell, 1987b: 82-109; Smith, 1994; Miller, 1994: 197; Archibold, 1995: 298).

3C.1122 Puna *Puya* communities
Formations dominated by the large, spectacular, resinous- and succulent-leaved caulirosette bromeliad *Puya raimondii* (*Pourretia gigantea*) of the Peruvian and Bolivian moist puna, at altitudes of 4000-4400 metres.
(Koepcke, 1961: 180-183, 188; Troll, 1968: 43-44; Walter and Breckle, 1991b: 166; Smith, 1994: 3; Miller, 1994: 197).

3C.113 *Lupinus* giant rosette communities
Formations of the paramo, the superparamo and the puna dominated by large rosette or caulirosette Fabaceae of genus *Lupinus*.
(Koepcke, 1961: 180-183, 185, 188; Cuatrecasas, 1968: 178, 182; Schnell, 1987b: 91; Smith, 1994: 7; Miller, 1994: 195).

3C.1131 Paramo *Lupinus* communities
Formations of the paramo and superparamo dominated by large rosette or caulirosette Fabaceae of genus *Lupinus*, in particular *Lupinus alopecuroides*.
(Cuatrecasas, 1968: 178, 182; Schnell, 1987b: 91; Smith, 1994: 7; Miller, 1994: 195).

3C.1132 Puna *Lupinus* communities
Heath-like grey-green coloured formations dominated by the tall, up to two metres, woody stemmed Fabaceae *Lupinus allargyreius* (*Lupinus paniculatus*) of the high Andes of Peru, mostly characteristic the upper basin of the rios Rimac and Chilon, at an altitude of 3700-4000 metres. The accompanying cortège includes *Ambrosia peruviana*, *Mutisia viciaefolia*, semifrutescent species of genus *Calceolaria* and *Clematis peruviana*.
(Koepcke, 1961: 180-183, 185, 188).

3C.114 Superparamo white-wooly *Senecio* communities
Communities of the superparamo, at altitudes above 4500-4600 metres formed, by large, white, wooly subrosulate herbs of subsection *Culcitium* of genus *Senecio*, in particular, *Senecio canescens*, *Senecio nivalis*, *Senecio cocuyanam*, *Senecio santanderensis*, accompanied by shrubs, cushion plants and herbs, in particular, *Cerastium caespitosum*, *Cerastium floccosum*, *Draba pachythryrsa*, *Lupinus alopecuroides*, *Luzula racemosa*, *Poa trachyphylla*, *Poa orthophylla*, *Agrostis nigritella*, *Bromus oliganthus*, *Senecio adglacialis*, *Senecio gelidus*, *Senecio supremus*. They have a highly discontinuous, archipelagic distribution in the high northern Andes, with a subsequent high rate of endemism.
(Troll, 1968; Cuatrecasas, 1968: 180, 182; Schnell, 1987b: 95; Archibold, 1995: 298).

3C.1141 Eastern Colombian superparamo communities
Superparamo *Senecio* communities of the Eastern Cordillera of Colombia, associated with the largest semicontinuous ensemble of paramos in the Andes.
(Troll, 1968; Cuatrecasas, 1968: 180, 182; Schnell, 1987b: 95; Archibold, 1995: 298).

3C.1142 Ecuadorian superparamo communities
Senecio communities of the paramos and superparamos of the main Andes of Ecuador and extreme southern Colombia.
(Cuatrecasas, 1968; Hueck and Seibert, 1981: unit 83 *p.*).

3C.1143 Western Colombian superparamo communities
Senecio communities of the paramos and superparamos of the Cordillera Central and Cordillera Occidental of Colombia, relatively small and very disjunctly distributed, in particular in the Nevado de Huila-Pan de Azucar complex, the Nevado de Tolima ensemble and the northern Paramillo massif.
(Cuatrecasas, 1968: 180, 182; Hueck and Seibert, 1981: unit 83 *p.*; Schnell, 1987b: 95).

3C.1144 Merida superparamo communities
Superparamo *Senecio* communities of the Cordillera de Merida of Venezuela, isolated at the northeastern limit of the range of paramos.
(Cuatrecasas, 1968; Huber and Alarcon, 1988: unit 90).

3C.115 Superparamo *Draba* communities
Communities of the superparamo dominated by the caulescent rosette *Draba chionophila*, often forming the upper level of plant growth at 4600-4800 metres.
(Cuatrecasas, 1968; Schnell, 1987b: 82-109; Pfitsch, 1994: 152-154; Archibold, 1995: 298).

3C.12 Tropical high-Andean shrublands
Suprasylvatic or extrasylvatic formations of the very high altitudes of the tropical Andes composed of bushy, non-cushion-forming sclerophyllous shrubs, dwarf shrubs, prostrate shrubs or dwarf trees, developed in the paramo, superparamo or superpuna alti-Andean environments. In the paramo, shrubs occur as elements of the community mosaic formed at various scales and can either participate in rosette communities (unit 3C.11) or in grasslands (unit 3C.14), or form extensive facies that can be individualized by use of codes of 3C.12, or else constitute independent communities not intimately associated with rosette communities or grasslands.
(Troll, 1968: 29; Cuatrecasas, 1968; Vuilleumier and Ewert, 1978: 53-63; Huber and Alarcon, 1988: unit 90).

3C.121 Northern high-Andean shrublands and heaths
Formations dominated by medium-tall, small or dwarf, erect or prostrate, non-cushion-forming, often ericoid, shrubs or cryptoshrubs of the northern, paramo, Andes developed at the subparamo, paramo, and superparamo or northern alto-Andine levels.

3C.1211 Subparamo brushes
Species-rich brushes of the subparamo zone of Venezuela, Colombia and Ecuador formed by an admixture of species of the high Andean forest and of the paramo, among them *Vaccinium floribundum*, *Gaultheria anastomosans*, *Weinmannia tomentosa*, *Hypericum hartwegii*, *Hypericum laricifolium*, *Clethra chrysoleuca*, *Tibouchina grossa*, *Miconia salicifolia*, *Miconia elaeoides*, *Miconia summa*.
(Cuatrecasas, 1968: 171, 177; Vuilleumier and Ewert, 1978: 55, 56-58; Schnell, 1987b: 93-94, 105).

3C.1212 Paramo scrubs, heaths and brushes
Paramo and lower superparamo formations dominated by medium-tall, small or dwarf, erect or prostrate, non-cushion-forming, often ericoid, shrubs or cryptoshrubs, in particular, the tall shrubs or small trees *Diplostephium revolutum*, *Valeriana arborea*, *Gynoxys paramuna*, *Senecio vaccinioides*, *Miconia summa*, *Polylepis boyacensis*, the Ericaceae of genera *Gaultheria*, *Pernettya* and *Vaccinium*, ericoid composites, in particular of genus *Loricaria*, or *Hypericum*, in particular *Hypericum laricifolium*, cryptoshrubs of genera *Bartsia*, *Senecio*, *Ranunculus*, *Sisyrinchium*, *Valeriana*, *Alchemilla*.
(Cuatrecasas, 1968: 167-168, 172-173, 177-179, 182; Schnell, 1987b: 90-95; Junk, 1993: 717).

3C.1213 Upper paramo and superparamo heaths
Formations of the upper altitudes of the paramos and of the superparamo dominated by fairly tall ericoid or cupressoid shrubs, in particular, *Loricaria thuyoides*.
(Cuatrecasas, 1968: 178, 181).

3C.1214 Superparamo dwarf scrubs
Sparse communities of the superparamo and of the upper limit of vegetation dominated by erect or prostrate, noncushion, dwarf shrubs or cryptoshrubs, often of genus *Draba*, in particular, the prostrate shrubby *Draba pamplonensis*, the erect shrubby *Draba arbuscula* and *Draba empetroides*, the large-leaved cryptoshrub *Draba bellardii*.
(Cuatrecasas, 1968: 167-168, 172-173, 177-179, 182; Schnell, 1987b: 90-95; Pfitsch, 1994: 151-154).

3C.122 Altiplano tolares
Heaths of the dry puna of the Altiplano of Peru and Bolivia dominated by the evergreen ericoïd scale-leaved composite shrub *Parastrephia quadrangularis*, constituting extensive zonal communities at altitudes comprised between 2800 and 4300 metres, particularly on volcanic ashes, with dense stands

0.5-1.5 metres tall, and up to 2 metres tall in favourable locations, extending to the high Andean altiplano of northern Chile, between 4000 and 5000 metres altitude and between 19° 20' S and nearly 23° S, where it forms low stands, characteristically on stony colluvions and alluvions, sometimes on sandy plains. Accompanying species include, in Peru, *Baccharis microphylla*, *Tetraglochin strictum*, *Festuca orthophylla*, *Calamagrostis breviaristata*, *Stipa spp.*, *Ephedra spp.* and cushion-forming opuntias, in northern Chile, *Festuca orthophylla*, *Pycnophyllum molle*, *Adesmia leucopogon*, *Astragalus arequipensis*, *Azorella compacta*. Similar communities occurring in azonal locations within the southern ultradry puna of Argentina, dominated by other evergreen ericoid scale-leaved shrubs of genus *Parastrephia* are listed in unit 72.2 (72.22), together with the desert and semidesert communities (72.21) that dominate their environment.
(Herzog, 1923: 225-228; Koepcke, 1961: 183; Troll, 1968: 37-39, 47; Hernandez, 1973: 11, 55-58; Ducoing, 1973: 52-53; Hueck, 1978: 436-439; Schnell, 1987b: 140-141, 331-332; Fjeldså and Krabbe, 1990: 19, 21; Walter and Breckle, 1991b: 166-167; Gajardo, 1994: units 2A1-2A15, 2A3-2A15).

3C.123 Central Andean supracejan shrublands and heaths
Heaths and brushes of the high altitudes of the eastern chains of the northern section of the southern tropical, puna, Andes, north of the Andean bend, developed between the main treeline of the central Andean ceja forests and alti-Andean grasslands on the wetter eastern flank, extending in impoverished form to the drier, eastern side, immediately below the grasslands. They are characteristic, in particular, of the very high Cordillera Real of central Bolivia, where, at about 3000-3800 metres, they include species of genera *Gaultheria*, *Clethra*, *Escallonia*, *Myrsine*, *Berberis*, *Fuchsia*, and, on the east side, at about 3500-3800 metres, species of genera *Solanum* (*Solanum lycoides*, *Solanum pseudolycoides*), *Mtuisia* (*Mutisia viciaefolia*), *Chuquiraga*, *Gnaphalium*, *Lupinus*, *Dalea*.
(Herzog, 1923: 211, 216, 220, 224-225; Schnell, 1987b: 146).

3C.124 Southern suprayungan shrublands and heaths
Mesophytic scrubs and brushes of the high altitudes of the eastern chains of the southern section of the southern tropical, puna, Andes, south of the Andean bend, from Jujuy to the Sierras de Velasco and Famatina, developed above the main treeline of the yungas forests, in the altitudinal level of the cloud grasslands of unit 3C.143, either immediately above the forest as an ecotonal belt, at about 2300-2400 metres, or in ravines and gullies of the grasslands, up to about 3000 metres, formed by *Berberis spp.*, bushy composites, shrubby alders and shrubby *Polylepis*. The rare finch *Poospiza baeri*, of very restricted range, is characteristic of this habitat.
(Vervoorst, 1982: 17; Ramadori, 1987: 8; Ridgely and Tudor, 1989: 458; Fjeldså and Krabbe, 1990: 688; Heinonen and Boso, 1994: 52, 55).

3C.125 Southern tropical Andean supradesertic shrublands and heaths
Scrubs of the very high altitudes of the western chains of the southern tropical, puna, Andes, and of the southern tropical Andean altiplano, developed above the puna semideserts and deserts or the western Andean deserts and semideserts, intermediate in ecology and physiognomy between the grasslands, cushion heaths and evergreen *Parastrephia quadrangulare* tola heaths of the altiplano and the deciduous shrub communities of the arid puna. They include, in particular, low, very open communities of small shrubs and tufted grasses of the high desertic Andes of northern Chile south of the Altiplano, between about 19° 20'S and nearly 23°S, dominated by *Baccharis incarum* and *Lampaya medicinalis*, with *Adesmia horrida*, *Junellia seriphioides*, *Opuntia ignescens*, commonly with *Festuca chrysophylla*, *Parastrephia quadrangularis*, *Stipa venusta*.
(Gajardo, 1994: region 2A2, units 2A2-2A22, 2A4-2A22, 2A5-2A22).

3C.13 Tropical high-Andean cushion-heaths
Suprasylvatic or extrasylvatic nondesert formations of the very high altitudes of the tropical Andes composed of cushion plants, developed at the paramo, superparamo or superpuna levels, often integrated within grassland or rosette communities, but capable of dominating the landscape, above 4000 metres, in both puna and paramo Andes.
(Koepcke, 1961: 191-192; Troll, 1968; Cabrera, 1968; Cuatrecasas, 1968; Schnell, 1987b: 82-110, 134-141; Gajardo, 1994: regions 2A1, 2A2; Smith, 1994: 9).

3C.131 Paramo cushion-heaths
Paramo formations dominated by cushion plants, in particular of genera *Azorella*, *Plantago*, *Oreobolus*, *Arenaria* and *Paepalanthus*, for the most part forming facies within rosette communities (unit 3C.11) or grasslands (unit 3C.14).
(Troll, 1968: 7; Cuatrecasas, 1968: 179; Schnell, 1987b: 99-109; Smith, 1994: 9).

3C.132 Superparamo cushion-heaths
Cushion-heaths of the northern part of the high Andean phytogeographical province in Venezuela, Colombia, Ecuador and northern Peru, developed at altitudes above 4300 metres, above the Paramo and to the level of eternal snows, dominated, in particular, by *Loricaria colombiana*.
(Cabrera and Willink, 1980: 85; Huber and Alarcon, 1988: unit 90 *p.*).

3C.133 Superpuna cushion-heaths
Cushion-heaths of the high Andean phytogeographical province of southern Peru, Bolivia, northern Chile and northern Argentina, developed at altitudes above 4300 metres, to 4800 and, locally, 5000 metres, between the puna and the unvegetated Andean summits, constituted by cushion-forming Apiaceae of genus *Azorella* (*Azorella compacta*), Caryophyllaceae of genera *Pycnophyllum* (*Pycnophyllum molle*, *Pycnophyllum bryoides*), *Plettkea*, *Arenaria*, *Paronychia*, Asteraceae (*Lucilia spp.*, *Werneria aretioides*), Oxalidaceae (*Oxalis compacta*), Valerianaceae (*Aretiastrum aschersonianum*), Fabaceae (*Adesmia erinacea*), Cactaceae (*Opuntia atacamensis*) and rosette-forming Portulacaceae, Ranunculaceae, Brassicaceae, Rosaceae, Fabaceae, Malvaceae, Gentianaceae, Asteraceae (*Werneria spp.*).
(Herzog, 1923: 225; Cabrera, 1958: 362-364, 367; Koepcke, 1961: 191-192; Cabrera, 1968; Cabrera and Willink, 1980: 85; Schnell, 1987b: 138, 152; Walter and Breckle, 1991b: 165, 166; Gajardo, 1994: units 2A13, 2A21).

3C.1331 Superpuna *Azorella* cushion-heaths
Cushion-heaths of rocky slopes within the 4000-5000 metre zone of the puna Andes dominated by dense cuhions of *Azorella spp.*, in particular, formations of the Chilean and Argentine high Andes constituted by *Azorella compacta*, often with *Parastrephia quadrangularis*, *Senecio graveolens*, *Pycnophyllum molle*, *Festuca orthophylla*, *Parastrephia lucida*, *Adesmia spinosissima*, *Nothotriche pulverulenta*, *Opuntia ignescens*, *Stipa leptostachia*, formations of Peru and Bolivia dominated by *Azorella diapensioides* or related species.
(Herzog, 1923: 225; Cabrera, 1958: 362; Koepcke, 1961: 191-192; Gajardo, 1994: unit 2A1-2A13, 2A2-2A13).

3C.1332 Superpuna *Senecio-Oxalis* cushion-heaths
Cushion-heaths of the high Andes of northern Argentina dominated by *Senecio algens* and *Oxalis compacta*.
(Cabrera, 1958: 367).

3C.1333 *Pycnophyllum* cushion-heaths
Cushion-heaths dominated by species of genus *Pycnophyllum*, distributed, in particular, in the Peruvian altiplano, in the Argentinian superpuna and in the high, desertic, Andes of northern Chile south of the Altiplano, between about 19° 20'S and nearly 23°S, where they form extremely low, mixed, communities of alternating dominance, consisting of cushion shrubs, tufted grasses and shrubs with reduced leaves, comprised of *Pycnophyllum molle*, *Oxalis exigua*, *Werneria glaberrima*, with *Festuca chrysophylla*, *Mulinum crassifolium*, *Parastrephia quadrangularis*, *Stipa venusta*, *Azorella compacta*.
(Koepcke, 1961: 191-192; Cabrera, 1968: 105, 107; Gajardo, 1994: units 2A2-2A21, 2A5-2A21).

3C.14 Tropical Andean grasslands
Suprasylvatic or extrasylvatic nondesert formations of the very high altitudes of the tropical Andes, north of the mediterranean Andes of Chile and the Cuyo Andes of Argentina, composed of tall tussock-forming grasses.
(Koepcke, 1961: 187-188, 189-190; Troll, 1968; Cabrera, 1968; Cuatrecasas, 1968; Schnell, 1971: 788-797; Hueck and Seibert, 1972: units 82 *p.*, 83 *p.*, 84 *p.*; Roig, 1982; Rieley and Page, 1990).

3C.141 Northern Andean grasslands
Suprasylvatic or extrasylvatic grasslands of the very high altitudes of the northern, paramo, tropical Andes, mostly composed of tall tussock-forming grasses, developed in the paramo, locally in the superparamo, and, in conditions of anthropogenic disturbance, in the subparamo or at lower altitudes.
(Troll, 1968; Cuatrecasas, 1968; Schnell, 1971: 788-797; Vuilleumier and Ewert, 1978: 53-63; Cabrera and Willink, 1980: 66-67, 84-85; Vareschi, 1985: 40; Schnell, 1987b: 88-109; Walter and Breckle, 1991b: 71-85; Smith, 1994: 4; Archibold, 1995: 298).

3C.1411 Paramo grasslands

Grasslands of the paramo dominated by grasses of genera *Calamagrostis* (*Calamagrostis effusa*), *Festuca* (*Festuca dolichophylla*, *Festuca toluensis*), *Stipa*, *Deyeuxia*, *Muehlenbeckia* (*Muehlenbeckia erectifolia*). These communities harbour many herbs, cryptoshrubs and geophytes, among them the terrestrial orchids *Spiranthes vaginata*, *Altensteinia fimbricata*, a large number of them endemic.
(Troll, 1968; Cuatrecasas, 1968; Schnell, 1971: 788-797; Vuilleumier and Ewert, 1978: 53-63; Cabrera and Willink, 1980: 66-67; Vareschi, 1985: 40; Schnell, 1987b: 88-109; Walter and Breckle, 1991b: 71-85; Smith, 1994: 4; Archibold, 1995: 298).

3C.1412 Superparamo grasslands
Grasslands of the very high altitudes, superparamo, slopes of the highest ranges of the paramo Andes of Venezuela, Colombia and Ecuador, low and open, formed by patches of grasses of genera *Festuca* (*Festuca sublimis*), *Calamagrostis* (*Calamagrostis ligulata*), *Agrostis* (*Agrostis nigritella*), *Poa* (*Poa orthophylla*, *Poa trachyphylla*), *Bromus* (*Bromus oliganthus*).
(Cabrera and Willink, 1980: 85; Schnell, 1987b: 95; Walter and Breckle, 1991b: 82).

3C.1413 Northern Andean mesophile meadows
Secondary mesophile grasslands of the montane forest belts of the northern Andes, developed at middle altitudes, between 2000 and 3000 metres, for the most part anthropogenic formations replacing mountain forests, invaded by exotic species, mostly dominated by grasses of genera *Calamagrostis* (*Calamagrostis viridiflavescens*), *Aegopogon* (*Aegopogon cenchroides*), *Panicum* (*Panicum bulbosum*), *Sporobolus* (*Sporobolus poiretii*).
(Schnell, 1987b: 111-112).

3C.142 Central tropical Andean grasslands
Suprasylvatic or extrasylvatic grasslands of the very high altitudes of the central tropical Andes, constituting the northern section of the puna Andes, developed on the moist puna Peruvio-Bolivian altiplano, on the upper slopes of mountains rising from the Peruvio-Bolivian altiplano, and in the extrasylvatic levels of the humid northeastern slope, north of the bend of the Andes.
(Koepcke, 1961: 188-189; Troll, 1968: 37, 47; Czajka, 1968: units 50, 13 *p.*; Schnell, 1987b: 140-146; Walter and Breckle, 1991b: 166-168).

3C.1421 Jalca grasslands
Evergreen bunch-grasslands of high Andean slopes of Peru and northern Bolivia developed at altitudes between about 3000 metres, sometimes 2300 metres, and 4500 metres, above the main treeline, forming narrow, more or less continuous belts on the east side of the Andes south to about 18° S, at the bend of the Andes, and on the west side to about 7° S, around Cajamarca, with more isolated outposts farther south, closely related to the paramo grasslands of more northern latitudes, in Venezuela, Colombia and Ecuador, but also physiognomically and floristically very similar to the semievergreen moist puna grasslands of the same latitudes, and like them, dominated by *Stipa ichu*.
(Koepcke, 1961: 188-189; Troll, 1968: 37; Czajka, 1968: unit 13 *p.*).

3C.1422 Moist puna mesophile grasslands
Semievergreen bunch-grasslands of the moist puna part of the northern and eastern altiplano of Peru and Bolivia, covering vast expanses at altitudes mostly comprised between about 4000 and 5000 metres, between Cajamarca, at about 6° S, and Tarija, at about 21° S, dominated by *Stipa ichu*.
(Koepcke, 1961: 188-189; Troll, 1968: 37, 47; Czajka, 1968: unit 50; Schnell, 1987b: 140-146; Walter and Breckle, 1991b: 166-168).

3C.1423 Cordillera Real alti-Andean grasslands
Grasslands of the high altitudes of very high chains rising above the moist puna Peruvio-Bolivian altiplano, in particular, of the Cordillera Real, where they are developed in the 4000 to 4600 metre-level on the western slopes and at the 3600 to 4300 metre-level on the eastern, more humid, slopes of the Sierra Real, dominated by grasses of genera *Calamagrostis*, (*Calamagrostis cephalantha*, *Calamagrostis fuscata*, *Calamagrostis nivalis*, *Calamagrostis vicunarum*, *Calamagrostis amoena*), *Dissanthelium* (*Dissanthelium supinum*, *Dissanthelium peruvianum*), *Anthochloa* (*Anthochloa lepida*), *Poa* (*Poa humillima*), *Aciachne* (*Aciachne pulvinata*), *Agrostis* (*Agrostis nana*), with a species-rich flora that comprises *Alchemilla pinnata*, *Gentiana armerioides*, *Gentiana prostrata*, *Gentiana primulifolia*, *Gnaphalium weddelianmum*, *Ranunculus pilosus*, *Ranunculus sibbaldioides*, *Trifolium*

peruvianum, *Valeriana pygmaea*, *Valeriana nivalis*, *Viola pygmaea*, *Viola nivalis*, *Werneria nubigena*, *Werneria dactylophylla*.
(Herzog, 1923: 204-225; Schnell, 1987b: 146).

3C.143 Yungas Andes cloud grasslands
Suprasylvatic subtropical mesic to humid grasslands (pajonales) of the humid eastern middle and high slopes of the high southern tropical crystalline Andes, extending from the bend of the Andes, at about 18° S, to about 27° S in a relatively narrow altitudinal belt extending from 2800 to 4000 metres at 18° S, and from 2000 to 3000 metres at 25° S, situated between upper yungan forests and dry puna or between low Andean subtropical dry grasslands and puna, constituted by bunchgrasses of genera *Festuca* (*Festuca hieronymi*), *Calamagrostris* and *Stipa* (*Stipa ichu*, *Stipa tenuissima*) dominating a double stratum formation. They harbour colonies of large rosette bromeliads of genus *Puya*, reminescent of those of the paramos. They are rich in endemic species and harbour relict populations of the vulnerable deer *Hippocamelus antisensis*.
(Czajka, 1968: unit 24; Vervoorst, 1982: 10-11, 16-17; Ramadori, 1987: 4-8; Coupland, 1992d: 364; Burkart &, 1994: 28-29, unit 16; Moreno, 1993: 15-16; Babarskas &, 1993: 3; Brown and Grau, 1993: 16, 30, 76; Daniele and Natenzon, 1994: unit 16; Chebez, 1994: 328-332; Brown, 1995: 112; Erize &, 1995: 26-57).

3C.144 Sierras Pampeanas summital grasslands
Extrasylvatic grasslands of the southern crystalline Sierras Pampeanas, outside of the range of yungas forests, insular southern representatives of the cloud grasslands of unit 3C.143, developed, in particular, in the Sierra Famatina, the Sierra de Velasco, the Sierra de Valle Fertil, the Sierra de Malanzan, the Sierra de San Luis and the Sierras de Cordoba, above Chacoan forests or Monte and prepuna semideserts and deserts, constituted by bunchgrasses of genus *Stipa* (*Stipa ichu*, *Stipa tenuissima*), of *Festuca hieronymi*, *Bouteloua curtipendula*, *Schyzachirium plumigerum*. They are rich in endemic species.
(Roig, 1982: 67-70; Moreno, 1993; Burkart &, 1994: 28-29; Daniele and Natenzon, 1994: unit 16 *p.*; Chebez, 1994).

3C.145 Superpuna grasslands
Grasslands of the altimontane level of the dry puna Andes of Argentina, northern Chile, southern Bolivia and western Peru, mostly developed at altitudes comprised between 4000-4300 metres and 5000 metres, superior to those occupied by the puna semideserts or deserts, dominated by bunchgrasses of genera *Festuca*, *Stipa*, *Poa* and *Deyeuxia*, often accompanied by cushion shrubs, cryptoshrubs and dwarf herbs. Characteristic genera of the alti-Andean level include *Barneoudia*, *Paradiodoxa*, *Aschersoniodoxa*, *Pycnophyllum*, *Nototriche*, *Werneria*, *Urbania*, *Hexaptera*. In the western cordilleras they occupy a wider altitudinal range, from 4000 metres to almost 6000 metres north of latitude 25° S, from about 2000 metres to about 5000 metres at latitude 30° S.
(Cabrera, 1958: 336; Cabrera, 1968: 99, 102; Troll, 1968: 38-40; Czajka, 1968: unit 21 *p.*; Cabrera and Willink, 1980: 84-85; Vervoorst, 1982: 17; Schnell, 1987b: 138; Gajardo, 1994: regions 2A1, 2A2, 2A5; Burkart &, 1994: 27-28; Daniele and Natenzon, 1994: unit 15).

3C.1451 Superpuna *Festuca* grasslands
Grasslands of the altimontane level of the dry puna Andes of Argentina, northern Chile, southern Bolivia and western Peru dominated by bunchgrasses of genus *Festuca*, mostly by *Festuca orthophylla*.
(Cabrera, 1958: 362-364; Troll, 1968: 38-40; Cabrera, 1968: 99, 102; Cabrera and Willink, 1980: 84-85; Gajardo, 1994: units 2A11, 2A12; Burkart &, 1994: 27-28).

3C.14511 Eastern superpuna *Festuca* steppe
Grasslands of the altimontane level of the dry puna Andes of Argentina and southern Bolivia formed by *Festuca orthophylla*, *Festuca chrysophylla* and *Poa gymnantha* with numerous cushion plants, in particular, of genera *Adesmia*, *Azorella* (*Azorella compacta*), *Junellia*, *Anthobryum*, *Opuntia* (*Opuntia atacamenis*), *Pycnophyllum*, *Werneria*, *Senecio*, *Oxalis*, and dwarf erect shrubs, in particular, *Baccharis incarum*.
(Cabrera, 1958: 362-364; Cabrera, 1968: 102; Erize &, 1995: 161-163).

3C.14512 Western altiplano *Festuca* steppe
Grasslands of the altimontane level of the altiplano of northern Chile, western Bolivia and southwestern Peru dominated by bunchgrasses of genus *Festuca*, mostly by *Festuca orthophylla*.

(Gajardo, 1994: units 2A11, 2A12).

3C.145121 *Festuca orthophylla-Deyeuxia* steppe
Extensive grassland communities of the high Andean altiplano of northern Chile, between 4000 and 5000 metres altitude and between 19° 20'S and nearly 23°S, composed of *Festuca orthophylla*, and *Deyeuxia breviaristata* accompanied by *Pycnophyllum molle*, commonly with *Astragalus arequipensis*, *Nothotriche pulverulenta*, occasionally with *Hypsela reniformis*, *Parastrephia lucida*, *Senecio adenophyllus*.
(Gajardo, 1994: unit 2A1-2A12).

3C.145122 *Festuca orthophylla-Parastrephia* transition steppe
Low shrub and tufted grass communities, of the high Andean altiplano of northern Chile, between 4000 and 5000 metres altitude and between 19° 20'S and nearly 23°S, characteristically near water margins; representative species include *Festuca orthophylla*, *Parastrephia lucida* accompanied by *Pycnophyllum molle*, commonly with *Astragalus arequipensis*, *Deyeuxia brefiaristata*, *Hypsela reniformis*, *Nothotriche pulverulenta*, occasionally with *Senecio pulviniformis*, *Werneria aretioides*, *Werneria poposa*.
(Gajardo, 1994: unit 2A1-2A11).

3C.14513 Southern superpuna *Festuca* steppes
Steppic grasslands of the southern puna Andes of La Rioja and Catamarca formed by medium-tall *Festuca eriostoma*, *Stipa chrysophylla* and *Calamagrostis cabrerae*, accompanied by *Stipa speciosa*, *Stipa nardoides*, very low carpets of *Adesmia nanolignea*, physiognomically very similar to the *Festuca-Poa* formations of unit 3C.14411, of more northern distribution.
(Hunziker, 1952: 180-181; Haene &, 1993: 11, 15-16).

3C.1452 Superpuna *Poa* grasslands
Grasslands of the altimontane level of the dry puna Andes of Argentina, northern Chile, southern Bolivia and western Peru dominated by bunchgrasses of genus *Poa*, in particular, *Poa gymnantha*, *Poa lilloi*, *Poa munozensis*.
(Cabrera, 1958: 364; Cabrera, 1968: 102; Gajardo, 1994: unit 2A52; Erize &, 1995: 163).

3C.1453 Superpuna *Deyeuxia* grasslands
Grasslands of the altimontane level of the dry puna Andes of Argentina dominated by the bunchgrass *Deyeuxia cabrerae*.
(Cabrera, 1958: 364; Cabrera, 1968: 102).

3C.1454 Superpuna *Stipa* grasslands
Low, usually very open, steppic grasslands of sandy or pebbly lithosols of the altimontane level of the dry puna Andes of Argentina and northern Chile, south to the Cordillera de La Rioja, where they occur at altitudes between 3500 and 4300 metres, dominated by bunchgrasses of genus *Stipa*, in particular, *Stipa caespitosa*, *Stipa chrysophylla*, *Stipa frigida*, *Stipa speciosa*, in association, or alone, generally growing in small globular yellowish clumps. Low compact shrubs of *Adesmia*, in particular, *Adesmia glanduligera*, *Adesmia nanolignea*, *Adesmia subterranea*, are common. Numerous other species are frequent, including perennial herbs *Calandrinia picta*, *Calandrinia gilliesii*, *Hexaptera cuneata*, *Hexaptera tridens*, *Cristaria andicola*, *Pachylaena atriplicifolia*, *Chaetanthera lanata*, *Chaetanthera revoluta*, *Stipa nardoides*, *Leuceria pteropogon*, *Perezia hunzikeri*, *Senecio jarae*, *Lenzia chamaepytis*, *Verbena digitata*, *Viola montagnei*, *Kurzamra pulchella*, *Huarpea andina*, annuals, *Chenopodium frigidum*, *Phacelia cumingii*, *Schizopetalon rupestre*, *Gayophutum micranthum*, *Chaetanthera gnaphalioides*, *Viola frigida*, *Gilia crassifolia*, *Doniophyton anomalum*, *Atriplex hypsophilum*. At the upper limits of the zone small cushion-shrubs and other species commonly associate, in particular *Chaetanthera sphaeroidalis*, *Chaetanthera pulvinata* var. *polymalla*, *Nototrichia transandina*, *Nototrichia ovata*, *Nototrichia hillii* and *Opuntia tarapacana*, subshrubs *Senecio volckmannii*, *Senecio sundtii*, *Senecio pissisi*, *Adesmia spuma*, *Adesmia capitellata*. Regional endemics, including *Sarcodraba andina*, are present.
(Hunziker, 1952: 179-181, plates xi, xii; Cabrera, 1958: 366; Cabrera, 1968: 102; Haene &, 1993: 11, 15; Gajardo, 1994: units 2A5-2A52, 2A7-2A52; Burkart &, 1994: 28; Erize &, 1995: 163).

3C.14541 Superpuna *Stipa frigida* grasslands

Very open steppes of extremely dry sites within the alti-Andean level of the puna Andes of Argentina, from Jujuy to La Rioja, dominated by *Stipa frigida* (*Stipa hieronymusii*), with *Artemisia copa*, *Fabiana bryoides*.
(Hunziker, 1952: 179-181, plates xi, xii; Cabrera, 1958: 366; Cabrera, 1968: 102; Haene &, 1993: 11, 15).

3C.14542 Superpuna *Stipa chrysophylla* steppes
Steppic, very open, *Stipa chrysophylla* grasslands of the altimontane level of the southern puna Andes of Chile and Argentina, often developed at very high altitudes, marking the upper limit of vegetation, with many species shared with the mediterranean Andes high montane steppic grasslands (unit 36.21), characteristic, in particular, of the Puna de Atacama Andes of Chile, of the very high altitudes of the Ojos de Salado range, of the alti-montane level of the Andes of La Rioja. Associated bunchgrasses include *Stipa atacamensis*, *Stipa speciosa*, *Stipa frigida*.
(Hunziker, 1952: 179-181, plates xi, xii; Haene &, 1993: 11, 15; Gajardo, 1994: units 2A5-2A52, 2A7-2A52).

3C.146 Subtropical low Andean dry grasslands
Dry steppic grasslands of the middle altitudes, between 1000 and 2000 metres, of dry valleys and slopes of the eastern side of the southern puna Andes developed between latitudes 23° S and 28° S below the level of the mesic pajonal cloud grasslands of unit 3C.143 or of superpuna grasslands of unit 3C.144, often in conjunction with prepuna semidesert communities of unit 73.44.
(Czajka, 1968: unit 25; Brown and Grau, 1993: 30, 76).

3C.15 Tropical Andean mires and vegas
Mires of the high tropical Andes, developed in puna, paramo and alti-Andean environments.
(Koepcke, 1954: 89-90; Cabrera, 1958: 351, 367-368; Koepcke, 1961: 139; Cuatrecasas, 1968: 177-179; Cabrera, 1968: 102; Vuilleumier and Ewert, 1978: 53-63; Gajardo, 1994: 2A16).

3C.151 Northern tropical Andean mires
Mires of the paramo, widespread in the main eu-paramo belt, alternating in mosaic with grassland and rosette communities.
(Cuatrecasas, 1968: 177-179; Vuilleumier and Ewert, 1978: 53-63; Schnell, 1987b: 101, 104, 108; Junk, 1993: 716-717).

3C.1511 Paramo *Distichia* mires
Flush and cushion mires of the paramo constituted by carpets or cushions of *Distichia muscoides* (*Distichia tolemensis*), usually floating on peaty pools, characteristic of the 3400 - 5000 metre altitudinal level. Characteristic associated species include *Calamagrostis spp.*, *Werneria pygmaea*, *Plagiocheilus solivaeformis*, *Gentiana sedifolia*, *Plantago rigida*, *Oritrophium peruvianum*, *Oreobolus obtusangulatus*.
(Cuatrecasas, 1968: 177-179; Schnell, 1987b: 101).

3C.1512 Paramo *Sphagnum* mires
Bogs of the paramo constituted by carpets or cushions of *Sphagnum cuspidatum*, *Sphagnum magellanicum*, *Sphagnum sanctojosephense*, associated with rosette plants, grasses or Xyridaceae, characteristic of the 2800 - 3800 metre altitudinal belt.
(Cuatrecasas, 1968: 177-179; Schnell, 1987b: 104; Junk, 1993: 716-717).

3C.15121 Paramo *Espeletia-Sphagnum* mires
Bogs of the paramo constituted by carpets or cushions of *Sphagnum* associated with rosette plants of genus *Espeletia* and with the fern *Blechnum loxense*.
(Cuatrecasas, 1968: 177-179; Schnell, 1987b: 104; Junk, 1993: 717).

3C.15122 Paramo *Puya-Sphagnum* mires
Bogs of the paramo constituted by carpets or cushions of *Sphagnum* associated with rosette plants of genus *Puya*.
(Junk, 1993: 717).

3C.15123 Paramo *Swallenochloa-Sphagnum* mires

Bogs of the paramo constituted by carpets or cushions of *Sphagnum* associated with grasses of genus *Swallenochloa*.
(Cuatrecasas, 1968: 177-179; Junk, 1993: 717).

3C.15124 Paramo *Xyris*-*Sphagnum* mires
Bogs of the paramo constituted by carpets or cushions of *Sphagnum* associated with Xyridaceae of genus *Xyris*.
(Junk, 1993: 717).

3C.1513 Paramo *Calamagrostis* mires
Mires of the paramo dominated by the grass *Calamagrostis ligularis*, with the sedge bed species *Marchantaria plicata*, *Epilobium denticulatum*, *Epilobium meridense*.
(Junk, 1993: 717).

3C.152 Central tropical Andean mires and shore meadows
Fens of the high altitudes of the northern part of the southern tropical Andes, developed within the environment of the moist puna, forming dense short-sward lakeside and brookside meadows, permanently waterlogged and evergreen. The extensive shore meadows, lakeside meadow-like fens, of the larger, shallow high Andean lakes of the moist Puna are an essential feeding ground for high-altitude waterbirds, in particular, Anatidae, Charadriiformes, Threskiornithidae, Rallidae, Ardeidae.
(Koepcke, 1954: 89-90; Koepcke, 1961: 139; Fjeldså and Krabbe, 1990: 27).

3C.153 Southern tropical Andean vegas and bofedales
Fens of the high altitudes of the southern tropical Andes mostly developed within the environment of the alti-Andean superpuna communities, locally descending into the puna level.
(Cabrera, 1958: 351, 367-368; Cabrera, 1968: 102; Gajardo, 1994: units 2A16, 2A61).

3C.1531 Alti-Andean *Oxychloe* vegas and bofedales
Fens of the high altitude alti-Andean zone of the tropical Andes of northwestern Argentina and northern Chile, forming in humid depressions and along watercourses, constituted by dense low sward waterlogged carpets of dwarf rhizomaceous, predominantly monocot, junciform or graminiform species accompanied by showy-flowered dicots, dominated by *Oxychloe andina*, accompanied by *Carex incurva* var. *misera*, *Carex fuscula*, *Scirpus atacamensis*, *Scirpus macrolepis*, *Calamagrostis rigescens*, *Deyeuxia curvula*, *Deyeuxia ackelii*, *Deyeuxia subsimilis*, *Werneria pygmaea*, *Werneria solivaefolia*, *Werneria spathulata*, *Werneria pinnatifida*, commonly *Gentiana prostrata*, *Gentianella punensis*, *Calandrinia acaulis*, *Eudema friesii*, *Hypochaeris thrincioides*, *Bryopsis andicola*.
(Cabrera, 1958: 367-368; Cabrera, 1968: 102; Gajardo, 1994: unit 2A1-2A16).

3C.1532 Alti-Andean *Distichia* vegas and bofedales
Fens of the high altitude alti-Andean zone of the tropical Andes of northwestern Argentina in which the dominance of *Oxychloe andina* is replaced by that of *Distichia muscoides*, accompanied, in particular, by *Scirpus atacamensis*.
(Cabrera, 1958: 368).

3C.1533 Alti-Andean *Deyeuxia* vegas and bofedales
Fens of the high altitude alti-Andean zone of the tropical Andes of northwestern Argentina invaded by mats of the taller grass *Deyeuxia fulva*.
(Cabrera, 1958: 368).

3C.1534 Puna *Hypsela* fens
Fens of the high altitudes of the southern tropical Andes developed within the environment of the dry puna, constituted by a dense evergreen waterlogged carpet of dwarf rhizomateous sedges, in particular, *Scirpus atacamensis*, *Eleocharis atacamensis*, *Carex nebularum* accompanied by the small rush *Juncus depauperatus*, by rosette plants with long-pedicelled flowers and fruits, notably, the tiny plantain *Plantago tubulosa* and the pigmy bellflower *Hypsela oligophylla*. In inundation zones they are joined by *Lilaeopsis andina*, *Codula pedicellata*, *Cardamine flaccida*, *Mimulus glabratus*.
(Cabrera, 1958: 351).

3C.1535 Atacama *Adesmia sentis* communities
Humid communities of the high Andean altiplano of northern Chile, above 4000 metres altitude, limited to the region of the great Andean salares of southern Antofagasta and northern Atacama,

dominated by *Adesmia sentis*, with *Acaena macrostemma*, *Chaetanthera chilensis*, *Ephedra breana*, *Jaborosa caulescens*, *Juncus balticus*, *Astragalus bustillosii*, *Atriplex deserticola*, *Fabiana imbricata*, *Hordeum comosum*, *Nicotiana corymbosa*, *Opuntia ovata*, *Senecio crispus*.
(Gajardo, 1994: unit 2A6-2A61).

3C.2 Brazilian shield high mountain communities

Suprasylvatic or extrasylvatic formations of the high altitudes of the mountains of the Brazilian shield, including the Atlantic cordilleras, the more inland chains that parallel them and isolated, mostly lower ranges of the central and western shield.
(Harley, 1995: 24-35).

3C.21 Atlantic Brazilian paramos
Suprasylvatic or extrasylvatic formations of the high altitudes of the Atlantic coastal chain of Brazil, including the Serra da Mantiqueira, the Serra do Mar, the Serra dos Orgaos, the Pico da Bandeira, floristically somewhat related to Andean paramos, mostly developed above 2000 metres, composed of grass and shrub communities interspersed with humid depressions.
(Schnell, 1987a: 284, 286-288; Harley, 1995: 26).

3C.211 Atlantic Brazilian paramo grassland and scrubland
Suprasylvatic or extrasylvatic grass and shrub formations of the high altitudes of the Atlantic coastal chain of Brazil with the grass *Cortaderia modesta*, the dwarf bamboo *Chusquea pinnifolia*, sedges, small shrubs of families Melastomaceae (*Miconia*, *Lavoisiera*, *Tibouchina*, *Trembleya*) and Ericaceae (*Gaultheria*, *Gaylussacia*, *Leucothoe*), tufts of *Senecio bradii* and *Senecio orgaosanus*, orchids of genera *Habenaria* and *Liparis*, a variety of forbs, in particular, *Eryngium spp.*, *Baccharis spp.*, *Paepanthus spp.*, *Gnaphalium purpureum*, *Hypochaeris gardneri*, *Leucopholis phylicoides*, *Plantago spp.*, *Trixis gigas*, *Vellozia candida* and the cycad-like fern *Lomaria imperialis*. They harbour a highly distinctive fauna, including the endemic furnariid *Schizoeaca moreirae* and bunting *Poospiza thoracica*, the tapaculo *Scytalopus speluncae* and the nightjar *Caprimulgus longirostris*, of Andean origin.
(Schnell, 1987a: 284, 286-288; Sick, 1993: 12-13; Harley, 1995: 26).

3C.212 Atlantic Brazilian paramo fen communities
Communities of humid depressions of the suprasylvatic or extrasylvatic zones of the high altitudes of the Atlantic coastal chain of Brazil, with *Sphagnum spp.*, *Drosera villosa* and *Utricularia spp.*.
(Schnell, 1987a: 287).

3C.22 Brazilian shield campo ruprestre communities
Suprasylvatic or extrasylvatic xeromorphic grass, shrub and forb communities of the upper levels of the old-fold inland mountains of the Brazilian shield, in particular, of the Serra do Espinjaço-Chapada Diamantina system, of the Serra da Canastra in Minas Gerais and associated mountains, of the mountains of the Brazilian planalto of Goias, of the Serra do Cachimbo and other mountains of Para, of the Serra Ricardo Franco and othern ranges of extreme western Mato Grosso and eastern Bolivia.
(Hueck, 1978: 333, 309; Lewis, 1987: 8, plate 2; Prance, 1989: 127-128; Sick, 1993: 12; Harley, 1995: 24-35).

3C.221 Espinhaço-Diamantina campo rupestre communities
Suprasylvatic or extrasylvatic, mostly xeromorphic and often open formations of grasses, shrubs and forbs of the high altitudes of the Serra do Espinjaço-Chapada Diamantina system and associated mountains of the Brazilian shield to the south and east, west of the coastal chain, in particular, of the Serra da Canastra of Minas Gerais, occupying a juxtaposition of rock outcrops, sandy flats, podzols and bogs at altitudes mostly above about 1000 metres, sometimes as low as 600 metres. The complex mosaic of vegetation types, rich in small palms (*Alagoptera*, *Diplothemium*), includes saxicolous, psammophilous and mire communities. Their rock and sand components comprise Velloziaceae (*Barbacenia*, *Vellozia*), Eriocaulaceae, Xyridaceae, Asteraceae, Melastomataceae, Ericaceae, Labiaceae, Leguminose, Rubiaceae, Lythraceae, Malpighiaceae, Verbenaceae, Myrtaceae, Euphorbeaceae, Orchidaceae, Bromeliaceae, Cyperaceae, Poaceae (*Aristida*, *Panicum*, *Paspalum*, *Axonopus*, *Ctenium*), their mire component Cyperaceae, Rapateaceae, Eriocaulaceae, Orchidaceae,

Lentibulariaceae, Droseraceae, Lycopodiaceae, Osmundaceae, Blechnaceae. They harbour a fauna rich in endemics, in particular, the hummingbirds *Augastes scutatus* and *Augastes lumachellus*, the tyrannid *Polystictus superciliaris*, the furnariid *Asthenes luizae*, the bunting *Embernagra longicauda*.
(Hueck, 1978: 333; Sick, 1993: 12; Harley, 1995: 24-35).

3C.222 Central Brazilian shield campo ruprestre communities
Suprasylvatic or extrasylvatic formations of the high altitudes of the mountains of the Brazilian Planalto of Goias, in particular, Parque Nacional da Chapada dos Veadeiros, of the Serra do Cachimbo and other mountains of Para.
(Harley, 1995: 26).

3C.223 Western Brazilian shield campo ruprestre communities
Suprasylvatic or extrasylvatic formations of the high altitudes of the Serra Ricardo Franco and other ranges of extreme western Mato Grosso and eastern Bolivia.
(Harley, 1995: 26).

3C.3 Guianian shield tepui, highland and inselberg communities

Extrasylvatic communities of the isolated mountains of the Guianan shield of northeastern South America and of isolated rock outcrops of the shield and its periphery.
(Schnell, 1987a: 265-272, 411-414; Huber, 1995: 138-140, 147, 150-152, units 67, 68, 69, 90, 91, 93, 94, 95, 97, 98, 99, 100, 101).

3C.31 Guianan shield highland and tepui summital communities
Extrasylvatic communities of the high isolated mountains of the Guianan shield of northeastern South America, including the Serrania de Mapichi and the Cerro Guanay-Cerro Coro Coro-Cerro Yavi system in northern Venezuelan Amazonas, the Serrania Paru system and the 2396 metres-high Mount Duida complex in central Venezuelan Amazonas, the Sierra de la Neblina in extreme southern Venezuelan Amazonas, the Jaua, Sarisariñama, Guanacoco and Ichun ranges in southern Bolivar and the Sierra Parima in adjacent Roraima, the Cerro Guaiquinima, the Auyan-tepui, the Chimanta massif, the Ptari-Los Testigos-Aparaman system in eastern Bolivar, the 2772 metres-high Mount Roraima complex on the borders of Bolivar, Roraima and Guyana, the Pakaraima Mountains in southwestern Guyana.
(Cabrera and Willink, 1980: 67-69; Steyermanrk, 1985: 44; Schnell, 1987a: 411-414; Huber and Alarcon, 1988: units 115, 126, 134, 138, 142, 147, 150; George, 1989; Huber, 1995: 138-140, 147, 150-152, units 67, 68, 69, 90, 91, 93, 94, 95, 97, 98).

3C.311 Guianan shield highland and tepui shrub communities
Extrasylvatic shrub communities of the tepuis and other mountain or hill ranges of the Guianan shield of northeastern South America.
(Schnell, 1987a: 412; Huber, 1995: 137-138, units 56, 57, 58, 59, 60, 61, 62, 67, 68, 69).

3C.3111 High tepui shrubland
Extrasylvatic shrub communities of the high altitudes of the tepuis, high isolated mountains of the Guianan shield of northeastern South America, in particular, of Mount Roraima, Mount Duida, Mount Neblina, the Auyan-tepui, the Chimanta range, Mount Jaua, the Guanay, Yutaje and Coro Coro system, the Cuao-Sipapo system, the Paru range.
(Huber, 1995: 137-138, units 59, 61, 62, 67, 68, 69).

3C.3112 Guianan shield lower-montane shrubland
Extrasylvatic shrub communities of the lower altitudes of the tepuis and of other mountain or hill ranges of the Guianan shield of northeastern South America, in particular, of the Paru range, the Guaiquinima, Marutani, Ichun, Sarisariñama uplands, the Gran Sabana uplands.
(Huber, 1995: 137-138, units 56, 57, 58, 60, 67).

3C.312 Guianan shield highland and tepui grasslands
Extrasylvatic grassland communities of the high isolated mountains of the Guianan shield of northeastern South America, in particular, of Auyan-tepui, the Chimanta range, the Sierra de Maigualida, Cerro Marahuaka of Venezuelan Guiana and the Pakaraima Mountains of southern

Guyana. Dominant species include *Cortaderia roraimensis*, *Cladium costatum*, *Rhynchocladium steyermarkii*, *Aulonemia spp.*, *Axonopus spp.*.
(Schnell, 1987a: 411; Huber, 1995: 138-140, 147).

3C.313 Guianan shield highland and tepui forb communities
Extrasylvatic forb communities of the high isolated mountains of the Guianan shield of northeastern South America, in particular, of the Guanacoco, Sarisarinama, Jaua, Maigualida, Yutaje, Coro Coro, Autana, Cuao, Sipapo, Paru, Duida, Marahuaka, Huachamacari, Aracamuni, Neblina, Auyan-tepui, Chimanta, Roraima, Karaurin-tepui, Uei-tepui, Ptari-tepui, Los Testigos, systems.
(Huber, 1995: 138-140, 150-152, units 90, 91, 93, 94, 95, 97, 98).

3C.32 Guianan inselberg communities
Grassland, forbland or shrubland communities occupying isolated igneous-metamorphic rock outcrops, mostly granitic, constituting inselbergs within the Guianan shield rain forest region or around the periphery of the shield. Although often situated at relatively low altitudes, these communities have clear affinities with those of the high elevations of the high mountains of the Guianan shield and are therefore listed in this unit.
(Whittow, 1984: 273; Schnell, 1987a: 265-272; Huber, 1995: units 99, 100, 101).

3C.321 Eastern Guianan inselberg communities
Grassland, forbland or shrubland communities occupying isolated igneous-metamorphic rock outcrops, mostly granitic, constituting inselbergs within the eastern Guianan shield rain forest region.
(Schnell, 1987a: 265-272).

3C.3211 Eastern Guianan inselberg grasslands
Grasslands of eastern Guianan inselbergs.
(Schnell, 1987a: 265-272).

3C.3212 Eastern Guianan inselberg scrubs
Shrub communities of eastern Guianan inselbergs, developed on level rock areas with a rich growth of *Clusia spp.*, grasses, bromeliads and *Selaginella spp.*.
(Schnell, 1987a: 265-272).

3C.3213 Eastern Guianan inselberg forb communities
Forb communities of eastern Guianan inselbergs developed on slopes of slight inclination and in depressions, with orchids such as *Cyrtopodium andersonii*, grasses of the genera *Axonopus* and *Ischmaeum* and Cyperaceae.
(Schnell, 1987a: 265-272).

3C.3214 Eastern Guianan inselberg forest edge thickets
Communities of east Guianan inselbergs developed on the flanks of rock outcrops and at the forest edge, with small trees such as *Tabebuia spp.* and large rosette herbs of the genera *Anthurium* and *Furcraea*.
(Schnell, 1987a: 265-272).

3C.322 Guiano-Llanan inselberg communities
Communities occupying lajas, isolated igneous-metamorphic rock outcrops constituting inselbergs on the northern and northwestern periphery of the Guianan shield, along the southern edge of the Llanos in the states of Amazonas and Bolivar.
(Huber, 1995: units 99, 100).

3C.323 Guiano-Amazonian inselberg communities
Evergreen shrub communities occupying isolated granitic rock outcrop inselbergs of the Amazonian western periphery of the Guianan shield, in particular in the Casiquiari region where they rise up to 800 metres from the surrounding lowland rain forest. They are formed by Clusiaceae, Ochnaceae, Melastomaceae, Rubiaceae, Theaceae, accompanied by bromeliads, Rapateaceae and terrestrial orchids.
(Huber, 1995: unit 101).

3C.4 Caribbean summital communities

Extrasylvatic grass and shrub communities of the high isolated mountains of the Caribbean façade of northern South America, developed at altitudes superior to 2200 metres on the Silla de Caracas, Silla del Naiguata and a few crests of Aragua in the central Venezuelan coast ranges, and in the Macizo del Turimiquire in the eastern Venezuelan coast range, with subparamo characteristics. The species cortège includes *Befaria aestuans*, *Befaria ledifolia*, *Libanothamnus neriifolius*, *Dodonea viscosa*, *Clusia spp.*, *Agrostis humboldtiana*, *Chusquea spencei*, *Aulonemia subpectinata*, *Rhynchospora flexuosa*, *Excremis coarctata*, *Acaena cylindrostachya*.
(Huber and Alarcon, 1988: units 100, 108 *p.*).

3C.5 Oceano-montane communities

Extrasylvatic communities of the higher altitudes of tropical and subtropical oceanic islands, in particular, of the Galapagos archipelago and South Trinidad Island.

3C.51 Galapagos montane scrubs and heaths
Extrasylvatic communities of the higher altitudes of the tropical Galapagos archipelago developed above the *Scalesia* cloud-forest zone, at altitudes superior to 400-550 metres, usually composed of two belts, a lower one dominated by shrubs, a higher one by ferns and sedges.
(Wiggins and Porter, 1971: 24-30).

3C.511 Galapagos tall montane scrub
Thickets of tall, up to 3-4 metres, shrubs occupying the lower belt of summital communities of the Galapagos archipelago, with a lower limit varying between 400-550 metres and an upper limit comprised between 500-700 metres.
(Wiggins and Porter, 1971: 24-27).

3C.5111 Santa Cruz *Miconia* scrub
Thickets of the lower belt of summital communities of Santa Cruz formed by dense almost pure stands of *Miconia robinsoniana* with abundant epiphytic lichens, diluted at the lower edge ("brown zone") by an intermixture of other shurbs and a dense growth of epiphytic liverworts and mosses.
(Bowman, 1961: 17; Wiggins and Porter, 1971: 25).

3C.5112 Eastern Galapagos mixed *Miconia* scrub
Thickets of the lower belt of summital communities of the large eastern Galapagos islands San Cristobal, San Salvador and Santa Maria, dominated by *Miconia robinsoniana* in more open stands than on Santa Cruz, and with a greater admixture of other shrubs.
(Wiggins and Porter, 1971: 25).

3C.5113 Western Galapagos tall montane scrub
Thickets of the lower belt of summital communities of the large western Galapagos islands Isabela and Fernandina, devoid of *Miconia robinsonia*, dominated by *Baccharis gnidifolia*, *Darwiniothamnus tenuifolius*, *Hyptis gymnocaulos*, *Dodonaea viscosa*. The species cortège includes, in particular, *Acalypha parvula* var. *parvula*, *Drymaria rotundifolia*, *Eupatorium solinaginoides*, *Euphorbia equisetiformis*, *Gnaphalium vira-vira*, *Linum harlingii*, *Pilea peploides* and *Verbena glabrata* var. *tenuispicata*.
(Wiggins and Porter, 1971: 25-26).

3C.512 Galapagos montane fern-sedge communities
Extrasylvatic communities of ferns, grasses and sedges occupying the upper belt of summital communities of the Galapagos archipelago, above an altitude of about 500-700 metres of altitude, to the peaks of all the larger islands (highest elevation 1707 metres on Isabela). The most prevalent sedges belong to genera *Cyperus*, *Eleocharis*, *Rhynchospora* and *Scleria*, the main fern constituents are *Cyathea weatherbyana*, *Grammitis serrulata*, *Hypolepis hostilis*, *Ophioglossum reticulatum*, *Pityrogramma calomelanos* and *Pteridium aquilinum* var. *arachnoideum*; the accompanying cortège includes the dwarf shrub *Pernettya howellii*, forbs of genera *Apium*, *Jaegeria*, *Lindernia* and *Ludwigia*, clubmosses (*Lycopodium spp.*), *Sphagnum spp.*, liverworts and lichens.
(Wiggins and Porter, 1971: 27-30).

3C.5121 Eastern Galapagan upland sedge-fern communities
Extrasylvatic communities of ferns, grasses and sedges occupying the upper belt of summital communities of the eastern Galapagos islands, Santa Cruz, San Cristobal, San Salvador and Santa Maria, comparatively species-poor.
(Wiggins and Porter, 1971: 27-30).

3C.5122 Western Galapagan upland sedge-fern communities
Extrasylvatic communities of ferns, grasses and sedges occupying the upper belt of summital communities of the western Galapagos islands Fernandina and Isabela, more species-rich than the homologous communities of the eastern islands; the ferns *Elaphoglossum tenuiculum*, *Elaphoglossum yarumalense*, *Notholeana aurea* and *Polystichum muricatum*, the horsetail *Equisetum bogotense*, forbs such as *Calceolaria meistantha*, *Jungia hirsuta*, *Nama dichotomum*, *Plumbago coerulea* and *Stellaria media* are essentially limited to them.
(Wiggins and Porter, 1971: 27-30).

3C.5123 Galapagan upland tree fern communities
Stands of the large Galapagan endemic tree fern *Cyathea weatherbyana*, occupying particularly ravines, deep swales, pockets at the base of cliffs and large potholes within the sedge-fern zone.
(Wiggins and Porter, 1971: 28).

3C.513 Galapagos pothole communities
Communities of sedges, grasses and *Sphagnum* mosses occupying swales and small potholes in the fern-sedge zone of the Galapagos Islands, often with ferns and *Lycopodium spp.* at the margin and communities of annual forbs, in particular *Apium leptophyllum*, *Mecardonia dianthera*, *Lindernia anagallidea*, in ephemeral pools.
(Wiggins and Porter, 1971: 27-28).

3C.52 South Trinidad montane communities
Communities of the higher altitudes of the subtropical South Trinidad Island, constituted mostly by grasses and sedges except for relict tree-fern formations.
(Murphy, 1936: 174; Olson, 1981: 487).

3C.521 South Trinidad tree fern thickets
Thickets of the subtropical South Trinidad Island, at 20° 30' S latitude, and rising to an altitude of 600 metres, formed by the tree fern *Cyathea copelandi*. Tall forest-like stands of the species are listed in unit 49.52.
(Murphy, 1936: 174; Olson, 1981: 487; Sick, 1993: 16).

3C.522 South Trinidad upland grass and sedge communities
Extrasylvatic communities, mostly of grasses and sedges, of the higher altitudes of the subtropical South Trinidad Island.
(Murphy, 1936: 174; Olson, 1981: 487).

4 . FORESTS

Natural or seminatural communities physiognomically dominated by trees. Included are all natural, near-natural or managed forests and woods, dense or clear, on dry substrates, on permanently or temporarily waterlogged soils or on ground permanently or temporarily inundated by marine or non-marine waters. By extension, are also included small tree or shrub communities of riverine or marshland sites, as well as plantations of trees within or near their natural area of occurrence, accompanied by seminatural undergrowth.

Forests and woodland of native winter-deciduous trees, other than floodplain or mire woods, of the nemoral, subantarctic, steppic, warm-temperate humid and mediterranean zones of South America; forests dominated by broad-leaved deciduous trees, but comprising broad-leaved evergreen trees, are included.
(Oberdorfer, 1960; Hueck and Seibert, 1972, 1981: units 78, 80; Dimitri, 1972, 1977; Quintanilla, 1974, 1987; Hueck, 1978; Cabrera and Willink, 1980; Moore, 1983; Ramirez *et al.*, 1985a; San Martin *et al.*, 1986; Schmaltz, 1991; Burkart *et al.*, 1994; Gajardo, 1994: regions 4A, 4B, 4C, 5A, 6A, 6B, 7B, 7C; Coig *et al.*, 1994; Erize *et al.*, 1995: 169-209).

41.1 Central Chilean supramediterranean deciduous forests

Forests of *Nothofagus alpina*, *Nothofagus glauca*, *Nothofagus obliqua*, *Nothofagus alessandri* developed above the upper limit of sclerophyllous forests of central Chile, between 33° S and the Bio-Bio in the Cordillera de la Costa, between 34° and 35° 30' in the pre-Andes, northern outposts of the southern Chilean sub-mediterranean deciduous forests, often degraded or reduced to relictual stands as a result of human activities.
(Hueck, 1978: 391-398; Quintanilla, 1984: units IIIB1, IV1, IV3, IV4; Quintanilla, 1987: 21-26; Schmaltz, 1991: 558, 560, 564-565; Gajardo, 1994: region 4A; Coig *et al.*, 1994; Arroyo *et al.*, 1994: 55).

41.11 Central Chilean *Nothofagus obliqua* forests
Forests of the supramediterranean level of the Andes and the coast ranges of central Chile dominated by *Nothofagus obliqua*.
(Hueck, 1978: 391-398; Quintanilla, 1984: units IIIB1, IV1, IV3, IV4; Quintanilla, 1987: 21-26; Schmaltz, 1991: 558, 560, 564-565; Gajardo, 1994: region 4A; Coig *et al.*, 1994; Arroyo *et al.*, 1994: 55).

41.111 Central Chilean *Nothofagus obliqua-Cryptocarya* forests
Forests of *Nothofagus obliqua* and *Cryptocarya alba* of the supramediterranean level of central Chile, distributed sporadically in both the pre-Andes and the coastal ranges.
(Gajardo, 1994: units 4A11, 4A45).

41.1111 Santiagan *Nothofagus obliqua-Cryptocarya* forests
Woods of *Nothofagus obliqua* var. *macrocarpa* of the mesetas of the highest parts of the pre-Andes of Santiago and O'Higgins, between 33° S and 36° 30' S. Accompanying species include *Cryptocarya alba*, *Azara petiolaris*, *Chusquea cumingii*, *Lomatia hirsuta*, *Quillaja saponaria*, *Schinus montanus* and a participation of neighbouring sclerophyllous and high Andean steppe elements.
(Gajardo, 1994: units 4A1-4A11, 4A2-4A11).

41.1112 Transition *Nothofagus obliqua-Cryptocarya* forests
Forests dominated by *Nothofagus obliqua* of the Linares Andes, with outliers in the coast range and interior hills south of Concepcion, accompanied by *Cryptocarya alba* and *Aristotelia chilensis*, *Colletia ulicina*, *Escallonia revoluta*, *Lithrea caustica*, *Peumus boldus*, *Ribes punctatum*, *Lapageria rosea*, of drier localities than those of the *Nothofagus obliqua-Persea* forests of unit 41.1122, and often highly invaded and altered by sclerophyllous elements.
(Gajardo, 1994: units 4A4-4A45, 4B5-4A45, 4B7-4A45).

41.112 Central Chilean pre-Andean *Nothofagus obliqua* forests
Forests dominated by *Nothofagus obliqua*, often with *Austrocedrus chilensis* and a rich floristic cortège comprising many austral forest elements, of the foothills of the Andean cordillera of Central Chile between southern O'Higgins and northern Bio-Bio.
(Gajardo, 1994: units 4A21, 4A41).

41.1121 Pre-Andean currant *Nothofagus obliqua* forests
Forests of the foothills and pre-Andean cordilleras of O'Higgins, Maulin and Bio-Bio, between 34° 45' S and 37° S, frequently occupying damp valleys and slopes with southern exposure, dominated by *Nothofagus obliqua*, often forming a dense, high upper canopy, accompanied by *Ribes punctatum*, *Aristotelia chilensis*, *Sophora macrocarpa*, *Azara petiolaris*, *Cryptocarya alba*, *Lomatia dentata*, *Berberis actinacantha*.
(Gajardo, 1994: units 4A2-4A21, 4A4-4A21).

41.1122 Linares *Nothofagus obliqua-Persea* forests
Forests of *Nothofagus obliqua* and *Persea lingue* of the Linares Andes, between 35° 45' S and 36° 30' S, situated in damp valleys, on gentle south-facing slopes and near watercourses, accompanied by *Aextoxicon punctatum*, *Gevuina avellana*, *Aristotelia chilensis*, *Blechnum auriculatum*, *Cissus striata*, *Lapagria rosea*, *Chusquea quila*, *Laurelia sempervirens*, *Lomatia dentata*, *Lomatia hirsuta*, *Peumus boldus*.
(Gajardo, 1994: units 4A2-4A41, 4A4-4A41).

41.1123 Pre-Andean *Nothofagus obliqua-Austrocedrus* forests
Nothofagus obliqua-dominated parts of the *Austrocedrus chilensis-Nothofagus obliqua* forests of the foothills of the Andean cordillera of central Chile between O'Higgins and Bio-Bio, between 34° S and 37° S, with *Austrocedrus chilensis*, accompanied by *Aristotelia chilensis*, *Azara petiolaris*, *Baccharis rhomboidalis Cryptocarya alba*, *Kageneckia oblonga*, *Lithrea caustica*, *Maytenis boaria* and a variable floristic cortège.
(Gajardo, 1994: unit 4A2-4A22 *p.*).

41.113 Central Chilean *Nothofagus obliqua-Gomortega* forests
Lauriphyllous forests of *Nothofagus obliqua*, of exceptional occurrence within the coast range deciduous forest zone between 35° S and 36° 30' S, limited to streamsides in a few canyons. The cortège, of great floristic richness, comprises *Gomortega keule*, *Podocarpus saligna*, *Aextoxicon punctatum*, *Gevuina avellana*, *Lapageria rosea*, *Lomatia dentata*, *Luma apiculata*, *Boquila trifoliolata*, *Caldcluvia paniculata*.
(Gajardo, 1994: unit 4A3-4B51).

41.12 Central Chilean *Nothofagus glauca* forests
Forests of the supramediterranean level of the Andes and the coast ranges of central Chile dominated by *Nothofagus glauca*.
(Hueck, 1978: 391-398; Quintanilla, 1984: units IIIB1, IV1, IV3, IV4; Quintanilla, 1987: 21-26; Schmaltz, 1991: 558, 560, 564-565; Gajardo, 1994: units 4A31, 4A32, 4A43 *p.*; Coig *et al.*, 1994; Arroyo *et al.*, 1994: 55).

41.121 Central Chilean *Nothofagus glauca-Gevuina* forests
Forests dominated by *Nothofagus glauca* of the coastal range and the pre-cordilleran Andes of Maulin, occupying humid south-facing ravines and slopes more favourable to development than those of the *Nothofagus glauca-Azara* forests of unit 41.122, with *Gevuina avellana*, *Aristotelia chilensis*, *Escallonia pulverulenta*, *Gaultheria phyllyreaefolia*, *Myrceugenia obtusa*, *Lithrea caustica*, *Ribes punctatum*, *Azara petiolaris*, occasional *Nothofagus obliqua* and *Chusquea quila*, and several relict species including *Nothofagus alessandri* and *Gomortega keule*.
(Gajardo, 1994: units 4A3-4A32, 4A4-4A32).

41.122 Central Chilean *Nothofagus glauca-Azara* forests
Forests dominated by *Nothofagus glauca* occupying less moist locations within the range of Maulinian *Nothofagus glauca* forests, extending on the lower flanks of the Andes north to Santiago, accompanied by *Azara petiolaris*, *Aristotelia chilensis*, *Lithrea caustica*, *Ribes punctatum*, *Sophora macrocarpa*, *Baccharis rhomboidalis*, *Cryptocarya alba*, *Maytenis boaria* and occasional *Nothofagus obliqua* and *Chusquea cumingii*.
(Gajardo, 1994: unit 4A1-4A31, 4A3-4A31, 4A4-4A31).

41.123 Central Chilean *Nothofagus glauca-Austrocedrus* forests

Nothofagus glauca-dominated facies of the *Austrocedrus chilensis-Nothofagus glauca* forests, between 35° 30' S and 36° 30' S, accompanied by *Austrocedrus chilensis*, *Baccharus rhomboidalis*, *Lomatia hirsuta*, *Collliguaja salicifolia*, *Gochnatia foliolosa*, *Lithrea caustica*, *Myoschilos oblonga*, usually occupying gentle slopes; these forests are highly altered in their structure, are of variable density and have the appearence of forest regrowth formations.
(Gajardo, 1994: unit 4A4-4A43 *p.*).

41.13 Central Chilean *Nothofagus alpina* forests
Forests of the supramediterranean level of the Andes of central Chile dominated by *Nothofagus alpina*, well-developed, species-rich, situated in humid localities of the Linares Andes, between 35° 30' S and 36° 30' S. They are accompanied by *Drimys winteri*, *Aristotelia chilensis*, *Lomatia dentata*, *Aextoxicon punetatum*, *Blechnum auriculatum*, *Gevuina avellana*, *Nothofagus oblqua*, *Ribes punctatum*, *Viola capillaris*; *Azara petiolaris*, *Nothofagus glauca*, *Chusquea quila*, *Sophora macrocarpa* are often present. These forests are uncommon among the *Nothofagus* communities of this region.
(Hueck, 1978: 391-398; Quintanilla, 1984: units IIIB1, IV1, IV3, IV4; Quintanilla, 1987: 21-26; Schmaltz, 1991: 558, 560, 564-565; Gajardo, 1994: region 4A, unit 4A4-4A44; Coig *et al.*, 1994; Arroyo *et al.*, 1994: 55).

41.14 Central Chilean *Nothofagus alessandrii* forests
Forests and woods of the supramediterranean level of the coast ranges of central Chile dominated by the endangered *Nothofagus alessandrii*, restricted to a very few isolated locations around Curepto and Constitucion, between the Mataquito-Lontue and the Maule.
(Quintanilla, 1984: unit IV3; Quintanilla, 1987: 21-26; Schmaltz, 1991: 560, 565; Coig *et al.*, 1994: 121; Arroyo *et al.*, 1994: 55).

41.2 Mediterraneo-Valdivian deciduous forests

Deciduous or mixed deciduous-evergreen forests dominated by *Nothofagus obliqua* or *Nothofagus alpina* (*Nothofagus nervosa*, *Nothofagus procera*) of the Chilean central depression, south of 38° S, of the slopes of the Coastal Cordillera, south of 37° S, and of the western Andes, south of 36° S, developed in the transition zone between the mediterranean and Valdivian regions, and, locally, within the Valdivian region, extending southwards to about 41° S. Outposts exist on the east side of the Andes around 40° S latitude. *Nothofagus obliqua* and *Nothofagus alpina* are tall species, thermophile and hygrophile. *Nothofagus obliqua* folds its leaves during dry periods; its young leaves are pubescent. *Nothofagus alpina* is large-leaved. In regions of overlap with *Nothofagus pumilio* and *Nothofagus antarctica* (units 41.22, 41.23, 41.24), they occupy lower latitudes, lower altitudes and more humid stations.
(Oberdorfer, 1960; Dimitri, 1972: 61, 76-77, 119; Hueck and Seibert, 1972, 1981: unit 78; Quintanilla, 1974, 1987; Dimitri, 1977: 4, 29-30; Hueck, 1978: 391-398; Cabrera and Willink, 1980; Veblen *et al.*, 1983: unit 8 *p.*; Santos Biloni, 1990: 272-274; Schmaltz, 1991; Gajardo, 1994: regions 4B, 4C, 5A1, 6A4, 6A5; Coig *et al.*, 1994).

41.21 Southern Chilean lowland *Nothofagus obliqua* forests
Forests of *Nothofagus obliqua*, rich in lauriphyllous species, of the Chilean central depression and adjacent lower and middle slopes of the Chilean coastal cordillera south of 37° S.
(Gajardo, 1994: region 4B).

41.211 Southern Chilean *Nothofagus obliqua-Gomortega* forests
Forests of *Nothofagus obliqua*, with *Gomortega keule* and *Podocarpus saligna*, of the lower and middle slopes of the Coastal Cordillera, distributed between about 36° 30' S and 39° S, in the region extending from Concepcion to Puerto Saavedra and Lago del Budi. The species cortège of these forests, exceptionally rich, in particular, in rare lauriphyllous arborescent elements and species at the northern limit of their range, includes *Aextoxicon punctatum*, *Lapageria rosea*, *Lomatia dentata*, *Luma apiculata*, *Boquila trifoliolata*, *Caldcluvia paniculata*, *Greigia sphacelata*, *Luzuriaga radicans*, *Cryptocarya alba*. The forests have been eliminated in most of their range and replaced in great part by plantations of *Pinus radiata*.
(Gajardo, 1994: unit 4B5-4B51).

41.212 Southern Chilean *Nothofagus obliqua-N. dombeyi* forests
Open woods of *Nothofagus obliqua*, with *Nothofagus dombeyi* and *Aextoxicon punctatum*, of the Frontera, the Concepcion coastal cordillera and the southern Chilean central depression, between about 36° S and 41° S, installed in plains, canyons and on damp slopes. Accompanying species include *Eucryphia cordifolia*, *Hydrangea serratifolia*, *Blechnum auriculatum*, *Bowuila trifoliata*, *Chusquea quila*, *Cissus striata*, *Mitraria coccinea*, *Pseudopanax laetevirens*, *Sarmienta repens*, *Drimys winteri*. These forests are now mostly replaced by fields, pastures and tree plantations.
(Gajardo, 1994: unit 4B5-4B61, 4B6-4B61, 4B8-4B61).

41.213 Southern Chilean *Nothofagus obliqua-Laurelia* forests
Woods dominated by *Nothofagus obliqua*, with *Laurelia sempervirens* and *Persea lingue*, rich in lauriphyllous species, of the southern central Chilean depression, between 38° 30' S and 41° 15' S. Accompanying species include *Aextoxicon punctatum*, *Blechnum auriculatum*, *Lapageria rosea*, *Luma apiculata*, *Boquila trifoliolata*, *Chusquea quila*, *Cissus striata*, *Gevuina avellana*, *Sarmiento repens*, *Lomatia hirsuta*. These forests are widespread in the region, on plains and the lower sides of adjacent cordilleras, often on morainal ridges; frequently transformed into wooded pastures with only the dominant upper storey trees remaining, they impart a characteristic aspect to the landscape of the region. The few remaining multistrata lauriphyllous-dominated forests with emergent *Nothofagus obliqua* of this region are listed under 45.43.
(Gajardo, 1994: unit 4B8-4B81 *p.*).

41.214 Southern Chilean *Nothofagus obliqua-Podocarpus* forests
Woods dominated by *Nothofagus obliqua*, with *Podocarpus saligna*, locally distributed in the southern Chilean central depression and the coastal range, between 36° S and about 41° 20' S. Accompanying species include *Aristotelia chilensis*, *Chusquea quila*, *Gevuina avellana*, *Lomatia hirsuta*, *Azara lanceolata*, *Berberis darwinii*, *Blechnum auriculatum*.
(Gajardo, 1994: unit 4B8-4B82, 5A1-4B82).

41.22 Western Andean mediterraneo-Valdivian deciduous forests
Forests of *Nothofagus obliqua* or *Nothofagus alpina*, characteristically with a dense understorey, of the intermediate and upper slopes of the Chilean Andes, from 37° S to just beyond 40° S, in conditions of higher precipitation and lower temperature than those of the Chilean central depression and Coastal Cordilleran slopes; for the most part, they have been subjected to forestry exploitation.
(Schmaltz, 1991: 566-570; Gajardo, 1994: regions 4C9, 4C10, 5A1, 6A5, units 4C91, 4C93, 4C101).

41.221 Western Andean *Nothofagus obliqua-N. alpina* forests
Forests of *Nothofagus obliqua* and *Nothofagus alpina* of the middle and upper slopes of the pre-Andes of Bio-Bio and extreme northern La Araucania regions, between about 37° S and 38° 30' S, with *Aristotelia chilensis*, *Gaultheria phyllyreaefolia*, *Lapageria rosea*, *Lomatia hirsuta*, *Berberis darwinii*, *Myoschilos oblonga*, *Rhaphithamnus spinosus*, *Ribes valdivianum*, *Chusquea culeou*.
(Gajardo, 1994: unit 4C9-4C91).

41.222 Western Andean *Nothofagus obliqua* steppe forests
Xeric *Nothofagus obliqua* woods of the middle and upper slopes of the pre-Andes of Bio-Bio and extreme northern La Araucania regions, and of the xeric inner Andean basin of the upper Rio Bio-Bio, with a tall tree layer over a very open shrub layer and a dense herb layer of tufted grasses. Principal species include *Baccharis obovata*, *Berberis buxifolia*, *Berberis trigona*, *Discaria serratifolia*, *Geranium berterianum*, *Trisetum spicatum*, *Hordeum comosum*, *Stipa duriuscula*, *Agrostis tenuis*, *Cortaderia araucana*, *Koeleria phleoides*, *Osmorhiza chilensis*.
(Gajardo, 1994: units 4C9-4C93, 6A5-4C93).

41.223 Western Andean *Nothofagus alpina-N. dombeyi* forests
Mixed deciduous-evergreen forests dominated by *Nothofagus alpina*, accompanied by *Nothofagus dombeyi*, of the Chilean Andes, between nearly 38° S and 40° 30' S, occupying more humid stations than the purely deciduous forests of unit 41.221. Their varied floristic cortège, comprising many lauriphyllous and high Andean elements, includes *Gaultheria phyllyreaefolia*, *Chusquea culeou*, *Maytenus magellanica*, *Pseudopanax laetevirens*, *Azara lanceolata*, *Boquila trifoliolata*, *Dasyphyllum diacanthoides*, *Mutisia retusa*, *Elytropus chilensis*, *Hydrangea serratifolia*, *Laurelia philippiana*, *Lomatia hirsutan*, *Lomatia ferruginea*.

(Gajardo, 1994: units 4C9-4C101, 4C10-4C101).

41.23 Eastern Andean *Nothofagus obliqua* and *N. alpina* forests

Deciduous or mixed deciduous-evergreen forests dominated by *Nothofagus obliqua* or *Nothofagus alpina* (*Nothofagus nervosa*, *Nothofagus procera*) of the Argentinian Andes of Neuquen, mostly limited to Lanin National Park, at about 40° S latitude.

(Dimitri, 1972: 61, 76-77, 119; Hueck and Seibert, 1972, 1981: unit 78; Dimitri, 1977: 4, 29-30; Santos Biloni, 1990: 272-274; Schmaltz, 1991: 566-570; Chebez, 1994: 500; Erize *et al.*, 1995: 175-176, 188).

41.231 Eastern Andean *Nothofagus obliqua* forests

Deciduous or mixed deciduous-evergreen forests dominated by *Nothofagus obliqua* of the Argentinian Andes of Neuquen, occupying substantial surfaces in the southern and northern parts of Lanin National Park. *Nothofagus obliqua* is considered to be endangered in Argentina.

(Dimitri, 1972: 61, 76-77, 119; Dimitri, 1977: 4, 30; Santos Biloni, 1990: 273-274; Chebez, 1994: 500; Erize *et al.*, 1995: 175-176, 188).

41.232 Eastern Andean *Nothofagus alpina* forests

Deciduous or mixed deciduous-evergreen forests dominated by *Nothofagus alpina* (*Nothofagus nervosa*, *Nothofagus procera*) of the Argentinian Andes of Neuquen, limited to small surfaces within Lanin National Park. *Nothofagus alpina* is considered to be vulnerable in Argentina.

(Dimitri, 1972: 61, 76-77, 119; Dimitri, 1977: 4, 29; Santos Biloni, 1990: 272-273; Chebez, 1994: 500; Erize *et al.*, 1995: 175-176, 188).

41.24 Upper Nahuelbuta-Pelada mediterraneo-Valdivian deciduous forests

Deciduous *Nothofagus obliqua* or *Nothofagus alpina* forests of the high slopes of the Cordillera Nahuelbuta and the Cordillera Pelada.

(Schmaltz, 1991: 569-570; Gajardo, 1994: region 6A4, units 4C91, 4C101).

41.241 Upper Nahuelbuta *Nothofagus obliqua-N. alpina* forests

Forests of *Nothofagus obliqua* and *Nothofagus alpina* of the upper slopes of the Cordillera de Nahuelbuta, characteristic of middle altitudes on eastern, less rainy, slopes of the range.

(Gajardo, 1994: unit 6A4-4C91).

41.242 Nahuelbuta-Pelada *Nothofagus alpina-N. dombeyi* forests

Mixed deciduous-evergreen forests of *Nothofagus alpina* and *Nothofagus dombeyi* of very humid slopes of the Cordillera de Nahuelbuta and of high eastern slopes of the Cordillera Pelada.

(Gajardo, 1994: unit 6A4-4C101, 5A1-4C101).

41.3 Andino-Patagonian deciduous forests

Forests dominated by *Nothofagus pumilio* and *Nothofagus antarctica* of the southern Andes and their piedmont, mostly characteristic of the drier eastern side of the range and of high altitudes, extending from 37° S, where they occupy the upper limit of vegetation, southward to the southern limit of forests and eastward to the edge of the Patagonian steppe.

(Oberdorfer, 1960; Hueck and Seibert, 1972, 1981: unit 80; Dimitri, 1972: 21, 23, 61, 62, 77, 117, 119; Dimitri, 1977: 4, 28, 30; Quintanilla, 1974, 1987; Hueck, 1978: 418-432; Cabrera and Willink, 1980: 100-102; Moore, 1983: 26; Veblen *et al.*, 1983: 7; Ramirez *et al.*, 1985a; San Martin *et al.*, 1986; Schmaltz, 1991; Burkart *et al.*, 1994: 17-18; Gajardo, 1994: regions 6A3, 6B, 7B, 7C; Coig *et al.*, 1994; Erize *et al.*, 1995: 169-209).

41.31 Andino-Patagonian *Nothofagus pumilio* forests

Forests of the southern Andes and their piedmont dominated by *Nothofagus pumilio*, constituting the most extensive deciduous forest type of the Andino-Patagonian region, reaching from 36° 50' S to Cape Horn and from the plains and the ecotone with the Patagonian steppe to the tree limit and the combat zone with alpine vegetation, mostly confined, except at high altitudes, to the eastern, drier side of the range. Their upper limit ranges from 200 metres above sea level on Staten Island to 1300 metres at 39° S, their lower limit from sea level in Tierra del Fuego to 1500 metres in the north. Floristic cortège and main tree associates of the dominant vary from south to north, as well as altitudinally.

Forest stature varies strongly with altitude and exposure, sometimes, particularly in the south, continuously, so that there is an unbroken series from tall forest through low forest, elfin forest or tall scrub to prostrate scrub (unit 31). Three subdivisions can be conveniently recognized, although their limits may, in some regions, at least, be poorly defined.
(Oberdorfer, 1960; Hueck and Seibert, 1972, 1981: unit 80; Dimitri, 1972: 21, 61, 73, 77, 119; Dimitri, 1977: 4, 30; Quintanilla, 1974, 1987; Hueck, 1978: 419-425; Cabrera and Willink, 1980: 100-102; Moore, 1983: 26; Veblen *et al.*, 1983: 7; Schmaltz, 1991: 572-576; Burkart *et al.*, 1994: 18; Gajardo, 1994: regions 6A3, 6B, 7B; Coig *et al.*, 1994; Erize *et al.*, 1995: 173, 179).

41.311 Southern *Nothofagus pumilio* forests
Forests dominated by *Nothofagus pumilio* of the Magellanic region. Accompanying species include *Maytenus disticha*, *Adenocaulon chilense*, *Berberis ilicifolia*, *Berberis buxifolia*, *Codonorchis lessonii*, *Lagenifera hariotii*, *Macrachaenium gracile*, *Osmorhiza chilensis*, *Pernettya mucronata*, *Ribes geoides*, *Chiliotrichum diffusum*, *Valeriana lapathifolia*, *Asplenium dareoides*, *Blechnum penna-marina*, *Drysopsis glechomoides*. These forests have a very constant species cortège although they vary considerably in structure and physiognomy with local ecological conditions. Forests on well-developed soils, in particular, brown forest podsols, with good drainage, are dense and tall, reaching a height of 20 metres in the south, 30 metres in the north. Forests on less favourable soils are more open, with a denser shrub and herb layer, comprising, on wet soils, *Cardamine glacialis*, *Chrysoplenium macranthum*, *Gunnera magellanica*, *Senecio acanthifolius* and, on dry soils, *Acaena ovalifolia*, *Cotula scariosa*, *Rubus geoides*, *Schizeilema ranunculus*, *Viola magellanica*, *Viola maculata*.
(Hueck and Seibert, 1972, 1981: unit 80; Dimitri, 1972: 61, 62, 77, 119; Quintanilla, 1989: 9-10, 16-18, map; Dimitri, 1977: 4, 30; Hueck, 1978: 419-425; Cabrera and Willink, 1980: 100-102; Moore, 1983: 26; Schmaltz, 1991: 572-576; Gajardo, 1994: unit 6B9-6B101, 6B10-6B101, 7B7-6B101; Erize *et al.*, 1995: 173).

41.312 Northern *Nothofagus pumilio* forests
Forests of *Nothofagus pumilio* of the high slopes of the Andes within the domain of occurrence of *Araucaria araucana*, at latitudes comprised between 37° S and 39° 30' S, at the northern limit of the range of the Andino-Patagonian deciduous forests. *Araucaria araucana*, *Nothofagus dombeyi*, *Nothofagus antarctica*, *Nothofagus obliqua*, *Nothofagus alpina* may be associated with *Nothofagus pumilio*.
(Oberdorfer, 1960: 136-140; Hueck and Seibert, 1972, 1981: unit 76 *p.*; Dimitri, 1972: 21, 77, 119; Quintanilla, 1974: 64-65; Dimitri, 1977: 4, 30; Hueck, 1978: 399-400, 418-432; Cabrera and Willink, 1980: 100-102; Veblen *et al.*, 1983: 7; Schmaltz, 1991: 572-576; Gajardo, 1994: regions 6A3, 6A4; Erize *et al.*, 1995: 170, 173).

41.3121 Araucanian *Nothofagus pumilio-N. antarctica* forests
Woods dominated by *Nothofagus pumilio* and *Nothofagus antarctica* of the western Andes, between 37° S and 39° 30' S, developed, in particular, in the upper levels of forest vegetation of the Chillan Andes and in cold, humid valleys of the Araucanian Andes. Accompanying species include *Escallonia alpina*, *Maytenus disticha*, *Pernettya myrtilloides*, *Viola maculata*, *Valeriana lapathifolia*, *Anemone antucensis*.
(Oberdorfer, 1960: 136-140; Quintanilla, 1974: 64-65; Gajardo, 1994: unit 6A2-6A21, 6A3-6A21).

41.3122 *Nothofagus pumilio-N. dombeyi* forests
Nothofagus pumilio-dominated forests of the eastern flank of the Andes of Neuquen within or near the range of *Araucaria araucana*, at about 37° S to 39° 30' S, in an area where the Andino-Patagonian *Nothofagus pumilio-Nothofagus antarctica* forests overlap with mediterraneo-Valdivian deciduous forests, mostly confined to lower altitudes and with conifer forests. *Nothofagus dombeyi*, *Nothofagus alpina*, *Araucaria araucana*, *Drimys winteri*, *Chusquea culeou*, *Berberis pearcei* accompany *Nothofagus pumilio*.
(Hueck and Seibert, 1972, 1981: unit 76 *p.*; Dimitri, 1972: 21, 77, 119; Dimitri, 1977: 4, 30; Hueck, 1978: 399-400, 418-432; Schmaltz, 1991: 570-576; Erize *et al.*, 1995: 170, 173).

41.313 Upper Andean *Nothofagus pumilio* forests
Forests of *Nothofagus pumilio* of the upper altitudes of the Patagonian Andes, north to 40° S latitude, of lower stature than the forests of unit 41.311, often reduced to elfin forests or grading into scrubs

(unit 31). Particularly in the south, the transition from tall forest to scrub may be entirely gradual, without sharp boundaries.
(Hueck and Seibert, 1972, 1981: unit 80 *p.*; Quintanilla, 1974, 1989; Hueck, 1978: 418-432; Moore, 1983: 26; Veblen *et al.*, 1983: 7; Schmaltz, 1991: 572-576; Gajardo, 1994: regions 6A3, 6B, 7B).

41.3131 *Nothofagus pumilio-Drimys* forests
Forests of *Nothofagus pumilio* with *Drimys winteri* var. *andina* of the upper altitudes of the Patagonian Andes south of 39° 30' S. In the northern part of their range, north of about 43° S, these communities often take the form of forests. In the more southerly mountains, where they are subjected to steady high winds, an arborescent stature is maintained only in sheltered areas, otherwise, they occur in the form of a matorral (unit 31.82). Accompanying species include *Berberis montana*, *Embothrium coccineum*, *Macrachaenium gracile*, *Maytenus disticha*, *Ovidia andina*, *Ranunculus peduncularis*, *Senecio acanthifolius*, *Valeriana lapathifolia*, *Carex trichodes*, *Escallonia alpina*, *Gunnera magellanica*, *Ribes cucullatum*, *Rubus geoides*.
(Gajardo, 1994: unit 6B6-6B61, 6B8-6B61).

41.3132 Elfin *Nothofagus pumilio-Ribes* forests
Very low, discontinuous woods of stunted, twisted *Nothofagus pumilio*, of the Patagonian Andes, south of 39° 30' S, subsisting at the upper forest limit, accompanied by *Ribes cucullatum*, *Adenocaulon chilense*, *Drimys winteri* var. *andina*, *Perezia prenanthoides*, often with *Berberis empetrifolia*, *Ribes magellanicum*, *Rubus geoides*, *Valeriana laxiflora*, *Viola maculata*.
(Cabrera and Willink, 1980: 100; Veblen *et al.*, 1983: 7; Gajardo, 1994: units 6B6-"6A82" = 6B82, 6B8-"6B81" = 6B82, *p.*).

41.32 *Nothofagus antarctica* forests
Forests of *Nothofagus antarctica* of the Andino-Patagonian and Magellanic forest zones, of lower stature than *Nothofagus pumilio* forests, characteristic of the edges of marshy bottomland and peatbogs, of higher altitudes, of steppe ecotones, of soils with fluctuating hydric regime, of pioneer situations on fresh lava and ash deposits, after forest fires or glacier retreat.
(Oberdorfer, 1960: 142-143; Hueck and Seibert, 1972, 1981: unit 80; Dimitri, 1972: 23, 61, 63, 73, 77, 117; Dimitri, 1977: 4, 28; Quintanilla, 1974, 1989; Hueck, 1978: 425-429; Cabrera and Willink, 1980: 100-102; Moore, 1983: 26; Ramirez *et al.*, 1985a; San Martin *et al.*, 1986; Schmaltz, 1991: 576-577; Burkart *et al.*, 1994: 17-18; Gajardo, 1994: regions 6A3, 6B, 7B, 7C; Coig *et al.*, 1994; Erize *et al.*, 1995: 173, 189).

41.321 Fuegian *Nothofagus antarctica* forests
Low, often open woods of twisted *Nothofagus antarctica* of Tierra del Fuego, its archipelago and peninsula Brunswick, mostly occupying areas of more extreme growing conditions than those populated by *Nothofagus pumilio*, in particular, stations with shallower soils, higher water tables, peaty ground, higher wind exposure or greater aridity, including the zone of contact with the southern Patagonian *Festuca gracillima* steppes. The shrub and herb layers, tending to be much more developed than in woods of *Nothofagus pumilio* because of the open canopy, includes *Berberis buxifolia*, *Chiliotrichum diffusum*, *Embotherium coccineum*, *Empetrum rubrum*, *Galium aparine*, *Luzula alopecurus*, *Osmorhiza chilensis*, *Osmorhiza depauperata*, *Ranunculus peduncularis*, *Anemone multifida*, *Vicia magellanica*, *Pratia repens*, *Uncinia lechleriana*.
(Dimitri, 1972: 63; Moore, 1980: 26; Quintanilla, 1989: 16-18, map; Gajardo, 1994: units 6B10-6B81, 7C11-7B72 *p.*, 7B8-7B85 *p.*, 7C14-7B85 *p.*, 7B9-7C111 *p.*, 7C11-7C111 *p.*).

41.322 Timberline *Nothofagus antarctica* forests
Low or stunted forests of *Nothofagus pumilio* forming at treeline in the southern Andes and the Chilean coastal range. Part of the formation is a scrub, listed under unit 31.
(Oberdorfer, 1960: 142-143; Quintanilla, 1974: 65-66; Quintanilla, 1989: 16-18; Hueck, 1978: 427; Moore, 1983: 26; Ramirez *et al.*, 1985a; Schmaltz, 1991: 576-577; Gajardo, 1994: units 6A4-6B81, 6B8-6B81, 6B10-6B81, 7C11-7B72, 7C11-7C111, *p.*; Erize *et al.*, 1995: 173).

41.3221 Alto-Andean *Nothofagus antarctica* forests
Nothofagus antarctica woods forming a discontinuous strip of elfin forest or krummholz above the *Nothofagus pumilio* forests in the mainland southern Andes, from the Cordillera Ultima Esperanza, in the south, north to the northern limit of Andino-Patagonian woods, at about 37° 30' S, developing at

increasingly higher altitudes northwards. *Calceolaria biflora*, *Maytenus disticha*, *Lagenophora hirsuta*, *Berberis buxifolia*, *Azorella caespitosa*, *Pernettya pumila*, *Poa pratensis*, *Ranunculus peduncularis*, *Trisetum canescens*, *Acaena ovalifolia*, *Alopecurus magellanicus*, *Anemone multifida*, *Blechnum penna-marina*, *Deschampsia flexuosa*, *Galium antarcticum*, *Macrachaenium gracile* participate in the communities. Parts of the communities are scrubs and are listed under unit 31.
(Oberdorfer, 1960: 142-143; Quintanilla, 1974: 65-66; Quintanilla, 1989: 16-18, map; Hueck, 1978: 427; Ramirez *et al.*, 1985a: 56-57, sample 1; Schmaltz, 1991: 576-577; Gajardo, 1994: unit 6B8-6B81; Erize *et al.*, 1995: 173).

41.3222 Coast range timberline *Nothofagus antarctica* forests
Low woods of stunted *Nothofagus antarctica* occupying the highest parts of the Cordillera de Nahuelbuta and the Cordillera Pelada, in situations homologous with the Andes but where less restrictive ecological conditions permit a greater diversity of flora and vegetation over a relatively small area. Parts of the communities are scrubs and are listed under unit 31.
(Ramirez *et al.*, 1985a: 59, samples 10, 11; Gajardo, 1994: unit 6A4-"6A81"= 6B81).

41.323 Pre-Patagonian *Nothofagus antarctica* forests
Forests of *Nothofagus antarctica* forming in regions of highest aridity within the Andino-Patagonian deciduous forest zone, in particular, in and near the ecotone between forests and Patagonian sub-Andean steppes, where they occupy, predominantly, the mallines, areas of fine sandy soils with strongly alternating hygric regime, waterlogged and poorly aerated in winter, dessicated in summer, leaving the intervening moraine hills to *Nothofagus pumilio*; they also occupy, both in the ecotone region and within the adjacent deciduous or evergreen forests, stony alluvions of large rivers. The transition from woodland to steppe is ragged, irregular, and marked by isolated woods and open groves of trees, as well as by steppe enclaves in woodland, constituting a mosaic that blurs its sharpness. Some of the woods are riverine galleries or swamp woods, listed under unit 44. Steppe shrubs and grasses constitute an important fraction of the understorey cortège, which comprises *Berberis buxifolia*, *Blechnum penna-marina*, *Fragaria chilensis*, *Geranium berterianum*, *Holcus lanatus*, *Osmorhiza chilensis*, *Ovidia andina*, *Ribes magellanicum*, and, particularly in the south, *Chiliotrichum diffusum*.
(Dimitri, 1972: 117; Dimitri, 1977: 4, 28; Quintanilla, 1989: 9-10, 11, 12-13, 18; Hueck, 1978: 428, 429; Schmaltz, 1991: 576-577; Gajardo, 1994: units 6B9-6B94 *p.*, 7B7-6B94 *p.*, 7B7-7B72 *p.*).

41.324 Andean cold-pocket *Nothofagus antarctica* forests
Forests of *Nothofagus antarctica* forming in anomalous cold stations of the Andean range of mediterraneo-Valdivian deciduous forests, in particular, in cold-pocket depressions and valleys, on and around moors and marshes. The undergrowth includes *Ribes cucullatum*, *Pernettya poeppigii*, *Dioscorea helicifolia*, *Mutisia retusa*.
(Hueck, 1978: 429; Ramirez *et al.*, 1985a: 57, sample 2; Schmaltz, 1991: 576-577; Erize *et al.*, 1995: 173).

42. TEMPERATE CONIFEROUS FORESTS

Forests and woodland of native coniferous trees, other than floodplain and mire woods, of the nemoral, warm-temperate humid and mediterranean zones, in particular, forests of *Araucaria*, *Austrocedrus* and *Fitzroya* of the southern Andes, the Patagonian piedmont and the Valdivian region.
(Oberdorfer, 1960; Hueck and Seibert, 1972, 1981: units 76, 77, 75 *p.*; Dimitri, 1972, 1977; Quintanilla, 1974, 1987; Hueck, 1978; Cabrera and Willink, 1980; Burkart *et al.*, 1994; Gajardo, 1994; Coig *et al.*, 1994; Erize *et al.*, 1995).

42.1 Araucaria araucana forests

Forests of temperate South America dominated by *Araucaria araucana*, alone or accompanied by *Nothofagus* species. They are limited to the main ranges of the Andes between 37° S and 40° S latitude, and to the Cordillera de Nahuelbuta in the Chilean coastal range, often occupying dry northwest or northeast facing slopes, and wind-exposed crests, rocks and ridges. The species is considered vulnerable in both Argentina and Chile.
(Oberdorfer, 1960: 138, 140-142; Dimitri, 1972: 72, 76, 117, 203; Quintanilla, 1973; Quintanilla, 1974: 63-64; Dimitri, 1977: 3, 26; Hueck, 1978: 399-403; Cabrera and Willink, 1980: 99-100; Hueck and Seibert, 1981: unit 76; Veblen *et al.*, 1983: 7; Schmaltz, 1991: 570-572; Burkart *et al.*, 1994: 18; Gajardo, 1994: regions 6A3, 6A4, 6A5; Chebez, 1994: 494-495; Coig *et al.*, 1994: 51-52, 68-71, 74-77, 82-85, 120, 128; Erize *et al.*, 1995: 170-173).

42.11 Andean *Araucaria* forests
Forests of *Araucaria araucana* of the main ranges of the Andes, distributed between 37° S and 40° S latitude, at altitudes of about 900-1800 m on the Chilean slopes, of about 600-1800 m on the Neuquén slopes of Argentina.
(Oberdorfer, 1960: 140-142; Dimitri, 1972: 72, 76, 117, 203; Quintanilla, 1973; Quintanilla, 1974: 63-64; Dimitri, 1977: 3, 26; Hueck, 1978: 399-403; Cabrera and Willink, 1980: 99-100; Veblen *et al.*, 1983: 7; Schmaltz, 1991: 570-572; Gajardo, 1994: regions 6A3, 6A5; Chebez, 1994: 494-495; Coig *et al.*, 1994: 68-71, 74-77, 82-83, 128; Erize *et al.*, 1995: 170-173).

42.111 Andean *Araucaria-Nothofagus dombeyi* forests
Forests of the middle levels of the western and eastern slopes of the Andes, in areas of higher precipitation, dominated by *Araucaria araucana* with *Nothofagus dombeyi*, accompanied by *Adenocaulon chilense*, *Lagenophora hirsuta*, *Pseudopanax laetevirens*, *Chusquea culeou*, *Desfontainia spinosa*, *Drimys winteri* var. *andina*, *Libertia ixioides*, *Myoschilos oblonga*, *Berberis buxifolia*, *Embothrium coccineum*, *Escallonia virgata*, *Lycopodium magellanicum*, *Macrachaenium gracile*, *Maytenus magellanica*, *Osmorhiza chilensis*, *Pernettya mucronata*.
(Quintanilla, 1973; Quintanilla, 1974: 63-64; Hueck, 1978: 399-403; Schmaltz, 1991: 570-572; Gajardo, 1994: unit 6A3-6A32).

42.112 Andean *Araucaria-Nothofagus pumilio* forests
Forests of the upper levels of the western and eastern slopes of the Andes dominated by *Araucaria araucana*, accompanied by *Nothofagus pumilio* or, particularly at the highest altitudes and on xeric slopes, in pure stands. The undergrowth includes *Adenocaulon chilense*, *Codonorchis lessonii*, *Lagenophora hirsuta*, *Chusquea culeou*, *Berberis buxifolia*, *Berberis pearcei*, *Lycopodium magellanicum*, *Macrachaenium gracile*, *Maytenus disticha*, *Perezia prenanthoides*, *Anemone antucensis*, *Chiliotrichum diffusum*, *Fragraria chilensis*, *Viola maculata*.
(Oberdorfer, 1960: 138, 140-142; Dimitri, 1972: 72, 76, 117, 203; Quintanilla, 1973; Quintanilla, 1974: 63-64; Dimitri, 1977: 3, 26; Hueck, 1978: 399-403; Schmaltz, 1991: 570-572; Gajardo, 1994: units 6A3-6A31, 6A5-6A31; Erize *et al.*, 1995: 170-173).

42.113 Andean *Araucaria-Nothofagus antarctica* forests
Forests of the eastern Andes of Neuquén dominated by *Araucaria araucana* accompanied by *Nothofagus antarctica*.
(Dimitri, 1972: 72, 76, 117, 203; Dimitri, 1977: 3, 26; Hueck, 1978: 399-403; Schmaltz, 1991: 570-572).
42.114 Pre-Patagonian *Araucaria* forests
Forests of *Araucaria araucana* occupying dry, cold locations on the stony substrates of high summits and lava fields at the western limit of the Patagonian steppe, and in pre-Patagonian inner Andean basins, in particular, the upper basin of the Bio-Bio. Outposts extend into the steppe. The understorey, grassy and steppe-like, is formed, in particular, by *Festuca scabriuscula*, *Poa obvalata*, *Quinchamalium chilense*, *Poa julietii*, with *Adesmia emarginata*, *Empetrum rubrum*, *Escallonia virgata*, *Perezia pedicullariaefolia*, *Pernettya pumila*, *Senecio julietii*, *Valeriana fonckii*, *Azara alpina*, *Berberis linearifolia*, *Ribes cucullatum*.
(Dimitri, 1972: 72, 76, 117, 203; Quintanilla, 1973; Quintanilla, 1974: 63-64; Dimitri, 1977: 3, 26; Hueck, 1978: 399-403; Schmaltz, 1991: 570-572; Gajardo, 1994: units 6A3-6A51, 6A5-6A51; Erize *et al.*, 1995: 170-173; Coig *et al.*, 1994: 128).

42.12 Nahuelbuta *Araucaria* forests
Forests of *Araucaria araucana* of the Cordillera de Nahuelbuta of the Chilean coastal range, limited to an area of about 1000 ha at altitudes between 600 m and 1400 m.
(Oberdorfer, 1960: 138; Quintanilla, 1973; Quintanilla, 1974: 63-64; Hueck, 1978: 399-403; Cabrera and Willink, 1980: 99-100; Schmaltz, 1991: 570-572; Gajardo, 1994: region 6A4; Coig *et al.*, 1994: 70, 128).

42.121 Nahuelbuta *Araucaria-Nothofagus dombeyi* forests
Forests dominated by *Araucaria araucana* with *Nothofagus dombeyi* of the Cordillera de Nahuelbuta, developed at lower altitudes than the forests of unit 42.122.
(Gajardo, 1994: unit 6A4-6A32).

42.122 Nahuelbuta *Araucaria-Nothofagus pumilio* forests
Forests of the higher altitudes of the Cordillera de Nahuelbuta dominated by *Araucaria araucana*, accompanied by *Nothofagus pumilio* or, particularly at the highest altitudes, in pure stands.
(Gajardo, 1994: unit 6A4-6A31).

42.2 Fitzroya cupressoides forests

Forests of the Tertiary relict *Fitzroya cupressoides* occupying localities with cool rain forest conditions of the Valdivian Coastal Cordillera, Chiloe Island and the Andes between 40° S and 43° S; individual trees may reach more than 60 m in height and 3000 years of age. They mostly occupy soils unsuitable for development of the broad-leaved Valdivian forests, often peaty. Formerly widespread in the southern part of the central depression of Chile, *Fitzroya* forests have been submitted to heavy exploitation, and reduced to very small tracts or patches on pre-Andean and Andean slopes and in the highlands of the coastal range. More extensive stands were preserved on the Argentinian side of the Andes through earlier application of corrective measures, including legislation restricting or banning exploitation and the establishment of national parks protecting the forest ecosystems they constitute, measures now also applied in Chile. *Fitzroya cupressoides* is considered endangered in Argentina and vulnerable in Chile.
(Oberdorfer, 1960: 112-115; Hueck and Seibert, 1972: unit 75 *p.*; Dimitri, 1972: 74, 76, 117; Quintanilla, 1973; Quintanilla, 1974: 63; Dimitri, 1974: 4, 27; Hueck, 1978: 385-388, 390; Cabrera and Willink, 1980: 98; Veblen *et al.*, 1983: 7, 25, 29; Gajardo, 1994: units 7A11, 7A12, 7A21; Chebez, 1994: 499; Coig *et al.*, 1994: 51-52, 80-85, 120, 129; Erize *et al.*, 1995: 193, 194-197).

42.21 Andean *Fitzroya* forests
Tall forests of *Fitzroya cupressoides*, rich in lauriphilous elements, of the middle altitudes of the Andes, between 40°S and 43°S, limited to regions of cool climate and heavy precipitation, mostly on the western flank, extending locally, in the western Lago Nahuel Huapi district and Alerces National Park, to the extreme western Argentinian Andes.

(Hueck and Seibert, 1972: unit 75 *p.*; Dimitri, 1972: 74, 76, 117; Quintanilla, 1973; Quintanilla, 1974: 63; Dimitri, 1974: 4, 27; Hueck, 1978: 385-388, 390; Veblen *et al.*, 1983: 7; Gajardo, 1994: units 7A2-7A11, 7A2-7A21, 5A4-7A21; Chebez, 1994: 499; Coig *et al.*, 1994: 80-85, 120, 129; Erize *et al.*, 1995: 193, 194-197).

42.211 *Fitzroya-Nothofagus betuloides* forests
Tall forests of *Fitzroya cupressoides* of the upper and middle slopes of the Chilean Andes between 40° 30' S and 43°S, accompanied by *Nothofagus betuloides* and a cortège rich in lauriphilous species comprising *Desfontainia spinosa*, *Drimys winteri* var. *andina*, *Asteranthera ovata*, *Azara lanceolata*, *Blechnum magellanicum*, *Chusquea culeou*, *Embothrium collineum*, *Gaultheria phyllyreaefolia*, *Maytenus magellanica*, *Myrceugenia chrysocarpa*, *Podocarpus nubigena*, *Pseudopanax laetevirens*, *Saxegothaea conspicua*.
(Gajardo, 1994: units 7A2-7A21, 5A4-7A21).

42.212 *Fitzroya-Nothofagus dombeyi* forests
Forests, sometimes extensive and imposing, dominated by *Fitzroya cupressoides*, limited to, and considered to be endangered in, the extreme western Argentinian Andes between 40°S to 42°S, in particular, near Puerto Blest, Lago Nahuel Huapi, Lago Frias and the Alerces National Park, with close affinities to the Valdivian and Western Andean *Fitzroya* forests, but constituting outliers at the eastern limit of these forests. Accompanying species include *Nothofagus dombeyi*, *Podocarpus nubigenus*, *Saxegothaea conspicua*, *Lomatia hirsuta*, *Azara microphylla*, *Embothrium coccineum*, *Fuchsia magellanica*, *Pernettya poeppigii*, *Gaultheria phillyreaefolia*, *Berberis spp.*, *Desfontainea spinosa*, *Drimys winteri*, *Ribes magellanicus*, *Gunnera chilensis*, *Blechnum spp.*, *Chusquea culeou*. In very marshy situations *Fitzroya* is associated with *Pilgerodendron uvifera*.
(Dimitri, 1972: 74, 76; Hueck, 1978: 385-388, 390; Cabrera and Willink, 1980: 98; Veblen *et al.*, 1983: 7; Santos Biloni, 1990: 264-267; Chebez, 1994: 499; Erize *et al.*, 1995: 175, 193, 194-197).

42.213 Low Andean *Fitzroya-Tepualia* forests
Forests of *Fitzroya cupressoides*, accompanied by *Tepualia stipularis*, of the lower altitudes of the western, Valdivian, Andes, between 41° 30' S, and 43° S, characteristic of humid flats and gentle slopes.
(Gajardo, 1994: unit 7A2-7A11).

42.22 Pelada *Fitzroya* forests
Woods and forests dominated by *Fitzroya cupressoides* of the Valdivian coastal Cordillera Pelada, between 40° S and 41° 30'S, relatively open-canopied, with a dense shrub layer of a cortège of lauriphyllous or hygrophilous elements.
(Oberdorfer, 1960: 112-115; Hueck and Seibert, 1972: unit 75 *p.*; Quintanilla, 1973; Quintanilla, 1974: 63; Hueck, 1978: 385-388, 390; Veblen *et al.*, 1983: 7, 25; Gajardo, 1994: units 7A1-7A11, 7A1-7A12; Coig *et al.*, 1994: 80-84, 129).

42.221 Pelada *Fitzroya-Tepualia* forests
Forests of *Fitzroya cupressoides*, accompanied by *Tepualia stipularis*, and with *Desfontainia spinosa*, *Drimys winteri*, *Nothofagus nitida*, *Podocarpus nubigena*, *Philesia magellanica*, *Pilgerodendron uvifera*, *Asteranthera ovata*, of the Cordillera Pelada, characteristic of humid slopes and mesetas.
(Gajardo, 1994: units 7A1-7A11, 7A3-7A11).

42.222 Pelada *Fitzroya-Oreobolus* forests
Forests of *Fitzroya cupressoides* of high gentle slopes of the Cordillera Pelada, in direct contact with peaty shrublands, with *Nothofagus betuloides*, and a dense understorey comprising *Oreobolus obtusangulus*, *Chusquea montana*, *Desfontainia spinosa*, *Gaultheria antarctica*, *Philesia magellanica*, *Berberis serrato-dentata*, *Blechnum magellanicum*, *Drimys winteri*, *Embothrium coccineum*, *Pernettya mucronata*, *Podocarpus nubigena*.
(Gajardo, 1994: unit 7A1-7A12).

42.23 Chiloe *Fitzroya* forests
Forests of *Fitzroya cupressoides* of Chiloe, now restricted to relict patches in the northern highlands.
(Quintanilla, 1973; Quintanilla, 1974: 63; Gajardo, 1994: unit 7A3-7A11; Coig *et al.*, 1994: 129).

42.3 Austrocedrus chilensis forests

Forests of *Austrocedrus chilensis* (*Libocedrus chilensis*) of dry slopes of the Andes, between 900 and 1400 m altitude.
(Oberdorfer, 1960: 26-27; Dimitri, 1972: 74, 78, 117; Quintanilla, 1973; Quintanilla, 1974: 61-62; Dimitri, 1977: 4, 26; Hueck, 1978: 403-405; Cabrera and Willink, 1980: 100; Rundel, 1981: 186-187; Hueck and Seibert, 1981: unit 77; Quintanilla, 1984: unit IV-5; Quintanilla, 1987: 25-26; Gajardo, 1994; Coig *et al.*, 1994: 51, 120; Erize *et al.*, 1995: 173).

42.31 Mediterraneo-Chilean *Austrocedrus chilensis* forests
Austrocedrus chilensis forests, woods and groves of the foothills and middle slopes of the western side of the Andes, between 32° 39' S, on Cerro Tabasco, and 37° S, located within the supramediterranean and sub-mediterranean dry scrubland and deciduous forest zones.
(Oberdorfer, 1960: 26-27; Quintanilla, 1974: 61-62; Hueck, 1978: 403-405; Rundel, 1981: 187; Hueck and Seibert, 1981: unit 77; Quintanilla, 1984: unit IV-5; Quintanilla, 1987: 25-26; Gajardo, 1994: units 2B104, 4A22, 4A43; Coig *et al.*, 1994: 51, 120).

42.311 *Austrocedrus-Schinus* forests
Woods of *Austrocedrus chilensis* and *Schinus montanus* developed in the dry Andean scrub zone of the lower slopes of the Chilean Andes, between 32° 37' S and 35° S, where they constitute relict forest patches occupying exceptional south-facing locations and cordilleran valleys and in the montane and pre-cordilleran deciduous forest zones, between 34° S and 37° S, where they occupy rocky stations at the higher altitudes; the accompanying flora includes *Maytenus boaria*, *Acaena pinnatifida*, *Aristotelia chilensis*, *Calceolaria petiolaris*, *Koeleria phleoides*, *Quillaja saponaria*, *Ribes punctatum*, *Azara integrifolia*, *Baccharis rhomboidalis*, *Haplopappus canescens*, *Kageneckia oblonga*. The forests of the northern part of the range have been much reduced by intensive human activity.
(Rundel, 1981: 187; Gajardo, 1994: units 2B10-2B104, 4A2-2B104, 4A4-2B104).

42.312 *Austrocedrus-Nothofagus glauca* forests
Forests of *Austrocedrus chilensis* of the Linares Andes, between 35° 30' S and 36° 30' S, accompanied by *Nothofagus glauca*, *Baccharus rhomboidalis*, *Lomatia hirsuta*, *Colliguaya salicifolia*, *Gochnatia foliolosa*, *Lithrea caustica*, *Myoschilos oblonga*, usually occupying gentle slopes; these forests are highly altered in their structure, are of variable density and have the appearence of forest regrowth formations.
(Gajardo, 1994: unit 4A4-4A43 *p.*).

42.313 *Austrocedrus-Nothofagus obliqua* forests
Austrocedrus chilensis-dominated parts of the *Austrocedrus chilensis-Nothofagus oblique* forests of the foothills of the Andean cordillera of central Chile in O'Higgins and Bio-Bio, between 34° S and 37° S, accompanied by *Aristotelia chilensis*, *Azara integrifolia*, *Baccharis rhomboidalis*, *Cryptocarya alba*, *Kageneckia oblonga*, *Lithrea caustica*, *Maytenus boaria*, *Escallonia pulverulenta*, *Hypericum perforatum*, *Lomatia hirsuta*, *Quillaja saponaria*, *Sophora macrocarpa*.
(Gajardo, 1994: unit 4A2-4A22 *p.*).

42.32 Andino-Patagonian *Austrocedrus chilensis* forests
Austrocedrus chilensis forests of the Patagonian cordilleras, between 36° 30'S and 43° 35'°S, mostly limited to the eastern, Argentinian, side of the Andes in Neuquen, Rio Negro and Chubut, where they are particularly extensive, notably in the Lanin, Nahuel Huapi and Los Alerces national parks, and in the vicinity of Puelo, Epuven and Cholila lakes, often with *Nothofagus* species, in particular *Nothofagus dombeyi*, extending to the Chilean Los Lagos region in the middle sectors of the great basins of the Futalefu and Palena rivers. Typical accompanying species include, in the tree layer, *Nothofagus dombeyi*, *Lomatia hirsuta*, *Maytenus boaria*, *Diostea juncaea*, in the shrub layer, *Azara microphylla*, *Fabiana imbricata*, *Pernettya poeppigii*, *Berberis buxifolia*, *Berberis darwinii*.
(Dimitri, 1972: 74, 78, 117; Quintanilla, 1973; Quintanilla, 1974: 61-62; Dimitri, 1977: 4, 26; Hueck, 1978: 403-405; Hueck and Seibert, 1981: unit 77; Gajardo, 1994: unit 6B71; Coig *et al.*, 1994: 51, 120; Erize *et al.*, 1995: 173).

42.321 Inner Andean *Austrocedrus* forests
Austrocedrus chilensis forests of inner valleys and slopes of the Patagonian cordilleras, often dense, developed both on stoney superficial soils and on deep soils of low acidity, where they reach their best development, mostly extyensive in Lanin, Nahuel Huapi and Los Alerces national parks, often accompanied by *Nothofagus dombeyi*.
(Dimitri, 1972: 74, 78, 117; Quintanilla, 1973; Quintanilla, 1974: 61-62; Dimitri, 1977: 4, 26; Hueck, 1978: 403-405; Hueck and Seibert, 1981: unit 77; Erize *et al.*, 1995: 173).

42.322 Pre-Patagonian *Austrocedrus* forests
Austrocedrus chilensis forests and woods of the ecotone between Andino-Patagonian woods and Patagonian steppe, between 36° 30'S and 43° 35'°S, with outposts into the Patagonian steppe, often very open and with a highly xeric undergrowth.
(Dimitri, 1972: 74, 78, 80, 117; Dimitri, 1977: 4, 26; Hueck, 1978: 403-405; Hueck and Seibert, 1981: unit 77; Erize *et al.*, 1995: 173).

42.323 Futaleufu-Palena *Austrocedrus* forests
Open forests of *Austrocedrus chilensis*, *Lomatia hirsuta* and *Maytenus boaria* with an understorey of *Colletia spinosa*, *Chusquea culeou*, *Discaria serratifolia*, *Fragaria chiloensis*, of the Chilean middle reaches of the Futaleufu and Palena river systems.
(Gajardo, 1994: unit 6B7-6B71).

42.4 Temperate podocarp forests

Forests, woods or parts of forests of Valdivian Chile and the southern Andes dominated by the temperate podocarps *Podocarpus nubigena*, *Podocarpus saligna* or *Saxegothaea conspicua*, in particular, small dense woods of *Podocarpus saligna* of the sub-mediterranean deciduous woodland zone of the southern part of the Chilean central depression.
(Gajardo, 1994: units 4B8-4B82, 5A1-4B82, *p.*).

43. TEMPERATE MIXED FOREST

Forest and woodland of mixed deciduous and coniferous trees of the nemoral, sub-antarctic, steppic, warm-temperate humid and mediterranean zones. Detailed habitats can be coded by transposing subdivisions of unit 41, replacing prefix 41 by prefix 43. Included here are communities of combined deciduous and conifer dominance in which both constituants play a substantial part and that are related to primarily deciduous forests. Deciduous forests with a dominated stratum of conifers or with a small admixture of conifers in the dominant layer may be coded under 41. Conifer forests with a dominated stratum of deciduous trees and somewhat mixed facies of primarily coniferous forests are included in 42. Mixed coniferous and broad-leaved evergreen woodland is not included under 43, but listed under 42 or 45, depending on dominance.

44. TEMPERATE WETLAND FORESTS AND BRUSH

Tree and shrub vegetation of flood plains, marshes, fens and bogs of the nemoral, subantarctic, steppic, warm-temperate humid, mediterranean and subtropical desert zones. Within the latter zone and its transition areas, in which most or all tree growth is linked to permanent or temporary water courses or water tables, only the formations that depend on the highest water tables, such as those formed by southern riparian trees, have been included in this category, while arroyo- or oasis-dependant thorn woodland and palm communities are included in 4B.
(Oberdorfer, 1960: 30-32, 116, 120-122; Hueck and Seibert, 1972, 1981: unit 87 *p.*; Dimitri, 1972, 1977; Hueck, 1978; Rundel, 1981; Veblen *et al.*, 1983; Pisano, 1983; Moore, 1983; Quintanilla, 1987; Gajardo, 1994; Erize *et al.*, 1995).

44.1 Pilgerodendron peatland forest and brush

Pilgerodendron uvifera forests, woods and matorrals of wet peaty soils of the southern Chilean mainland, the Chilean Fjordland and archipelago, the southern Andes and the Magellanic moorland region.
(Schmithüsen, 1956: 43, 44; Oberdorfer, 1960: 116; Hueck and Seibert, 1972, 1981: units 75, 79, *p.*; Dimitri, 1972: 76-77; Dimitri, 1977: 27; Hueck, 1978: 388, 391, 415, 417; Veblen *et al.*, 1983: unit 5; Pisano, 1983: 306-309; Moore, 1983: 28; Gajardo, 1994: units 7A31, 7A32, 7A41; Erize *et al.*, 1995: 175).

44.11 Northern Magellanic *Pilgerodendron* woodland
Forests, woods and scrubs of *Pilgerodendron uvifera* of the northern Magellanic evergreen forest region ("north Patagonian" coastal rain forest), characteristic of Chiloe, the islands of the Golfo de Corcovado and the Cordillera de Puyuhuapi, the Chonos, the Guaytecas, the Taitao peninsula, extending south sparingly to the Canal Messier area, and with northern outposts in the Cordillera Pelada.
(Schmithüsen, 1956: 43; Hueck and Seibert, 1972, 1981: unit 75 *p.*; Hueck, 1978: 391, 415, 417; Veblen *et al.*, 1983: unit 5 *p.*; Gajardo, 1994: units 7A3-7A31, 7A4-7A31, 7A1-7A31, 7A5-7A31, 7C10-7A31, 7C12-7A31,).

44.111 Corcovadan *Pilgerodendron-Tepualia* woodland
Forests, woods and scrubs of *Pilgerodendron uvifera*, often accompanied by *Tepualia stipularis*, of the northern Magellanic evergreen forest region ("north Patagonian" coastal rain forest), distributed on the summits of the Cordillera Pelada, on Chiloe Island, on the summits and coasts of the Guaytecas and the Chonos, the islands and coasts of the Gulf of Corcovado and the Cordillera de Puyuhuapi, the regions of Isla Magdalena and Puerto Baja Pisagua and the Taitao peninsula, extending south sparingly to the Canal Messier area; they occupy wet peaty ground of oceanic lowlands and summits. Frequent accompanying species include *Drimys winteri*, *Blechnum chilense*, *Lomatia ferruginea*, *Nothofagus nitida*, *Weinmannia trichosperma*, *Campsidium valdiviense*, *Desfontainia spinosa*, *Embothrium coccineum*, *Myrceugenia parvifolia*, *Nothofagus betuloides*, *Podocarpus nubigena*, *Saxegothaea conspicua*, *Gevuina avellana*. On Chiloe Island, these communities are widespread on gentle slopes and on inundated flats, particularly in the south where they reach nearly to sea level. In favourable conditions they may form dense, impenetrable thickets. On the Chonos and Guaytecas they constitute the most abundant habitat type next to the *Pilgerodendron-Astelia* formations of unit 44.113.
(Hueck and Seibert, 1972, 1981: unit 75 *p.*; Hueck, 1978: 415, 417; Veblen *et al.*, 1983: unit 5 *p.*; Gajardo, 1994: units 7A3-7A31, 7A4-7A31, 7A1-7A31, 7A5-7A31, 7C10-7A31, 7C12-7A31, 7A3-7A32, 7A1-7A41, 7A3-7A41, 7A4-7A41).

44.112 Chiloe *Pilgerodendron-Philesia* woods

Pilgerodendron uvifera and *Philesia magellanica* woods of the higher altitudes of Chiloe Island, developed on peaty soils in wetter conditions than the more extensive formations of unit 44.111 of the same region. Accompanying species include *Tepualia stipularis*, *Drimys winteri*, *Desfontainia spinosa*, *Gleichenia quadripartita*, *Berberis ilicifolia*, *Lebetanthus myrsinites*, *Pernettya mucronata*, *Podocarpus nubigena*, *Pseudopanax laetevirens*.
(Gajardo, 1994: unit 7A3-7A32).

44.113 *Pilgerodendron-Astelia* woodland
Matorral of tall, spaced shrubs and low cushion plants, characteristic of flat plateaux and gentle slopes of the summital areas of the Guaytecas and Chonos archipelagos, with representatives on Chiloe Island and, locally, in the summital area of the Cordillera Pelada, dominated by *Pilgerodendron uvifera* accompanied by *Astelia pumila*, *Donatia fascicularis*, *Oreobolus obtusangulus*, with *Baccharis magellanica*, *Desfontainia spinosa*, *Drimys winteri*, *Embothrium coccineum*, *Nothofagus betuloides*, *Nothofagus antarctica*, *Philesia magellanica*, *Podocarpus nubigena*, *Tepualia stipularis*, often with *Chusquea montana*, *Drosera uniflora*, *Myrteola nummularia*, *Schizaea fistulosa*.
(Gajardo, 1994: units 7A1-7A41, 7A3-7A41, 7A4-7A41).

44.12 Southern Magellanic *Pilgerodendron* woodland
Woods and tall scrubs dominated by *Pilgerodendron uvifera*, usually with *Philesia magellanica*, of the southern Chilean Fjordland and archipelago, from the Canal Messier area southwards, with outposts in the southernmost Argentinian Andes, mostly characteristic of the western Magellanic moorland region.
(Schmithüsen, 1956: 44; Hueck and Seibert, 1972, 1981: unit 79 *p.*; Hueck, 1978: 391; Pisano, 1983: 306-309; Moore, 1983: 28; Gajardo, 1994: units 7C12-7A32, 7C13-7A32).

44.121 *Pilgerodendron-Drimys-Nothofagus* woods
Woods dominated by *Pilgerodendron uvifera*, with *Drimys winteri* and *Nothofagus betuloides* as co-dominants, of the southern Magellanic region, distributed in the Chilean Fjordland and archipelago, mostly north of 52° 15' S, with an outpost in the Lago Argentino region of Argentina, occupying wet peaty soils. Associated species include *Philesia magellanica*, *Empetrum rubrum*, *Lebetathus myrsinites*, *Desfontainia spinosa*, *Berberis ilicifolia*, *Escallonia serrata*.
(Dimitri, 1972: 74, 76-77; Dimitri, 1977: 27; Hueck, 1978: 391; Moore, 1983: 28, 64, 65; Pisano, 1983: 306-309).

44.122 Sphagnum *Pilgerodendron* woods
Wet peaty woods of the Magellanic moorland region dominated by *Pilgerodendron uvifera* in pure, relatively low-growing stands or intermingled with small *Nothofagus betuloides* and *Drimys winteri*, distributed in the Chilean archipelago south of 52° 15'S. The shrub layer, fairly open and often discontinuous, is mostly composed of *Empetrum rubrum*, associated in the better-drained sites with *Berberis ilicifolia*, otherwise with *Philesia magellanica*, *Desfontainia spinosa* and *Nothofagus antarctica*. The ground cover is mostly formed by large cushions of *Sphagnum magellanicum*.
(Moore, 1983: 28, 64, 65; Pisano, 1983: 306-309).

44.13 Andean *Pilgerodendron* woodland
Rare forests, woods or scrubs of *Pilgerodendron uvifera* of the southern Andes, between 38° S and 42° S, occupying marshy peaty flats in regions under Valdivian influence.
(Dimitri, 1972: 76-77; Hueck and Seibert, 1972, 1981: unit 75 *p.*; Dimitri, 1977: 27; Hueck, 1978: 388, 391; Veblen *et al.*, 1983: unit 5 *p.*; Gajardo, 1994: units 4C10-7A31, 5A4-7A31).

44.131 Western Andean *Pilgerodendron-Tepualia* woodland
Woods and matorrals dominated by *Pilgerodendron uvifera* with *Tepualia stipularis* of the Andean mixed deciduous and Andean lauriphyllous forest zones, between 38° S and nearly 42° S, situated on peaty marshy ground within the narrow altitudinal band between the southern deciduous forests and the high Andean deciduous forests. These communities are rare and local, being relictual at their northern limit in the northern part of the area.
(Gajardo, 1994: unit 4C10-7A31, 5A4-7A31).

44.132 Trans-Andean *Pilgerodendron* woodland

Rare peaty woods of the Andes of Neuquen and Chubut dominated by or rich in *Pilgerodendron uvifera*, usually associated with *Fitzroya cupressoides*, limited to Nahuel Huapi and Los Alerces national parks. *Pilgerodendron* is endangered in Argentina.
(Dimitri, 1972: 74, 76-77; Hueck and Seibert, 1972, 1981: unit 75 *p.*; Dimitri, 1977: 27; Hueck, 1978: 388, 391; Chebez, 1994: 499; Erize *et al.*, 1995: 175).

44.2 Valdivio-mediterranean riverine myrtle and laurel forests

Arborescent communities, rich in Myrtaceae, of the mediterranean xerophyllous, Valdivio-mediterranean deciduous, Valdivian evergreen, northern Magellanic evergreen, mediterraneo-Andean and Valdivio-Andean forest zones lining watercourses and lakes, or forming in permanent swamps, dominated by broad-leaved evergreen, lauriphyllous or xerophyllous, species. They are best defined within mediterranean, Valdivio-mediterranean deciduous and Andean regions. Within the Valdivian evergreen forest region they grade into the humid lauriphyllous forests of unit 45 with which they share many species.
(Schmithüsen, 1956: 32-33, 36; Oberdorfer, 1960: 30-31, 120-122; Hueck and Seibert, 1972, 1981: unit 87 in 74; Dimitri, 1972: 75, 117; Dimitri, 1977: 5, 36, 55; Hueck, 1978: 378, 388-389; Rundel, 1981: 183-184; Veblen *et al.*, 1983: 11-12; Gajardo, 1994: regions 3, 4, 5; Erize *et al.*, 1995: 176, 190-191).

44.21 Valdivio-Andean riverine myrtle forests
Low, dense-crowned forests dominated by *Myrceugenella apiculata* (*Luma apiculata*) or *Myrceugenia exsucca* of low, marshy areas of the Valdivian forest zone of the Andes. Companion species may include *Amomyrtus luma*, *Amomyrtus meli*, *Chusquea quila*, *Fuchsia magellanica*, *Laurelia philippiana*, *Luzuriaga radicans*, *Mitraria coccinea*, *Myrceugenia planipes*, *Azara lanceolata*, *Dasyphyllum diacanthoides*, *Aextoxicon punctatum*, *Drimys winteri*, *Nertero granadensis*, *Eucryphia cordifolia*, *Lomatia ferruginea*, *Lomatia hirsuta*, *Rhaphithamnus spinosus*, *Aristotelia chilensis*, *Cyperus eragrostis*, *Blechnum chilensis*, *Blechnum blechnoides*, *Crysosplenium valdivianum*, *Pteris semiadnata*.
(Oberdorfer, 1960: 120-122; Dimitri, 1972: 75, 117; Dimitri, 1977: 5, 36, 55; Hueck, 1978: 388-389; Gajardo, 1994: unit 5A2-5A23; Erize *et al.*, 1995: 176, 190-191).

44.211 *Luma apiculata* arrayan woodland
Low forests dominated by *Myrceugenella apiculata* (*Luma apiculata*), beautiful small trees with smooth cinnamon-coloured bark, twisted branches and white flowers, on the marshy shores of rivers and lakes in the Valdivian forest region essentially within the 39° S - 42° S latitude zone, in particular, of the western Andean lake district, often with a dense shrub stratum and of river and lake margins of the Andino-Patagonian sector of eastern Neuquen, Rio Negro and Chubut, including the woods of Los Arrayanes National Park on peninsula de Quetrihue and the northern Isla Victoria, Nahuel Huapi National Park, often forming spectacular communities.
(Dimitri, 1972: 75, 117; Dimitri, 1977: 5, 36; Cabrera and Willink, 1980: 98; Gajardo, 1994: unit 5A2-5A23 *p.*; Erize *et al.*, 1995: 176, 190-191).

44.212 *Myrceugenia exsucca* patagual woodland
Low, dense-crowned forests dominated by *Myrceugenia exsucca* of marshy shores of rivers and lakes in the Valdivian forest region essentially within the 39°S-42°S latitude zone, in particular, the lower slopes of the western Andean lake district, and of eastern Andino-Patagonian flooded lakeshores and depressions, often forming an intermediate stage between pioneering shrub communities and *Nothofagus dombeyi* and *Nothofagus obliqua* forests, notably in Lanin and Nahuel Huapi national parks.
(Dimitri, 1972: 75, 117; Dimitri, 1977: 5, 55; Gajardo, 1994: unit 5A2-5A23 *p.*; Erize *et al.*, 1995: 176).

44.22 Central Chilean riverine myrtle and laurel forests
Arborescent Myrtaceae communities of watercourse banks, swampy areas and vegas of the mediterranean zone of central Chile, for the most part destroyed and replaced by plantations of exotic trees.
(Oberdorfer, 1960: 30-31; Hueck and Seibert, 1972, 1981: unit 87 in 74; Hueck, 1978: 378).

44.221 Central Chilean *Blepharocalyx* riverine forests
Rare, very local woods of streamsides of central Chile formed by *Blephorocalyx cruckshanksii* (*Temu cruckshanksii*) and *Crinodendron patagua* with *Drimys winteri*, *Escallonia revoluta*, *Aristotelia chilensis*, *Chusquea cumingii*, *Cissus striata*, *Cryptocarya alba*, *Persea lingue*.
(Oberdorfer, 1960: 31; Gajardo, 1994: units 3B9-3C107, 3C10-3C107, 3C13-3C107).

44.222 Central Chilean *Drimys-Luma chequen* riverine woodland
Dense hygrophile arborescent Myrtaceae communities limited to marshy substrates along canyon-bottom streams of mediterranean central Chile, mostly in the coast range between 32° S and 34° S, with scarcer outliers extending north in the interior to 30° S, dominated by, or rich in, *Luma chequen* (*Myrceugenella chequen*), accompanied by *Drimys winteri*, *Myrceugenia exsucca* and *Maytenus boaria*. The cortège includes *Aristotelia chilensis*, *Escallonia illinita*, *Escallonia revoluta*, *Muelhenbeckia hastulata*, *Peumus boldus*, *Baccharis confertifolia*, the Vitaceae *Cissus striata*, *Psoralea glutinosa*, *Gunnera chilensis*, *Blechnum chilense*, *Dryopteris spectabilis*. They have been, for the most part, destroyed.
(Schmithüsen, 1956: 21; Oberdorfer, 1960: 30-31; Hueck and Seibert, 1972, 1981: unit 87 in 74; Ducoing, 1973: 63; Hueck, 1978: 378; di Castri and Vitali-di Castri, 1981: 450; Gajardo, 1994: units 3A26-3C104, 3A3-3C104, 3A4-3C104, 3A5-3C104, 3C10-3C104).

44.23 Valdivian riverine myrtle and laurel forests
Forests of poorly drained soils and marshy rivercourses of the Valdivian region dominated by myrtaceae and laurel-leaved trees, or by evergreen *Nothofagus* species with a cortège rich in Myrtaceae and Lauraceae. Laurel forests of the Valdivian zone and of enclaves within the central Chilean mediterranean or supramediterranean zone are dependent on high precipitation or atmospheric humidity and are mostly concentrated in ravines and near water courses. The boundary between the lauriphyllous forests of unit 45 and riverine forests of unit 44 is thus difficult to draw in these zones and somewhat arbitrary. Only the communities that are exclusively or almost exclusively linked to areas of poor drainage have been included in unit 44.23; other communities, although they may often be riverine, have been retained within unit 45 to preserve the unity of that section.
(Ducoing, 1973: 63; Veblen *et al.*, 1983: 11-12; Gajardo, 1994: regions 4, 5).

44.231 Valdivian *Myrceugenia-Blepharocalyx* riverine myrtle forests
Forests and arborescent scrubs of *Blepharocalyx divaricatum* (*Temu divaricatum*), *Myrceugenia exsucca* and *Drimys winteri* of the coast range, the Frontera and the central valley of Chile, between 36° S and 41° 30' S, occupying marshy ground along slow watercourses of flat lowlying areas, gentle hills and ravines. Accompanying species include *Luma apiculata* (*Myrceugenella apiculata*), *Cyperus eragrostis*, *Juncus procerus*, *Chusquea quila*, *Gunnera tinctoria*.
(Ramirez *et al.*, 1989; Gajardo, 1994: units 4B5-4B62, 4B6-4B62, 4B7-4B62, 4B8-4B62, 5A1-4B62; Quintanilla, 1995: 41).

44.232 Valdivian *Nothofagus dombeyi-Drimys* forests
Rare wetland forests of *Nothofagus dombeyi* of the southern part of the Chilean central depression, between Valdivia and Puerto Montt, accompanied by *Drimys winteri* and a diverse cortège of myrtaceous shrubs, Cyperaceae and epiphytic hemenophyllaceous ferns, small trees and tall shrubs *Blepharocalyx divaricatum* (*Temu divaricatum*), *Tepualia stipularis*, *Myrceugenia exsucca*, *Myrceugenia gayana*, *Myrceugenella apiculata*, *Chusquea uliginosa*, *Caldcluvia paniculata*, *Lomatia ferruginea*, *Ovidia pillo-pillo*, *Embothrium coccineum*, *Nothofagus antarctica*, small shrubs *Escallonia leucantha*, *Baccharis lyciodes*, *Berberis buxifolia*, *Pernettya spp.*, *Lophosoria quadripinnata*, *Ugni molinae*, lianas and epiphytes *Boquila trifoliata*, *Luzuriaga radicans*, *Hymenophyllum spp.*, *Luzuriaga erecta*, and the large ground-rooted fern, *Blechnum chilense*. *Nothofagus dombeyi-Drimys* forests are restricted to poorly drained sites on flat or undulating glacially derived shallow substrates over iron-rich hardpan (ñadis) and swampy areas of stream systems (hualves). Much of the forest has been destroyed in attempts to cultivate the land.
(Veblen *et al.*, 1983: unit 4; Quintanilla, 1995: 42).

44.24 Valdivio-Magellanic *Tepualia* woodland
Forests or woods, generally low, dominated by *Tepualia stipularis*, often accompanied by *Pilgerodendron uvifera*, of the southern Valdivian forest zone and the northern Magellanic evergreen

forest zone, installed on poorly drained ridge flanks, sides of river courses, strands and marshy plains, plateaux and depressions generally wet throughout the year. *Tepualia* characteristically forms a dense canopy 5-8 metres above standing water. *Astelia pumila*, *Oreobolus obtusangulus*, *Myrteola nummularia*, *Drosera uniflora*, *Leptocarpus chilensis* and *Sphagnum* mosses constitute the undergrowth. The low forest communities are most characteristic in the southern Valdivian zone; they occur, with a slightly modified floristic composition throughout the northern Magellanic evergreen zone and even farther south, though, with decreasing stature of the dominant tree, they correspond increasingly to scrubs, listed under unit 44.33.
(Veblen *et al.*, 1983: 12, 19, unit 5; Gajardo, 1994: unit 7A31 *p.*).

44.3 Valdivio-mediterranean broad-leaved evergreen wetland brush

Shrub communities of the Valdivian evergreen, northern Magellanic evergreen, mediterraneo-Andean and Valdivio-Andean forest zones lining watercourses and lakes, or forming in permanent swamps, dominated by broad-leaved evergreen, lauriphyllous or xerophyllous, species.
(Schmithüsen, 1956: 32-33, 36; Oberdorfer, 1960: 30-32, 116, 120-122; Hueck and Seibert, 1972, 1981: unit 87 in 74; Dimitri, 1972: 75, 117; Ducoing, 1973: 76; Dimitri, 1977: 5, 36, 55; Hueck, 1978: 378, 388-389; Rundel, 1981: 183-184; Veblen *et al.*, 1983: 11-12; Gajardo, 1994: regions 3, 4, 5; Erize *et al.*, 1995: 176, 190-191).

44.31 Valdivio-Andean *Luma-Myrceugenia* brush
Dense shrub communities dominated by *Myrceugenella apiculata* (*Luma apiculata*) or *Myrceugenia exsucca* of low, marshy areas and waterbody margins of the Valdivian forest zone of the Andes, essentially within the 39°S-42°S latitude zone, in particular, the lower slopes of the western Andean Lake District and the eastern Andino-Patagonian region, often of secondary origin.
(Dimitri, 1972; Dimitri, 1977: 5; Gajardo, 1994: units 5A2-5A22, 5A2-5A23 *p.*, 5A3-5A22 *p.*; Erize *et al.*, 1995: 176).

44.311 *Luma apiculata* brush
Shrub communities dominated by *Myrceugenella apiculata* (*Luma apiculata*) bordering rivers and lakes and saturated depressions of the lower slopes of the western Andean Lake District and of eastern, Andino-Patagonian, Neuquen, Rio Negro and Chubut.
(Dimitri, 1972, 1977; Gajardo, 1994: units 5A2-5A22 *p.*, 5A2-5A23 *p.*, 5A3-5A22 *p.*).

44.312 *Myrceugenia exsucca* scrub
Shrub communities dominated by *Myrceugenia exsucca* of lowlying waterlogged areas of the lower slopes of the western Andean Lake District and the eastern Andino-Patagonian region, in particular, Lanin and Nahuel Huapi national parks.
(Dimitri, 1972, 1977; Gajardo, 1994: units 5A2-5A22, 5A2-5A23, 5A3-5A22).

44.32 Central Chilean *Blepharocalyx* riverine brush
Uncommon scrubs of streamsides of central Chile formed by *Blephorocalyx cruckshanksii* (*Temu cruckshanksii*) and *Crinodendron patagua*, with *Drimys winteri*, *Escallonia revoluta*, *Aristotelia chilensis*, *Chusquea cumingii*, *Cissus striata*, *Cryptocarya alba*, *Persea lingue*, shrubby form of unit 44.221.
(Oberdorfer, 1960: 31; Gajardo, 1994: units 3B9-3C107, 3C10-3C107, 3C13-3C107).

44.33 Valdivio-Magellanic *Tepualia* riverine brush
Dense, shrubby, *Tepualia stipularis*-dominated communities of the southern Valdivian rain forest region and the Magellanic region occupying areas remaining damp or flooded throughout the year, frequently associated with *Pilgerodendron stipularis* or *Drimys winteri*.
(Moore, 1983: 152; Veblen *et al.*, 1983: 12, unit 5 *p.*; Ovington, 1983: 3).

44.34 Andean *Escallonia* scrub
Escallonia virgata scrubs of flooded and very wet ground of the Andino-Patagonian Andes and *Escallonia myrtoides* woods of mediterranean Andean streamcourses.
(Dimitri, 1977: 4, 45; Gajardo, 1994: unit 2B10-2B103).
44.341 *Escallonia virgata* scrub

Dense shrub formations dominated by *Escallonia virgata* of flooded and very wet ground of the Andino-Patagonian Andes, in particular, in Lanin, Nahuel Huapi and Los Alerces national parks.
(Dimitri, 1977: 4, 45).

44.342 *Escallonia myrtoides* scrub
Woods or scrub of streamcourses of the mediterranean Andes formed by *Escallonia myrtoides*, *Maytenus boaria*, *Escallonia illinita*, *Baccharis linearis*, *Muehlenbeckia hastulata*, *Happlopappus canescens*, *Valenzuelia trinervis*.
(di Castri and Vitali-di Castri, 1981: 450; Gajardo, 1994: unit 2B10-2B103).

44.35 Mediterraneo-Valdivian evergreen ñadi thickets
Dense thickets of *Drimys winteri*, *Escallonia rigida*, *Embothrium coccineum*, *Tepualia stipularis*, *Laurelia ferruginea*, with myrtles and the podocarps *Podocarpus nubigena* and *Saxegothaea conspicua*, of the ñadis of the Valdivian and mediterraneo-Valdivian transition forest zones of the Chilean Lake District, the Cordillera Pelada and Chiloe.
(Quintanilla, 1973, 1974: 59).

44.4 Deciduous Nothofagus wetland forests and brush

Riverine, peatland and ñadi forests and brush of the mediterranean xerophyllous, Valdivio-mediterranean deciduous, Valdivian evergreen, mediterraneo-Andean, Valdivio-Andean and Andino-Patagonian forest zones, of the Patagonian sub-Andean steppe zone and its ecotone with the Andino-Patagonian forests, dominated by deciduous species of genus *Nothofagus*, mostly *Nothofagus antarctica*.
(Hueck, 1978: 429; Ramirez *et al.*, 1985a: 58-59; San Martin *et al.*, 1986; Schmaltz, 1991: 576-577; Walter and Breckle, 1991c: 420; Gajardo, 1994: units 6B9-6B94 *p.*, 6B9-6B96, 8A1-6B96).

44.41 Andino-Patagonian *Nothofagus antarctica* riverine galleries
Gallery woods and streamside woods of permanent watercourses of the Patagonian pre-Andean steppes, dominated by *Nothofagus antarctica*, often with *Maytenus boaria* on stony alluvions or sandy banks of large rivers, in particular, small streamside woods with *Baccharis patagonica*, *Berberis buxifolia*, *Mulinum spinosum*, *Ribes cucullatum*, *Acaena splendens*, *Acaena pinnatifida*, *Festuca pallescens*, *Calceolaria uniflora*, *Ranunculus peduncularis*.
(Walter and Breckle, 1991c: 420; Gajardo, 1994: units 6B9-6B94 *p.*, 6B9-6B96, 8A1-6B96).

44.42 Mediterraneo-Valdivian *Nothofagus antarctica* wetland forests
Azonal forests of *Nothofagus antarctica* of the mediterraneo-Valdivian deciduous forest zone and of adjacent areas, in particular, of the mediterranean forest zone of Chile and the Valdivian Andes, developed in and around fens and marshes or on soils with seasonal alternance of waterlogging and dessication.
(Hueck, 1978: 429; Ramirez *et al.*, 1985a; San Martin *et al.*, 1986; Schmaltz, 1991: 576-577).

44.421 Andino-Valdivian *Nothofagus antarctica* peatland forests
Forests and scrubs of *Nothofagus antarctica* of the southern part of the central Chilean valley and the mediterraneo-Valdivian Andes, forming around fens, bogs and marshes, often in cold stations with extreme growing conditions. Their cortège includes *Chusquea nigricans*, *Chusquea uliginosa*, *Juncus procerus*, *Blechnum penna-marinum*, *Astelia pumilia*, *Baccharis magellanica*, *Pilgerodendron uviferum*, the sedges *Scirpus inundatus*, *Carex magellanica*, *Carex fuscula*, *Schoenus rhynchosporoides*, *Cyperus eragrostis*, and generally an abundance of *Sphagnum magellanicum*.
(Quintanilla, 1973; Quintanilla, 1974: 59; Ramirez *et al.*, 1985a: 57-58, 65, samples 3, 5-9; Erize *et al.*, 1995: 173).

44.422 Cauquen *Nothofagus antarctica* wetland forests
Remarkable woods of *Nothofagus antarctica* up to 8 metres tall, forming, at the northwestern extreme of the range of the species, under mediterranean macroclimate, in valleys of the Chilean coastal range, at 35° 50' S latitude and 550-625 metres altitude, on soils with winter waterlogging and summer dessication. *Drimys winteri*, *Desfontainia spinosa*, *Luma gayana*, *Scirpus cernuus*, *Carex fuscula* var. *distenta* constitute the cortège.

(San Martin *et al.*, 1986).

44.423 Mid-Chilean *Nothofagus antarctica* ñadi forests

Forests of *Nothofagus antarctica*, growing up to 11 metres tall, of the southern part of the central Chilean valley, forming in anomalous stations with extreme growing conditions on soils with fluctuating water regime (ñadis). The cortège includes *Discaria serratifolia*, *Embothrium coccineum*, *Chusquea tenuiflora* and very many herbaceous species.
(Hueck, 1978: 429; Ramirez *et al.*, 1985a: 57, 65, sample 4; San Martin *et al.*, 1986; Schmaltz, 1991: 576-577).

44.5 Magellanic Nothofagus betuloides bog woods

Nothofagus betuloides forests, woods and scrubs of the Magellanic evergreen forest region and the Magellanic tundra region occupying bogs, fens and blanket bogs. Within the environment of the latter, *Nothofagus betuloides* scrubs occupying rocky outcrops and other well-drained sites have been included in unit 32.5.
(Quintanilla, 1989: 15; Gajardo, 1994: units 7C13-7C135, 7C14-7B84, 7B9-7C135, *p.*).

44.51 *Nothofagus betuloides-Astelia* forests

Low or shrubby *Nothofagus betuloides* woods of peatlands of the Chilean Fjordlands and southern Chilean archipelagoes, between 49° 30' S and 54° S, and, locally, of Isla Navarrino and the neighbouring Canal Beagle region, at latitude 55° S. The accompanying cortège includes *Astelia pumila*, *Berberis ilicifolia*, *Chiliotrichum diffusum*, *Drimys winteri*, *Myrteola nummularia*, *Lebetenthus myrsinites*, *Luzuriaga marginata*, *Gunnera magellanica*, *Carpha alpina*, *Blechnum penna-marina*, *Empetrum rubrum*, *Festuca thermarum*, *Marsippospermum grandiflorum*.
(Quintanilla, 1989: 15; Gajardo, 1994: 7B9-7C135, 7C13-7C135).

44.52 *Nothofagus betuloides-Hierochloe* forests

Woods or tall scrubs of *Nothofagus betuloides* colonizing peatlands of the Magellanic evergreen forest zone and the Magellanic tundra zone, north nearly to 51° S and south to Cape Horn. Accompanying species include *Hierochloe redolens*, *Philesia magellanica*, *Marsippospermum grandiflorum*, *Chiliotrichum diffusum*, *Berberis ilicifolia*, *Lebetanthus myrsinites*, *Pernettya mucronata*.
(Gajardo, 1994: 7B8-7B84, 7C14-7B84).

44.6 Temperate Salix riverine forests and brush

Woods of *Salix humboldtiana* (*Salix chilensis*) of the mediterranean zone of central Chile and of the Patagonian steppes and semidesert and their ecotone with Andino-Patagonian forests, at the southern limit of the range of the mainly neotropical, deciduous, *Salix humboldtiana*.
(Oberdorfer, 1960: 30-32; Hueck and Seibert, 1972, 1981: unit 87 in 64-67; Ducoing, 1973: 63; Rundel, 1981: 184-185; Santos Biloni, 1990: 136; Walter and Breckle, 1991c: 420; Gajardo, 1994: unit 3B55).

44.61 Central Chilean *Salix* riverine forests

Woods of *Salix humboldtiana* (*Salix chilensis*) and *Maytenus boaria* of the mediterranean zone of central Chile, with *Escallonia illinita*, *Luma chequen*, *Muehlenbeckia hastulata*, *Baccharis pingraea*, *Tessaria absinthioides*. They are now apparently restricted to little altered stream courses of canyon bottoms of the Andean foothills of central Chile, between 32° S and 33° 20' S.
(Oberdorfer, 1960: 30-32; Ducoing, 1973: 63; Rundel, 1981: 184-185; Gajardo, 1994: region 3, units 3B5-3B55, 3B6-3B55).

44.62 Patagonian *Salix humboldtiana* galleries

Small narrow gallery woods of *Salix humboldtiana* forming along permanent watercourses of the northern Patagonian steppes and semideserts and their ecotone with Andino-Patagonian woods, south to 44° S.
(Hueck and Seibert, 1972, 1981: unit 87 in 64-67; Santos Biloni, 1990: 136; Walter and Breckle, 1991c: 420).

44.7 Mediterraneo-Chilean Tessaria-Baccharis riverine brush

Riverine brush of the large rivers of the central Chilean mediterranean zone formed by *Tessaria absinthioides*, *Baccharis marginalis* and *Psoralea glutinosa*.
(Oberdorfer, 1960: 30-32).

45. TEMPERATE BROAD-LEAVED EVERGREEN FORESTS

Temperate forests dominated by broad-leaved sclerophyllous or lauriphyllous evergreen trees, or by palms. They are characteristic of the mediterranean and warm-temperate humid zones, with a few representatives in the nemoral, steppic and transition to subtropical desert zones. In South America, they are limited to the southern Pacific seaboard and the southern Andes, in the mediterranean, mediterraneo-Valdivian transition, Valdivian, northern Magellanic and Magellanic zones.
(Schmithüsen, 1956: 22-44; Oberdorfer, 1960: 13-29, 76-111, 117-119; Hueck and Seibert, 1972: units 74, 75, 79; Dimitri, 1972: 73, 77, 119; Dimitri, 1977: 4, 5; Hueck, 1978: 374-380, 380-391, 411-418; Cabrera and Willink, 1980: 93, 97-100, 103-104; Moore, 1983: 28; Ovington, 1983; Veblen *et al.*, 1983; Burkart *et al.*, 1994: 18; Erize *et al.*, 1995: 173-175, 176).

45.1 Nothofagus dombeyi forests

Temperate broad-leaved evergreen forests of Pacific southern South America and the southern Andes dominated by the very tall evergreen southern beech *Nothofagus dombeyi*, most characteristic of the Andino-Valdivian region, within the pre-Andean and Andean parts of the Valdivian evergreen forest zone and the Valdivio-Mediterranean transition deciduous forest zone, extending, in restricted localities, to the supramediterranean deciduous and conifer forest zones of the Andes and the coastal cordillera, to the Valdivian coastal cordillera and to the northern part of the Chilean Fjordland Magellanic evergreen forest region.
(Schmithüsen, 1956: 39-43; Oberdorfer, 1960: 76-111; Hueck and Seibert, 1972, 1981: units 75, 76, 77, 78, 79; Dimitri, 1972: 73, 77, 119; Quintanilla, 1973, 1974: 55-57, 62; Dimitri, 1977: 3, 4, 29; Hueck, 1978: 381, 411-414, 415-416; Cabrera and Willink, 1980: 98; Veblen *et al.*, 1983: types 14, 15; Ramirez *et al.*, 1984: 127; Burkart *et al.*, 1994: 18; Gajardo, 1994: regions 5A, 4C, 4A, 6A; Erize *et al.*, 1995: 173-175, 176; Quintanilla, 1995: 23, 30).

45.11 Valdivian *Nothofagus dombeyi-Eucryphia-Laurelia* forests
Nothofagus dombeyi-Eucryphia cordifolia-Laurelia philippiana lauriphyllous forests of the main Valdivian evergreen forest zone, constituting the predominant and most typical forest formation in the northern and northwestern part of the region on the lower slopes of the Andes of Los Lagos, distributed more locally in the southern part of the region, around the northern periphery of the Golfo de Corcovado, including Chiloe Island, penetrating northwards in the deciduous forest zone of the lower slope of the Andes in northern Los Lagos and La Araucania, extending to Argentina in the region of Puerto Blest and Laguna Frias. The emergent tree stratum is formed by *Nothofagus dombeyi*, with *Eucryphia cordifolia*; a lower tree stratum is constituted by *Laurelia philippiana* and *Saxegothaea conspicua*, a small tree and tall shrub stratum by *Drimys winteri*, *Pseudopanax laetevirens*, *Chusquea quila*, *Myrceugenella apiculata*, *Amomyrtus luma*, *Gevuina avellana*. The undergrowth comprises a small shrub stratum that includes *Rhaphithamnus spinosus*, *Lophosoria quadripinnata*, *Ribes punctatum*, lianas and epiphytes, particularly hymenohyllaceous ferns, *Mitraria coccinea*, *Luzuriaga radicans*, *Cissus striata*, *Fascicularia bicolor*, *Asplenium dareoides*, *Elytropus chilensis*, *Hydrangea integerrima*.
(Schmithüsen, 1956: 39-43; Oberdorfer, 1960: 76-111; Hueck and Seibert, 1972, 1981: unit 75; Dimitri, 1972: 73, 77, 119; Quintanilla, 1973: unit coigue-ulmo-tepa-mañios; Quintanilla, 1974: 55-57, 62; Dimitri, 1977: 3, 4, 29; Hueck, 1978: 381, 411-414, 415-416; Cabrera and Willink, 1980: 98; Veblen *et al.*, 1983: type 6; Ramirez *et al.*, 1984: 127; Burkart *et al.*, 1994: 18; Gajardo, 1994: units 5A2-5A21, 5A3-5A21; Erize *et al.*, 1995: 173; Quintanilla, 1995: 23, 30).

45.12 Andino-Valdivian *Nothofagus dombeyi* forests

Nothofagus dombeyi-dominated evergreen and mixed evergreen-deciduous forests of the Andean periphery of the Valdivian evergreen forest zone, mostly developed at higher altitudes than the forests of unit 45.11.
(Schmithüsen, 1956: 39-43; Oberdorfer, 1960: 76-111; Hueck and Seibert, 1972, 1981: units 76, 77, 79; Dimitri, 1972: 73, 77, 119; Quintanilla, 1973, 1974: 55-57, 62; Dimitri, 1977: 3, 4, 29; Hueck, 1978: 381, 411-414, 415-416; Cabrera and Willink, 1980: 98; Veblen *et al.*, 1983: types 8, 10; Gajardo, 1994: units 4C10-5A21, 4C9-4C101 *p.*, 4C10-4C101 *p.*, 5A4-5A41, 4A2-4C92, 4C9-4C92, 4A4-4A42; Erize *et al.*, 1995: 173).

45.121 Andino-Valdivian *Nothofagus dombeyi* lauriphyllous forests
Nothofagus dombeyi-dominated evergreen forests rich in lauriphyllous species of the middle Andean slopes of the Valdivian evergreen forest zone, extending, in favourable locations, to the supramediterranean Andes of southern central Chile.
(Schmithüsen, 1956: 39-43; Oberdorfer, 1960: 76-111; Hueck and Seibert, 1972, 1981: units 76, 77, 79; Quintanilla, 1973, 1974: 55-57, 62; Hueck, 1978: 381, 411-414, 415-416; Cabrera and Willink, 1980: 98; Veblen *et al.*, 1983: type 7; Gajardo, 1994: units 4C10-5A21, 5A4-5A41).

45.1211 Andino-Valdivian *N. dombeyi-Laurelia* forests
Evergreen beech forests with conifers of well-drained soils of the Andean Cordillera of southern continental Chile, extending from the upper limit of unit 45.111 to about 950 metres altitude, constituting the most extensive forest type remaining in the Chilean Lake district, with an emergent tree stratum formed by *Nothofagus dombeyi*, a lower tree stratum formed by *Weinmannia trichosperma*, *Laurelia philippiana*, *Saxegothaea conspicua*, *Podocarpus nubigenus*, a small tree and tall shrub stratum composed of *Dasyphyllum diacanthoides*, *Chusquea culeou*, *Amomyrtus luma*, a small shrub stratum that includes *Ribes punctatum*, *Azara lanceolata*, lianas and epiphytes, particularly hymenohyllaceous ferns, *Asteranthera ovata*, *Mitraria coccinea*, *Luzuriaga radicans*, *Asplenium dareoides*, *Hydrangea integerrima*.
(Quintanilla, 1973: unit coigue; Quintanilla, 1974: 55-57, 62; Veblen *et al.*, 1983: unit 7; Gajardo, 1994: unit 4C10-5A21).

45.1212 Andean *Nothofagus dombeyi-Gevuina* forests
Evergreen, lauriphyllous forests dominated by *Nothofagus dombeyi* of the middle slopes of the Andes of Los Lagos, between about 40° 30' S and 41° 30' S. Accompanying species include *Gevuina avellana*, *Gaultheria phyllyreaefolia*, *Desfontainia spinosa*, *Embothrium coccineum*, *Lomatia hirsuta*, *Ugni molinae*, *Baccharis obovata*, *Nothofagus antarctica*, *Ovidia pillopillo*.
(Quintanilla, 1973: unit coigue; Quintanilla, 1974: 55-57, 62; Gajardo, 1994: unit 5A4-5A41).

45.1213 Pre-cordilleran *Nothofagus dombeyi-Podocarpus* forests
Scarce hygrophyllous forests dominated by *Nothofagus dombeyi* of south-facing canyons of the Linares Andes, accompanied by *Podocarpus saligna*, *Persea lingue*, *Drimys winteri*, *Luma apiculata*, *Lomatia dentata*, *Laurelia sempervirens*, *Cryptocarya alba*, *Chusquea quila*.
(Gajardo, 1994: unit 4A4-4A42).

45.122 Andino-Valdivian *Nothofagus dombeyi* mixed forests
Nothofagus dombeyi-dominated mixed evergreen-deciduous forests of the Andean periphery of the Valdivian evergreen forest zone.
(Gajardo, 1994: units 4C9-4C101 *p.*, 4C10-4C101 *p.*).

45.1221 *Nothofagus dombeyi-N. alpina* forests
Mixed beech forests with conifers of well-drained soils of southern continental Chile, developed in the same altitude range as unit 45.121, but more northerly, differing from it by the presence of the deciduous *Nothofagus alpina* in the emergent tree stratum together with *Nothofagus dombeyi*, and by the lesser development of epiphytes, with a lower tree stratum formed by *Weinmannia trichosperma*, *Laurelia philippiana*, *Saxegothaea conspicua*, a small tree and tall shrub stratum composed of *Chusquea quila*, *Dasyphyllum diacanthoides*, *Chusquea culeou*, *Myrceugenia chrysocarpa*, a small shrub stratum that includes *Ribes punctatum*, *Azara lanceolata*, lianas and epiphytes, particularly hymenohyllaceous ferns, *Asteranthera ovata*, *Griselinia racemosa*, *Luzuriaga radicans*, *Asplenium dareoides*, *Hydrangea integerrima*. When the deciduous *Nothofagus alpina* takes sufficient precedence over the evergreen emergent *Nothofagus dombeyi* and the evergreen lower stratum trees, the community is listed in unit 41 as 41.223.

(Veblen *et al.*, 1983: unit 8; Gajardo, 1994: units 4C9-4C101, 4C10-4C101, *p.*).

45.1222 *Nothofagus dombeyi-N. pumilio* forests
Evergreen beech forests with rare, scattered conifers of well-drained soils of the Andean Cordillera of southern continental Chile, north of latitude 40° 47'S, at altitudes above 1000 metres, developed between units 45.121 or 45.123 and the deciduous timberline *Nothofagus pumilio* forests, with an emergent tree stratum formed by *Nothofagus dombeyi*, a lower tree stratum formed by *Nothofagus pumilio*, a small tree and tall shrub stratum composed of *Chusquea tenuiflora*, *Myrceugenia chrysocarpa*, a small shrub stratum that includes *Drimys winteri* var. *andina*, *Berberis serrato-dentata*, *Berberis buxifolia*, *Maytenus disticha* and few lianas and epiphytes, in particular, *Asteranthera ovata*.
(Veblen *et al.*, 1983: unit 10).

45.123 Supramediterranean *Nothofagus dombeyi* forests
Nothofagus dombeyi-dominated evergreen forests of the supramediterranean montane deciduous forest zones of central and southern mainland Chile, poorer in lauriphyllous eu-Valdivian elements than the forests of unit 45.121.
(Oberdorfer, 1960: 76-111; Gajardo, 1994: units 4A2-4C92, 4C9-4C92, 4A4-4A42 = 5A13).

45.1231 Bio-Bio *Nothofagus dombeyi-Gaultheria* forests
Forests dominated by *Nothofagus dombeyi* of shaded valleys and slopes of the Bio-Bio Andes, between about 37° S and 38° 30' S, within the domain of southern montane deciduous forests. Accompanying species include *Gaultheria phyllyreaefolia*, *Aristotelia chilensis*, *Drimys winteri*, *Maytenus disticha*, *Ribes punctatum*, *Berberis actinacantha*, *Acaena ovalifolia*, *Osmorhiza chilensis*, *Viola maculata*.
(Gajardo, 1994: unit 4C9-4C92).

45.1232 Maulean *Nothofagus dombeyi-Gaultheria* forests
Forests dominated by *Nothofagus dombeyi* of the northern limit of the deciduous forest zone, between 34° 30' and 37°, constituting a very rare, little studied community, mostly developed at the head of great valleys, at altitudes around 1500 metres, northern representative of the forests of unit 45.1231 with which they share the accompanying species cortège.
(Gajardo, 1994: unit 4A2-4C92).

45.124 Eastern Andean *Nothofagus dombeyi* forests
Andino-Patagonian forests dominated by *Nothofagus dombeyi* of the eastern, Argentinian, flank of the Andes, where they form, between about 38° S and 46° S, tall forests from the banks of the Andino-Patagonian lakes to an altitude of 900-1100 metres. They differ from the forests of unit 45.11 that reach the Argentinian Andes in the region of Puerto Blest-Laguna Frias and of Lago Puelo, by the reduced admixture of Valdivian lauriphyllous species. *Chusquea culeou* usually predominates in their understorey.
(Hueck and Seibert, 1972, 1981: units 75 *p.*, 77 *p.*, 79 *p.*; Dimitri, 1972: 73, 77, 119; Dimitri, 1977: 3, 4, 29; Hueck, 1978: 381, 411-414, 415-416; Cabrera and Willink, 1980: 98; Erize *et al.*, 1995: 173).

45.13 Coast range *Nothofagus dombeyi* forests
Nothofagus dombeyi]-dominated evergreen lauriphyllous forests of Valdivian sectors of the Chilean coast range, in particular, of the Cordillera Pelada and the Cordillera de Nahuelbuta, with relictual outliers in the Maule coast range.
(Oberdorfer, 1960: 76-111; Hueck and Seibert, 1972, 1981: units 75, 76, 78; Quintanilla, 1973, 1974: 57; Gajardo, 1994: units 5A1-5A13, 6A4-5A41, 4A3-4A42 = 5A13; Quintanilla, 1995: 23, 30).

45.131 Coastal Valdivian *Nothofagus dombeyi* forests
Hygrophyllous forests dominated by *Nothofagus dombeyi* of the Valdivian coastal cordilleras, between 39° S and 41° 30' S, of reduced surface, but widespread occurrence within the region. Accompanying species include *Podocarpus saligna*, *Persea lingue*, *Drimys winteri*, *Luma apiculata*, *Lomatia dentata*, *Laurelia sempervirens*, *Aristotelia chilensis*, *Blechnum auriculatum*, *Chusquea quila*.
(Gajardo, 1994: unit 5A1-5A13).

45.132 Nahuelbuta *Nothofagus dombeyi* forests
Evergreen forests dominated by *Nothofagus dombeyi* of the middle slopes of the Cordillera de Nahuelbuta, limited to shaded humid slopes, with a lauriphyllous cortège including *Gevuina avellana*.

(Gajardo, 1994: unit 6A4-5A41).

45.133 Maule coast range *Nothofagus dombeyi* forests
Nothofagus dombeyi]-dominated lauriphyllous forests constituting relictual outliers in the Maule coast range, between about 35° S and 36° 30' S.
(Gajardo, 1994: unit 4A3-4A42 = 5A13; Quintanilla, 1995: 23, 30).

45.2 Nothofagus betuloides forests

Temperate broad-leaved evergreen forests of Pacific southern South America and the southern Andes dominated by the evergreen southern beech *Nothofagus betuloides*, most characteristic of the central and southern parts of the Magellanic evergreen forest zone, extending to the northern, pre-Valdivian, part of the Magellanic evergreen forest zone and, at higher altitudes, to the Andino-Valdivian and Valdivian zones.
(Schmithüsen, 1956: 44; Oberdorfer, 1960: 117-119; Hueck and Seibert, 1972: unit 79; Dimitri, 1972: 61, 63, 73, 77, 119; Quintanilla, 1973; Quintanilla, 1974: 54-55; Dimitri, 1977: 2-3, 5, 28; Hueck, 1978: 414, 416; Cabrera and Willink, 1980: 99; Moore, 1983: 28; Ovington, 1983; Veblen *et al.*, 1983; Quintanilla, 1989: 13, 15-16; Burkart *et al.*, 1994: 18; Gajardo, 1994: regions 6B, 7A, 7B, 7C; Erize *et al.*, 1995: 173-175, 176).

45.21 Magellanic *Nothofagus betuloides* forests
Nothofagus betuloides forests constituting the main component of the Magellanic evergreen forests of Pacific southern South America, distributed mostly to the south of 48° S latitude.
(Schmithüsen, 1956: 44; Oberdorfer, 1960: 117-119; Hueck and Seibert, 1972: unit 79; Dimitri, 1972: 61, 63, 73, 77, 119; Quintanilla, 1973; Quintanilla, 1974: 54-55; Dimitri, 1977: 2-3, 5, 28; Hueck, 1978: 414-415, 416-417; Cabrera and Willink, 1980: 99; Moore, 1983: 28; Veblen *et al.*, 1983: types 14 *p.*, 16; Pisano, 1983: 314, 317-318; Quintanilla, 1989: 13, 15-16; Gajardo, 1994: regions 6B10, 7B8, 7B9, 7C; Erize *et al.*, 1995: 176).

45.211 Magellanic *Nothofagus-Drimys* evergreen forests
Forests dominated by *Nothofagus betuloides* with *Drimys winteri* widespread along the coasts of sea inlets, fjords, channels and large glacial lakes of the Magellanic evergreen forest zone, north nearly to 51° S, with outliers occurring in the Navarino evergreen forest and matorral zone between 55° S and 56° S and southards, in the Magellanic deciduous forest zone, notably around the lakes of Los Glaciares National Park, in periglacial areas and on the islands of the southern Magellanic archipelago. Accompanying species include *Berberis ilicifolia*, *Desfontainia spinosa*, *Lebetanthus myrsinites*, *Embothrium coccineum*, *Pernettya mucronata*, *Philesia magellanica*, *Maytenus magellanica*, *Pseudopanax laetevirens*, *Gleichenia quadripartita*, *Luzuriaga marginata*, *Senecio acanthifolius*, *Acaena ovalifolia*, *Adenocaulon chilense*, *Drysopsis glechomoides*. Slow decomposition of tree-trunks favours the occurrence of filmy ferns, in particular, *Hymenophyllum ferrugineum*, *Hymenophyllum peltatum*, *Serpyllopsis caespitosa*.
(Hauman, 1926: 142-149; Oberdorfer, 1960: 117-119; Dimitri, 1972: 61, 63, 73, 77, 119; Dimitri, 1977: 3, 5, 28; Hueck, 1978: 414-415, 416-417, 423, 425; Moore, 1983: 28; Pisano, 1983: 317-318; Veblen *et al.*, 1983: type 14 *p.*; Quintanilla, 1989: 13, 15-16, map; Gajardo, 1994: 6B10-7B81, 7B8-7B81, 7B9-7B81, 7C11-7B81, 7C13-7B81, 7C14-7B81).

45.212 Sub-antarctic *Nothofagus betuloides* forests
Evergreen forests occupying less favoured sites within the range of Magellanic evergreen forests, in particular, inland, drier, sites, peaty soils, shallow soils, exposed and high-altitude stations, dominated by *Nothofagus betuloides*, forming the arborescent stratum alone, or with only a very small admixture of *Drimys winteri*.
(Hauman, 1926: 142-149; Oberdorfer, 1960: 117-119; Moore, 1983: 28; Veblen *et al.*, 1983: type 15; Quintanilla, 1989: 13, 15-16, map; Gajardo, 1994: units 6B10, 7B8, 7B9, 7C).

45.2121 Fuego-Patagonian inland *Nothofagus betuloides* forests
Pure *Nothofagus betuloides* woods of Tierra del Fuego and the eastern slope of the Andes north to about 50° S, developed often on rather shallow, peaty soils, between sea level, outside of coastal areas,

and about 400 metres altitude. Above 200 metres the stands are mostly restricted to glacial valleys, riversides and other sheltered areas. The most frequent associates are *Berberis ilicifolia*, *Lebetanthus myrsinites*, *Empetrum rubrum*, *Philesia magellanica*, *Luzuriaga marginata*, *Senecio acanthifolius*, *Gunnera magellanica*, *Blechnum magellanicum*, *Blechnum penna-marina*, *Hymmenophyllum spp.*, in particular *Hymmenophyllum pectinatum*, *Hymmenophyllum secundum*, *Hymmenophyllum tortuosum*.
(Hauman, 1926: 142-149; Dimitri, 1972: 61, 63, 73, 77, 119; Dimitri, 1977: 3, 5, 28; Hueck, 1978: 414-415, 416-417, 423, 425; Moore, 1983: 28; Quintanilla, 1989: 13, 15-16, map; Gajardo, 1994: units 7B8-7B82, 7B8-7B83).

45.21211 *Nothofagus betuloides-Chiliotrichum* forests
Nothofagus betuloides woods of the Magellanic evergreen forest zone, with *Chiliotrichum diffusum*, *Berberis ilicifolia*, *Drimus winteri*, *Escallonia serrata*, *Empetrum rubrum*, *Lebetanthus myrsinites*, *Gunnera magellanica*, *Hierochloe redolens*, *Philesia magellanica*, *Marsippospermum grandiflorum*, *Gleichenia auadrinarita*, *Senecio acanthifolius*.
(Gajardo, 1994: 7B8-7B82).

45.21212 *Nothofagus betuloides-Pernettya* forests
Impoverished *Nothofagus betuloides* woods of the Magellanic evergreen forest zone, with *Pernettya mucronata*, *Pernettya pumila*, *Chiliotrichum diffusum*, *Berberis ilicifolia*, *Lebetanthus myrsinites*, *Empetrum rubrum*.
(Gajardo, 1994: 7B8-7B83).

45.2122 Periglacial *Nothofagus betuloides* forests
Nothofagus betuloides woods of the periphery of the southern Andean ice fields, between 46° 30' S and 52° S, and of rocky slopes and outcrops of Isla Navarino and the southern Magellanic archipelago. The accompanying cortège may include *Pernettya mucronata*, *Escallonia serrata*, *Lebetanthus myrsinites*, *Luzuriaga marginata*, *Pernettya pumila*, *Chiliotrichum diffusum*, *Berberis ilicifolia*, *Empetrum rubrum*, *Gunnera magellanica*, *Uncinia tenuis*.
(Veblen *et al.*, 1983: type 15; Quintanilla, 1989: 13, 15-16, map; Gajardo, 1994: units 7B9-7B91, 7C11-7B91, 7C12-7B91, 7C11-7B82, 7B8-7B83, 7C11-7B83, 7C13-7B83).

45.213 Magellanic *N. betuloides-N. pumilio* forests
Mixed evergreen-deciduous forests of the Magellanic region dominated by *Nothofagus betuloides* with *Nothofagus pumilio*, characteristic of higher altitudes, dry slopes and more continental areas within the region of Magellanic evergreen forest zones, in particular, of Isla Navarino and the upper slopes of the basins of the great southern Andino-Patagonian lakes.
(Hauman, 1926: 142-149; Hueck, 1978: 423, 425; Veblen *et al.*, 1983: unit 16; Quintanilla, 1989: 13, 15-16, map; Gajardo, 1994: unit 7B9-6B91).

45.22 Valdivio-Magellanic *Nothofagus betuloides* forests
Nothofagus betuloides forests of the northern part ("northern Patagonian") of the Magellanic evergreen forests of Pacific southern South America, distributed mostly betwen 41° S and 48° S latitude, with an admixture of Valdivian elements.
(Schmithüsen, 1956: 44; Oberdorfer, 1960: 117-119; Hueck and Seibert, 1972: unit 75 *p.*; Quintanilla, 1973; Quintanilla, 1974: 54-55; Hueck, 1978: 414; Veblen *et al.*, 1983: types 12, 14 *p.*; Quintanilla, 1989: 8, 10-11, map; Gajardo, 1994: regions 5A4, 7A, 7B6, 7C12).

45.221 *Nothofagus betuloides-Podocarpus* forests
Nothofagus betuloides forests of the northern part ("northern Patagonian") of the Magellanic evergreen forests of Pacific southern South America rich in *Podocarpus nubigena*, distributed mostly between 42° 30' S and 45° S latitude, on the lower slopes of the Puyuhuapi Andes bordering the Gulf of Corcovado and the Canal Moraleda, the Isla Magdalena-Puerto Aisen-Cordillera Huemules region, with outliers at the base of the Taitao peninsula and the Golfo de Peñas area; accompanying species include *Desfontainia spinosa*, *Drimys winteri*, *Lebetanthus myrsinites*, *Philesia magellanica*, *Blechnum magellanicum*, *Pseudopanax laetevirens*, *Campsidium valdiviense*, *Luzuriaga marginata*, *Maytenus magellanica*, *Mitraria coccinea*, *Weinmanmia trichosperma*.
(Oberdorfer, 1960: 117-119; Quintanilla, 1973; Quintanilla, 1974: 55; Veblen *et al.*, 1983: type 14 *p.*; Quintanilla, 1989: 10-11; Gajardo, 1994: units 7A5-7A51, 7C12-7A51).

45.222 *Nothofagus betuloides-Laurelia* forests
Nothofagus betuloides-dominated forests of the middle western slopes and valleys of the Patagonian Andes of Chile, between 43° S and 46° S. Their cortège, floristically richer at lower stations, includes *Laurelia philippiana*, *Amomyrtus luma*, *Azara lanceolata*, *Fuchsia magellanica*, *Hydrangea serratifolia*, *Saxegothaea conspicua*, *Asteranthera ovata*, *Chusquea argentina*, *Chusquea quila*, *Blechnum chilense*, *Blechnum blechnoides*, *Asplenium dareoides*.
(Quintanilla, 1973; Gajardo, 1994: 7B6-7B61).

45.223 *Nothofagus betuloides-Chusquea* forests
Tall *Nothofagus betuloides*-dominated forests of the western Andes of Los Lagos and northern Aisen, between 40° 30' S and 46° 30' S, characteristic of higher altitudes and cold valleys, particularly in the northern part of the range. The accompanying cortège, forming an understorey that is not very dense, includes *Chusquea macrostachya*, *Maytenus magellanica*, *Myrceugenia chrysocarpa*, *Azara lanceolata*, *Asteranthera ovata*, *Drimys winteri*, *Adenocaulon chilense*, *Lagenophora hirsuta*, *Valeriana lapathifolia*, *Viola reichei*.
(Veblen *et al.*, 1983: type 12; Quintanilla, 1989: 10; Gajardo, 1994: 5A4-7B62, 7A2-7B62, 7A5-7B62, 7B6-7B62).

45.23 Western Andean *Nothofagus betuloides-N. pumilio* forests
Mixed *Nothofagus betuloides-Nothofagus pumilio* forests of the higher altitudes of the Valdivian and northern Magellanic western slopes and chains of the Patagonian Andes and of the upper Rio Baker basin, distributed mostly between 39° S and 49° S latitude.
(Quintanilla, 1973; Quintanilla, 1974: 54-55; Hueck, 1978: 415; Veblen *et al.*, 1983: type 11; Quintanilla, 1989: 9, map; Gajardo, 1994: unit 6B6-6B91, 6B7-6B91, 6B8-6B91, 6B9-6B91, 7B7-7B71).

45.231 Valdivio-Magellanic *Nothofagus betuloides-N. pumilio* forests
Forests dominated by *Nothofagus pumilio* and *Nothofagus betuloides* of the western slopes and wide valleys of the high Andes, widespread between 43° S and 49° S, extending north to 39° 30' S and south to 49° 30' S; accompanying species include *Adenocaulon chilense*, *Macrachaenium gracile*, *Maytenus disticha*, *Valeriana lapathifolia*, *Berberis pearcei*, *Chusquea macrostachya*, *Desfontainia spinosa*, *Dysopsis glechomaides*, *Lagenophora hirsuta*, *Osmorhiza chilensis*, *Ribes magellanicum*, *Viola maculata*.
(Quintanilla, 1973; Quintanilla, 1974: 54-55; Hueck, 1978: 415; Veblen *et al.*, 1983: type 11; Quintanilla, 1989: 9, map; Gajardo, 1994: unit 6B6-6B91, 6B7-6B91, 6B8-6B91, 6B9-6B91).

45.232 Baker basin *Nothofagus betuloides-N. pumilio* forests
Open woods of *Nothofagus betuloides* of the Baker and Aisen Andes evergreen and mixed forest zones, between 43° 30' S and 49° 30' S. The accompanying cortège includes *Berberis serrato-dentata*, *Nothofagus pumilio*, *Pernettya mucronata*, *Ribes magellanica*, *Adenocaulon chilense*, *Acaena ovalifolia*, *Hypochaeris radicata*, *Osmorhiza chilensis*, *Ovidia andina*, *Viola maculata*.
(Gajardo, 1994: 7B7-7B71).

45.3 Nothofagus nitida forests

Temperate broad-leaved evergreen forests of Pacific southern South America and the southern Andes dominated by the evergreen southern beech *Nothofagus nitida*, most characteristic of the northern Magellanic evergreen forest zone ("north Patagonian" coastal rain forest), extending to more southern parts of the Magellanic evergreen forest zone and to the Valdivian zone, lauriphyllous with a lower tree stratum formed by *Weinmannia trichosperma*, *Drimys winteri*, *Laurelia philippiana*, *Saxegothaea conspicua*, *Podocarpus nubigenus*, a small tree and tall shrub stratum composed of *Caldcluvia paniculata*, *Maytenus magellanica*, *Lomatia ferruginea*, *Pseudopanax laetevirens*, *Chusquea quila*, *Embothrium coccineum* and, in the north, Myrtaceae, including *Amomyrtus luma*, a small shrub stratum that includes *Desfontainia spinosa*, *Pernettya mucronata* and the tree-like ferns *Blechnum chilense*, *Blechnum magellanicum* and *Lophosoria quadripinnata*, very abundant woody lianas and

epiphytes, particularly hymenohyllaceous ferns, *Asteranthera ovata*, *Mitraria coccinea*, *Philesia magellanica*, *Luzuriaga radicans*, *Griselinia ruscifolia*, *Campsidium valdiviana*.
(Schmithüsen, 1956: 43; Hueck and Seibert, 1972: unit 75; Veblen *et al.*, 1983: type 13; Quintanilla, 1989: 8, 10; Gajardo, 1994: units 5A3-5A31, 7A1-5A31, 7A2-5A31, 7A3-5A31, 7A4-5A31, 7A5-5A31, 7C10-5A31, 7C12-5A31).

45.31 Interior *Nothofagus nitida* forests
Lauriphilous forests dominated by *Nothofagus nitida* of the lower Andean slopes of the Chilean Lake District, the Gulf of Corcovado and the Puyuhuapi Cordillera, the basins and hills of the eastern fjords of northern Aisen from Seno Ventisquero and Canal Puyuhuapi south to Estero Elefantes, around 47° S.
(Schmithüsen, 1956: 43; Veblen *et al.*, 1983: type 13; Quintanilla, 1989: 10; Gajardo, 1994: units 7A2-5A31, 7A5-5A31).

45.32 Maritime *Nothofagus nitida* forests
Lauriphyllous forests dominated by *Nothofagus nitida* of Chiloe Island, the Seno de Reloncavi region, the high slopes and summits of the Cordillera Pelada, the Chonos archipelago and the Taitao peninsula.

(Hueck and Seibert, 1972: unit 75; Quintanilla, 1989: 8, map; Gajardo, 1994: units 5A3-5A31, 7A1-5A31, 7A3-5A31, 7A4-5A31, 7C10-5A31, 7C12-5A31).

45.4 Valdivian mixed lauriphyllous forests

Warm-temperate humid forests of Valdivian Chile dominated by lauriphyllous evergreen trees of genera *Aextoxicon*, *Persea*, *Laurelia*, *Eucryphia*, *Weinmannia*, *Drimys*, many of them laurels or laurel-like, with a species-rich, often luxuriant, largely lauriphyllous undergrowth. Centered in southern mainland Chile and the northern periphery of the Golfo de Corcovado, they extend north along the coastal cordillera and the Andes, increasingly limited to humid ravines, humid rain- or fog-exposed and south-facing slopes and the vicinity of watercourses, to the supramediterranean zone of central Chile, and extremely locally, to desert hills.
(Schmithüsen, 1956: 39-44; Oberdorfer, 1960: 76-111; Hueck and Seibert, 1972: unit 75; Quintanilla, 1973; Quintanilla, 1974: 55-57; Hueck, 1978: 380-391; Cabrera and Willink, 1980: 98; Ovington, 1983; Veblen *et al.*, 1983; Quintanilla, 1984; Quintanilla, 1987: 14, 18, 21; Gajardo, 1994; Quintanilla, 1995).

45.41 Valdivian *Aextoxicon* laurisilvas
Aextoxicon punctatum-dominated or -rich multi-specific lauriphyllous forests of the Valdivian evergreen forest zone of southern mainland Chile and Chiloe Island and of cool, humid stations within the mediterraneo-Valdivian deciduous forest zone, with an exceptional outpost in fogbound coastal hills of the northern mediterranean zone of northern central Chile.
(Schmithüsen, 1956: 39-44; Oberdorfer, 1960: 76-111; Hueck and Seibert, 1972: unit 75; Quintanilla, 1973, 1974: 55-57; Hueck, 1978: 380-391; Veblen *et al.*, 1983: 10-11; Quintanilla, 1984, 1987: 14, 18, 21; Gajardo, 1994; Goic *et al.*, 1994; Quintanilla, 1995: 25).

45.411 Eu-Valdivian *Aextoxicon-Eucryphia* forests
Multispecific lauriphyllous forests of *Aextoxicon punctatus* and *Eucryphia cordifolia* constituting the main forest community of the eu-Valdivian evergreen forest region, under a year-round rainy climate with little annual temperature variation, and in the part of southern South America least influenced by the Pleistocene glaciations and volcanic activity. They are situated on the middle slopes of the Valdivian Cordillera Pelada, on the low slopes of the Andes of Los Lagos and, very locally, around the northern periphery of the Gulf of Corcovado, on Chiloe, in the region of the Gulf of Reloncavi, Reloncavi fjord, Rio Puelo and southeast Lago Llanquihue. The multi-strata forests comprise a tall tree canopy formed by *Aextoxicon punctatum* and *Laurelia philippiana*, with emergent *Eucryphia cordifolia*, a small tree and tall shrub stratum of *Drimys winteri*, *Myrceugenia planipes*, *Chusquea quila*, *Luma apiculata* (*Myrceugenella apiculata*), *Gevuina avellana*, *Amomyrtus luma*, *Amomyrtus meli*, *Pseudopanax laetevirens*, *Lomatia ferruginea*, a small shrub stratum of *Rhaphithamnus spinosus*, *Lophosoria quadripinnata*, *Pseudopanax valdiviense*, *Ribes punctatum*, *Geigia sphacelata*, and lianas

and epiphytes, including *Hydrangea serratifolia*, *Lapageria rosea*, *Boquila trifoliolata*, *Cissus striata*, *Luzuriaga radicans*, *Luzuriaga erecta*, *Mitraria coccinea*, *Fascicularia bicolor*, *Hymenophyllum spp.* (Veblen *et al.*, 1983: type 2; Gajardo, 1994: 5A1-5A11, 5A2-5A11, 5A3-5A11; Goic *et al.*, 1994: 84-85; Quintanilla, 1995: 25).

45.412 Mediterraneo-Valdivian *Aextoxicon-Laurelia* forests
Aextoxicon punctatum-dominated or -rich multi-specific lauriphyllous forests of the mediterraneo-Valdivian deciduous forest zone, limited to humid, shaded slopes and valleys, ravines and the proximity of watercourses, more prevalent, or formerly more prevalent, in the southern part of the region and the low slopes of the Andes in areas of contact with the Valdivian evergreen forest zone. They are multi-stratum, with a canopy formed by a matrix of tall laurel-like trees, mostly *Aextoxicon punctatum*, *Laurelia sempervirens*, *Persea lingue*, often with very tall emergent *Nothofagus obliqua* and occasional *Eucryphia cordifolia*, a small tree and tall shrub stratum of *Myrceugenia planipes*, *Chusquea quila*, *Luma apiculata* (*Myrceugenella apiculata*), *Gevuina avellana*, *Amomyrtus luma*, a small shrub stratum of *Rhaphithamnus spinosus*, *Rhamnus diffusus*, *Pseudopanax valdiviense*, *Azara lanceolata* and lianas and epiphytes, including *Lapageria rosea*, *Boquila trifoliolata*, *Cissus striata*, *Sarmienta repens*, *Luzuriaga radicans*, *Mitraria coccinea*, *Hydrangea serratifolia*. These forests harbour many sclerophyllous trees and shrubs, reflecting their location in a region of severe summer droughts bordering the sclerophyllous *Cryptocarya-Peumus-Quillaja* forest zone. Very few complete examples of this forest remain, in particular, a few tracts near Lake Villarrica. Elsewhere, these multi-strata mixed forests have been reduced to *Nothofagus obliqua*-dominated woodland with pastures, listed under 41.213.
(Veblen *et al.*, 1983: 10-11, type 1; Gajardo, 1994: 4B5-4B83, 4B8-4B83, 4C9-4B83, 4C10-4B83).

45.413 Fray Jorge-Talinay lauriphyllous forests
Aextoxicon punctatum forests of Fray Jorge and Talinay, in Fray Jorge National Park, in the coastal hills of the Limari basin, near 31° S, in the northern, predesert, part of the mediterranean zone of Chile, representing an isolated, insular relict of Valdivian lauriphyllous forest, in ecological conditions of high humidity linked with permanent coastal fogs. Constituting species include *Rhaphithamnus spinosus*, *Myrceugenia correaefolia*, *Uncina phleoides*, *Blechnum auriculatum*, *Asplenium dareoides*, *Peperomia coquimbensis*, *Drimys winteri*, *Urtica magellanica*.
(Hueck and Seibert, 1972: unit 75 *p.*; Quintanilla, 1984, 1987: 14; Arroyo *et al.*, 1994; Gajardo, 1994: 3A3-5A12; Campodonico, 1995).

45.42 Valdivian *Eucryphia-Weinmannia-Persea* forests
Mixed lauriphyllous forests of the Valdivian region of Chile dominated by *Eucryphia cordifolia*, *Weinmannia trichosperma*, *Laurelia philippiana*, *Persea lingue*, in which *Aextoxicon punctatum* is absent or not prominent. They are most characteristic of the southern part of the eu-Valdivian region and its transition to the Magellanic evergreen region, extending sparingly farther north in favourable locations.
(Schmithüsen, 1956: 39-44; Oberdorfer, 1960: 76-111; Hueck and Seibert, 1972: unit 75; Quintanilla, 1973, 1974: 55-57; Hueck, 1978: 380-391; Veblen *et al.*, 1983: 10-11; Quintanilla, 1984, 1987: 14, 18, 21; Gajardo, 1994; Goic *et al.*, 1994; Quintanilla, 1995: 21-22).

45.421 Valdivian *Eucryphia-Weinmannia* forests
Lauriphyllous forests of the southern sector of the Valdivian coastal Cordillera Pelada, extending southwards on both sides of the Golfo de Corcovado to the Chonos archipelago and to the valleys and low slopes of the western Cordillera de Puyuhuapi, south to about 46° 30' S, and northwards to the southern part of the Andean mixed deciduous forest region in scarce pockets at middle elevations, around 40° S. Accompanying species include *Eucryphia cordifolia*, *Laurelia philippiana*, *Weinmannia trichosperma*, *Nothofagus dombeyi*, *Rhaphithamnus spinosus*, *Gevuina avellana*, *Luma apiculata*, *Luzuriaga radicans*, *Aextoxicon punctatus*, *Myrceugenia planipes*, *Azara lanceolata*, *Caldcluvia paniculata*, *Chusquea quila*, *Mitraria coccinea*, *Nertera granadensis*, *Amomyrtus luma*.
(Veblen *et al.*, 1983: type 3; Gajardo, 1994: 4C10-5A14, 5A1-5A14, 7A4-5A14, 7A5-5A14).

45.422 Valdivian *Persea-Eucryphia* forests
Uncommon lauriphyllous forests of the Valdivian coastal Cordillera Pelada, and the low slopes of the Andes of Los Lagos, developed on good, well-drained soils, dominated by *Persea lingue* and *Eucryphia cordifolia*, with *Rhaphithamnus spinosus*, *Luma apiculata*, *Luzuriaga radicans*, *Boquila*

trifoliolata, *Cissus striata*, *Hydrangea serratifolia*, *Chusquea quila*, *Blechnum auriculatum*, *Blechnum chilense*, *Amomyrtus luma*, *Laurelia philippiana*.
(Gajardo, 1994: 5A1-5A15, 5A2-5A15).

45.423 Central Chilean *Persea-Luma* forests
Hygrophyllous lauriphyllous forests of canyons and humid valleys of the sclerophyllous pre-Andean foothills of Central Chile, between about 33° 30' S and 36° 45' S, constituted by *Persea lingue*, *Luma chequen*, *Cryptocarya alba*, *Aristotelia chilensis*, with *Drimys winteri*, *Maytenus boaria*, *Blechnum auriculatum*, *Equisetum bogotense*, *Hypochaeris scorzonerae*.
(Gajardo, 1994: units 3C11-3C121, 3C12-3C121).

45.5 Andino-Magellanic presteppic evergreen forests

Mixed evergreen forests of the Magellanic region, of the Andino-Patagonian forest region and of the Cuyo Andes dominated by lauriphyllous or xerophyllous trees other than *Nothofagus spp.*, in particular, the Proteaceae *Embothrium coccineum* and *Lomatia hirsuta*, the Celastraceae, *Maytenus magellanica* or *Maytenus boaria*, the Rhamnaceae *Chacaya trinervis*.
(Morello, 1958: 91; Roig, 1982: 63; Moore, 1983: 28; Quintanilla, 1989: 16; Gajardo, 1994: 7B8-7B86, 8A2-7B86; Erize *et al.*, 1995: 173).

45.51 Magellanic *Maytenus-Drimys* forests
Evergreen forests of the Magellanic region, in particular of Tierra del Fuego, dominated by *Maytenus magellanica* and *Drimys winteri*, apparently now extinct, represented by occasional *Drimys* stands, by arborescent matorrals formed by *Drimys winteri*, *Maytenus magellanica*, *Embothrium coccineum*, *Ribes magellanicum*, *Berberis buxifolia*, *Acaena ovalifolia*, *Acaena magellanica*, and probably by the woods of unit 45.52.
(Moore, 1983: 28; Gajardo, 1994: units 7B8-7B86, 8B2-7B86).

45.52 Magellanic *Embothrium* forests
Small evergreen forest stands dominated by tall *Embothrium coccineum*, characteristic of the Seno Almirantazgo area of Tierra del Fuego, possible relicts of the extinct *Maytenus-Drimys* forests.
(Moore, 1983: 28, 155; Gajardo, 1994: units 7B8-7B86, 8B2-7B86).

45.53 *Lomatia* woodland
Mixed evergreen forests of the Magellanic evergreen forest region dominated by *Lomatia hirsuta*, with *Nothofagus betuloides*, *Berberis serrato-dentata*, *Berberis buxifolia*, *Chusquea coleu*, *Maytenus boaria*, *Ribes valdivianum*, *Blechnum penna-marina*, locally extending to the deciduous forest zone on the eastern side of the Andes, in particular, in Nahuel Huapi National Park of Argentina and in Aisen, replaced in the ecotone between deciduous woodland and sub-Andean Patagonian steppe by *Lomatia* brushes (unit 32.4232). In its main Magellanic evergreen forest range this community has been mostly destroyed by deforestation.
(Dimitri, 1972: 74-75, 117; Dimitri, 1977: 5, 31; Gajardo, 1994: units 6B9-7B63, 7B6-7B63; Erize *et al.*, 1995: 173).

45.54 Eastern Andean *Maytenus boaria* woodland
Gallery woods of *Maytenus boaria* of the eastern piedmont of the Andes and their eastern flanking chains, developed under mediterranean regimes or their transition to subtropical deserts. They accompany rivers at the eastern edge of Andino-Patagonian forests and into adjacent steppes, notably in the valley of the Traful, extending north to the Cuyo in Mendoza, Cordoba and San Luis, occopying abrupt ravines in the main Andean chain and entering the periphery of the Monte.
(Morello, 1958: 91; Roig, 1982: 63; Santos Biloni, 1990: 291-292; Erize *et al.*, 1995: 173).

45.6 Central Chilean sclerophyllous forests

Evergreen sclerophyllous or mixed sclerophyllous and lauriphyllous forests and woodland of the mediterranean zone of central Chile formed by *Cryptocarya alba*, *Lithrea caustica*, *Azara petiolaris*,

Beilschmiedia miersii, *Peumus boldus*, *Dasyphyllum excelsum*, *Kageneckia oblonga*, *Persea lingue*, *Maytenus boaria*, *Myrceugenia spp.* They are distributed from 31° S along the Pacific coast and 33° S in lower Andean valleys to 37° S at the coast and 38° S in the Chilean Central Valley, bordered in the north by thorn scrub and succulent formations, in the south by the mixed lauriphyllous evergreen and deciduous Valdivian forests of 45.4. They are characteristic of climates with strong contrast between summer drought and winter rains. They have, for the most part been destroyed, replaced by cultivation or matorral (32.11), sometimes arborescent. Dense, tall stands subsist, generally on mesic, south-facing slopes at moderate elevations, particularly of the wetter Pacific slopes of the coast range and of damp valleys of the Andes, with good examples surviving, notably, on the lower slopes of Cerro La Campana.
(Schmithüsen, 1956: 6-7, 22-34, 36, 39-42; Oberdorfer, 1960: 13-29; Hueck and Seibert, 1972, 1981: unit 74; Quintanilla, 1973; Quintanilla, 1974: 52; Hueck, 1978: 374-380; Cabrera and Willink, 1980: 93; Rundel, 1981: 184-185; Quintanilla, 1984; Quintanilla, 1987: 12, 16-17; Arroyo *et al.*, 1994: 55; Gajardo, 1994: region 3).

45.61 Central Chilean sclerophyllous litre-boldo-quillai forests
Xerophile and xero-mesophile sclerophyllous forests of mediterranean Chile, dominated by the Anacardiaceae *Lithrea caustica*, the Monimiaceae *Peumus boldus* or the Rosaceae *Quillaja saponaria*, for the most part reduced to matorrals, listed in unit 32.
(Schmithüsen, 1956: 28-29; Oberdorfer, 1960: 23-29; Hueck, 1978: 374-375; Rundel, 1981: 184-185, 188-191; Quintanilla, 1987: 17; Gajardo, 1994).

45.611 *Lithrea-Peumus* woodland
Remnant woods of *Lithrea caustica* and *Peumus boldus* of the central Chilean mediterranean zone, scattered in the coast range of Valparaiso, Santiago, O'Higgins, Maule and northern Bio-Bio, extending locally into the sub-Andean region of southern O'Higgins, Maule and extreme northern Bio-Bio, accompanied by a largely spiny undergrowth, with *Quillaja saponaria*, *Trevoa trinervis*, *Nassella chilensis*, *Satureja gilliesii*, *Cryptocarya alba*, and with *Puya*, other ground bromeliads and succulents in the driest locations, characteristic of dry stony north-facing slopes with coarse soil.
(Schmithüsen, 1956: 28; Oberdorfer, 1960: 26; Hueck, 1978: 375; Gajardo, 1994: units 3B7-3C105, 3B8-3C105, 3B9-3C105, 3C10-3C105, 3C12-3C105, 3C13-3C105, *p.*).

45.612 *Quillaja* forests
Remnant, often open sclerophyllous forests and woods of *Quillaja saponaria* of the mediterranean zone of Chile, mostly confined to the low and middle slopes of the Andes, the inner slopes of the coastal cordillera, the hills of the northern central valley and the southern transition zone of the central valley.
(Schmithüsen, 1956: 28-29; Oberdorfer, 1960: 26; Quintanilla, 1974: 52; Hueck, 1978: 375; Gajardo, 1994: units 3B58, 3C111, 3C112, 3C141).

45.6121 Pre-cordilleran *Quillaja* forests
Quillaja saponaria forests of the low and middle slopes of the Andes of Santiago and O'Higgins, extending north, at somewhat higher altitudes, to southern Coquimbo and across the valley to the upper slopes of the inner coast range in Santiago and O'Higgins.
(Gajardo, 1994: units 3C111, 3C112).

45.61211 *Quillaja-Lithrea* forests
Quillaja saponaria forests, usually open, of the low and middle slopes of the Andes and the upper slopes of the inner coast range of Santiago and O'Higgins, extending north, at somewhat higher altitudes, to southern Coquimbo. The species cortège includes *Lithrea caustica*, *Pasithaea coerulea*, *Baccharis rhomboidalis*, *Maytenus boaria*, *Nassella chilensis*.
(Gajardo, 1994: units 2B10-3C111, 3C11-3C111, 4A1-3C111).

45.61212 *Quillaja-Colliguaja* forests
Quillaja saponaria forests, usually very open, of the slopes of the Andes of Santiago and O'Higgins, extending north to southern Coquimbo, usually developed at higher altitudes than the formations of 45.61211, on rocky slopes and in high valleys, with *Colliguaja odorifera*, *Adesmia arborea*, *Porlieria chilensis*, *Alstroemeria angustifolia*.
(Gajardo, 1994: units 2B10-3C112, 3C11-3C112).

45.6122 Serranias *Quillaja-Porlieria* woodland
Quillaja saponaria woodland of gentle slopes at middle elevations of the hills of the Chilean central valley, lying between the coast range and the Andes, between about 31° 30' S and 33° S. They are formed of tall, spaced trees of *Quillaja saponaria* and *Porlieria chilensis* and clustered scrub communities, leaving ample openings where vernal meadows appear. Accompanying species include *Colliguaja odorifera*, *Proustia cuneifolia*, *Kageneckia oblonga*, *Avena barbata*, *Bromus berterianus*, *Erodium cicutarium*.
(Gajardo, 1994: unit 3B5-3B58 *p.*).

45.6123 Southern transition *Quillaja-Fabiana* woodland
Open woods of the southern limit of the mediterranean evergreen sclerophyll zone of Chile, occupying arenales, sandy and stony well-drained soils, dominated by *Quillaja saponaria*, *Lithrea caustica*, *Schinus polygamus*, with *Aira caryophylla*, *Calandrinia sericea*, *Haplopappus integerrimus*, *Maihuenia poeppigii*, in alternation with *Fabiana imbricata*-dominated shrub communities (unit 32.14).
(Ducoing, 1973: 69; Hueck, 1978: 376; Gajardo, 1994: 3C14-3C141 *p.*).

45.62 Central Chilean sclerophyllous laurel forests
Mesophile or hygrophyle sclerophyllous forests of mediterranean Chile dominated by the Lauraceae *Cryptocarya alba* or *Beilschmiedia miersii*, mostly characteristic of ravines, shaded slopes and humid stations.
(Schmithüsen, 1956: 25-27; Oberdorfer, 1960: 18-23; Hueck, 1978: 377-378; Rundel, 1981: 184-185, 188, 191; Gajardo, 1994).

45.621 *Cryptocarya* forests
Mesophile sclerophyllous forests of mediterranean Chile dominated by the peumo, *Cryptocarya alba* (*Cryptocarya mammosa*, *Cryptocarya rubra*), or by the boldo, *Peumus boldus* with *Cryptocarya* and *Schinus latifolius*, constituting the drier variants of the *Cryptocaryion* forests, limited to the Chilean coast range and the low slopes of the Andes in Santiago and O'Higgins.
(Schmithüsen, 1956: 27; Oberdorfer, 1960: 18-21; Hueck, 1978: 377-378; Quintanilla, 1987: 18; Gajardo, 1994).

45.6211 Coast range *Cryptocarya* forests
Cryptocarya alba mesophile sclerophyllous forests of the mediterranean Chilean coast range of Santiago and O'Higgins.
(Schmithüsen, 1956: 27; Oberdorfer, 1960: 18-21; Hueck, 1978: 378; Gajardo, 1994: units 3C102, 3C106).

45.62111 Coast range *Cryptocarya-Schinus* forests
Woods of damp canyon bottoms and shady slopes of the coast range of central Chile formed of *Cryptocarya alba*, *Schinus latifolius* and *Peumus boldus* with *Lithrea caustica*, *Quillaia saponaria*, *Adenopeltis serrata*, *Azara celastrina*, *Chusquea cumingii*, *Escallonia revoluta*, *Myrceugenia obtusa*, *Podanthus mitiqui*, *Proustia pyrifolia*.
(Gajardo, 1994: units 3B8-3C102, 3C10-3C102).

45.62112 Coast range *Cryptocarya-Luma* forests
Woods of the coast range of central Chile, limited to moist south-facing canyon bottoms, especially where there is permanently flowing water, formed of *Cryptocarya alba* and *Luma chequen* with *Cestrum parqui*, *Escallonia illinita*, *Maytenus boaria*, *Loasa triloba*, *Alstroemeria haemantha*.
(Gajardo, 1994: units 3B7-3C106, 3C10-3C106).

45.6212 Andean *Cryptocarya* forests
Cryptocarya alba mesophile sclerophyllous forests of the mediterranean Andes of Santiago and O'Higgins.
(Gajardo, 1994: units 3C113, 3C114, *p.*).

45.62121 Andean *Cryptocarya-Quillaja* forests

Forests of mesic south-facing slopes and valleys of the mediterranean sub-Andean hills of Santiago and O'Higgins, formed by *Cryptocarya alba* and *Quillaja saponaria*, with *Trevoa trinervis*, *Alstroemeria angustifolia*.
(Gajardo, 1994: units 3B7-3C113, 3C11-3C113, *p.*).

45.62122 Andean *Cryptocarya-Lithrea* forests
Forests of ravines of the mediterranean sub-Andean hills of Santiago and O'Higgins, formed by *Cryptocarya alba* and *Lithrea caustica*, with *Pasithaea coerulea*, *Alstroemeria haemantha*.
(Gajardo, 1994: unit 3C11-3C114 *p.*).

45.622 *Beilschmiedia* forests
Rare meso-hygrophile or hygrophyle mixed sclerophyllous-lauriphyllous forests of mediterranean Chile dominated by the evergreen Lauraceae, belloto (*Beilschmiedia miersii*), constituting the most humid variants of the *Cryptocaryion* forests. They are of very local occurrence, within an extremely restricted range in the coastal cordillera of central Chile, where they occupy the sides and bottom of canyons holding flowing water and fogbound hyper-humid south-facing slopes. The main accompanying tree species include *Cryptocarya alba*, *Schinus latifolius*, *Citronella mucronata*, *Peumus boldus* and, in the most humid, bottom, part of the canyons, *Crinodendron patagua*. The species cortège, rich in lauriphyllous species, comprises *Persea lingue*, *Drimys winteri*, *Proustia pyrifolia*, *Azara integrifolia*, *Cassia stipulacea*, *Myrceugenia obtusa*, *Chusquea cumingii*, *Adiantum chilense* and the epiphyte *Tillandsia usneoides*.
(Schmithüsen, 1956: 26-27; Oberdorfer, 1960: 22-23; Hueck, 1978: 377; Quintanilla, 1987: 18; Gajardo, 1994: unit 3C10-3C101).

45.63 Supramediterranean *Kageneckia* forests
Sclerophyllous forest of the Central Chilean Andes, developed above 1500 metres, between about 31°S and 34°S, dominated by the Rosaceae *Kageneckia angustifolia*.
(Gajardo, 1994: units 2B10-2B101, 4A1-2B101, 4A2-2B101, *p.*; Quintanilla, 1994: 26; Arroyo *et al.*, 1994: 54-56).

45.7 Juan Fernandez lauriphyllous forests

Forests occupying the slopes and valleys of the Juan Fernandez Islands, formed of evergreen trees and shrubs of subantarctic affinities belonging to genera *Drimys*, *Myrceugenia*, *Rhaphithamnus*, *Escallonia* accompanied by tropical elements, by ferns, by the endemic palm *Juania australis* and by a tertiary-relict complex of arborescent composites with leaves in apical rosettes included in the endemic genera *Centaurodendron*, *Yunquea*, *Robinsonia*, *Symphyocheta*, *Rhetinodendron*, *Dendroseris*, *Rea*, *Phaenicoseris*. The native sandalwood, *Santalum fernandezianum*, is now extinct.
(Murphy, 1936: 255-258; Skottsberg, 1953a; Cabrera and Willink, 1980: 103-104; Gajardo, 1994: region 5B; Campodonico, 1995: 86-91).

45.71 Mas a Tierra forests
Lauriphyllous forests of Mas a Tierra in the Juan Fernandez archipelago.
(Skottsberg, 1953a; Gajardo, 1994: region 5B5).

45.711 Mas a Tierra lower montane forests
Lauriphyllous forests of the low and middle slopes of Mas a Tierra, in the Juan Fernandez archipelago, formed by *Nothomyrcia fernandeziana*, *Drimys confertifolia* and *Fagara mayu*, with *Coprosma pyrifolia*, *Boehmeria excelsa*, *Chusquea fernandeziana*, *Escallonia callcottiae*, *Peperomia fernadeziana*, *Rhaphithamnus venustus*, *Juania australis*.
(Skottsberg, 1953a: 899-904; Cabrera and Willink, 1980: 104; Gajardo, 1994: unit 5B5-5B51).

45.7111 Mas a Tierra lower montane *Nothomyrcia* forests
Low and middle slope lauriphyllous forests of Mas a Tierra, dominated by *Nothomyrcia fernandeziana* accompanied, in the canopy or in an emergent stratum, by *Drimys confertifolia*, *Fagara mayu*, *Coprosma pyrifolia* and, occasionally, *Rhaphithamnus venustus* or *Juania australis*.
(Skottsberg, 1953a: 899-904; Cabrera and Willink, 1980: 104; Gajardo, 1994: unit 5B5-5B51).

45.7112 Mas a Tierra *Boehmeria* forests
Lauriphyllous forests of the low and middle slopes of Mas a Tierra dominated by *Boehmeria excelsa*, alone or associated with the species of unit 45.7111, characteristic of valley bottoms, canyons and streamsides.
(Skottsberg, 1953a: 903-904).

45.7113 Mas a Tierra *Dendroseris* forests
Lauriphyllous forests of the low and middle slopes of Mas a Tierra dominated by *Dendroseris micrantha*, forming low, sparse forests on dry stony soils.
(Skottsberg, 1953a: 899).

45.712 Mas a Tierra upper montane forests
Forests of the upper woodland zone of Mas a Tierra in the Juan Fernandez archipelago, developed in conditions of high humidity, rich in arborescent ferns, in particular *Dicksonia berteroana*, filmy ferns (Hymenophyllaceae) and bryophytes, in particular, *Weymouthia spp.*, formed by *Drimys confertifolia* and *Nothomyrcia fernandeziana*, accompanied by, in the upper tree strata, *Azara fernandeziana*, *Juania australis*, *Dicksonia berteroana*, *Coprosma hookeri*, *Coprosma pyrifolia*, and with *Rhetinodendron berterii*, *Cuminia fernandeziana*, *Boehmeria excelsa*, *Ochagavia elegans*, *Ugni selkirkii*, *Chusquea fernandeziana*, *Peperomia fernandeziana*, *Rhaphithamnus venustus*, *Thyrsopteris elegans*. In some formations *Dicksonia berteroana* may be the most densely represented species, constituting an almost continuous upper shrub layer.
(Skottsberg, 1953a: 904-910; Cabrera and Willink, 1980: 104; Gajardo, 1994: unit 5B5-5B52).

45.72 Mas Afuera forests
Lauriphyllous forests of Mas Afuera, in the Juan Fernandez archipelago, formed by *Fagara externa*, *Myrceugenia schulzei*, *Drimys confertifolia*, *Coprosma pyrifolia* with *Coprosma hookeri*, *Rhaphithamnus venustus*, *Dendroseris gigantea*, *Dicksonia externa*, *Gunnera masafuerae*, *Peperomia fernandiana*.
(Skottsberg, 1953a: 933-938; Cabrera and Willink, 1980: 104; Gajardo, 1994: unit 5B-5B61).

45.721 Mas Afuera lauriphyllous forests
Mas Afuera lauriphyllous forests dominated by *Myrceugenia schulzei*, with *Fagara externa*, *Drimys confertifolia* or *Coprosma pyrifolia*, often rich in ferns, including *Dicksonia externa*, particularly at higher altitudes.
(Skottsberg, 1953a: 933-938; Cabrera and Willink, 1980: 104; Gajardo, 1994: unit 5B-5B61).

45.722 Mas Afuera fern forests
Mas Afuera forests dominated by the tree-fern *Dicksonia externa*, often accompanied by *Blechnum cycadifolium*, *Blechnum longicauda*, mostly characteristic of the higher altitudes and of damp ravines. Fern forests are the preferred habitat of the endemic petrels *Pterodroma externa* and *Pterodroma longirostris* and the endemic furnariid *Aphrastura masafuerae*.
(Skottsberg, 1953a; Cabrera and Willink, 1980: 104; Brooke, 1987: 581-586; Brooke, 1988: 4-9; Gajardo, 1994: unit 5B-5B61).

45.8 Temperate palm groves

Woods, often riparian, formed by palm trees of the mediterranean and Valdivian zones, *Jubea chilensis* of Chile, and *Juania australis* of the Juan Fernandez Islands.
(Skottsberg, 1953a; Oberdorfer, 1960; Hueck and Seibert, 1972, 1981; Hueck, 1978: 374-376; Rundel, 1981: 192-193; Blombery and Rodd, 1982: 109; Quintanilla, 1984, 1987; Gajardo, 1994; Coig *et al.*, 1994).

45.81 Central Chilean palm groves
Groves or stands of the vulnerable endemic palm *Jubaea chilensis* of the Chilean coastal cordillera between the Limari, at 31° S and Cocalan, at 35° S, with outliers occurring in scarce, reduced stands southwards in the interior to 36° 30'S. Most formations are small except for the extensive palm groves of Ocoa and Cocalan. The accompanying shrubby understorey is formed by sclerophyllous species characteristic of the region, in particular, *Lithrea caustica*, *Colliguaja odorifera*, *Muehlenbeckia*

hastulata, *Puya chilensis*, *Schinus polygamus*, *Trevoa trinervis*, *Trichocereus chilensis*, *Adesmia arborea*, *Baccharis linearis*, *Chusquea cumingii*, *Peumus boldus*, *Podanthus mitiqui*, *Proustia cuneifolia*, *Quillaja saponaria*.
(Oberdorfer, 1960; Hueck and Seibert, 1972, 1981: unit 74 *p.*; Hueck, 1978: 374-376; Rundel, 1981: 192-193; Blombery and Rodd, 1982: 109; Quintanilla, 1984; Quintanilla, 1987: 14; Gajardo, 1994: units 3C10-3C103, 3C13-3C103, 3A4-3C102 = 3A4-3C103; Coig *et al.*, 1994: 92, 94, 120, 129).

45.82 Juan Fernandez palm groves
Groves or stands of the endemic palm *Juania australis* of Masatierra in the Juan Fernandez archipelago. *Juania australis* mostly occurs as an element of the lower and upper montane forests of Masatierra, where it has been considerably reduced to relatively rare occurrence. It does, however, form groves in a few locations and, apparently, did so more frequently in the past.
(Skottsberg, 1922b: 108-109; Skottsberg, 1953a: 838-839).

45.9 Mediterraneo-Chilean arborescent cactus groves

Woods and groves of the mediterranean zone of Chile and its transition to Chileno-Peruvian desert formed by arborescent cacti of genus *Trichocereus* (*Echinopsis*).
(Hoffmann, 1989: 42-45).

45.91 Mediterraneo-Chilean *Trichocereus chilensis* groves
Woods and groves of the central mediterranean zone of Chile, sometimes very dense, formed by the up to 8-metre tall, very branched or multi-trunked arborescent cactus *Trichocereus chilensis*.
(Hoffmann, 1989: 45, 84-85).

45.92 Mediterraneo-Chilean *Trichocereus skottsbergii* groves
Woods and groves of the northern mediterranean zone of Chile, in the area of transition to the Chileno-Peruvian desert, formed by the vulnerable multi-metre tall, little branched arborescent cactus *Trichocereus skottsbergii*, limited to coastal slopes mostly in the area of Fray Jorge.
(Hoffmann, 1989: 44, 90-91).

46. EVERGREEN RAIN FORESTS

Multi-strata broad-leaved evergreen forests, of great species diversity, situated in the lowlands within ever-wet warm tropical climates, humid or hyper-humid tropical climates lacking a dry or a cold season. In South America, they are mostly constituted by zonal dryland "tropical humid forests", developed under precipitation regimes with less than 2.5 dry months per year and annual totals superior to 2000 mm, at altitudes inferior to 500 to 1200 metres, depending on local conditions. Typically, their multi-layered structure is very tall, with many trees exceeding 30 metres, buttressed, their undergrowth is sparse, large woody climbers are abundant, non-vascular epiphytes are uncommon. In some areas, forests described as premontane or submontane share those characteristics and are included. Seasonal evergreen forests, submitted to limited seasonal moisture stress, but with no or few deciduous trees and sharing the structural characteristics of ever-wet evergreen forests, are included. Azonal forests developed under similar conditions of altitude and climate on soils that determine low growth, sparse structure and a higher degree of xerophytism, such as white sands, are excluded and listed under unit 4B. Inundatable forests and riverine gallery forests are also excluded and listed under unit 4A. The extremely rich rain forests of South America are divided into three widely disjunct ensembles: one (unit 46.1) still covers vast areas in the Amazonian basin, although it suffers in many areas from rapid range contraction and fragmentation; the other two (units 46.2 and 46.3) are extremely reduced and fragmented, occupying only a small fraction of their potential range, and their extraordinary wealth of endemic animal and plant species is severely threatened.
(Richards, 1952; Koepcke, 1961: 150-153; Birot, 1970; Schnell, 1971; Hueck and Seibert, 1972, 1981: units 1-13, 23-24, 26; Letouzey, 1978; Hueck, 1978; Whitmore, 1978, 1989; Prance, 1982, 1989; Schnell, 1987a; Huber and Alarcon, 1988; Benzing, 1989; Ridgely and Tudor, 1989; Emmons, 1990; Walter and Breckle, 1991b; Whitmore, 1992: 12-15, i.a.; Maître *et al.*, 1993; Huetz de Lemps, 1994; Henderson, 1995; Archibold, 1995: 15-59; Maître *et al.*, 1993: 15-16, 18-24; Huber, 1995).

46.1 Amazonian rain forests

Evergreen terra firme rain forests of the Amazon and Orinoco basins and the Guianas, constituting the Hylaea, the largest forest on the planet. Terra firme forest is developed on slightly elevated plateaux not subject to river flooding. The highest tree stratum reaches 30-40 metres, with emergents up to 50 or 60 metres, among them, *Bertholletia excelsa*. Tree diversity is extremely high, with richnesses of 40 species per hectare, in Belem, to 290 species per hectare in western Amazonia. The tree species cortège includes a high representation of Fabales, in particular, of genera *Cassia*, *Crudia*, *Cynometra*, *Dalbergia*, *Erythrina*, *Parkia*, *Pentaclethra*, *Pterocarpus*, of Annonaceae, Bombaceae, Burseraceae, Dichepetalaceae, Ebenaceae, Humiriaceae, Icacinaceae, Lauraceae, Lecythidaceae, Moraceae, Myristicaceae, Olacaceae, palms, Rosacae (Chrysobalaneae) (genus *Parinari*), Sapotaceae, Vochysiaceae, acompanied by Apocynaceae (genera *Aspidosperma* and *Parachonaria*), Combretaceae (genus *Buchenavia*), Emeocapaceae (genus *Sloanea*), Humiriaceae (genus *Sacoglottis*) and Meliaceae (genus *Cedrela*). Endemic tree genera include *Antidaphne*, *Berthholletia*, *Couroupita*, *Dinizia*, *Duckeodendron*, *Hevea*, *Theobroma*. Palms are abundant in the dominated tree strata, tabular roots, respiratory bracing roots, thick-stemmed vines are abundant. Undergrowth is sparse. The subdivisions of the unit are mainly geographical, based on the floristic provinces defined by Prance, and the pattern of refuges and centers of endemism constructed by Haffer for birds, by Prance for higher plants.
(Richards, 1952; Birot, 1970; Hueck and Seibert, 1972, 1981: units 1-13, 23-24, 26; Haffer, 1974: 143-157; Haffer, 1978: 54-64; Letouzey, 1978; Hueck, 1978; Schnell, 1987a: 203-276; Huber and Alarcon, 1988; Prance, 1989: 101-103, 112; Benzing, 1989; Ridgely and Tudor, 1989; Emmons, 1990; Rieley and Page, 1990; Walter and Breckle, 1991b; Whitmore, 1992; Sick, 1993: 6; Maître *et al.*, 1993; Huetz de Lemps, 1994; Henderson, 1995; Archibold, 1995: 15-59; Huber, 1995).

46.11 Western Amazonian rain forests

Rain forests of the western and southwestern sector of the Amazonian region, including all of Peruvian, Ecuadorian and Bolivian Amazonia and, in Brazil, the basin of the right bank tributaries of the Rio Solimoas-Rio Amazonas, from the Rio Tefe and the Rio Jurua westwards, and the upper basins of the Rio Purus and the Rio Madeira. Their floral cortège is characteristic of the Napo, Sao Paulo de Olivença, Tefe, eastern Peruvian and Beni centres of endemism, their avifauna of the Napo and eastern Peruvian centres of endemism. Most prominent among the tree assembly are members of the fabaceids, the Myristicaceae, the Bombacaceae, the Solanaceae, the Rubiaceae, the composites, the Lauraceae, the Vochysiaceae, the Flacourtiaceae; the Meliacaceae are better represented than in any other part of Amazonia; genus *Theobroma* is almost endemic to the unit; the species richness of palms is very high.
(Hueck and Seibert, 1972, 1981: units 6, 8, 9; Haffer, 1974: 143-157; Haffer, 1978: 54-64; Hueck, 1978: 54-56, 76-77, 77-78, 52-54; Schnell, 1987a: 225-226, 228, 229-230; Prance, 1989: region 10c; Maître *et al.*, 1993: 20, units 6, 8; Henderson, 1995: 32-34).

46.111 Napo rain forests
Rain forests of the northern part of the western and southwestern sector of the Amazonian region, comprising Ecuadorian Amazonia and Peruvian Amazonia north of the Maranon. Their floral cortège and their avifauna are characteristic of the Napo centre of endemism to which have been attributed about 40 characteristic species, including the curassows *Mitu salvini* and *Nothocrax urumutum*, the antbirds *Dichrozona cincta*, *Megastictus margaritatus* and *Neoctantes niger*, the plushcrown *Metopothrix aurantiacus*, the hookbill *Ancistrops strigilatus*, the cotinga *Porphyrolaema porphyrolaema*.
(Hueck and Seibert, 1972, 1981: units 6 *p.*, 9 *p.*; Haffer, 1974: 68-69, 143-157; Haffer, 1978: 54-56; Hueck, 1978: 54-56, 77-78; Prance, 1989: 101-103, 112; Henderson, 1995: 32-34).

46.112 Inambari rain forests
Rain forests of the central western part of the southwestern sector of the Amazonian region, including Peruvian Amazonia south of the Maranon and the Acre region of Brazil. Their floral cortège and their avifauna are characteristic of the Inambari, eastern Peruvian or eastern Peruvian-Acre centre of endemism. Among representative tree species are *Hevea brasiliensis*, *Myroxylon balsamum*, *Phytelephas microcarpa*, *Swietenia macrophylla* and *Torresea acreana*. Other species identified in the south of the region are *Calophyllum brasiliense*, *Hura crepitans*, *Ochroma lagopus* and *Virola spp.* About 50 bird species are characteristic of the Inambari refuge, among them the tinamou *Crypturellus bartletti*, the macaw *Ara couloni*, the jacamar *Galbalcyrhynchus purusianus*, the antbirds *Formicarius rufifrons* and *Grallaria eludens*, the cotinga *Conioptilon mcilhennyi*, the cacique *Cassicus koepckeae*.
(Hueck and Seibert, 1972, 1981: units 6 *p.*, 8, 9 *p.*; Haffer, 1974: 143-157; Haffer, 1978: 55, 56-57; Hueck, 1978: 54-56, 76-77, 77-78; Prance, 1989: 101-103, 112; Maître *et al.*, 1993: 20, unit 8; Henderson, 1995: 32-34).

46.113 Jurua rain forests
Rain forests of the northwestern part of the southwestern sector of the Amazonian region, centered on the middle basin of the Rio Jurua and other right bank tributaries of the Rio Solimoas. Their floral cortège is characteristic of the Sao Paulo de Olivença and Tefe centres of endemism, their avifauna of the Inambari or eastern Peruvian centre of endemism, though in an attenuated way.
(Hueck and Seibert, 1972, 1981: unit 6 *p.*; Haffer, 1974: 143-157; Haffer, 1978: 55; Hueck, 1978: 54-56; Prance, 1989: 101-103, 112; Maître *et al.*, 1993: 20, unit 6; Henderson, 1995: 32-34).

46.114 Beni rain forests
Rain forests of the extreme southwestern part of the southwestern sector of the Amazonian region, centered on Bolivian Amazonia. Their floral cortège is characteristic of the Beni centre of endemism and includes a high representation of species of southern affinities. Their avifauna of the Inambari or eastern Peruvian centre of endemism.
(Hueck and Seibert, 1972, 1981: units 8 *p.*, 9 *p.*; Haffer, 1974: 143-157; Haffer, 1978: 55, 56-57; Hueck, 1978: 76-77, 77-78; Prance, 1989: 101-103, 112; Henderson, 1995: 32-34).

46.12 Madeira-Tapajos rain forests
Rain forests of the south-central sector of the Amazonian region, including the basins of the Rio Purus, the Rio Madeira, the Rio Tapajos and the Rio Xingu-Rio Iriri. Their floral cortège is characteristic of the Tapajos and Aripuana centres of endemism, their avifauna of the Rondonia or Madeira-Tapajos

centre of endemism, with about 25 characteristic species, among them the cotinga *Idioptilon aenigma*, the tyrannid *Todirostrum senex*, the antbird *Myrmeciza stictothorax*.
(Hueck and Seibert, 1972, 1981: units 4, 5; Haffer, 1974: 70, 143-157; Haffer, 1978: 57-64; Hueck, 1978: 50-52, 52-54; Schnell, 1987a: 225, 227, 229-230; Prance, 1989: regions 10d, 10b *p.*, 10a *p.*, 10c *p.*; Maître *et al.*, 1993: 19-20, units 4, 5; Henderson, 1995: 32-34).

46.121 Tapajos rain forests
Rain forests of the eastern part of the south-central sector of the Amazonian region, centered on the basins of the Rio Tapajos and of the Rio Xingu-Rio Iriri. Their floral cortège is characteristic of the Tapajos centre of endemism, their avifauna of the Rondonia or Madeira-Tapajos centre of endemism.
(Hueck and Seibert, 1972, 1981: unit 4; Haffer, 1974: 70, 143-157; Hueck, 1978: 50-52; Haffer, 1978: 58-60; Prance, 1989: 101-103, 112, unit 10d *p.*; Maître *et al.*, 1993: 19, unit 4; Henderson, 1995: 32-34).

46.122 Aripuana rain forests
Rain forests of the western part of the south-central sector of the Amazonian region, centered on the basins of the Rio Aripuana-Rio Madeira and of the Rio Purus. Their floral cortège is characteristic of the Aripuana centre of endemism, their avifauna most characteristic of the Rondonia or Madeira-Tapajos centre of endemism. Typical species of trees include fabaceids (*Hymenolobium excelsum*, *Peltogyne densiflora*, *Eperua spp.*, *Dinizia excelsa*), Meliaceae (*Swietenia macrophylla*, *Carapa guianensis*), Boraginaceae (*Cordia goeldiana*), Sapotaceae (*Manilkara huberi*), Sterculiaceae (*Theobroma spp.*), Euphorbiaceae (*Hevea brasiliensis*), palms (*Euterpe oleracea*), some of them, eastern Amazonian species at the western limit of their distribution area. Striking endemics are the only species of Magnoliacee of the Amazon basin, *Talauma amazonica* and the world's tallest species among the Polygalaceae, *Polygala scleroxylon*.
(Hueck and Seibert, 1972, 1981: unit 5; Haffer, 1974: 70, 143-157; Hueck, 1978: 52-54; Haffer, 1978: 58-60; Prance, 1989: 101-103, 112, units 10d *p.*, 10b *p.*, 10a *p.*, 10c *p.*; Maître *et al.*, 1993: 20, unit 5; Henderson, 1995: 32-34).

46.13 North central Amazonian rain forests
Rain forests of the north-central sector of the Amazonian region, including the lower basin of the Rio Negro, the left bank watershed of the Rio Branco and the basin of the Rio Trombetas. Their floral cortège is characteristic of the Manaus and Trombetas centres of endemism, their avifauna is in part central Amazonian and in part eastern Amazonian with an influence of the Imeri and Guianan centres of endemism.
(Hueck and Seibert, 1972, 1981: unit 7 *p.*; Haffer, 1974: 143-157; Haffer, 1978: 54-64; Hueck, 1978: 58-62; Schnell, 1987a: 224-225, 229-230; Prance, 1989: region 10b; Emmons, 1990; Maître *et al.*, 1993: 20, unit 7 *p.*; Henderson, 1995: 32-34).

46.131 Manaus rain forests
Rain forests of the western part of the north-central sector of the Amazonian region, in the lower basin of the Rio Negro, below the confluent with the Rio Branco, and of the Rio Amazonas between the Rio Coari in the west, the Rio Madeira and the Rio Jalapu in the east. Their floral cortège is characteristic of the Manaus centre of endemism, their avifauna is characterized by the presence of central Amazonian species, with an influence of the Imeri and Guianan centres of endemism.
(Hueck and Seibert, 1972, 1981: unit 7 *p.*; Haffer, 1974: 143-157; Haffer, 1978: 58, 59, 61, 63; Hueck, 1978: 58-62, 52-54; Prance, 1989: 101-103, 112; Henderson, 1995: 32-34).

46.132 Trombetas rain forests
Rain forests of the western part of the north-central sector of the Amazonian region, in the lower basin of the Rio Negro, below the confluent with the Rio Branco, and of the Rio Amazonas between the Rio Coari in the west, the Rio Madeira and the Rio Jalapu in the east. Their floral cortège is characteristic of the Manaus centre of endemism, their avifauna is characterized by the presence of central Amazonian species, with an influence of the Imeri and Guianan centres of endemism.Rain forests of the eastern part of the north-central sector of the Amazonian region, including the left bank watershed of the Rio Branco and the basin of the Rio Trombetas. Their floral cortège is characteristic of the Trombetas centre of endemism, their avifauna is distinctly eastern Amazonian with a strong influence of the Guianan centre of endemism.

(Hueck and Seibert, 1972, 1981: unit 7 *p.*; Haffer, 1974: 143-157; Haffer, 1978: 58, 59, 61, 63; Hueck, 1978: 58-62, 45-46; Prance, 1989: 101-103, 112; Henderson, 1995: 32-34).

46.14 Rio Negro rain forests

Rain forests of the northwestern sector of the Amazonian region, south to the Rio Solimoes-Rio Amazonas and the basin of the Rio Japura-Rio Caqueta, including the Rio Solimoes-Rio Negro interfluve, the Rio Negro-Rio Branco interfluve in Brazil, extreme southwestern Venezuelan Amazonas and Colombian Amazonia in the provinces of Amazonas, Caqueta, Vaupes and Guainia, north to the Rio Guaviare. Their floral cortège and avifauna are mostly governed by the Imeri and Napo centres of endemism. The tree composition is one of the richest in Amazonia. The best represented group is the fabaceids, among which the Caesalpinaceae have in the unit one of their world centres of greatest diversity. Other very numerous families are the Vochyasiaceae, the Euphorbiaceae, with many endemics, the Guttiferae (Clusiaceae *s.l.*), the Sapotaceae, commoner and more diverse in the unit than in any other part of Amazonia, among them *Pouteria ucuqui*, one of the tallest trees in the Amazon basin. Also important are Myristicaceae, Linaceae, Rutaceae, Malpighiaceae, Trigoniaceae, Anacardiaceae, Tiliaceae, Elaeocarpaceae, Bombacaceae, Lecythidaceae, and palms, including the near-endemic *Leopoldina piassaba*. About 15 bird species are characteristic of the unit, among them the rare furnariid *Tripophaga cherriei*.
(Hueck and Seibert, 1972, 1981: units 10, 7 *p.*, 11 *p.*, 28 *p.*; Haffer, 1974: 70, 143-157; Haffer, 1978: 58-59; Hueck, 1978: 78, 58-62, 78-82; Veillon, 1985a: units 7, 4; Schnell, 1987a: 226-227, 229-230, 274-275; Huber and Alarcon, 1988: units 48, 50 *p.*; Prance, 1989: regions 10a, 8; Henderson, 1995: 32-34; Huber, 1995: 113, unit 14).

46.141 Negro-Branco rain forests

Rain forests of the eastern part of the northwestern sector of the Amazonian region, centered on the Rio Negro-Rio Branco interfluve. Their floral cortège and avifauna are most characteristic of the Imeri centre of endemism.
(Hueck and Seibert, 1972, 1981: unit 7 *p.*; Haffer, 1974: 143-157; Haffer, 1978: 59; Hueck, 1978: 58-62; Prance, 1989: 101-103, 112; Lewis and Owen, 1989: 5; Henderson, 1995: 32-34).

46.142 Negro-Solimoes rain forests

Rain forests of the western part of the northwestern sector of the Amazonian region, centered on the Rio Solimoes-Rio Negro interfluve, including in the northwest, the Rio Icana and Rio Uaupes basins. Their avifauna is an admixture of western and central Amazonian species with a reduced influence of the Imeri centre of endemism. Their floral cortège is influenced by the Imeri, Napo and Tefe centres of endemism.
(Hueck and Seibert, 1972, 1981: unit 7 *p.*; Haffer, 1974: 143-157; Haffer, 1978: 59; Hueck, 1978: 58-62; Prance, 1989: 101-103, 112; Henderson, 1995: 32-34).

46.143 Guaviare-Caqueta rain forests

Rain forests of the northwestern part of the northwestern sector of the Amazonian region, in Amazonian Colombia, between the Guaviare and Caqueta river basins. Their floral cortège and avifauna are influenced by the Imeri and Napo centres of endemism.
(Haffer, 1974: 143-157; Hueck and Seibert, 1972, 1981: unit 10; Haffer, 1978: 59; Hueck, 1978: 78; Prance, 1989: 101-103, 112; Henderson, 1995: 32-34).

46.144 Casiquiare-Orinoco rain forests

Rain forests of the southwestern part of Venezuelan Amazonas and extreme eastern Colombian Guainia, in the upper Rio Negro, lower Rio Guainia, Rio Casiquiare, upper Orinoco and Ventuari basins. Situated at the northern end of the range of Amazonian forests, they form a mosaic with edaphic, xerophytic (unit 4B) or inundatable (unit 4A), forests and with savannas. Their floral cortège and avifauna are characteristic of the Imeri centre of endemism, with influences of the Guianan centres. The main constituents of the tree assembly are Fabaceae (*Lecointea amazonica*, *Clathrotropis glaucophylla*, *Swartzia spp.*), Caesalpiniaceae (*Peltogyne venosa*), Lauraceae (*Ocotea*, *Nectandra*), Chrysobalanaeceae (*Licania*), Meliaceae (*Trichilia*, *Guarea*), Sapindaceae (*Toulicia guianensis*), Vochysiaceae (*Erisma uncinatum*, *Ruizterania spp.*), Burseraceae (*Protium crenatum*), Myristicaceae, Sapotaceae (*Pouteria venosa*), Annonaceae, Moraceae (*Trymatococcus amazonicus*), Lecythidaceae (*Gustavia pulchra*). Tall palms (*Socatea exorrhiza*, *Leopoldinia piassaba*, *Bactris gasipaes*,

Oenocarpus spp.) are frequent. Endemics are numerous, among them the Meliaceae *Trichilia gamopetela* and the Fabaceae *Alexa superba*.
(Hueck and Seibert, 1972, 1981: units 7 *p.*, 11 *p.*, 28 *p.*; Hueck, 1978: Hueck, 1978: 58-62, 78-82; Veillon, 1985a: units 7, 4; Huber and Alarcon, 1988: units 48, 50 *p.*; Henderson, 1995: 32-34; Huber, 1995: 113, unit 14).

46.1441 Casiquiare rain forests
Rain forests of southernmost Venezuelan Amazonas, in the upper Rio Negro, lower Rio Guainia, Rio Casiquiare and uppermost Orinoco basins, mostly limited to a fairly continuous block along the western escarpment of the Guianan shield, tall, dominated by Sapotaceae (*Ecclinusa spp.*, *Ragala ulei*, *Ragala spurei*, *Micrandra spruceana*), Caesalpiniaceae (*Eperua leucantha*, *Eperua purpurea*), Myristicaceae, Lecythidaceae (*Eschweilera spp.*, *Aldina kunhardtiana*), Chrysobalanaceae (*Licania heteromorpha*, *Couepia spp.*)
(Veillon, 1985a: unit 7; Huber, 1995: 113, unit 14 *p.*).

46.1442 Ventuari rain forests
Rain forests of central Venezuelan Amazonas and adjacent eastern Colombian Guainia, in the Orinoco bend and the Ventuari basin, of lower stature and more interdigitated with savannas and scrublands than the forests of unit 46.1441, of similar composition, but with Burseraceae (*Protium guianense*), Caryocareaceae (*Caryocar glabrum*), replacing the Chrysobalanaceae.
(Veillon, 1985a: unit 4; Huber, 1995: 113, 126, unit 14 *p.*).

46.15 Guianan rain forests
Rain forests of the northern part of the Guianan-eastern Amazonian sector of the Amazonian region, including Venezuelan Guiana, the Orinoco delta, Guyana, Surinam, French Guiana, Amapa and northeastern Para in the basins of the Rio Jari and the Rio Paru, extending to the southern Lesser Antilles, in part seasonal or with a tendency to seasonality. Their floral cortège is characteristic of the Imataca, western Guiana and eastern Guiana centres of endemism, their avifauna of the Guianan center of endemism. Characteristic species of trees include *Carapa guianensis*, *Goupia glabra*, *Iryanthera sagotiana*, *Micropholis guianensis*, *Perebea laurifolia*, *Pouteria lateriflora* and *Roucheria punctata*. The avifaunal cortège is particularly distinctive, with more than 50 representative species, among them at least three belonging to endemic genera, the cotingas *Perissocephalus tricolor* and *Haematoderus militaris*, the tanager *Cyanicterus cyanicterus*.
(Richards, 1952: 317-320; Birot, 1970: 109-110; Hueck and Seibert, 1972, 1981: units 12, 11, 13, 2; Haffer, 1974: 143-157; Haffer, 1978: 63; Hueck, 1978: 82-84, 78-82, 84-87, 45-46; Veillon, 1985a: unit 9; Schnell, 1987a: 229-230, 253-271, 274-275; Huber and Alarcon, 1988: units 42, 43, 74, 75, 80; Prance, 1989: region 9; Henderson, 1995: 32-34; Maître *et al.*, 1993: 13-15, unit 2; Huber, 1995: 113, units 4, 5, 6, 11).

46.151 Orinoco delta rain forests
Terra firme rain forests of the Orinoco upper delta and of the alluvial plain of Atlantic Venezuela, north to the southwestern coast of the Gulf of Paria, south to the Barima and Amacuro basins, extending inland to the Serrania de Imataca and the Rio Cuyuni. Chrysobalanaeceae (*Licania densiflora*), Lecythidaceae (*Eschweilera decolorans*, *Gustavia angusta*), Bignoniaceae (*Tabebuia capitata*), Meliaceae (*Trichilia pleeana*, *Carapa guianensis*) Burseraceae (*Tetragastris altissima*), Bombacaceae (*Catostemma commune*), Myristicaceae (*Virola surinamensis*), Caesalpiniaceae (*Alexa imperatricis*, *Mora excelsa*, *Peltogyne venosa*), Sterculiaceae (*Sterculia pruriens*) dominate the forest composition in the alluvial plain and hill land, joined in the upper delta by Lauraceae (*Ocotea*), Fabaceae (*Erythrina*), Anacardiaceae (*Spondias mombin*), Polygonaceae (*Triplaris surinamensis*).
(Hueck and Seibert, 1972, 1981: unit 13; Haffer, 1974: 143-157; Haffer, 1978: 63; Hueck, 1978: 84-87; Veillon, 1985a: unit 9; Schnell, 1987a: 229-230, 253-271, 274-275; Huber and Alarcon, 1988: units 42, 43, 75, 72 *p.*; Prance, 1989: 101-103, 112; Henderson, 1995: 32-34; Huber, 1995: 113, units 4, 5).

46.152 Western Guianan rain forests
Rain forests of the piedmont of the Roraima system, northwestern part of the Guianan shield, in particular of the Caura and Caroni basins of Venezuelan Guiana and the Guyano-Venezuelan upper Cuyuni basin, on the northern flank of the system, and of the Urariocora basin on the southern flank of the system, westernmost extension of the Guianan forests. Their floral cortège is characteristic of the Imataca centre of endemism, their avifauna of the Guianan centre of endemism. Tree families of

particular prominence include Caesalpiniaceae (*Crudia oblonga*, *Copaifera spp.*, *Brownea coccinea*, *Hymenaea courbaril*), Lecythidaceae (*Eschweilera decolorans*), Chrysobalanaeceae (*Licania*), Burseraceae (*Protium heptaphyllum*), Meliaceae (*Trichilia*, *Cedrela fissilis*), Bombacaceae (*Catostemma commune*, *Pachira spp.*), Fabaceae (*Clathrotropis brachypetala*, *Alexa imperatricis*, *Erythrina spp.*, *Dipteryx punctata*, *Lonchocarpus spp.*, *Centrolobium orinocensis*, *Platymiscium spp.*, *Pterocarpus vernalis*), Lauraceae (*Endlicheria spp.*), Mimosaceae (*Inga alba*), Annonaceae (*Anaxagorea spp.*), Apocynaceae (*Aspidosperma marcgravianum*), Sterculiaceae (*Sterculia pruriens*), Anacardiaceae (*Anacardium spp.*), Sapotaceae (*Manilkara spp.*), Clusiaceae (*Calophyllum spp.*)
(Hueck and Seibert, 1972, 1981: unit 11; Haffer, 1974: 143-157; Haffer, 1978: 63; Hueck, 1978: 78-82; Veillon, 1985a: unit 9; Schnell, 1987a: 274; Huber and Alarcon, 1988: unit 80; Prance, 1989: 101-103, 112; Henderson, 1995: 32-34; Huber, 1995: 113, units 6, 11).

46.153 Central Guianan rain forests
Evergreen rain forests of Guyana and Surinam. Their floral cortège is characteristic of the western Guianan centre of endemism, their avifauna of the Guianan centre of endemism. These forests are in part seasonal and include, in addition to typical mixed forests with no dominance, a number of communities with a single dominant or a tendency to single-species dominance, probably linked to infertile soils or a combination of soil and topography. Their rich epiphytic flora includes *Hymenophyllum polyanthos*, *Hymenophyllum ciliatum*, *Peperomia spp.*, orchids (*Maxillaria uncata*), Araceae (*Anthurium jenmanii*, *Anthurium gracile*, *Philodendron demerarae*), Bromeliaceae (*Tillandsia bulbosa*, *Aechmea spp.*) and *Rhipsalis baccifera*.
(Richards, 1952: 230, 236-243, 261-263; Hueck and Seibert, 1972, 1981: unit 12; Haffer, 1974: 143-157; Haffer, 1978: 63; Hueck, 1978: 82-84; Schnell, 1987a: 258-259; Prance, 1989: 101-103, 112; Henderson, 1995: 32-34).

46.1531 Central Guianan mixed rain forests
Widespread dense climax rain forests of Guyana and Surinam with no tendancy to oligodominance. Lecythidaceae, Lauraceae and Araliaceae are prominent in the tallest tree stratum, Annonaceae and Violaceae in the lowest, third, stratum. Characteristic species include *Eschweilera sagotiana*, *Chaetocarpus schomburgkiana*, *Dicorynia guianensis*, *Eperua falcata*, *Eschweilera odora*, *Goupia glabra*, *Licania venosa*, *Ocotea rodioei*, *Ocotea rubra*, *Pentaclethra macroloba* and *Tetragestris altissima*. Lecythidaceae are abundant.
(Richards, 1952: 25-28, 230, 236-243; Schnell, 1987a: 258-259; Maître *et al.*, 1993: 14).

46.1532 Central Guianan seasonal evergreen forests
Lowland rain forests of Guyana and Surinam submitted to a marked dry season, dominated by the Apocynaceae *Aspidosperma excelsum*, the Celastraceae *Goupia glabra*, the Fabaceae *Swartzia leiocalycina*, the Sapotaceae *Manilkara bidentata*, the Combretaceae *Terminalia amzonica*, the Chrysobalanaceae *Parinari campestris*, the Vochysiaceae *Vochysia surinamensis*, the Humiriaceae *Humiria balsamifera*, the Caesalpiniaceae *Hymenaea coubaril*.
(Fanshawe, 1952; Schnell, 1987a: 259).

46.1533 Central Guianan oligarchic rain forests
Rain forests of Guyana, Surinam and extreme eastern Venezuela with a tendency to dominance by a single or a small number of species, in particular, of genera *Mora*, *Eschweilera*, *Dicorynia*, *Eperua*, *Chaetocarpus*, *Ocotea*. Besides the communities identified in the subunits, single-dominant forests comprise riverine Mora forests, listed in unit 4A, and white-sand wallaba forests, included in unit 4B.
(Richards, 1952: 230, 236-243, 255-256, 262-263; Hueck, 1978: 82-83; Schnell, 1987a: 258-259; Huber, 1995: 108).

46.15331 Central Guianan mora forests
Rain forests of Guyana, Surinam and extreme eastern Venezuela, developed on steep rocky slopes with an impermeable and very shallow clay soil, dominated by *Mora excelsa*, *Pterocarpus officinalis*, *Pentaclethra macroloba*.
(Richards, 1952: 237-238; Hueck, 1978: 82; Schnell, 1987a: 258; Huber, 1995: 108).

46.15332 Central Guianan morabukea forests
West Guianan rain forests, developed mostly on the noninundatable lower slopes of low hills, dominated by *Mora gongrijpii*, with *Eschweilera sagotiana*, *Catostemma commune* and species of genera *Licania*, *Ocotea*, *Pentaclethra*.
(Richards, 1952: 238-239; Hueck, 1978: 82; Schnell, 1987a: 258-259).

46.15333 Central Guianan greenheart forests
Rain forests of Guyana, developed on sides of ridges with reddish-brown sandy soils, dominated by *Ocotea rodiaei*, with *Pentaclethra macroloba*, *Eschweilera sagotiana*, *Licania venosa*.
(Richards, 1952: 239-240; Hueck, 1978: 83; Schnell, 1987a: 258).

46.15334 Central Guianan *Dicymbe* forests
Rain forests of Guyana, very widespread in the interior, to the foot of the Pakaraima, developed on a variety of soils, including white sands and red earths, dominated by the leguminous tree *Dicymbe corymbosa*.
(Richards, 1952: 255-256).

46.15335 Central Guianan *Dimorphandra* forests
Rain forests of Guyana, developed in the vicinity of coastal savannas, dominated by leguminous trees of genus *Dimorphandra*, in particular *Dimorphandra conjugata*, often in pure stands.
(Richards, 1952: 256, 324).

46.154 Eastern Guianan rain forests
Rain forests of French Guiana, Amapa and northeastern Para. Their floral cortège is characteristic of the eastern Guianan centre of endemism, their avifauna of the Guianan centre of endemism. Fabaceids, Lecythidaceae, Vochysiaceae, Sapotaceae are the best-represented families or super-families of trees. Richness in palm species is very high; among them, *Asterogyne guianensis* is endemic to the unit and typical of the eastern Guianan centre of endemism.
(Hueck and Seibert, 1972, 1981: unit 12 *p.*, 2; Haffer, 1974: 143-157; Haffer, 1978: 63; Hueck, 1978: 82-84, 45-46; Schnell, 1987a: 256; Prance, 1989: 101-103, 112; Tostain *et al.*, 1992: 17; Maître *et al.*, 1993: 15, 19, unit 2; Henderson, 1995: 32-34, 253).

46.155 Trinidad and Tobago evergreen rain forests
Lowland evergreen rain forests of Trinidad and Tobago, very similar to mainland Guianan rain forests, but with an even greater tendancy to seasonality linked to stronger seasonal moisture stress, somewhat intermediate to semievergreen forests, though with few deciduous trees and with a structure more akin to that of aseasonal evergreen rain forests, differing only in slightly lower stature and sparser emergents.
(Richards, 1952: 195, 197, 318-320; Hueck and Seibert, 1972, 1981: unit 13 *p.*; ffrench, 1976: 8-9, 19; Maître *et al.*, 1993: 12).

46.1551 Trinidad seasonal evergreen rain forests
Lowland seasonal evergreen rain forests of Trinidad, about 35 metre-tall, multi-stratum, with three storeys of trees, the emergents more spaced than in ever-wet rain forest, and with a sparse undergrowth; *Carapa guianensis*, *Eischweilera subglandulosa*, *Ceiba pentandra*, *Spondias monbin*, *Pachira insignis*, *Tabebuia serratifolia*, are prominent among the emergents, *Pentaclethra macroloba*, *Diospyros ierensis* in the upper canopy.
(Beard, 1944a; Richards, 1952: 32, 195, 197, 318-320; Hueck and Seibert, 1972, 1981: unit 13 *p.*; ffrench, 1976: 8-9; Maître *et al.*, 1993: 12).

46.1552 Tobago seasonal evergreen rain forests
Lowland seasonal evergreen rain forests of Tobago, limited to the northern piedmont of the Main Ridge, with *Carapa guianensis* and *Andira inermis* prominent among the emergents, *Licania biglandulosa* and palms of genus *Euterpe* in other tree storeys.
(Beard, 1944b; Hueck and Seibert, 1972, 1981: unit 13 *p.*; ffrench, 1976: 19; Maître *et al.*, 1993: 12).

46.1553 Trinidad *Mora* forests
Oligarchic lowland seasonal evergreen rain forests of Trinidad dominated by *Mora excelsa*, over 40 metres-tall, similar to mainland Guianan *Mora* rain forests, but with more closed canopies and sparser

undergrowth; alone in the very continuous upper tree-stratum, *Mora excelsa* is accompanied by, among others, *Clathrotropis brachypetala* in the second and third tree storeys.
(Richards, 1952: 33, 34, 195, 237, 319; Hueck and Seibert, 1972, 1981: unit 13 *p.*; ffrench, 1976: 8-9, 19; Maître *et al.*, 1993: 12).

46.16 Belem rain forests
Rain forests of the southern part of the Guianan-eastern Amazonian sector of the Amazonian region, including the Amazon delta and the Belem region west to the western reaches of the Tocantins basin. Their floral cortège and their avifauna are characteristic of the Belem centre of endemism.
(Hueck and Seibert, 1972, 1981: units 3, 1; Haffer, 1974: 143-157; Haffer, 1978: 63; Hueck, 1978: 48-50, 38-40; Schnell, 1987a: 224-225, 229-230; Prance, 1989: region 9; Emmons, 1990; Maître *et al.*, 1993: 19, units 3, 1; Henderson, 1995: 32-34).
46.161 Lower Tocantins rain forests
Rain forests of extreme eastern Para, the Belem region, the lower Tocantins basin and the lower Xingu basin. They are formed by, among others, *Anacardium giganteum*, *Aspidosperma desmanthum*, *Bauhinia splendens*, *Carapa guianensis*, *Caryocar glabrum*, *Caryocar villosum*, *Didymopanax morotononi*, *Eschweilera spp.*, *Guarea spp.*, *Guatteria poeppigiana*, *Gustavia spp.*, *Hirtella spp.*, *Licania macrophylla*, *Lucuma spp.*, *Manilkara speciosa*, *Miconia spp.*, *Minquartia guianesis*, *Mouriria sagotiana*, *Ocotea spp.*, *Parkia pendula*, *Persea spp.*, *Piptadenia spp.*, *Pithecolobium rapezifolium*, *Pouteria huberi*, *Protium spp.*, *Ptychopetalum olacoides*, *Qualea spp.*, *Sacoglottis amazonica*, *Sterculia pruriens*, *Swartzia spp.*, *Tachigalia myrmecophila*, *Terminalia amazonica*, *Theobroma subincanum*, *Trichilia spp.*, *Virola spp.*, *Vitex triflora*, *Vochysia guiansis* and *Vouacapoua americana*. *Cenostigma tocantinum*, *Bombax tocantinum*, *Bauhinia bombaciflora*, *Discolobium tocantinum*, *Strychnos melinoniana*, *Strychnos solimoesiana* are probably characteristic.
(Hueck and Seibert, 1972, 1981: unit 3; Haffer, 1974: 143-157; Haffer, 1978: 63; Hueck, 1978: 48-50; Schnell, 1987a: 225; Prance, 1989: 101-103, 112; Maître *et al.*, 1993: 19, unit 3; Henderson, 1995: 32-34).

46.162 Amazonian delta rain forests
Rain forests of the Amazon delta, Ilha de Marajo and the Rio do Para. Typical species and genera of trees include fabaceids (*Parkia paraensis*, *Parkia reticulata*, *Vatairea guianensis*, *Dimorphandra glabrifolia*), Sapoteceae (*Manilkara paraensis*, *Manilkara siqueiraei*, *Pradosia pedicellata*, *Pradosia praealta*, *Pradosia huberi*), Vochysiaceae (*Vochysia guianensis*), Myriticaceae (*Virola melinonii*).
(Hueck and Seibert, 1972, 1981: unit 1; Haffer, 1974: 143-157; Haffer, 1978: 63; Hueck, 1978: 38-40; Schnell, 1987a: 224; Prance, 1989: 101-103, 112; Maître *et al.*, 1993: 19, unit 1; Henderson, 1995: 32-34).

46.2 Atlantic rain forests

Lowland evergreen rain forests of the Brazilian Atlantic seaboard, limited to the narrow coastal plain and low slopes of the coastal cordillera, developed mostly between 20 and 200 metres of altitude. They constitute a fragmented belt extending from about 6° S to almost 30° S. They are tall-canopied forests, up to 30-35 metres, with a dense shrubby undergrowth, groups of large tree ferns and palms which mostly remain embedded in the undergrowth, rarely reaching the canopy. Lianas and epiphytes, in particular, aroids, bromeliads, orchids, Piperaceae, gesneriads, polypods, are extraordinarily abundant, the humid soil favours the presence of numerous Marantaceae and Strelitziaceae. These forests, which share with the montane rain forests of unit 49.2, a very high degree of floral and faunal endemism, including, for instance, 30 endemic genera and 160 endemic species of birds, are reduced to a few remnant tracts. Most of their remarkable species cortège is severely threatened.
(Hueck and Seibert, 1972: units 26, 25 *p.*; Haffer, 1974: 71, 148; Letouzey, 1978; Hueck, 1978: 166-171; Sick and Teixeira, 1979; Snow, 1982; Schnell, 1987a: 277-289; Prance, 1989: 101-103, 109, 111, 112; Emmons, 1990; Rieley and Page, 1990: 41; Huetz de Lemps, 1994: 145-146; Whitmore, 1992: 90, 94-95; Sick, 1993: 9-10, 10-11; McQueen and McQueen, 1993: 7-9; Wege and Long, 1995: 61, 67, 75-80, 81-94, 95-109, 110-113).

46.21 Pernambucan rain forests
Lowland evergreen rain forests of the Atlantic seaboard of Pernambuco, Alagoas and Sergipe, with a floral and faunal cortège characteristic of the Pernambuco centre of endemism. The spectacular

curassow *Mitu mitu*, now apparently extinct in the wild, was endemic to this unit. The communities themselves are almost extinct.
(Delacour and Amadon, 1973; Haffer, 1974: 148; Schnell, 1987a: 280; Prance, 1989: 101-103, 112; Sick, 1993: 10-11; Wege and Long, 1995: 61, 67, 75-80).

46.22 Bahian rain forests
Lowland evergreen rain forests of the Atlantic seaboard of Bahia and Espirito Santo, with a floral and faunal cortège characteristic of the Bahia centre of endemism. The curassow *Crax blumenbachii*, the parrot *Amazona rhodocorytha*, the hummingbird *Glaucis dohrnii*, the antbird *Dysithamnus plumbeus*, the cotinga *Cotinga maculata*, the tapaculo *Merulaxis stresemanni* are endemic or near-endemic to this unit. Very few examples of these communities remain.
(Haffer, 1974: 148; Sick and Teixeira, 1979; Snow, 1982; Renvoize, 1984: 7; Lewis, 1987: 6, 10; Schnell, 1987a: 282; Prance, 1989: 101-103, 112; Sick, 1993: 9-10; Wege and Long, 1995: 61, 67, 81-94).
46.23 Paulistan rain forests
Lowland evergreen rain forests of the Atlantic seaboard of Rio de Janeiro, Sao Paulo and Parana, with a floral and faunal cortège characteristic of the Paulista (Rio de Janeiro-Espirito Santo) centre of endemism. The upper tree strata are rich in leguminous species (*Piptadenia communis*, *Piptadenia rigida*, *Hymenaea stilbocarpa*, *Melanoxylon brauna*, *Centrolobium robustum*, *Dalbergia nigra*, *Machaerium spp.*, *Myrocarpus frondosus*, *Myroxylum peruiferum*, *Sclerolobium chrysophyllum*), in Bignoniaceae (*Jacaranda*, *Tecoma*, *Tabebuia*), Lauraceae (*Ocotea*, *Nectandra*), Meliaceae (*Cabralea laevis*, *Cedrela velloclana*), Sapotaceae (*Lucuma laurifera*, *Sideroxylon crassipedicellatum*). The dominated layers are rich in palms, including *Euterpe edulis*, and tree-ferns (*Alsophila*, *Cyathae*, *Hemitelia*). Epiphytes are abundant, comprising gesneriads, ferns (*Hymenophyllum*), bromeliads, orchids (*Epidendron*, *Sophronitis coccinea*) and mosses. Endemic or near-endemic birds include the cracid *Penelope obscura bronzina*, the dove *Claravis godefrida*, the parrot *Amazona brasiliensis*, the purpletuft *Iodopleura pipra*, the tyrannid *Phylloscartes oustaleti*. Like all Atlantic forests, these communities are reduced to a very small fraction of their former range.
(Haffer, 1974: 148; Sick and Teixeira, 1979; Snow, 1982; Schnell, 1987a: 283-286; Prance, 1989: 101-103, 112; Sick, 1993: 9-10; Wege and Long, 1995: 61, 67, 95-109).

46.24 Catarinian rain forests
Lowland evergreen rain forests of the Atlantic seaboard of Santa Catarina, of fairly low stature, not usually exceeding 15-20 metres, of reduced species diversity, usually dominated by a limited number of species, in particular, *Ocotea pretiosa*, *Ocotea aciphylla*, *Ocotea catharinensis*, *Nectandra rigida*, *Tapirira guianensis*, in various combinations. *Euterpe edulis*, *Alchornea triplinervia*, *Matayba guianensis*, *Ficus organensis*, *Sloanea guianensis*, *Ilex theezans*, *Ilex tumosa*, *Didymopanax angustissimum*, *Psychotria barbiflora*, *Rapanea venosa*, *Torrubia olfersiana*, *Cryptocarya moschata* are important accompaniers. The canopy is often fairly open, allowing the development of a lush undergrowth rich in bromeliads, with, in particular, the tall *Nitidularium innocentii* var. *paxianum* and *Nitidularium procerum*. The endangered tyrannid *Hemitriccus kaempferi* is endemic to the unit, which is reduced to forest fragments.
(Schnell, 1987a: 288-289; Wege and Long, 1995: 61, 67, 110-113).

46.3 Caribbeo-Pacific rain forests

Evergreen rain forests, in part per-humid, often very tall, of the Pacific lowlands and low Andean slopes of northern South America south to extreme northern Peru, of the Caribbean lowlands of the Gulf of Uraba, of the middle Magdalena Valley of Colombia and of the southwestern basin of Lake Maracaibo, constituting a region of very high endemism. The three subdivisions are highly distinct.
(Koepcke, 1961: 150-153; Hueck and Seibert, 1972: units 23, 24; Haffer, 1974: 143-157; Hueck, 1978: 139-166; Haffer, 1978: 54-64; Veillon, 1985a: unit 16; Schnell, 1987a: 203-204, 272-276; Schnell, 1987b: 76-78; Huber and Alarcon, 1988: unit 10; Prance, 1989: 101-103, 112; Emmons, 1990; Whitmore, 1992: 90, 94-95).

46.31 Pacific rain forests
Humid and perhumid evergreen rain forests of the Pacific lowlands and low Andean slopes of northern South America south to extreme northern Peru, extending to an altitude of about 1000 metres. They are

extremely species-rich, with a species cortège, both floral and faunal, mostly characteristic of the Choco centre of endemism, and, in the extreme northern part, of the southern Central American Darien centre of endemism. Important tree species of the very tall upper tree stratum include *Coussapoa eggersii*, *Brosimum utile*, *Terminalia amazonica*, *Virola spp.*, *Dialyanthera spp.*, *Apeiba aspera*, *Cordia alliodora*, *Castilla panamensis*, *Humiria spp.*, *Tabebuia spp.*, *Brownea spp.*, *Huberodendron spp.*, of the second tree stratum the palms *Jessenia polycarpa*, *Welfia regia*, *Phytelephas spp.*. Other well-represented tree species belong to the families Anacardiaceae, Annonaceae, Apocynaceae, Burseraceae, Bombacaceae, Guttiferaceae, Humiriaceae, Lauraceae, Fabaceae, Meliaceae, Moraceae, Myristicaceae, Ochnaceae, Olacaceae, Rosaceae, Rubiaceae, Sapotaceae, Sterculiaceae, Vochysiaceae. Palm genera include *Iriartea*, *Socratea*, *Euterpe*, *Astrocaryum*, *Catostigma*, *Mauritiella*, *Ammania*, *Manicaria*, *Bactris*, *Orbignya*, *Attalea*, *Wettinia*, *Geonoma*, *Chamaedorea*, cycads are represented by genus *Zamia*. Epiphytes (Bromeliaceae, *Clusia*, Ericaceae]) as well as vines (Marcgraviaceae, Fabales, Sapindaceae, Menispermaceae and Loganiaceae such as *Strychnos panurensis* and *Strychnos mitscherlichii* are frequent. A high degree of endemism has been noted, in particular, for birds, butterflies, trees, including palms.
(Koepcke, 1961: 150-153; Hueck and Seibert, 1972: units 23, 24; Haffer, 1974: 66-67, 143-157; Hueck, 1978: 139-166; Schnell, 1987a: 203-204, 272-276; Prance, 1989: 101-103, 112; Emmons, 1990).

46.311 Chocoan rain forests
Main range, mostly perhumid, tall to very tall, evergreen rain forests of the Pacific lowlands and low Andean slopes of northern South America, developed between about 7° N and 2° N, under rainfalls of up to 10000 mm per year, constituting the main area of occurrence of floras and faunas originating from the Choco centre of endemism, one of the most strongly characterized centers of endemism of the continent. Among birds, the tinamous *Crypturellus kerriae* and *Crypturellus berlepschi*, the cracids *Crax rubra* and *Penelope hortoni*, the woodrail *Aramides wolfi*, the pigeon *Columba goodsoni*, the parrot *Pionositta pulchra*, the jacamar *Galbula ruficauda melanogenia*, the toucans *Rhamphastos brevis* and *Pteroglossus torquatus sanguineus*, the antbirds *Sipia berlepschi*, *Sipia rosenbergi*, *Formicarius nigricapillus*, the manakins *Machaeropterus deliciosus* (*Allocotopterus deliciosus*), *Pipra mentalis*, *Manacus vitellinus*, the tyrannid *Rhynchociclus pacificus*, the icterid *Psarocolius cassini*, the tanagers *Tangara johannae*, *Tangara florida auriceps*, *Chlorothraupis olivacea olivacea*. They constitute the only perhumid lowland rain forests of South America.
(Hueck and Seibert, 1972: units 23, 24; Haffer, 1974: 66-67, 143-157; Hueck, 1978: 139-166; Schnell, 1987a: 203-204, 272-276; Prance, 1989: 101-103, 112; Eisenberg, 1989: 16-17).

46.312 Darienian rain forests
Humid evergreen rain forests of the northern part of the Pacific lowlands of northern South America and of the coasts of the Gulf of Uraba, with a floristic and faunistic composition strongly influenced by Central America, the former characteristic of the Darien centre of endemism. Central American taxa, limited within South America or Pacific South America, to this region, include the tapir *Tapirus bairdii*, the monkeys *Cebus capucinus*, *Alouatta villosa*, *Ateles geoffroyi*, *Saguinus geoffroyi*, the raccoon *Procyon lotor*, the pigeon *Columba nigrirostris*, the parrot *Pionopsitta haematotis*, the toucans *Rhamphastos sulfuratus* and *Pteroglossus torquatus torquatus*, the antpitta *Pittasoma michleri*, the tyrranid *Rhynchociclus brevirostris*, the mahogany *Swietenia macrophylla*. These forests extend north into Central America.
(Hueck and Seibert, 1972, 1981: unit 23; Haffer, 1974: 78-80, 154-157; Hueck, 1978: 142, 161; Prance, 1989: 112; Eisenberg, 1989: 17, 116-117; Whitmore, 1992: 90, 94-95).

46.313 Esmeraldo-Tumbezian Pacific rain forests
Evergreen rain forests, of the Ecuadorian and northern Peruvian Pacific lowlands and low Andean slopes, at the southern end of the range of the Pacific evergreen forests of northern South America, drier than the forests of unit 46.311, although still developed under conditions of high year-round rainfall, increasingly discontinuous southwards and with a progressively impoverished Chocoan species cortège. Tree species that remain prominent include *Dialyanthera otoba*, *Cespedesia spathulata*, *Brosimum utile*, *Hura crepitans*, *Aniba perutilis*, *Nectandra spp.*, *Ficus spp.*, *Tabebuia spp.*, *Cedrela odorata*. Rain forest bird species occurring south to Peru, and restricted there to this unit, comprise *Claravis pretiosa*, *Ictinia plumbea*, *Herpetotheres cachinnans fulvescens*, *Piaya cayana nigricrissa*, *Taraba major transandeana*, *Sittasomus griseicapillus aequatorialis*, *Megarynchus*

pitangua chrysogaster, *Onychorhynchus occidentalis*, *Pachyramphus spodiurus*, *Cacicus cela flavicrissus*.
(Koepcke, 1961: 150-153; Hueck and Seibert, 1972: unit 23; Hueck, 1978: 139-166; Schnell, 1987a: 274; Parker *et al.*, 1982: 52).

46.32 Magdaleno-Caucan rain forests
Evergreen rain forests of Caribbean Colombia, limited to the Magdalena and Cauca basins, and, very locally, the slopes of the Sierra Nevada de Santa Marta, with a floristic cortège characteristic of the Magdalena and Santa Marta areas of endemism, an avian cortège characteristic of the Nechi center of endemism. Chararacteristic trees include the endemic *Caryocar amygdaliferum*, the mahogany *Swietenia macrophylla* and *Cariniana pyriformis*, shared with the Darienian forests, as well as *Aspidosperma curranii*, *Aspidosperma dugandii*, *Bombacopsis quinata*, *Carapa guianensis*, *Cedrela fissilis*, *Cedrela mexicana*, *Cordia alliodora*, *Cordia geraschanthoides*, *Prioria copaifera*, *Tabebuia pentaphylla*. The tamarin *Saguinus leucopus* is limited to these forests. Characteristic birds are the tinamou *Crypturellus columbianus*, the curassow *Crax alberti*, the jacamar *Brachygalba salmoni*, the puffbird *Nonnula ruficapilla frontalis*, the barbet *Capito hypoleucus*, the antbird *Thamnophilous nigriceps*, the dacnis *Dacnis vigueri*, the tanagers *Tangara inornata* and *Habia gutturalis*, the oropendola *Psaracolius guatimozinnus*. These forests have disappeared except for a few remnants.
(Hueck and Seibert, 1972: unit 23; Haffer, 1974: 67, 78-80, 90-94, 144-146; Hueck, 1978: 144; Schnell, 1987a: 272-273; Eisenberg, 1989: 237, 239; Prance, 1989: 101-103, 107, 112; Whitmore, 1992: 90, 94-95; Wege and Long, 1995: 137).

46.33 Catatumban rain forests
Evergreen rain forests of the southern and southwestern basin of Lake Maracaibo, with a floral and faunal cortège characteristic of the Catatumbo centre of endemism, very tall, exceeding 40 metres, relatively species-poor with about 40-60 tree species, dominated by Sapotaceae (*Neoxythece dura*, *Pouteria anibaefolia*, *Pouteria spp.*), Mimosaceae (*Parkia pendula*, *Inga novilis*, *Inga spp.*, *Pithecellopium jupumba*, *Pithecellopium spp.*) Rosaceae (*Hirtella bicornis*, *Hirtella spp.*, *Licania arborea*, *Licania spp.*), Annonaceae (*Xilopia amazonica*, *Xilopia pittieri*, *Xilopia venezuelana*), Celastraceae (*Goupia glabra*). Characteristic species of the floral cortège include *Anacardium excelsum*; *Gustavia hexapetala*, *Cariniana pyriformis*, *Ceiba pentandra*, *Sterculia apetala*, *Trichilia pleeana*, *Trichilia maynasiana*, *Faramea capillipes*, *Ochoterenaea colombiana*, *Miconia mocquerysii*, *Vochysia lehmannii*, and the endemics *Rhodospatha perezii*, *Spathiphyllum perezii*. The porcupine *Sphiggurus vestitus* is entirely dependent on these forests. A number of strongly differentiated subspecies of birds are characteristic, in particular, the motmot *Momotus momota osgoodi*, the jacamar *Galbula ruficauda brevirostris*, the piculet *Picumnus cinnamommeus venezuelensis*, the woodcreepers *Dendrocalyptes certhia punctipectus* and *Dendrocincla homochroa meridionalis*, the manikins *Piprites chloris perijanus*, *Machaeropterus regulus zulianus* and *Machaeropterus regulus obscrurostriatus*. These forets have been reduced to small remnant patches.
(Hueck and Seibert, 1972: unit 23; Haffer, 1974: 67, 143-146; Hueck, 1978: 140, 144-145; Veillon, 1985a: unit 16; Ara and Arends, 1985: 47; Huber and Alarcon, 1988: unit 10; Prance, 1989: 101-103, 112; Emmons, 1990; Henderson, 1995).

47. SEMI-EVERGREEN RAIN FORESTS

Multi-strata, species-rich, broad-leaved forests of warm, very humid, tropical climates marked by seasonal moisture stress, composed of both evergreen and deciduous species in the upper storey. Species-richness in the canopy is less, gregarious occurrence is more prevalent, emergent trees are usually more scattered than in evergreen rain forests. In South America, semievergreen forests comprise, on the one hand, the highly distinctive ensemble of the Paranean forests, similar to seasonal rain forests but with a reduced thermophile cortège, and, on the other hand, a number of communities of the edge of the main Amazonian, Caribbeo-Pacific and Atlantic rain forest zones, transitional between these forests and drier or more markedly seasonal formations.
(Richards, 1952: 195, 197, 318, 320, 325, 330-331; Birot, 1970; Schnell, 1971; Hueck and Seibert, 1972, 1981: units 28 *p.*, 29 *p.*, 30 *p.*, 31 *p.*, 32 *p.*; Haffer, 1974: 143-157; Haffer, 1978: 54-64;

Letouzey, 1978; Hueck, 1978; Whitmore, 1978, 1989, 1992; Schnell, 1987a; Huber and Alarcon, 1988; Prance, 1989; Ridgely and Tudor, 1989; Rieley and Page, 1990; Maître *et al.*, 1993: 5-24; Huetz de Lemps, 1994: 114; Henderson, 1995; Archibold, 1995: 15-59; Huber, 1995).

47.1 Paranean semi-evergreen forests

Subtropical hygrophyte forests of southern Brazil, eastern Paraguay and northeastern Argentina, dense, multistrata, largely evergreen with a limited admixture of deciduous trees, particularly prominent among the emergents, and a generally dense undergrowth. Of all the subdivisions of unit 47, they constitute the entity most similar to the rain forests of unit 46, differing mostly in the absence of the most thermophile elements. They form a major biome, with original characteristics, in spite of strong affinities with the rain forests of the Atlantic seaboard. Formerly occupying over one million square kilometres, they have been reduced to less than 10 % of this surface, or 58 000 km², 95 % of which is secondary. Large continuous forest blocks are now mostly limited to Misiones and, locally, eastern Paraguay. Numerous plant and animal species or populations dependent on the Paranean semievergreen forests are threatened or endangered.
(Birot, 1970: 103-105, units 5, 3 *p.*; Martinez-Crovetto, 1963; Hueck and Seibert, 1972: unit 29; Hueck, 1978: 199-222; Willis, 1979; Cabrera and Willink, 1980: 60-61; Schnell, 1987a; Prance, 1989: 100-103, region 18, 13, *p.*; Santos Biloni, 1990; Burkart *et al.*, 1994: 5-7; Laclau, 1994; Chebez, 1994).

47.11 Misioneran semi-evergreen forests
Subtropical hygrophyte forests of the middle Parana system, occupying the southern part of the main range of formerly continuous Paranean semievergreen forests, extending over the western parts of the Brazilian states of Rio Grande do Sul, Santa Catarina and Parana, the Argentine province of Misiones and eastern Paraguay; *Ilex paraguariensis* is often present as an undergrowth element. The only remaining large blocks of Paranean forest are in this unit. Numerous threatened or endangered plant and animal species or populations depend on the Misioneran semievergreen forests for their survival or that of some of the most significant remaining populations, among them the monkey *Alouatta guariba*, the deer *Mazama rufina*, the jaguar *Panthera onca*, the guan *Pipile jacutinga*, the hawk *Leucopternis polionota*, the eagle *Harpia harpyja*, the palm *Euterpe edulis*.
(Birot, 1970: unit 5 *p.*; Martinez-Crovetto, 1963; Hueck and Seibert, 1972: unit 29 *p.*; Dimitri, 1974; Hueck, 1978: 199-222; Cabrera and Willink, 1980: 60-61; Schnell, 1987a: 290; Prance, 1989: 100-103, region 18 *p.*; Redford and Eisenberg, 1992; Vila and Bertonatti, 1993; Moreno, 1993; Chebez, 1994; Burkart *et al.*, 1994: 5-7; Laclau, 1994).

47.111 Misioneran laurel semi-evergreen forests
Forests dominated by *Nectandra saligna*, accompanied by *Nectandra lanceolata*, constituting the largest part of the Misioneran semievergreen forests. They occupy the western slopes of the Sierra de Misiones, extending to the Parana River in the west, to the southern limit of the palo rosa forests in the north, to the arborescent fern forests and the Uruguay River in the east and to a presentday southern limit coinciding approximately with a line extending from San Ignacio on the Parana through L.N. Alem to San Javier on the Uruguay. Important arboreal components include *Piptadenia rigida*, *Cedrela fissilis* (*Cedrela tubiflora*), *Holocalyx balansae*, *Lonchocarpus leucanthus*, *Ocotea puberula*, *Balfourodendron riedelianum*, *Cabralea oblongifolia*, *Cordia trichotoma*, *Chrysophyllum marginatum*, *Chrysophyllum gonocarpum*.
(Martinez-Crovetto, 1963: 178-188; Laclau, 1994: 15, 26; Chebez, 1994; Tressens *et al.*, 1994).

47.112 Misioneran palo rosa semi-evergreen forests
Misioneran semievergreen forests in which the very tall *Aspidosperma polyneuron* is the characteristic emergent and *Euterpe edulis* is present in the understorey, of extreme northern Misiones province, notably Iguazu National Park and Urugua-i Provincial Park where some well-preserved tracts still remain. Large continuous tracts formerly existed in southern Brazil, including the upper Parana, and eastern Paraguay; they are nowadays reduced to discontinuous parcels. Associated tree species include

Acacia polyphylla, *Astromium fraxinifolium*, *Campomanesia aurea*, *Copaifera langsdorfii*, *Platymenia modesta*, *Pouteria fragrans*, *Roupala cataractarum*, *Trichilia mollis*, often with *Nectandra saligua*, *Nectandra lanceolata*, *Lonchocarpus leucanthus*, *Balfourodendron riedelianum*.
(Martinez-Crovetto, 1963: 189-191; Dimitri, 1974: 3-7; Laclau, 1994: 15, 26; Chebez, 1994; Tressens *et al.*, 1994: 30).

47.113 Misioneran arborescent fern semi-evergreen forests
Misioneran semievergreen forests characterized by an understorey comprising the cyatheacean tree ferns *Alsophila atrovirens*, *Alsophila plagiopteris*, *Alsophila proccra*, *Dicksonia sellouiana* and *Hemitelia setosa*, and a floristic composition much like that of the Misioneran laurel forests and palo rosa forests, including arboreal species such as *Trichilia elegans*, *Ocotea acutifolia*, *Nectandra saligna*, *Balfourodendron riedelianum*, *Chrysophyllum marginatum*, *Cabralea oblongifoliola*, *Cedrela tubiflora*, *Trichilia catigua*, *Peptadenia rigida*, *Nectandra lanceolata*, situated on the eastern slopes of the Sierra de Misiones between the Misioneran laurel forests to the west and the *Araucaria angustifolia* forests of eastern Misiones and southern Brazil.
(Martinez-Crovetto, 1963: 191-192; Laclau, 1994: 15, 26).

47.114 Misioneran semi-evergreen capueras
Post-cutting and post-burning arborescent regrowth succession stages of Misioneran semievergreen forests, comprising pioneering small trees, many shrubs and herbaceous plants such as *Solanum auriculatum*, *Baccharis dracunculifolia*, *Croton hirtus*, *Eugenia uniflora*, *Schinus spp.*, *Cynodon dactylon*, *Paspalum spp.*, *Chloris spp.*, *Cassia spp.*, *Ipomoea spp.*, *Sida spp.*, *Passiflora coerulea*, *Pteridium aquilinum*.
(Martinez-Crovetto, 1963: 192-195).

47.12 Upper Paranean semi-evergreen forests
Subtropical hygrophyte forests of the Parana basin of western and central Sao Paulo, situated mainly north of the tropic and north of the range of *Ilex paraguariensis*, extending northward from the Misioneran semievergreen forests to the Rio Grande, at 20°S, constituting the northern part of the main range of the Paranean semievergreen forest zone, now mostly a mosaïc of small forest patches and cleared areas.
(Birot, 1970: 105, unit 5 *p.*; Hueck and Seibert, 1972: unit 29 *p.*; Hueck, 1978: 201-202; Willis, 1979; Schnell, 1987a: 281, 288; Prance, 1989: 100-103, region 18 *p.*; Laclau, 1994: 9, 26, 123-124).

47.13 Northern Paranean semi-evergreen forests
Subtropical hygrophyte forests of the upper Parana-Paranaiba system and the upper Sao Francisco system, constituting northern extensions of the Paranean forests, with a more archipelagic distribution than the forests of the main range, more montane, and with a floristic composition often more influenced by Amazonian or, occasionally, pre-Andean communities. They are associated in part with the Goian centre of endemism, in part with Atlantic centres.
(Birot, 1970: 103-105, unit 3; Hueck and Seibert, 1972, 1981: unit 29 *p.*; Haffer, 1974: 143-157; Hueck, 1978: 315-319; Schnell, 1987a: 386-396; Prance, 1989: 100-103, 112, region 13, 18, *p.*; Harley, 1995: 13-14).

47.131 Goianian semi-evergreen forests
Subtropical hygrophyte forests of the Mato Grosso of Goias, in southern and central Goias, north to the Sierra Dourada, in the interfluve between the upper Parana-Paranaiba basin and the high Tocantins, showing affinities with the Amazonian Hylaea and with the western Andean Yungas. Lecythidaceae (*Cariniana brasiliensis*), Cesalpiniaceae (*Copaifera langsdorfii*, *Hymenaea courbaril*), Fabaceae (*Myroxylon peruiferum*), Vochysiaceae (*Vochysia*), are among the important constituents.
(Birot, 1970: 103-105, unit 3 *p.*; Hueck and Seibert, 1972, 1981: unit 29 *p.*; Hueck, 1978: 316-319; Schnell, 1987a: 386-394).

47.132 Planaltan semi-evergreen forests
Hygrophyte, multi-specific remnant patches of forests of Minas Gerais, on the low slopes of the southern Serra do Espinhaço, the Serra da Mantiqueira and associated ranges of the western Planalto, west to the Serra da Mata da Corda, northeast to the middle basins of the Doce, Mucuri and Jequitinhonha rivers, constituting the northeastern extension of the Paranean semievergreen forests zone. The Lecythidaceae *Cariniana legalis*, the Apocynaceae *Aspidosperma macrocarpum* and *Aspidosperma leucomelanum*, the Meliaceae *Cabralea cangerana* and *Cedrela fissilis*, the Fabaceae

Pterodon pubescens, the Caricaceae *Jacaratia dodecaphylla*, the Phytolaccaceae *Gallesia gorazema*, the Bignoniaceae *Paratecoma peroba*, the palm *Euterpe edulis* are prominent in various formations.
(Birot, 1970: 103-105, unit 3 *p.*; Hueck and Seibert, 1972, 1981: unit 29 *p.*; Hueck, 1978: 317; Schnell, 1987a: 283; Laclau, 1994: 9; Harley, 1995: 13-14).

47.133 Maracaju semi-evergreen forests
Subtropical hygrophyte forests of the Serra de Maracaju and the Serra de Aquidauana in southern Mato Grosso, with connections to the Paranean forests of Paraguay on the one hand, with the semievergreen forests of Goias on the other hand.
(Birot, 1970: 103-105, unit 3 *p.*; Hueck and Seibert, 1972, 1981: unit 29 *p.*; Hueck, 1978: 315-316; Schnell, 1987a: 386; Laclau, 1994: 9).

47.14 Southeastern Paranean semi-evergreen forests
Lowland semievergreen rain forests of the Atlantic seaboard of Santa Catarina and Rio Grande do Sul, mostly of fairly low stature and reduced species diversity, with a strong tendency to oligodominance, southeastern and southeasternmost outliers of the Paranean-Atlantic semievergreen forests.
(Birot, 1970: 103-105, unit 5 *p.*; Hueck and Seibert, 1972, 1981: unit 29 *p.*; Hueck, 1978: 201; Schnell, 1987a: 288-291; Wege and Long, 1995: 61, 67, 110-113).

47.141 Catarinian semi-evergreen rainforests
Lowland semievergreen rain forests of the Atlantic seaboard of Santa Catarina, of fairly low stature, not usually exceeding 15-20 metres, of reduced species diversity, usually dominated by a limited number of species, in particular, *Ocotea pretiosa*, *Ocotea aciphylla*, *Ocotea catharinensis*, *Nectandra rigida*, *Tapirira guianensis*, in various combinations. *Euterpe edulis*, *Alchornea triplinervia*, *Matayba guianensis*, *Ficus organensis*, *Sloanea guianensis*, *Ilex theezans*, *Ilex tumosa*, *Didymopanax angustissimum*, *Psychotria barbiflora*, *Rapanea venosa*, *Torrubia olfersiana*, *Cryptocarya moschata* are important accompaniers. The canopy is often fairly open, allowing the development of a lush undergrowth rich in bromeliads, with, in particular, the tall *Nitidularium innocentii* var. *paxianum* and *Nitidularium procerum*. The endangered tyrannid *Hemitriccus kaempferi* is endemic to the unit, which is reduced to forest fragments.
(Schnell, 1987a: 288-289; Wege and Long, 1995: 61, 67, 110-113).

47.142 Canoan semi-evergreen forests
Small semievergreen forests of Rio Grande do Sul, situated on hills west of Lagoa dos Patos, south of the Jacui river, and in the Jacui and Taquari basins, representing the southeasternmost outliers of the Paranean-Atlantic semievergreen forests. Characteristic tree species include the Sapindaceae *Allophylus edulis*, *Cupania vernalis* and *Diatenopteryx sorbifolia*, the Cesalpiniaceae *Apuleia leicarpa* and *Peltophorum vogelianum*, the Fabaceae *Dalbergia variabilis* and *Holocalyx balansae*, the Mimosae *Piptadenia rigida* and *Piptadenia excelsa*, the Myrtaceae *Eugenia uwalha* and *Myrcia sphaerocarpa*, the Lauraceae *Nectandra rigida* and *Ocotea arechavaletae*, the Boraginaceae *Cordia hypoleuca* and *Cordia salicifolia*, the Apocynaceae *Aspidosperma australe*, the Meliaceae *Cedrela fissilis*, the Ulmaceae *Celtis lancifolia*, the Moraceae *Chlorophora tinctoria*, the Araliaceae *Didymopanax morototoni*, the Aquifoliaceae *Ilex domestica*, the Asteraceae *Moquinia polymorpha*, the Rosaceae *Prunus subcoriaceum*, the Bignoniaceae *Tabebuia ipe*, the Combretaceae *Terminalia australis* and the conifer *Araucaria angustifolia*.
(Hueck, 1978: 201; Schnell, 1987b: 290-291).

47.15 Pre-Chacoan Paranean semi-evergreen forests
Hygrophile forest patches of the Campos district of extreme western Misiones, northeastern Corrientes and adjacent Paraguay, and of the humid Chaco of western Corrientes, eastern Chaco, Formosa and Paraguay, constituting impoverished outposts of the Misioneran semievergreen forests, like them multistrata and with very mixed multispecific upper tree layers without single-species dominance.
(Hueck, 1978: 199-222; Carnevali, 1994: units 29, 71).

47.151 Paraguayo-Argentinian Campos hygrophile forests
Hygrophile multi-specific forest patches of the Campos district of extreme western Misiones, north-eastern Corrientes and adjacent Paraguay, related to the Misionerian laurel forests of which they constitute impoverished and fragmented outposts. Aborescent species characteristic of the interior include *Tabebuia heptaphylla*, *Piptademia rigida*, *Cordia trichotoma*, *Apuleia leiocarpa*, *Luehea*

divaricata, *Aspidosperma australe*, *Peltophorum dubium*, *Ruprechitia laxiflora*, *Patogonula americana*, *Nectandra megapotamica*, *Balfourodendron riedelianum*, *Cedrela tubiflora*, *Jacaranda semiserrata*, woodland mantle species include *Sebastiania brasiliensis*, *Fagara hymenalis*, *Astromium balansae*, *Chomelia obtusa*, *Celtis pubescens*, *Sapium haemastospernum*, *Schinus aroeira*, *Eugenia uniflora*, climbers *Bauhinia microstachya*, *Smilax campestris*, *Herreria spp.*, *Aristolochia triangularis*, *Melothria cucumis*, herb layer species *Bromelia balansae*, *Pseudoananas sagenarius*, *Hydrocotyle leucocephala*, *Spathicarpa hastifolia*, *Pteris denticulata*, *Adantopsis radiata*, *Blechnum brasiliense*, epiphytes *Aechmea recurvata*, *Tillandsia spp.*, *Oncidium pumilum*, *Philodendron selloanus*, *Sacolia spp.*, *Isochylus linearis*.
(Hueck, 1978: 199-222; Carnevali, 1994: unit 71).

47.152 Humid Chaco hygrophile forests
Hygrophile multi-specific forests of the humid Chaco of western Corrientes, eastern Chaco, Formosa and Paraguay, occupying small surfaces at the foot of, or on the slopes of, red-sand hills and enclaves within *Shinopsis balansae* woodland, rich in Misioneran forest species, often with large-crowned emergents in the larger stands. Smaller stands are often low, with a simplified single stratum tree layer. Constituting elements include trees *Tabebuia heptophylla*, *Luehea divaricata*, *Ficus luschinathiana*, *Enterolobium contorisiliquum*, *Gleditsia amorphoides*, *Phytolacca dioica*, *Patagonula americana*, *Pouteria gardneriana*, *Nectandra falcifolia*, the palm *Arecastrum romanzoffianum*, shrubs and smaller trees *Brunfelsia australis*, *Psidium guajava*, *Guaria spicifolia*, *Cecropia pachystachya*, *Celtis pubescens*, *Celtis iguanaea*, *Celtis spinosa*, *Sapium longiflorus*, *Coccoloba spp.*, *Solanum atropurpureum*, *Eugenia moraviana* and many subshrubs, ground bromeliads, lianas and herbs forming the mantle and understorey.
(Hueck, 1978: 199-222; Carnevali, 1994: unit 29).

47.2 Caribbeo-Pacific semievergreen forests

Semievergreen rain forests of the Pacific lowlands and low Andean slopes of northern South America south to extreme northern Peru, of the Caribbean lowlands of the Gulf of Uraba, of the middle Magdalena Valley of Colombia and of the southern basin of Lake Maracaibo and of the western lowlands of Golfo Triste.
(Koepcke, 1961: 150-153; Hueck and Seibert, 1972: unit 23 *p.*; Haffer, 1974: 143-157; Hueck, 1978: 139-142, 144; Haffer, 1978: 54-64; Veillon, 1985a: units 16 *p.*, 17 *p.*; Schnell, 1987a: 272-276; Huber and Alarcon, 1988: units 59, 14, 9 *p.*; Prance, 1989: 101-103; Gentry, 1995: 148; Murphy and Lugo, 1995: 17).

47.21 Pacific semievergreen forests
Semievergreen rain forests of the Pacific lowlands and low Andean slopes of northern South America, mostly limited to the southern Choco province of Colombia, the Esmeralda province of Ecuador, and extreme northern Peru, south to about 6°S, forming a mosaic with evergreen rain forests of unit 46.31, progressively supplanting them southwards. Fabaceae (*Swartzia spp.*), Ulmaceae (*Celtis schippii*), Mimosaceae (*Pithecellobium arboreum*) are among important trees. Their species cortège, both floral and faunal, is mostly characteristic of the Choco centre of endemism.
(Koepcke, 1961: 150-153; Hueck and Seibert, 1972: unit 23 *p.*; Haffer, 1974: 143-157; Hueck, 1978: 139-142, 144; Schnell, 1987a: 272-276; Prance, 1989: 101-103; Parker and Carr, 1992; Maître *et al.*, 1993: 22; Gentry, 1995: 148; Murphy and Lugo, 1995: 17).

47.22 Magdaleno-Caucan semievergreen forests
Semievergreen rain forests of Caribbean Colombia, limited to the Magdalena and Cauca basins, and, very locally, the slopes of the Sierra Nevada de Santa Marta, transitional between the Madgaleno-Caucan evergreen rain forest (unit 46.32) and the Colombian alisio forests (unit 48.1). Their floristic cortège is characteristic of the Magdalena and Santa Marta areas of endemism, their avian cortège characteristic of the Nechi center of endemism. These forests have disappeared except for a few remnants.
(Hueck and Seibert, 1972: unit 23 *p.*; Haffer, 1974: 143-157; Hueck, 1978: 139-142, 144; Haffer, 1978: 54-64; Schnell, 1987a: 272-276; Gentry, 1995: 148; Wege and Long, 1995: 137).

47.23 Catatumbo-Tristian semievergreen forests

Semievergreen rain forests of western Caribbean Venezuela, in particular of the western lowlands of Golfo Triste and the lower Andean slopes southeast of Lake Maracaibo. Characteristic species include the Myrtaceae *Eugenia spp.*, the Rutaceae *Zanthoxylum spp.*, the Fabaceae *Machaerium robiniaefolium*, the Capparidaceae *Capparis colobifolia*, *Capparis tenuisiliqua* and *Morisonia americana*, the Sapindaceae *Talisia olivaeformis* and the endemic Fabaceae *Apoplanesia cryptantha*. Forests that can be classified as semievergreen may also occur in the basin of Lake Maracaibo and the western Llanos, in local areas of transition between rain forests and semideciduous forests.
(Hueck and Seibert, 1972: unit 23 *p.*; Haffer, 1974: 143-157; Hueck, 1978: 139-142, 144; Haffer, 1978: 54-64; Veillon, 1985a: unit 17 *p.*; Huber and Alarcon, 1988: units 59, 86; Gentry, 1995: 148).

47.3 Northern Amazonian semievergreen forests

Semievergreen rain forests of the northern fringe of the Amazonian evergreen rain forest in Amapa, northern Para, Roraima, northern Brazilian Amazonas, Guianan Venezuela and southeastern Colombia. They constitute transition forests between the Amazonian evergreen forests and drier formations to the north.
(Richards, 1952: 195, 197, 318, 320, 325; Birot, 1970: 103-105, unit 2 *p.*; Hueck and Seibert, 1972, 1981: units 2, 7, 10, 11, 12, 13, *p.*; Haffer, 1974: 143-157; Haffer, 1978: 54-64; Veillon, 1985a: units 5, 8, 9, 10, *p.*; Schnell, 1987a: 215, 259; Huber and Alarcon, 1988: unit 64, 71, 72; Prance, 1989: 112, 123-125; Rieley and Page, 1990: 45-46; Walter and Breckle, 1991a: 209; Maître *et al.*, 1993: 17, 18; Henderson, 1995: 15; Huber, 1995: unit 7, 13).

47.31 Northwestern Amazonian semievergreen forests
Semievergreen rain forests of the western sector of the northern Amazonian fringe, in the upper Uaupes basin and northern Colombian Amazonia, in the provinces of Vaupes, Guainia and Guaviare. Their floral cortège and avifauna are mostly governed by the Imeri and Napo centres of endemism.
(Birot, 1970: 104; Hueck and Seibert, 1972, 1981: units 7, 10 *p.*; Haffer, 1974: 143-157; Haffer, 1978: 54-64).

47.32 Guianan semievergreen rain forests
Semievergreen rain forests of the eastern part of the northern fringe of the Amazonian forest, located on the periphery of the Guianan shield, in Venezuelan Guiana, Guyana, Surinam, French Guiana, Amapa, northeastern Para and Roraima. Their floral cortège is characteristic of the Imataca, western Guiana and eastern Guiana centres of endemism, their avifauna of the Guianan centre of endemism.
(Richards, 1952: 325; Birot, 1970: 104; Hueck and Seibert, 1972, 1981: units 2, 11, 12, 13, *p.*; Haffer, 1974: 143-157; Haffer, 1978: 54-64; Veillon, 1985a: units 8, 10, *p.*; Schnell, 1987a: 215, 216, 247, 248, 259; Huber and Alarcon, 1988: units 65, 73; Prance, 1989: 112, 123-125; Walter and Breckle, 1991a: 209; Huber, 1995: units 7, 32).

47.321 Northwestern Guianan semievergreen forests
Semievergreen rain forests of the northern and western piedmont of the Roraima system in northern Bolivar, developed in the basins of the Rio Caura and the Rio Caroni and other right-bank tributaries of the Orinoco, in the foothills of the Sierra de la Cerbatana and of the Serranias Turagna, and in the upper basin of the Rio Cuyuni. Their floral cortège is characteristic of the Imataca centre of endemism, their avifauna of the Guianan centre of endemism.
(Birot, 1970: 104; Hueck and Seibert, 1972, 1981: unit 11 *p.*; Haffer, 1974: 143-157; Haffer, 1978: 54-64; Veillon, 1985a: units 8, 10, *p.*; Huber and Alarcon, 1988: units 65, 73; Walter and Breckle, 1991a: 209; Huber, 1995: units 7, 32).

47.3211 Caura-Cuao semievergreen forests
Semievergreen rain forests of northwestern Bolivar, developed on the foothills of the Sierra de la Cerbatana, with outposts on the southern slopes of the Yavi-Yutaje-Guanay complex. Tree families of particular prominence include Chrysobalanaeceae (*Licania canescens*, *Licania cruegeriana*, *Licania densiflora*, *Parinari excelsa*), Vochysiaceae (*Vochysia glaberrima*, *Erisma uncinatum*), Sapotaceae (*Pouteria spp.*, *Elaeoluma glabrescens*), Bixaceae (*Cochlospermum orinocense*), Combretaceae

(*Terminalia amazona*), Rutaceae (*Galipea davisii*), Caesalpiniaceae (*Macrolobium spp.*), Meliaceae (*Trichilia spp.*), Lecythidaceae (*Eschweilera subglandulosa*).
(Birot, 1970: 104; Hueck and Seibert, 1972, 1981: unit 11 *p.*; Haffer, 1974: 143-157; Haffer, 1978: 54-64; Veillon, 1985a: unit 10 *p.*; Huber and Alarcon, 1988: unit 65; Walter and Breckle, 1991a: 209; Huber, 1995: units 32, 35).

47.3212 Caura-Caroni semievergreen forests
Semievergreen rain forests of northeastern Bolivar, developed in the basins of the Rio Caura and the Rio Caroni, on the foothills of the Serranias Turagna and in the upper basin of the Rio Cuyuni. Tree families of particular prominence include Chrysobalanaeceae (*Licania densiflora*), Burseraceae (*Tetragastris panamensis*, *Protium spp.*), Euphorbiaceae (*Chaetocarpus schomburgkianus*), Apocynaceae (*Aspidosperma marcgravianum*), Sterculiaceae (*Sterculia pruriens*), Sapotaceae (*Manilkara bidentata*, *Pouteria egregia*), Vochysiaceae (*Erisma unsinatum*).
(Birot, 1970: 104; Hueck and Seibert, 1972, 1981: unit 11 *p.*; Haffer, 1974: 143-157; Haffer, 1978: 54-64; Veillon, 1985a: unit 8 *p.*; Huber and Alarcon, 1988: unit 73; Walter and Breckle, 1991a: 209; Huber, 1995: unit 7).

47.322 Central Guianan semievergreen forests
Semievergreen rain forests of the southeastern and eastern periphery of the Roraima system and of the periphery of the Guianan Highlands, in Guyana, Surinam, French Guiana, Amapa, northeastern Para and Roraima, in particular of the fringe of the Branco-Rupunini savannas. Their floral cortège is characteristic of the western Guiana and eastern Guiana centres of endemism, their avifauna of the Guianan center of endemism. *Cordia alliodora* and *Centrolobium paraense*, accompanied by *Apeiba schomburgkii, [Enterolobium spp.*, *Peltogyne pubescens*, are characteristic of the forests on the lowest slopes of the Kanuku mountains, below 400 metres.
(Richards, 1952: 325; Birot, 1970: 104; Hueck and Seibert, 1972, 1981: unit 12 *p.*; Haffer, 1974: 143-157; Haffer, 1978: 54-64; Schnell, 1987a: 259, 411; Prance, 1989: 112, 123-125).
47.323 Trinidad and Tobago semievergreen forests
Semievergreen forests of Trinidad and Tobago, 20-26 metre tall, with two tree storeys and 15% to 25% of deciduous trees in the upper storey, about 10% in the lower storey.
(Richards, 1952: 195, 318, 320; Hueck and Seibert, 1972, 1981: unit 13 *p.*).

47.4 Southern Amazonian semievergreen forests

Semievergreen rain forests of the southern fringe of the Amazonian evergreen rain forest in Maranhao, southern and eastern Para, northern Mato Grosso, Rondonia, Acre, and Bolivian Amazonia. They constitute transition forests between the Amazonian evergreen forests and drier formations to the south. Lianas, palms or bamboos are often abundant, as are Brazil-nut trees, *Bertholletia excelsa*, and heveas (*Hevea brasiliensis*).
(Birot, 1970: 103-105, unit 2 *p.*; Hueck and Seibert, 1972, 1981: units 3, 4, 5, 8, *p.*; Haffer, 1974: 143-157; Haffer, 1978: 54-64; Schnell, 1987a: 215, 247, 248, 378-386; Prance, 1989: 112, 123-125; Rieley and Page, 1990: 45-46; Maître *et al.*, 1993: 17, 18; Henderson, 1995: 15).

47.41 Southeastern Amazonian semievergreen forests
Semievergreen rain forests of the eastern part of the southern fringe of the Amazonian forest, in the Atlantic and Tocantins basins of Maranhao and northeastern and eastern Para. Their floral cortège and their avifauna are characteristic of the Belem centre of endemism. Many transition forests of this region, particularly in the south of it, are palm forests, listed separately in unit 47.44. Other forests are constituted by Lecythidaceae (*Lecythis paraensis*, *Bertholletia excelsa*), Bombacaceae (*Ceiba pentandra*), Moraceae (*Casteilloa ulei*) and Caesalpiniaceae (*Hymenea courbaril*, *Vouacapoua americana*).
(Birot, 1970: 105; Hueck and Seibert, 1972, 1981: unit 3; Haffer, 1974: 143-157; Haffer, 1978: 63; Hueck, 1978: 48-50, 38-40; Schnell, 1987a: 216, 247-248; Prance, 1989: 112, 123-125; Maître *et al.*, 1993: 17, 18; Henderson, 1995: 15).

47.42 South-central Amazonian semievergreen forests
Semievergreen rain forests of the central part of the southern fringe of the Amazonian forest, in the basins of the Rio Purus, the Rio Madeira, the Rio Tapajos and the Rio Xingu-Rio Iriri, in southern

Para, Mato Grosso and northeastern Rondônia. Their floral cortège is characteristic of the Tapajos and Aripuana centres of endemism, their avifauna of the Rondonia or Madeira-Tapajos centre of endemism. Liana forests are common among them, in particular, between the Xingu and the Tocantins, and west to the Tapajos. Forests in southern Para are formed by Guttiferae (*Calophyllum brasiliense*), Simarubaceae (*Simaruba amara*), Caesalpiniaceae (*Hymenaea stilbocarpa*).
(Birot, 1970: 104-105, regions 104-105; Hueck and Seibert, 1972, 1981: units 4, 5 *p.*; Haffer, 1974: 70, 143-157; Haffer, 1978: 57-64; Hueck, 1978: 50-52, 52-54; Schnell, 1987a: 378-386; Prance, 1989: 112, 123-125; Maître *et al.*, 1993: 17, 18; Henderson, 1995: 15).

47.43 Southwestern Amazonian semievergreen forests
Semievergreen rain forests of the western part of the southern fringe of the Amazonian forest, in Bolivian Amazonia, Acre and western Rondonia. Their floral cortège is influenced by the Aripuana, eastern Peruvian and Beni centres of endemism, their avifauna by the eastern Peruvian centre of endemism. Some of these forests are bamboo forests, characterized by the occurrence of large clumps of bamboo reaching into the canopy.
(Birot, 1970: 104; Hueck and Seibert, 1972, 1981: units 6, 8, 9, 5 *p.*; Haffer, 1974: 143-157; Haffer, 1978: 54-64; Hueck, 1978: 54-56, 76-77, 77-78, 52-54; Schnell, 1987a: 378-386; Prance, 1989: 112, 123-125; Rieley and Page, 1990: 45-46; Maître *et al.*, 1993: 17, 18; Henderson, 1995: 15).

47.44 Amazonian transition palm forests
Forests of the southern Amazonian fringe of semievergreen forests, constituting the transition between Amazonian evergreen forests and drier formations to the south, dominated by palms, in particular, by *Orbignya martiana* (*Attalea speciosa*), most characteristic of the eastern sector of the belt, in the Tocantins basin, where it often forms pure stands, but also prominent in Mato Grosso, in the northern periphery of the Pantanal, and in southwestern Amazonia. Other palms that may dominate these forests or occur in association include *Oenocarpus distichus*, *Jessenia bataua*, *Euterpe precatoria*, *Maximiliana regia*.
(Birot, 1970: 105; Hueck and Seibert, 1972, 1981: unit 3; Haffer, 1974: 143-157; Haffer, 1978: 63; Hueck, 1978: 48-50, 38-40, 340-343; Schnell, 1987a: 216, 247-248, 378, 395; Prance, 1989: 112, 123-125; Maître *et al.*, 1993: 17, 18; Henderson, 1995: 15).

47.5 Northeastern Brazilian semievergreen forests

Semievergreen forests of the coastal regions of Paraiba, Pernambuco, Alagoas and Bahia, co-occurring with Pernambucan and Bahian Atlantic evergreen forests or developing inland from them, in the zone of transition to caatinga dry woodland and scrub. Characteristic trees include *Aspidosperma spp.*, *Caesalpinia echinata*, *Hymenaea courbaril, Manilkara rufula*, *Syagrus spp.*, *Tabebuia avellanaedae*. Among the numerous epiphytes are *Clusia spp.*, *Philodendron spp.*, *Tillandsia usnoides* and other Bromeliaceae. These forests are reduced to a few, often degraded, stands.
(Birot, 1970: 103-105, unit 3 *p.*; Hueck and Seibert, 1972, 1981: units 25, 44, *p.*; Haffer, 1974: 143-157; Schnell, 1987a: 279-280; Prance, 1989: 100-103, 112, regions 12, 14 *p.*).

47.6 Central Amazonian semievergreen rainforests

Semievergreen rain forests of the central Amazonian region, occurring in edaphic enclaves within the main range of the Hylaea.
(Prance, 1989: region 10b).

48. SEMIDECIDUOUS AND MONSOON FORESTS

Seasonal forests of humid tropical and subtropical regions with a very protracted dry season, particularly characteristic of monsoonal climates, characterized by a mostly deciduous upper canopy, a predominantly evergreen lower canopy and well-developed shrub and herb layers. Species diversity of canopy trees is much less than in either evergreen or semievergreen rain forests and single dominance is frequent; bamboos often play a dominant role in the shrub layer. In South America, they include an extensive system of forests in the northern part of the continent, located around the mountain ranges of the southern Caribbean coast and on the periphery of the Orinocco basin, locally known as alisio (trade winds) forests. They also include more fragmented and less well individualised entities around the southern periphery of the main, Amazonian, Atlantic, Paranean and Pacific, evergreen and semievergreen forest zones.
(Richards, 1952: 195, 317-321; Birot, 1970; Schnell, 1971, 1987a: 276, 367-385, 386-396; Hueck and Seibert, 1972, 1981: units 28, 29 *p.*, 30, 31; Letouzey, 1978; Hueck, 1978: 153-166, 199-222, 294-301, 315-319, 339-340; Whitmore, 1978, 1989, 1992; Ridgely and Tudor, 1989; Rieley and Page, 1990; Walter and Breckle, 1991a: 208-209; Walter and Breckle, 1991b: XX, 117-119; Maître *et al.*, 1993: 5-24; Huetz de Lemps, 1994: 114-115; Archibold, 1995: 15-59; Huber, 1995; Gentry, 1995).

48.1 Orinoco-Caribbean alisio forests

Seasonal semideciduous forests of northern South America, located around the mountain ranges of the southern Caribbean coast and on the periphery of the Orinoco basin, developed under a constantly warm climate, with a total annual precipitation ranging between 1200 and 2000 mm, and a pronounced alternance of dry and wet seasons under the effects of the trade winds (alisios), with 4 to 5 dry months.
(Birot, 1970: 104, units 4, 3, *p.*; Schnell, 1987a: 276; Hueck and Seibert, 1972, 1981: unit 28; Hueck, 1978: 153-166; Veillon, 1985a; Huber and Alarcon, 1988; Rieley and Page, 1990; Walter and Breckle, 1991a: 208-209; Walter and Breckle, 1991b: XX, 117-119; Huber, 1995).

48.11 Caribbean alisio forests
Seasonal semideciduous forests of the Caribbean coasts of northern South America, of their offshore islands, and of the piedmont of their coastal ranges.
(Birot, 1970: 104, units 4, 3, *p.*; Schnell, 1987a: 276; Hueck and Seibert, 1972, 1981: unit 28; Hueck, 1978: 153-166; Veillon, 1985a; Huber and Alarcon, 1988; Walter and Breckle, 1991a: 208-209; Maître *et al.*, 1993: 12; Huber, 1995).

48.111 Southwestern Caribbean alisio forests
Seasonal semideciduous forests of the Caribbean lowlands and pre-Andean hills of Colombia, in particular of the pre-Andean hills of Cordoba, Sucre and western Magdalena, and of the piedmont of the Sierra Nevada de Santa Marta.
(Hueck and Seibert, 1972, 1981: unit 28 *p.*).

48.112 Catatumban alisio forests
Seasonal semideciduous forests of the basin of Lake Maracaibo, in areas under the influence of the Catatumban centre of endemism, dense, medium-tall, with *Anacardium excelsum*, *Calycophyllum candidissimum*, *Brosimum alicastrum*, *Trophis racemosa*, *Simira klugii*, *Cordia thaisiana* and the endemic *Gustavia tejerae*; they extend on the slopes of the Sierra de Perija, to an altitude of 700-800 metres, with *Spondias mombin*, *Hirtella triandra*, *Melicocca bijuga*, *Terminalia oblonga*, *Trichilia martiana*, *Trichilia pleeana*.
(Hueck and Seibert, 1972, 1981: unit 28 *p.*; Haffer, 1974: 145-147; Hueck, 1978: 160; Veillon, 1985a; Huber and Alarcon, 1988: units 9, 81; Prance, 1989: 112).

48.113 Araguan alisio forests

Seasonal semideciduous forests of the central Caribbean coasts of Venezuela and the piedmont of the Cordillera de la Costa, in the region of influence of the Rancho Grande centre of endemism.
(Hueck and Seibert, 1972, 1981: units 96, 97 *p.*; Haffer, 1974: 145-147; Hueck, 1978: 153-166; Veillon, 1985a; Huber and Alarcon, 1988: units 96, 97; Prance, 1989: 112; Walter and Breckle, 1991a: 208-209).

48.1131 Araguan wet alisio forests
Humid seasonal semideciduous forests of the central Caribbean coasts of Venezuela and the piedmont of the Cordillera de la Costa, dense, relatively tall, with two to three tree stories formed by *Tabebuia chrysantha*, *Trichilia pleeana*, *Inga spp.*, *Allophilus occidentalis*, *Poulsenia armata*, *Trophis rasemosa*, *Pseudolmedia rigida*, *Ocotea glandulosa* and the endemic *Eugenia mcvaughii*.
(Hueck and Seibert, 1972, 1981: units 96, 97 *p.*; Haffer, 1974: 145-147; Hueck, 1978: 153-166; Veillon, 1985a; Huber and Alarcon, 1988: unit 97; Prance, 1989: 112; Walter and Breckle, 1991a: 208-209).

48.1132 Araguan dry alisio forests
Relatively dry seasonal semideciduous forests of the central Caribbean coasts of Venezuela and the piedmont of the Cordillera de la Costa, low to medium-tall, with a dense undergrowth and one to two tree stories formed by *Tabebuia billbergii*, *Bourreria cumanensis*, *Inga punctata*, *Bauhinia megalandra*, *Cassia emarginata*, *Calliandra caracasana*, *Erythrina poeppigiana*.
(Hueck and Seibert, 1972, 1981: units 96, 97 *p.*; Haffer, 1974: 145-147; Hueck, 1978: 153-166; Veillon, 1985a; Huber and Alarcon, 1988: unit 96; Prance, 1989: 112; Walter and Breckle, 1991a: 208-209).

48.114 Parian alisio forests
Seasonal semideciduous forests of the piedmont of the eastern Venezuelan Cordillera de la Costa, of the Paria peninsula and of the large nearshore islands of Trinidad, Tobago and Margarita, in the area of influence of the Paria centre of endemism.
(Hueck and Seibert, 1972, 1981: unit 28 *p.*; Hueck, 1978: 153-166; Veillon, 1985a; Huber and Alarcon, 1988: units 105, 106, 110; Prance, 1989: 112).

48.1141 Turimiquire alisio forests
Seasonal semideciduous forests of the piedmont of the eastern Venezuelan Cordillera de la Costa and of the Paria peninsula.
(Hueck and Seibert, 1972, 1981: unit 28 *p.*; Hueck, 1978: 153-166; Veillon, 1985a; Huber and Alarcon, 1988: units 105, 106).

48.11411 Turimiquire wet alisio forests
Humid seasonal semideciduous forests of the piedmont of the eastern Venezuelan Cordillera de la Costa and of the Paria peninsula, dense, medium-tall, with two tree storeys comprising, in particular, *Tabebuia chrysantha*, *Talisia hexaphyla*, *Trichila pallida*, *Swartzia pinata*.
(Huber and Alarcon, 1988: unit 106).

48.11412 Turimiquire dry alisio forests
Relatively dry seasonal semideciduous forests of the piedmont of the eastern Venezuelan Cordillera de la Costa and of the Paria peninsula, low to medium-tall, with *Tabebuia bilbergii*, *Aspidosperma cuspa*, *Bursera simaruba*, *Bauhinia aculeata*, *Bourreria cumanensis*, *Diospyros inconstans*.
(Huber and Alarcon, 1988: unit 105).

48.1142 Trinidad semideciduous forests
Seasonal semideciduous forests of Trinidad, distributed mostly on the northwestern peninsula, the Bocas Islands and the foothills of the Northern Range, with *Bursera simaruba*, *Lonchocarpus dominguensis*, *Machaerium robinifolium*, *Pithecellobium unguiscati*, *Cordia alliodora*.
(Richards, 1952: 195, 317-321; ffrench, 1976: 12-13).

48.1143 Tobago semideciduous forests
Seasonal semideciduous forests of Tobago, distributed on Little Tobago, St. Giles Island and the adjacent coast, with *Bursera simaruba*, *Lonchocarpus dominguensis*, and the palm *Coccothrinax australis* among the dominants, *Eugenia spp.* and *Mayepea caribaea* in the understorey.
(Beard, 1944b; Richards, 1952: 320-321; ffrench, 1976: 20).

48.1144 Margarita semideciduous forests
Seasonal semideciduous forests of the Venezuelan island of Margarita, limited to lower slopes, between 200 and 500-600 metres of altitude, low to medium-tall, relatively dense, formed in particular by *Tabebuia billbergii*, *Aspidosperma vargasii*, *Bursera simaruba*, with the endemics *Mikania johnstonii* and *Argythannia erubescens*.
(Huber and Alarcon, 1988: unit 110).

48.12 Upper llanos alisio forests
Seasonal semideciduous forests of the northwestern periphery of the Orinoco basin, forming a band between the Orinocan llanos and the submontane forests of the northwest Andes and the coast ranges of Venezuela.
(Birot, 1970: 104, units 4, 3, *p.*; Schnell, 1987a: 276; Hueck and Seibert, 1972, 1981: unit 28; Hueck, 1978: 153-166; Veillon, 1985a; Huber and Alarcon, 1988; Walter and Breckle, 1991a: 208-209; Huber, 1995).

48.121 Colombian upper llanos alisio forests
Alisio forests of the Colombian upper llanos with *Cedrela odorata*, *Aniba perutilis*, *Pseudosamanea guachapele*, *Anacardium rhinocarpus*, *Cinchona spp.*, *Guarea trichilioides*, *Hieronyma spp.*, *Taralea spp.*.
(Schnell, 1987a: 276; Hueck and Seibert, 1972, 1981: unit 28; Hueck, 1978: 153-166).

48.122 Western Venezuelan upper llanos alisio forests
Seasonal semideciduous forests of the western upper llanos of Venezuela in Barinas and Portuguesa, medium-tall to tall, fairly dense, with two or three tree strata formed by *Bombacopsis quinata*, *Spondias mombin*, *Chrysophyllum sericeum*, *Pouteria anibaefolia*, *Guazuma tomentosa*, *Inga spp.*, *Attalea maracaibensis*, *Roystonea venezuelana*, *Cordia bicolor*, *Cordia aliodora*, *Trichilia maynasiana*, *Gustavia poeppigiana*; they extend to 700-800 metres on the western slopes of the northern Andes.
(Huber and Alarcon, 1988: units 14, 85).

48.123 Rio San Juan alisio forests
Seasonal semideciduous forests of the extreme eastern upper llanos of Venezuela, in Monagas and eastern Sucre, tall, dense, with an abundance of lianas and two tree strata formed by *Tabebuia insignis* var. *monophylla*, *Trichilia pleeana*, *Erythrina spp.*, *Spondias mombin*, *Pachira aquatica*, *Symphonia globulifera*, *Cordia aliodora*, *Carapa guianensis*, *Pterocarpus officinalis*.
(Huber and Alarcon, 1988: unit 39; Walter and Breckle, 1991a: 208).

48.13 Guianan shield alisio forests
Seasonal semideciduous forests of the northwestern and northern piedmont of the Guianan shield of Venezuelan Guiana, located between the llanos of the Orinoco and semievergreen, lowland evergreen and montane forests of the Guianan shield.
(Birot, 1970: 104, units 4, 3, *p.*; Schnell, 1987a: 276; Hueck and Seibert, 1972, 1981: unit 28; Hueck, 1978: 153-166; Veillon, 1985a; Huber and Alarcon, 1988: units 64, 71; Walter and Breckle, 1991a: 208-209; Huber, 1995: units 13, 8, 24).

48.131 Northwestern Guianan shield alisio forests
Seasonal semideciduous forests of the northwestern piedmont of the Guianan shield of Venezuelan Guiana, located in the plain and the low hills of the right bank of the Orinoco, between the Rio Cuao and the Rio Cauca, medium-tall to low, dominated by the Fabaceae *Swartzia laevicarpa*, the Mimosaceae *Anadenanthera peregrina*, the Caesalpiniaceae *Cassia moschata* and *Copaifera pubiflora*, accompanied by the Anacardiaceae *Tapirira guianensis*, the Bignoniaceae *Tabebuia ochracea* ssp. *heterotricha*, the Burseraceae *Bursera simaruba*, the Bixaceae *Cochlospermum vitifolium*, the palm *Attalea maripa*.
(Huber and Alarcon, 1988: unit 64; Walter and Breckle, 1991a: 208-209; Huber, 1995: unit 13).

48.132 Northeastern Guianan shield alisio forests
Seasonal semideciduous forests of the northern piedmont of the Guianan shield of Venezuelan Guiana, located in the plains and low hills of the right bank of the Orinoco, east of the Rio Cauca, low to medium-tall, moderately dense to fairy open, dominated by the Caesalpiniaceae *Peltogyne floribunda* and *Copaifera pubiflora*, the Bignoniaceae *Tabebuia capitata*, the Bixaceae *Cochlospermum orinocense*, the Mimosaceae *Anadenanthera peregrina* and *Piptadenia spp.*, the Boraginaceae

Bourreria cumanensis, *Tournefortia punctata* and *Cordia alliodora*, the Bombacaceae *Ceiba pentandra* and *Pachira quinata*, the Anacardiaceae *Spondias mombin* and *Tapirira guianensis*, the Burseraceae *Bursera simaruba*.
(Huber and Alarcon, 1988: unit 71; Walter and Breckle, 1991a: 208-209; Huber, 1995: units 7 *p.*, 8).

48.14 Guaviare alisio forests
Seasonal semideciduous forests of the Guaviare valley of Colombia, located between the southern llanos and northwestern Amazonian rain forests.
(Hueck and Seibert, 1972, 1981: unit 28 *p.*).

48.2 Southern tropical semideciduous forests

Seasonal semideciduous forests of the southern belt of summer-rain tropical climates of South America, developed in regions with annual rainfall comprised mostly between 1000 and 2000 mm and a pronounced dry season, on the western Brazilian shield in the interfluve between the Amazonian and Paranean river systems, around the periphery of the dry Chaco and on the fringes of the Paranean and Atlantic rain forests. Many constitute transitions between evergreen or semievergreen lowland or montane forests and dry Chaco and Cerrado woods or Trinidad and Mato Grosso savannas. They also constitute faunal and floral links between Paranean and Atlantic forests and Amazonian or Andean forests.
(Birot, 1970: 104, units 4, 3, *p.*; Parker *et al.*, 1982: 16; Schnell, 1987a: 367-385, 386-396, 397-399; Hueck and Seibert, 1972, 1981: units 29 *p.*, 30, 31, 47 *p.*, 58 *p.*; Hueck, 1978: 294-301, 315-319; Loureiro *et al.*, 1982; Ridgely and Tudor, 1989; Walter and Breckle, 1991b: XX, 117-119).

48.21 Goiano-Planaltan semideciduous forests
Seasonal semideciduous forests of the periphery of the Pantanal, the southern Planalto de Mato Grosso, the Serra de Maracaju system, the Mato Grosso de Goias, the western Planalto do Brasil, east to the southern Serra do Espinhaço. Various distinctive communities exist, dependent on geographical, edaphic and altitudinal condition]. Apocynaceae (*Aspidosperma*), Bignoniaceae (*Tabebuia*), Mimoseae (*Piptadenia*, *Inga*), Chrysobalanaceae (*Licania*), Sterculiaceae (*Sterculia*), Fabaceae (*Swartzia*), Guttifereae (*Rheedia*), Anacardiaceae (*Astronium*), Lauraceae (*Nectandra*) are usually well represented.
(Birot, 1970: 104, unit 3 *p.*; Schnell, 1987a: 367-385, 386-396; Hueck and Seibert, 1972, 1981: units 29 *p.*, 30, 58 *p.*; Hueck, 1978: 315-319, 445; Loureiro *et al.*, 1982: 347-349).

48.22 Northeastern Bolivian semideciduous forests
Seasonal semideciduous forests of the northern periphery of the Chaco, in the Sierras de Chiquitos and the Mojos savannas of northeastern Bolivia, in contact with the Amazonian Hylaea in the north and northwest, with the eastern Andean montane rain and cloud forests in the southwest, the dry woodland of the Chaco in the south, and the cerrados of the Brazilian shield in the northeast.
(Herzog, 1923: 110-129; Birot, 1970: 104, units 4 *p.*; Schnell, 1987a: 397-399; Hueck and Seibert, 1972, 1981: units 31, 47; Hueck, 1978: 294-301).

48.221 Chiquitos semideciduous forests
Seasonal semideciduous forests of the eastern section of the northeastern Bolivian semideciduous woodlands and savannas area, in the upper basin of the Guapore and its tributaries, as well as of right bank tributaries of the Rio Paraguai, developed in the Sierras de Chiquitos, southwesternmost extension of the Brazilian shield west of the Pantanal. Bignoniaceae (*Tecoma*, *Jacaranda*), Cesalpiniaseae (*Hymenea*), Mimoseae (*Piptadenia*), Tiliaceae (*Luehea*), Sterculiaceae (*Sterculia*), Anacardiaceae (*Astronium*), Fabaceae, Lauraceae, Meliaceae, Myrtaceae, Sapindaceae, Bixaceae are well represented.
(Herzog, 1923: 110-129; Birot, 1970: 104, units 4 *p.*; Schnell, 1987a: 397-399; Hueck and Seibert, 1972, 1981: unit 31; Hueck, 1978: 299-301).

48.222 Santa Cruz-Trinidad semideciduous forests
Seasonal semideciduous forests of the western section of the northeastern Bolivian semideciduous woodlands and savannas area, in the upper basin of the Mamore and its tributaries, developed immediately to the west of the Brazilian shield, in the region of the Mojos savannas. Bignoniaceae (*Tecoma*), Bombacaceae (*Bombax*, *Ceiba*), Moraceae (*Chlorophora*), Apocynaceae (*Aspidosperma*), Rutaceae (*Fagara*), Fabaceae (*Machaerium*, *Platymiscium*), Mimoseae (*Pithecollobium*).

(Herzog, 1923: 110-129; Parker *et al.*, 1982: 16; Schnell, 1987a: 397-399; Hueck and Seibert, 1972, 1981: unit 47 *p.*; Hueck, 1978: 294-299).

48.23 Pre-Andean semideciduous forests

Seasonal semideciduous forests of the piedmont and lower slopes, up to about 500-600 metres, of the Andes of northern Argentina and Bolivia, north to northeastern Cochabamba, forming the transition between montane evergreen or semideciduous forests of the yungas and dry woodland of the western Chaco or savannas of the Mojos, developed under climatic conditions characterized by an annual rainfall of the order of 1000 mm, with a pronounced dry season and heavy, monsoon-like summer rains. They constitute one of the most threatened major forest types in South America.
(Herzog, 1923: 81-83, 106, 107, 108, 116-129, 129-133; Meyer, 1963: 12; Digilio and Legname, 1966: X-XIII; Ragonese and Castiglioni, 1968: 155; Hueck and Seibert, 1972, 1981: unit 36; Hueck, 1978: 260, 270-273; Vervoorst, 1982: 10, 14-16; Santos Biloni, 1990: XI-XII; Vila and Bertonatti, 1993: 59-60; Burkart *et al.*, 1994: 24; Brown, 1995: 109, 110, 114; Erize *et al.*, 1995: 49, 56; Gentry, 1995: 149, 152-153).

48.231 Tucumano-Saltenian transition forests

Seasonal semideciduous forests of the piedmont and lower slopes, up to about 500-600 metres, of the Andes of Tucuman and southern Salta, represented, in particular, within El Rey National Park, dominated by the Fabaceae *Tipuana tipu*, *Enterolobium contortisiliquum* and the Mimoseae *Anadenanthera macrocarpa*, accompanied by the Rutaceae *Fagara coco*, Ramnaceae *Scutia buxifolia*, the Bombacaceae *Chorisia insignis*, the Sapindaceae *Allophylus edulis*, the Bignoniaceae *Jacaranda mimosifolia* and the Myrtaceae *Eugenia uniflora*.
(Meyer, 1963: 12; Digilio and Legname, 1966: X-XIII; Ragonese and Castiglioni, 1968: 155; Hueck and Seibert, 1972, 1981: unit 36 *p.*; Hueck, 1978: 260, 270-273; Vervoorst, 1982: 10, 14-16; Santos Biloni, 1990: XI-XII; Burkart *et al.*, 1994: 24; Brown, 1995: 109, 110, 114; Erize *et al.*, 1995: 49).

48.232 Salteno-Bolivian transition forests

Seasonal semideciduous forests of the piedmont and lower slopes, up to about 500-600 metres, of the Andes of Jujuy, northern Salta and southern Bolivia, south of the Pilcomayo, represented, in particular, within Calilegua National Park, dominated by the Rubiaceae *Calycophyllum multiflorum* and the Ulmaceae *Phyllostylon rhamnoides*, accompanied by Mimoseae (*Adenantera macrocarpa* and *Parapiptadenia excelsa*), Moraceae (*Chlorophora tinctoria*), Boraginaceae (*Patagonula americana*), Bignoniaceae (*Jacaranda mimosifolia*, *Tabebuia avellanedae* and the threatened *Tabebuia lapacho*), with, among the emergents, the very tall Meliaceae *Cedrela angustifolia* and Fabaceae *Myroxylon peruiferum* and *Tipuana tipu*.
(Herzog, 1923: 107; Ragonese and Castiglioni, 1968: 153-154; Hueck and Seibert, 1972, 1981: units 36 *p.*; Hueck, 1978: 260, 270-273; Vervoorst, 1982: 10, 14-16; Santos Biloni, 1990: XI-XII; Vila and Bertonatti, 1993: 59-60; Chebez, 1994: 496; Burkart *et al.*, 1994: 24; Heinonen and Boso, 1994: 52, 55; Brown, 1995: 109, 110, 114; Erize *et al.*, 1995: 49, 56).

48.233 Southern Santacruzian pre-Andean semideciduous forests

Seasonal semideciduous forests of the piedmont and lower slopes of the Andes of Bolivia, between the Rio Pilcomayo and the Rio Piray, at the bend of the Andes, in particular, of the basin of the Rio Grande, forming a relatively broad belt between the northern Chaco dry woodlands and the northern section of the Tucumano-Bolivian montane laurel forests, with outposts in the extreme northern Chaco and the southern part of the Santa Cruz savannas, between the Rio Piray and the Rio Grande and between the Rio Grande and the Rio San Miguel.
(Herzog, 1923: 108, 116; Hueck and Seibert, 1972, 1981: unit 36 *p.*; Hueck, 1978: 260, 270-273).

48.234 Northern Santacruzian pre-Andean semideciduous forests

Seasonal semideciduous forests of the piedmont and lower slopes of the Andes of Bolivia, between the Rio Piray, at the bend of the Andes, and the Secure-Isibara interfluve, near the northern border of the department of Cochabamba, developed in a premontane belt located between the Mojos savannas and the southernmost extension of the central Andean montane forests, composing in the lowlands and hills a mosaïc with savanna grasslands, less tall savanna woodlands of unit 48.22, of more southern Brazilian affinities, and sub-Amazonian riverine gallery forest. Fabaceae (*Tipuana*, *Myroxylon*), Mimoseae (*Piptadenia*), Rubiaceae (*Calycophyllum*), Meliaceae *Cedrela*, are prominent, but, in contrast with southern communities of unit 48.23, palms are an important component of the tree stata, in particular, *Attalea princeps* and *Chamaedora lanceolata*.
(Herzog, 1923: 107; Hueck and Seibert, 1972, 1981: unit 36 *p.*; Hueck, 1978: 260, 270-273, 297).

48.24 Chaco-Paranean semideciduous forests
Subtropical mesoxerophile and single-dominance hygrophile forests of southern Brazil, eastern Paraguay and northeastern Argentina, in the eastern humid Chaco and the pre-Misioneran campos, characterized by single-species dominance of deciduous species, accompanied by a ligneous cortège shared with the semievergreen forests of the same regions, though much impoverished, or by mixed, relatively few, species dominance of mostly deciduous, predominantly Chacoan, species, with a smaller admixture of Misioneran species.
(Martinez-Crovetto, 1963; Ragonese and Castiglioni, 1968: 144-145; Hueck and Seibert, 1972, 1981: unit 35 *p.*; Morello and Adamoli, 1974; Hueck, 1978: 267; Eskuche, 1982: 45; Laclau, 1994: 15-16, 26; Carnevali, 1994; Burkart *et al.*, 1994: 8; Erize *et al.*, 1995: 71-72).

48.241 Chacoan mixed semideciduous forests
Subtropical mesoxerophile, oligarchic forests of the humid Chaco, medium tall, with two tree storeys, constituting communities of transition between hygrophytic forests and the xerophytic *Shinopsis balansae* woodland.
(Ragonese and Castiglioni, 1968: 144-145; Hueck and Seibert, 1972, 1981: unit 35 *p.*; Morello and Adamoli, 1974; Hueck, 1978: 267; Eskuche, 1982: 45; Carnevali, 1994: unit 31; Burkart *et al.*, 1994: 8; Erize *et al.*, 1995: 71-72).

48.2411 Corriento-Chacoan mesoxerophile tall forests
Subtropical mesoxerophile, oligarchic forests of the humid Chaco of Corrientes, medium tall, with two tree storeys, the upper formed by the Polygonaceae *Ruprechtia laxiflora*, the Sapotaceae *Bumelia obtusifolia*, the Caesalpiniaceae *Gleditsia amorphoides*, the Bignoniaceae *Tabebuia heptaphylla*, the Phytolacaceae *Phytolacca dioica*, the Moraceae *Maclura tinctoria*, the Tiliaceae *Luhea divaricata*, the Mimoseae *Enterolobium contortisiliquum*, and the palm *Arcastrum romanzoffianum*.
(Eskuche, 1982: 45; Carnevali, 1994: unit 31).

48.2412 Formoso-Chacoan mesoxerophile tall forests
Subtropical mesoxerophile, oligarchic forests of the north-eastern humid Chaco of Chaco Province and Formosa, medium tall, with two tree storeys, formed by the Anacardiaceae *Astronium balansae*, the Sapindaceae *Diplokeleba floribunda*, the Caesalpiniaceae *Caesalpinia paraguariensis*, the Bignoniaceae *Tabebuia ipe*, the Boraginaceae *Patagonula americana*, the Apocynaceae *Aspidosperma quebracho-blanco*.
(Morello and Adamoli, 1974: 46, 103, 108; Hueck, 1978: 267; Eskuche, 1982: 45).

48.242 Urunday woodland
Forests of western Misiones, the Campos district of north-eastern Argentina, southern Brazil and southern Paraguay, in humid Chaco and the region of transition between Paranean forests and the Chaco, dominated by the deciduous *Astronium balansae*, in more or less pure stands.
(Martinez-Crovetto, 1963; Morello and Adamoli, 1974: 6, 108; Eskuche, 1982: 45; Laclau, 1994: 15-16, 26; Carnevali, 1994: unit 70).

48.2421 Misioneran urunday forests
Forests of western Misiones, the Campos district of Corrientes, southern Brazil and southern Paraguay in the region of transition between Paranean forests and the Chaco, dominated by the deciduous *Astronium balansae*, in more or less pure stands.
(Martinez-Crovetto, 1963: 188-189; Laclau, 1994: 15, 26; Carnevali, 1994: unit 70).

48.2422 Chacoan urunday forests
Forests of the Eastern Chaco, in particular of the depressed Chaco, dominated by the deciduous *Astronium balansae*, in more or less pure stands.
(Morello and Adamoli, 1974: 6, 108).

48.243 Misioneran timbo forests
Forest patches of the Campos of eastern Misiones, western Corrientes, southern Brazil and southern Paraguay in the region of transition between Paranean forests and the Chaco, dominated by the deciduous *Enterolobium contortisiliquum*, in more or less pure stands.
(Martinez-Crovetto, 1963: 203-204; Laclau, 1994: 15-16, 26).

48.25 Atlantic semideciduous forests

Seasonal semideciduous forests of the eastern Brazilian shield, fringing the Atlantic evergreen and semievergreen rain forests or occupying favourable sites within the Agreste, the Caatinga and the western Cerrado, in Baia, northeaster Minas Gerais, Espirito Santo, Sergipe, Alagoas, Pernambuco and Paraiba, with, in particular, *Basiloxylon brasiliense*, *Bombax gracilipes*, *Cordia spp.*, *Machaerium spp.*, *Platymenia foliosa* and an undergrowth including tall, 3-4 metres high bromeliads. These forests have been reduced to a very few, often degraded, stands.
(Birot, 1970: 104, unit 3 *p.*; Schnell, 1987a: 279-281; Schnell, 1987b: 20-21; Hueck and Seibert, 1972, 1981: unit 29 *p.*; Hueck, 1978: 339-340; Renvoize, 1984: 7; Lewis, 1987: 6, 10).

48.26 Paraneo-Amazonian palm groves
Palm groves and palm forests of the seasonal semideciduous forest zone of the western Brazilian shield and its periphery, in the interfluve between the Amazonian and Paranean river systems. They are formed principally by palms of genera *Attalea* (*Orbygnia*), *Mauritia*, *Acrocomia*, accompanied by an undergrowth characteristic of mesophytic semideciduous forests, with a substantial representation of species of Amazonian or Paranean affinities.
(Schnell, 1987a: 380, 382, 397; Hueck and Seibert, 1972, 1981: units 29 *p.*, 30, 31, 47 *p.*, 58 *p.*; Hueck, 1978: 294-301, 315-319; Loureiro *et al.*, 1982).

48.261 Paraneo-Amazonian *Attalea* palm groves
Attalea phalerata (*Orbygnia phalerata*)- or *Attalea princeps*-dominated palm groves and palm forests of the seasonal semideciduous forest zone of the western Brazilian shield and its periphery, characteristic in particular of the Santa Cruz-Trinidad savanna region, of the Chiquitos plateau of northeastern Bolivia and of the periphery of the Pantanal.
(Hueck and Seibert, 1972, 1981: units 29 *p.*, 30, 31, 47 *p.*, 58 *p.*; Hueck, 1978: 297, 298; Loureiro *et al.*, 1982: 341, 344).

48.262 Paraneo-Amazonian *Acrocomia* palm groves
Acrocomia totai-dominated palm groves and palm forests of the seasonal semideciduous forest zone of the western Brazilian shield and its periphery, characteristic in particular of the Santa Cruz-Trinidad savanna region of northeastern Bolivia and the periphery of the Pantanal.
(Schnell, 1987a: 397; Hueck and Seibert, 1972, 1981: units 29 *p.*, 30, 31, 47 *p.*, 58 *p.*; Hueck, 1978: 297, 298; Loureiro *et al.*, 1982: 344).

48.3 Pacific semideciduous forests

Seasonal semideciduous forests of the southern fringes of the evergreen forest zone of the Pacific lowlands of northern South America, principally located in southern Ecuador and northern Peru, extending south to 8°S, dominated by Bombacaceae of genus *Bombax* (*Ceiba*) accompanied by Burseraceae (*Bursera*), Fabaceae (*Erythrina*), Bignoniaceae (*Tabebuia*), Anacardiaceae (*Loxopterygium huasango*) and various other Bombacaceae, with an abundant epiphytic growth of *Tillandsia*.
(Koepcke, 1961: 193-194; Birot, 1970: 104, unit 4 *p.*; Hueck and Seibert, 1972, 1981: units 23, 33, *p.*; Hueck, 1978: 153-166, 199-222, 294-301, 315-319, 339-340; Parker *et al.*, 1982: 24; Schnell, 1987a: 274; Parker and Carr, 1992; Maître *et al.*, 1993: 22).

49. TROPICAL MONTANE FORESTS

Forests of the slopes of tropical mountains, less species-rich, lower, more even-canopied than lowland rain forests, richer in microphyllous, cool-adapted species, often loaded with bryophytes and ferns. Included are lower montane rain forests, upper montane rain forests, tropical coniferous woodland, montane bamboo woodland, elfin forests, "tropical krummholz" formations.
(Koepcke, 1961: 154-160, 160-165, 165-173, 173-178; Troll, 1968; Lauer, 1968; Czajka, 1968; Schnell, 1971; Hueck and Seibert, 1972, 1981: units 16, 17-19, 20-22, 25, 27, 84 *p.*; Letouzey, 1978; Whitmore, 1978, 1989, 1992; Prance, 1982, 1989; Schnell, 1987a, 1987b; Huber and Alarcon, 1988; Ridgely and Tudor, 1989; Rieley and Page, 1990; Maître *et al.*, 1993: 5-24; Doumenge *et al.*, 1995; Henderson, 1995; Hamilton *et al.*, 1995; Long, 1995; Brown, 1995; de Barcellos Falkenberg and Voltolini, 1995; Flenley, 1995; Ohsawa, 1995; Harley, 1995; Huber, 1995).

49.1 Tropical Andean montane forests

Lower montane rain forests, upper montane rain forests, cloud forests, montane deciduous woodland, montane conifer woodland, elfin forests of the tropical Andes.
(Koepcke, 1961: 154-160, 160-165, 165-173, 173-178; Troll, 1968; Lauer, 1968; Czajka, 1968; Hueck and Seibert, 1972, 1981: units 16 *p.*, 17-19, 20-22, 84 *p.*; Letouzey, 1978; Prance, 1982, 1989; Schnell, 1987a, 1987b; Ridgely and Tudor, 1989; Maître *et al.*, 1993: 5-24; Doumenge *et al.*, 1995; Henderson, 1995; Hamilton *et al.*, 1995; Long, 1995; Brown, 1995).

49.11 Southern Andean montane tropical mixed forests
Multilayered, species-rich evergreen, semievergreen or semideciduous montane and cloud forests of the eastern flank of the southern tropical Andes, extending from the Andean bend in Bolivia, at about 18°S latitude, to Tucuman, at about 28°S, at altitudes above 500-600 metres.
(Herzog, 1923: 129-139; Meyer, 1963; Digilio and Legname, 1966: X-XIII; Hueck and Seibert, 1972, 1981: units 17, 20 *p.*; Hueck, 1978: 260, 270-273; Vervoorst, 1982: 10, 14-16; Schnell, 1987b: 130-131; Santos Biloni, 1990: XI-XII; Brown and Grau, 1993; Vila and Bertonatti, 1993: 59-60; Burkart *et al.*, 1994: 24; Brown, 1995: 109, 110, 114; Erize *et al.*, 1995: 49, 56).

49.111 Tucumano-Bolivian laurel forests
Lower montane semievergreen or semideciduous lauriphyllous rain forests developed between 600 and 900 metres on the eastern slope of the Andes between Santa Cruz, Bolivia, and Tucuman, extending to eastern Catamarca, dominated by the Lauraceae *Phoebe porphyria*, accompanied by the Meliaceae *Cedrela lilloi*, *Cedrela angustifolia* (*Cedrela balansae*), the Myrtaceae *Blepharocalyx gigantea*, the Juglandaceae *Juglans australis*, the Bignoniaceae *Jacaranda mimosifolia*, *Tabebuia avellanedae*, the Boraginaceae *Patagonula americana*, the Araliaceae *Pentapanax angelifolius*, the Sapindaceae *Cupania vernalis*, the Myrsinaceae *Rapanea laetevirens*, *Rapanea ferruginea*, the Fabaceae *Cascaronia astragalina*, the Rutaceae *Fagara coco*, with a dense species-rich undergrowth and abundant epiphytes and vines.
(Herzog, 1923: 129-139; Meyer, 1963; Digilio and Legname, 1966: X-XIII; Hueck and Seibert, 1972, 1981: unit 17; Hueck, 1978: 104-107; Vervoorst, 1982: 11-12; Schnell, 1987b: 130-131; Santos Biloni, 1990: XII; Burkart *et al.*, 1994: 24; Heinonen and Boso, 1994: 52, 55; Brown, 1995: 109-111, 114; Erize *et al.*, 1995: 49, 56).

49.1111 Jujeno-Bolivian laurel forests
Subtropical montane semievergreen or semideciduous laurel forests of the eastern slope of the Andes of southern Bolivia, northwestern Salta and Jujuy south to the Zapla hills, constituting the northern section of the lower montane yunga forest of the southern tropical Andes, represented, in particular, within Calilegua and Baritu National Parks. Characteristic tree species include the Lauraceae *Nectandra pichurim*, the Meliaceae *Cedrela angustifolia* (*Cedrela balansae*), the Bignoniaceae *Tabebuia lapacho*, the Sapindaceae *Athyanna weinmanifolia*, the Fabaceae *Amburana cearensis*,

Lonchocharpus lilloi , the Moraceae *Ficus maroma*, the Euphorbiaceae *Croton densiflorus*, the Melastomataceae *Miconia molybdea*. Epiphytes are numerous, mostly bromeliads, including the endemic *Vriesia icterica*, orchids (*Epidendron*, *Isochilus*) and ferns. The undergrowth is dominated by ferns, heliconias and bamboos.
(Herzog, 1923: 129-139; Hueck and Seibert, 1972, 1981: unit 17; Hueck, 1978: 104-107; Vervoorst, 1982: 11-12; Ramadori, 1987: 10-15; Santos Biloni, 1990: XII; Burkart *et al.*, 1994: 24; Heinonen and Boso, 1994: 52, 55; Brown, 1995: 109-111, 114; Erize *et al.*, 1995: 49, 56).

49.1112 Salto-Jujenian laurel forests
Subtropical montane semievergreen or semideciduous laurel forests of the eastern Andean Sierra de Chani system, between the Quebrada de Humahuaca and the Quebrada del Toro, and of the isolated Sierra de la Cresta del Gallo-Sierra del Maiz Gordo system in southeastern Jujuy and central Salta, constituting the central section of the lower montane yunga forest of the southern tropical Andes, represented, in particular, within El Rey National Park, dominated, in the upper storey, by *Phoebe porphyria*, *Tipuana tipu* and *Patagonula americana*, the latter reaching in this unit the southern limit of its range, as do *Trichilia hyeronimii*, *Ocotea puberula*, *Myroxylon peruiferum*.
(Hueck and Seibert, 1972, 1981: unit 17; Hueck, 1978: 104-107; Vervoorst, 1982: 11-12; Santos Biloni, 1990: XII; Babarskas *et al.*, 1993: 2; Burkart *et al.*, 1994: 24; Brown, 1995: 109-111; Erize *et al.*, 1995: 49, 55-56).

49.1113 Tucumano-Saltenian laurel forests
Subtropical montane semievergreen or semideciduous laurel forests developed between 500 and 800 metres on the eastern slope of the Andes of southern Salta, Tucuman and eastern Catamarca, constituting the southern section of the lower montane yunga forest of the southern tropical Andes.
(Meyer, 1963; Digilio and Legname, 1966: X-XIII; Hueck and Seibert, 1972, 1981: unit 17; Hueck, 1978: 104-107; Vervoorst, 1982: 11-12; Santos Biloni, 1990: XII; Burkart *et al.*, 1994: 24; Brown, 1995: 109-111; Erize *et al.*, 1995: 49).

49.112 Tucumano-Bolivian myrtle forests
Evergreen or semievergreen cloud forests of the middle slopes of the eastern Andes of southern Bolivia and northern Argentina, constituting the upper segment of the mixed-species montane forests, at altitudes of 800-1000 metres to 1400-1700 metres, rich in Myrtaceae, with an abundance of epiphytic mosses and ferns, generally, but not always, well individualized from the laurel forests of lower altitudes.
(Herzog, 1923: 129-139; Meyer, 1963; Digilio and Legname, 1966: X-XIII; Hueck and Seibert, 1972, 1981: unit 20 *p.*; Hueck, 1978: 106-107; Vervoorst, 1982: 11-12; Schnell, 1987b: 130-131; Ramadori, 1987: 10-15; Babarskas *et al.*, 1993: 2; Heinonen and Boso, 1994: 52, 55; Brown, 1995: 110-111, 114; Erize *et al.*, 1995: 49-50, 56).

49.1121 Jujeno-Bolivian myrtle forests
Evergreen or semievergreen Myrtaceae-rich mixed-species cloud forests of the middle eastern slopes of the Andes of southern Bolivia, northwestern Salta and Jujuy, south to the Zapla hills, constituting the northern section of the upper montane yungas forest of the southern tropical Andes, represented, in particular, within Calilegua and Baritu National Parks, at altitudes of 1100 to 1700 metres.
(Herzog, 1923: 129-139; Hueck and Seibert, 1972, 1981: unit 20 *p.*; Ramadori, 1987: 10-15; Heinonen and Boso, 1994: 52, 55; Brown, 1995: 110-111, 114; Erize *et al.*, 1995: 49-50, 56).

49.11211 Jujeno-Bolivian upper myrtle forests
Evergreen or semievergreen Myrtaceae-rich mixed-species cloud forests of the middle eastern slopes of the Andes of southern Bolivia, northwestern Salta and Jujuy, at altitudes of 1300 to 1700 metres, with tall, over 40 metres, sparse, emergent tree stratum formed by *Cedrela spp.*, an upper semicontinuous, 30 metre tall, tree stratum dominated by *Tabebuia lapacho* and *Juglans australis*, a lower, 20 metre tall, tree stratum dominated by Myrtaceae and Solanaceae of genus *Brumfelsia*.
(Ramadori, 1987: 10-11).

49.11212 Jujeno-Bolivian lower myrtle forests
Evergreen or semievergreen Myrtaceae-rich mixed-species cloud forests of the middle eastern slopes of the Andes of southern Bolivia, northwestern Salta and Jujuy, developed in the transition zone between the upper myrtle forests of unit 49.11211 and the laurel forests of unit 49.111, at altitudes of 1100 to 1300 metres, in which the emergent stratum is formed by *Tipuala tipu*, the continuous upper stratum is richer in Lauraceae of genera *Ocotea* and *Phoebe* associated with *Parapiptadenia excelsa*

and lower *Tipuala tipu*; the lower tree stratum has *Croton spp.*, *Bocconia spp.* associated with the Myrtaceae.
(Ramadori, 1987: 11-12).

49.11213 Jujeno-Bolivian tree-fern groves
Formations of the myrtle cloud forest belt of the middle eastern slopes of the Andes of southern Bolivia, northwestern Salta and Jujuy dominated by tree ferns of genus *Nephelea* in pure, 8 metre tall stands, restricted to the altitudinal belt of 1200 to 1500 metres.
(Herzog, 1923: 129-139; Vervoorst, 1982: 11; Ramadori, 1987: 12-13).

49.1122 Salto-Jujenian myrtle forests
Evergreen or semievergreen Myrtaceae-rich cloud forests of the middle slopes of the eastern Andean Sierra de Chani system, between the Quebrada de Humahuaca and the Quebrada del Toro, and of the isolated Sierra de la Cresta del Gallo-Sierra del Maiz Gordo system in southeastern Jujuy and central Salta, constituting the central section of the upper montane yunga forest of the southern tropical Andes, represented, in particular, within El Rey National Park, at altitudes of 800-900 metres to 1500 metres, with *Cedrela lilloi*, *Blepharocalyx gigantea*, *Juglans australis*, *Eugenia uniflora*.
(Hueck and Seibert, 1972, 1981: unit 20 *p.*; Babarskas *et al.*, 1993: 2; Brown, 1995: 110-111, 114; Erize *et al.*, 1995: 49-50, 56).

49.1123 Tucumano-Saltenian myrtle forests
Evergreen or semievergreen cloud forests developed between 800 and 1400 metres on the eastern slope of the Andes of southern Salta, Tucuman and eastern Catamarca, constituting the southern section of the upper montane yunga forest of the southern tropical Andes. Myrtaceae are prominent in all strata, *Blepharocalyx gigantea* and *Pseudocariophyllus guili*, among the emergents, *Eugenia pungens*, *Eugenia pseudomato* in a second, 10-15 metre tall, tree stratum, *Eugenia mato* and *Myrrhinium rubiflorum* in the third, 5-10 metre tall, tree stratum. Accompanying trees include the laurel *Phoebe porphyria* and the cedrellas *Cedrela angustifolia* and *Cedrela lilloi* among the emergents, the Myrsinaceae *Rapanea ferruginea*, *Rapanea laetevirens*, the Aquifoliaceae *Ilex argentina*, the Sapindaceae *Cupania vernalis* in the second tree stratum, the Sapindaceae *Allophylus aedulis*, Styracaceae *Styrax subargenteus*, the Piperaceae *Piper tucumanum* and *Piper hieronymi* in the third tree stratum. The nettles *Boehmeria caudata* and *Urera caracasana*, the tall fern *Pteris deflexa*, the bamboo *Chusquea lorentziana*, the fuchsia *Fuchsia boliviana* are prominent in the undergrowth. The profuse epiphytes include bromeliads (*Aechmea distichanta*, *Tillandsia maxima*, *Tillandsia usneoides*, *Tillandsia spp.*), ferns (*Phlebodium aureum*, *Polypodium tweedianum*, *Polypodium aglaolepis*, *Asplenium spp.*, *Elaphoglossum spp.*, *Campyloneurum lorentzii*, *Hymenophyllum spp.*), orchids (*Malaxis padilliana*, *Govenia tinguens*, *Oncidium viperinum*), begonias (*Begonia micrantha*, *Begonia cucullata*), Araceae (*Asterostigma vermicida*), Piperaceae (*Peperomia spp.*), flat-stemmed cacti (*Rhipsalis lorentziana*, *Rhipsalis tucumanensis*), mosses (*Piltotrichella versicolor*, *Meteoropsis onusta*), lichens (*Parmelia cirrhata*). The numerous climbers and lianas include Bignoniaceae (*Bignonia unguiscati*), Tropeolaceae, Apocinaceae (*Mandevilla laxa*), Vitaceae (*Cissus striatus*), Cucurbitaceae (*Sicyos polyacanthus*, *Sicyos odonelli*, *Cyclanthera thamnifolia*), Ulmaceae (*Celtis triflora*).
(Meyer, 1963: 48-90; Digilio and Legname, 1966: X-XIII; Hueck and Seibert, 1972, 1981: unit 20 *p.*; Brown, 1995: 110-111, 114; Erize *et al.*, 1995: 49-50).

49.12 Central Andean montane tropical mixed forests
Multilayered, species-rich evergreen, semievergreen or semideciduous cloud and transition forests of the central tropical Andes, extending from the Huancabamba depression, at about 5° S, to the Andean bend, at about 18° S latitude, on the eastern flank of the chain, limited to northern Peru on the western flank.
(Herzog, 1923: 183-204; Koepcke, 1961: 154-160, 160-165, 165-173, 173-178; Troll, 1968; Czajka, 1968; Hueck and Seibert, 1972, 1981: units 18, 21; Hueck, 1978: 118-123; Schnell, 1987b; Maître *et al.*, 1993: 5-24; Doumenge *et al.*, 1995; Long, 1995; Leo, 1995).

49.121 Central eastern Andean montane tropical mixed forests
Multilayered, species-rich evergreen, semievergreen or semideciduous cloud and transition forests of the eastern flank of the central tropical Andes, extending from the Huancabamba depression, at about 5° S to the Andean bend, at about 18°S latitude.
(Herzog, 1923: 183-204; Hueck and Seibert, 1972: units 18, 21; Hueck, 1978: 118-124).

49.1211 Central Bolivian yungas mixed forests
Multilayered, species-rich evergreen, semievergreen or semideciduous cloud and transition forests of the eastern flank of the central tropical Andes of Bolivia, north of the Andean bend.
(Herzog, 1923: 183-204; Hueck and Seibert, 1972, 1981: units 18, 21; Hueck, 1978: 118-122).

49.12111 Central Bolivian lower yungas forests
Multi-layered, species-rich evergreen lower yungas transition forests of the eastern flank of the central tropical Andes of Bolivia, north of the Andean bend, with many similarities to hylaea forests which they prolong into Andean valleys up to about 2000 metres altitude, differing from the closely related yungas forests of the Tucumano-Bolivian region south of the Andean bend by the abundance of large palms of genera *Iriartea*, *Martinesia*, *Geonoma*, *Chamaedora*, by a greater diversity and prevalence of trees of Lauraceae genera, in particular, *Endlicheria*, *Hufelandia*, *Nectandra*, *Ocotea* and *Phoebe*, similar to them in having an abundant epiphyte flora of pteridophytes, bromeliads and orchids. These forests are the original habitat of *Chinchona callisaya*.
(Herzog, 1923: 183-204; Hueck and Seibert, 1972, 1981: unit 18; Hueck, 1978: 119-120).

49.12112 Central Bolivian upper yungas forests
Multilayered, species-rich evergreen or semievergreen medio-yungas cloud forests of the 2000-2800 metre level of the eastern flank of the central tropical Andes of Bolivia, north of the Andean bend, located in the belt of maximum atmospheric humidity generated by lingering cloud masses, with *Oreopanax spp.*, *Trichilia multiflora*, *Miconia spp.*, *Tibouchina spp.*, *Cecropia spp.*, numerous tree ferns, and a profusion of mosses and epiphytes covering both trees and rocks.
(Herzog, 1923: 183-204; Hueck and Seibert, 1972: unit 21 *p.*; Hueck, 1978: 121; Schnell, 1987b: 128).

49.12113 Central Bolivian ceja forests
Evergreen or semievergreen, relatively low-growing ceja forests of the 2800-3400 metre level of the eastern flank of the central tropical Andes of Bolivia, north of the Andean bend, with a prevalence of microphyllous trees, in particular, *Podocarpus nubigenus*, *Oreopanax artocarpoides*, *Clusia pseudomangle*, *Centropogon gloriosus*, *Weinmannia fagaroides*, *Mutisia bipontina*, Myrtaceae (*Myrteola microphylla*), Melastomaceae, Ericaceae (*Gaultheria spp.*), *Fuchsia spp.*. The upper levels of ceja forests include elfin and dwarf forests belonging to unit 49.16.
(Herzog, 1923: 183-204; Hueck and Seibert, 1972, 1981: unit 21 *p.*; Hueck, 1978: 121; Schnell, 1987b: 129).

49.1212 Peruvian montana and ceja forests
Multilayered, species-rich evergreen, semievergreen or semideciduous cloud and transition forests of the eastern flank of the central tropical Andes of Peru.
(Hueck and Seibert, 1972, 1981: units 18, 21; Hueck, 1978: 122-124; Schnell, 1987b: 126-127).

49.12121 Peruvian humid lower montana forests
Multi-layered, species-rich evergreen lower montana forests of the eastern flank of the central tropical Andes of Peru, with even greater similarity to hylaea forests than those of Bolivia, very rich in large palms of genera *Iriartea*, *Astrocaryum*, *Phytelephas*, *Bactris*, harbouring Cyclanthaceae (*Cyclanthus spp.*, *Carludovica palmata*), abundant lianas, epiphytes and lichens.
(Hueck and Seibert, 1972, 1981: unit 18; Hueck, 1978: 122-123; Schnell, 1987b: 126).

49.12122 Peruvian humid upper montana forests
Multilayered, species-rich evergreen or semievergreen forests of the upper levels of the montana belt, up to about 2000 metres, of the eastern flank of the central tropical Andes of Peru.
(Hueck and Seibert, 1972, 1981: unit 21; Hueck, 1978: 123).

49.12123 Peruvian ceja forests
Evergreen or semievergreen, relatively low-growing ceja forests of the 1800-2000 to 3400-3600, sometimes 3900, metre level of the eastern flank of the central tropical Andes of Peru, very similar to those of Bolivia, with microphyllous, xerophyllous, evergreen or, rarely, deciduous trees of 10-12 metre height, with twisted trunks covered with mosses and other epiphytes. The species cortège includes *Podocarpus oleifolius*, *Podocarpus glomeratus*, *Ceroxylon spp.*, *Chusquea spp.*, *Drimys spp.*, *Weinmania spp.*, Ericaceae (*Befaria*), *Ilex spp.*, *Gaiadendron spp.*, Lauraceae (*Endlicheria anomala*), *Bocconia integrifolia*, *Ribes spp.*, *Scallonia spp.*, *Berberis spp.*, *Hedyosmum spp.*, Proteaceae

(*Oreocallis grandiflora*), Araliaceae, Melastomaceae, Clethraceae, Gesneriaceae, *Fuchsia spp.*, *Viburnum spp.*, *Sambucus spp.*, *Gunnera spp.*. Large palms are absent.
(Hueck and Seibert, 1972, 1981: units 21; Hueck, 1978: 123-124; Schnell, 1987b: 127).

49.122 Central western Andean montane tropical mixed forests
Multispecific evergreen or semievergreen cloud and transition forests of the western flank of the central tropical Andes of northern Peru, extending south to Arequipa, in increasingly fragmented altitudinal belts.
(Hueck and Seibert, 1972: units 18, 21; Koepcke, 1961: 154-160, 160-162, 162-165).

49.1221 Central western Andean lower montane forests
Multi-specific mesothermic evergreen forests of lower slopes of the western flank of the central tropical Andes of northern Peru, southern, fragmented extension of the lower montane forests of southern Ecuador.
(Koepcke, 1961: 154-160).

49.1222 Central western Andean cloud forests
Multi-specific evergreen forests of the cloud-lingering level of the western flank of the central tropical Andes of northern Peru, fairly species-poor, rich in tree ferns, bryophytes and epiphytes, forming a transition belt between the lower montane forests of unit 49.1221 and the upper montane forests of unit 49.1223.
(Koepcke, 1961: 160-162).

49.1223 Central western Andean *Eugenia* ceja forests
Multi-specific oligothermic evergreen forests of the upper slopes of the western flank of the central tropical Andes of northern Peru, extending south to Arequipa, in increasingly isolated fragments formed by *Drimys spp.*, *Eugenia spp.*, *Ocotea architectorum*, *Podocarpus oleifolius*, *Weinmannia spp.*.

(Koepcke, 1961: 162-165).

49.123 Central inner Andean montane xeric woodlands
Montane forests of dry inner valleys of the Peruvian Andes, fairly open and xerophytic, comprising, in particular, montana open dry woods formed by spaced trees that include the Sapindaceae *Dilodendron bipinnatum*, the Tiliaceae *Luehea paniculata*, Bignoniaceae of genus *Cybistax*, Bombacaceae and Fabales accompanied by shrubs, in particular, *Dodonaea viscosa*, *Trema micrantha*, and species of genera *Curatella*, *Vernonia*, *Jatropha*, *Croton*, as well as xerocline or xerophile ceja forests with a flora characterized by west Andean affinities.
(Hueck, 1978: 123; Schnell, 1987b: 126-127, 127).

49.13 Northern Andean montane mixed forests
Multilayered, species-rich evergreen, semievergreen or semideciduous cloud and transition forests of the northern tropical Andes, north of the Huancabamba depression, at about 5° S, in Colombia, Ecuador and Venezuela.
(Cuatrecasas, 1954a; Troll, 1968; Lauer, 1968; Czajka, 1968; Hueck and Seibert, 1972, 1981: units 18 *p.*, 19, 21 *p.*, 22 *p.*; Schnell, 1987b: 76-81; Doumenge *et al.*, 1995; Long, 1995; Sarmiento, 1995).

49.131 Ecuadorian Andean forests
Species-rich evergreen, semievergreen or semideciduous cloud, montane and transition forests of the southern section of the northern tropical Andes, between the Huancabamba depression, at about 5° S, and the Cumbal range, at about 1° N, in the north.
(Czajka, 1968; Hueck and Seibert, 1972, 1981: units 18 *p.*, 21 *p.*; Schnell, 1987b: 76-81; Sarmiento, 1995).

49.1311 Ecuadorian eastern Andean forests
Multilayered, species-rich evergreen, semievergreen or semideciduous cloud and transition forests of the eastern slope of the southern section of the northern tropical, paramo, Andes in Ecuador and southern Colombia, north to the flanks of the Cerrado de Leiva and the Macarena range.
(Czajka, 1968; Hueck and Seibert, 1972, 1981: units 18 *p.*, 21 *p.*; Schnell, 1987b: 76-81; Sarmiento, 1995).

49.13111 Ecuadorian eastern Andean lower montane rain forests

Evergreen rain forests of the lower middle slopes of the eastern flank of the northern tropical Andes of Ecuador and southern Colombia, north to the flanks of the Cerrado de Leiva and the Macarena range, closely related to lowland western Amazonian forests.
(Hueck and Seibert, 1972, 1981: units 18 *p.*, 19; Hueck, 1978: 124-125; Schnell, 1987b: 81).

49.13112 Ecuadorian eastern Andean upper montane rain forests
Evergreen rain forests of the upper middle slopes of the eastern flank of the northern tropical Andes of Ecuador and southern Colombia, north to the flanks of the Cerrado de Leiva and the Macarena range.
(Hueck and Seibert, 1972, 1981: units 21 *p.*, 22 *p.*; Hueck, 1978: 124-125; Schnell, 1987b: 81).

49.13113 Ecuadorian eastern Andean cloud forests
Evergreen or semievergreen ceja cloud forests of the upper slopes of the eastern flank of the northern tropical Andes of Ecuador and southern Colombia, north to the flanks of the Cerrado de Leiva and the Macarena range, very similar to those of Peru.
(Hueck and Seibert, 1972, 1981: units 21 *p.*, 22 *p.*; Hueck, 1978: 124-125; Schnell, 1987b: 81).

49.1312 Western Ecuadorian montane wet forests
Multilayered, species-rich evergreen, semievergreen or semideciduous cloud and transition forests of the western slope of the northern tropical Andes of Ecuador and extreme southern Colombia, north to the Nevado de Cumbal range.
(Koepcke, 1961: 154-165; Czajka, 1968; Hueck and Seibert, 1972: map units 18 *p.*, 21 *p.*; Schnell, 1987b: 76-81; Parker and Carr, 1992: 49-51; Sarmiento, 1995).

49.13121 Western Ecuadorian lower montane forests
Multi-specific mesothermic evergreen forests of lower slopes, up to altitudes of about 1800-2000 metres, of the western flank of the southern section of the northern tropical Andes in Ecuador.
(Koepcke, 1961: 154-165; Czajka, 1968; Hueck and Seibert, 1972: map units 18 *p.*, 21 *p.*; Parker and Carr, 1992: 49-51; Sarmiento, 1995).

49.13122 Western Ecuadorian cloud forests
Multi-specific evergreen forests of the cloud-lingering level of the western flank of the southern section of the northern tropical Andes in Ecuador, developed at altitudes between about 2000 and 3000 metres.
(Koepcke, 1961: 154-165; Czajka, 1968; Hueck and Seibert, 1972: map units 18 *p.*, 21 *p.*; Parker and Carr, 1992: 49-51; Sarmiento, 1995).

49.1313 Ecuadorian inner Andean montane and cloud forests
Multispecific evergreen or semievergreen forests of small watersheds of the highland plateaux and transversal ranges of the southern section of the northern tropical Andes, in Ecuador.
(Sarmiento, 1995: 286, 292).

49.132 Colombian montane forests
Species-rich evergreen, semievergreen or semideciduous cloud, montane and transition forests of the northern section of the main ranges of the northern tropical, paramo, Andes, including the Caribbean, Pacific, eastern and inner slopes of the Western, Central and Eastern cordilleras of Colombia.
(Cuatrecasas, 1954a; Troll, 1968; Lauer, 1968; Czajka, 1968; Hueck and Seibert, 1972, 1981: units 19, 22 *p.*; Schnell, 1987b: 76-81; Doumenge *et al.*, 1995; Long, 1995; Sarmiento, 1995).

49.1321 Colombian eastern sub-Andean montane forests
Species-rich evergreen, semievergreen or semideciduous cloud, montane and transition forests of the eastern flank of the northern tropical, paramo, Andes of Colombia, developed on the eastern, Amazonian slopes of the Eastern Cordillera, north to the Leiva range and the Serrania de la Mascarena.

(Hueck and Seibert, 1972, 1981: unit 19).

49.1322 Colombian western sub-Andean montane forests
Species-rich evergreen, semievergreen or semideciduous cloud, montane and transition forests of the western flank of the northern tropical, paramo, Andes of Colombia, developed on the western, Pacific, slope of the Western Cordillera.
(Hueck and Seibert, 1972, 1981: unit 19; Schnell, 1987b: 78-79).

49.13221 Colombian lower sub-Andean forests

Lower montane forests of the western flank of the northern tropical, paramo, Andes of Colombia, developed at altitudes comprised between about 1000 and 1400 metres, with *Dendropanax macrocarpum*, *Brunellia comocladifolia*, *Dacryodes olivifera*, *Sloanea robusta*, *Casearia megacarpa*, *Allophylus angustatus*, *Brosimum utile*, *Castilla spp.*, *Cedrela subandina*, *Cinchona calycina*, *Eschweilera cincta*, *Guarea rubrisepala*, *Inga spp.*, *Nectandra spp.*, *Panopsis mucronata*, *Virola macrocarpa*, *Euterpe purpurea*, and tree ferns (*Alsophila spp.*, *Cythacea divergens*); epiphytes include *Clusia spp.*, *Schefflera sanguininensis*, *Begonia cuatrecasaba*, Vaccinaceae, bromeliads *Guzmania*, *Pitcairnia*, *Tillandsia*, *Vriesia*.
(Hueck and Seibert, 1972, 1981: unit 19; Schnell, 1987b: 78-79).

49.13222 Colombian middle sub-Andean forests
Upper montane forests of the western flank of the northern tropical, paramo, Andes of Colombia, developed at altitudes of the order of 1500 to 2200 metres, with tree genera *Billia*, *Brunellia*, *Calliandra*, *Cinchona*, *Clethra*, *Euplassa*, *Miconia*, *Nectandra*, *Panopsis*, *Quercus*, *Rapanea*, *Roupala*, *Saurauia*, *Tara*, *Tibouchina*, *Vochysia* and *Weinmannia*, the palm *Euterpe ziphiria* and tree ferns (*Alsophila*, *Cyathea*).
(Hueck and Seibert, 1972, 1981: unit 19; Schnell, 1987b: 80).

49.13223 Colombian upper sub-Andean cloud forests
Cloud forests of the western flank of the northern tropical, paramo, Andes of Colombia, developed at altitudes between 2200 and 2500 metres. The species cortège includes genera *Bejaria*, *Brunellia*, *Drimys*, *Juglans*, *Rhamnus*, *Ilex*, *Weinmannia*, *Viburnum*, *Quercus*.
(Hueck and Seibert, 1972, 1981: units 19, 22 *p.*; Schnell, 1987b: 79).

49.1323 Colombian interior low montane forests
Forests of the middle slopes of inner valleys and plateaux of the northern Andes of Colombia with *Aniba perutilis*, *Cedrela bogotensis*, *Cedrela montana*, *Enterolobium cyclocarpum*, *Astronium graveolens*, *Chlorophora tinctoria*, *Centrolobium spp.*, *Calophyllum mariae*, *Tabebuia spectabilis*, *Tabebuia chrysantha*, *Tabebuia bilbergii*, *Juglans colombiensis*, *Podocarpus spp.*, *Quercus spp.*.
(Schnell, 1987a: 273).

49.1324 Colombian eu-Andean cloud forests
Cloud forests of the northern section of the main northern tropical, paramo, Andes in Colombia, including the Caribbean, eastern and inner slopes of the Western, Central and Eastern cordilleras, at altitudes comprised between 2300 and 3600 metres, with *Brunellia macrophylla*, *Brunellia rufa*, *Drimys granatensis*, *Escallonia spp.*, *Gynoxis subcinerea*, *Hesperomeles languinosa*, *Ilex gabinetensis*, *Laplacea granatensis*, *Polylepis quadrijuga*, *Rhamnus granulosa*, *Sessea eliptica*, *Symplocos venulosa*, *Weinmannia balbisiana*, *Weinmannia caquetiana*, *Weinmannia magnifolia*, *Weinmannia microcarpa*, *Weinmannia microphylla*, *Weinmannia parviflora*, *Weinmannia penicillata*, *Weinmannia trianae*.
(Cuatrecasas, 1954a; Hueck and Seibert, 1972, 1981: unit 22; Schnell, 1987b: 79-80).

49.1325 Colombian oak cloud forests
Cloud forests of the upper sub-Andean level of the northern tropical, paramo, Andes of Colombia, dominated by *Quercus tolimensis* accompanied by *Clethra spp.*, *Clusia spp.*, *Saurauia excelsa*, and locally by *Gunnera chilensis*, with a remarkable juxtaposition of boreal and austral elements.
(Schnell, 1987b: 79-80).

49.1326 Colombian palm cloud forests
Cloud forests of the 2300 to 2500 metre level of the Andes of Colombia dominated by the very tall, threatened, endemic wax palm *Ceroxylon andicola*, the tallest palm in the world, harbouring the threatened parrots *Leptosittaca branickii* and *Ognorhynchus icterotis*.
(Forshaw, 1973: 409; Hueck, 1978: 127; Schnell, 1987b: 80; Uribe, 1995).

49.133 Colombo-Venezuelan Andean forests
Species-rich evergreen, semievergreen or semideciduous cloud, montane and transition forests of the northern spurs and outliers of the northern tropical, paramo, Andes of Colombia and Venezuela, including the Nevada de Santa Marta, the Sierra de Perija and the Merida Cordillera.

49.1331 Colombo-Venezuelan Andean lower montane forests
Lower montane rain forests of the northeasternmost spurs of the Andes, in Venezuela and extreme northeastern Colombia, ringing the lake Maracaibo basin and separating it from Caribbean and

Magdalenian Colombia to the west, from the llanos to the east, occupying the altitudinal belt of 1000 to 1800-2000 metres. Important tree families are Euphorbiaceae, Lauraceae, Myrtaceae, Burceraceae, Cunoniaceae, Moraceae, Araliaceae, Bignoniaceae. Vines and epiphytes are numerous, particularly large-leaved Araceae.
(Hueck, 1978: 129; Veillon, 1985a: unit 22; Huber and Alarcon, 1988: units 82, 87, 88).

49.13311 Meridean lower montane forests
Evergreen montane rain forests of the Sierra de Merida developed at altitudes comprised between 800 and 1800-2000 metres, medium tall, dense, with two to three tree strata dominated by Lauraceae, Moraceae, Myrtaceae, Bignoniaceae, Euphorbiaceae and Araliaceae, with the endemics *Piper ronaldii* and *Sterigmapetalum tachirense*.
(Hueck, 1978; Veillon, 1985a: unit 22; Huber and Alarcon, 1988: unit 88).

49.13312 Perijean lower montane forests
Evergreen pre-montane and montane forests of the Sierra de Perija developed at altitudes between 800 and about 2000 metres, grading at the highest altitudes into cloud forests. The montane forests of the Sierra de Perija harbour a number of endemic species, including *Chimarrhis perijaensis*, *Psychotria perijaensis*, *Spermacoce perijaensis*.
(Veillon, 1985a: unit 22; Huber and Alarcon, 1988: unit 82 *p.*).

49.13313 Northern Andean psammophile forests
Anomalous forests of the northern Andes, developed on sand in the 700-1200 metres altitude belt of the Sierra de Merida, medium tall and relatively dense with a relictual flora of Amazonian and Guianan affinities. Characteristic trees are the Elaeocarpaceae *Sloanea laurifolia*, the Lauraceae *Ocotea guianensis*, the Combretaceae *Terminalia amazonea* and *Buchenavia capitata*, the Chrysobalanaceae *Licania intrapetiolaris*, the Gutiferae *Calophyllum brasiliense*, the endemic podocarp *Podocarpus celatus*.
(Huber and Alarcon, 1988: unit 87).

49.1332 Colombo-Venezuelan Andean cloud forests
Forests of the upper altitudinal levels of the montane forests of the isolated northern spurs and outliers of the northern Andes, developed at altitudes comprised between about 2000 and 3200 metres.
(Hueck, 1978: 129-134; Schnell, 1987b: 80; Huber and Alarcon, 1988: units 89, 82 *p.*).

49.13321 Meridean cloud forests
Cloud forests of the Cordillera de Merida, with *Brunellia integrifolia*, *Hedyosmum glabratum*, *Oreopanax moritzii*, *Weinmannia jahnii*, *Weinmannia microphylla*, *Beilschmieda sulcata*, *Ruagea glabra*, *Ruagea pubescens*, *Escallonia tortuosa*, *Espeletia nerrifolia*, *Drimys granadensis*, *Senecio meridanus*, and numerous endemics, including *Podocarpus pendulifolius*, *Oreopanax veillonii*.
(Hueck, 1978: 129-134; Schnell, 1987b: 80; Huber and Alarcon, 1988: unit 89).

49.13322 Perijean cloud forests
Cloud forests of the Sierra de Perija, developed at altitudes between 2000 and 2500 metres, rich in palms, tree ferns and epiphytes, constituting the upper fringe of the Perijean montane forests of unit 49.132.
(Veillon, 1985a: unit 22; Huber and Alarcon, 1988: unit 82 *p.*).

49.14 Andean alder forests
Forests of the tropical Andes dominated by the deciduous *Alnus jorullensis* (*Alnus acuminata*), often in monospecific stands, distributed along the entire length of the cordillera, south to Catamarca, forming a homogeneous belt in the upper altitudinal level of montane forests of the southern tropical Andes of Argentina and Bolivia, more linked to river valleys at lower altitudes in the northern tropical Andes, from Venezuela to Ecuador.
(Czajka, 1968; Hueck and Seibert, 1972, 1981: unit 21; Hueck, 1978: 108-110, 114-115, 124, 131-132, 136; Schnell, 1987b; Erize *et al.*, 1995: 50).

49.141 Tucumano-Bolivian alder forests
Subtropical forests of the eastern flank of the southern tropical Andes, south of the Andean bend, dominated by the deciduous *Alnus jorullensis* (*Alnus acuminata*), developed between 800 and 2900 metres, forming monospecific stands in the upper altitudinal level of southern tropical Andean montane yungas forests, under annual precipitations of the order of 500 mm and high mist- and cloud-induced

atmospheric humidity, best developed in the vicinity of watercourses, descending along their valleys into the myrtle forest level. The species cortège includes *Sambucus peruviana*, *Schinus gracilipes*, *Polylepis autralis* and a number of herbs of holarctic affinities.
(Herzog, 1923: 52, 82, 145-146, 158-159, 164, 167; Digilio and Legname, 1966: XV; Czajka, 1968: unit 28; Hueck and Seibert, 1972, 1981: units 20 *p.*; Hueck, 1978: 108-111; Vervoorst, 1982: 11, 16; Grau, 1985: 237-240; Schnell, 1987b: 130-131; Ramadori, 1987: 9-10; Santos Biloni, 1990: XII, 4; Brown and Grau, 1993; Bravo and Grau, 1993: 39-40; Burkart *et al.*, 1994: 24; Brown, 1995: 112; Erize *et al.*, 1995: 50).

49.142 Central Andean alder forests
Woods of the central tropical Andes dominated by the deciduous *Alnus jorullensis* (*Alnus acuminata*), usually small, developed either at or near the upper limit of montane forests up to 3800 metres or at lower altitudes along valleys.
(Hueck, 1978: 122-124; Parker and O'Neill, 1980).

49.143 Northern Andean alder forests
Woods of the northern tropical Andes dominated by *Alnus jorullensis* (*Alnus acuminata*), relatively uncommon and closely associated with river valleys in the lower cloud forest level.
(Hueck, 1978: 124, 131-132, 136; Huber and Alarcon, 1988: unit 89 *p.*).

49.15 Tropical and subtropical Andean *Podocarpus* forests
Forests of the tropical Andes dominated by conifers of genus *Podocarpus*, developed in the upper level of tropical montane forests on the eastern flank of the southern tropical Andes and in the northern tropical Andes. In the central tropical Andes, trees of genus *Podocarpus*, in particular *Podocarpus glomeratus*, *Podocarpus nubigenus*, *Podocarpus oleifolius*, can be prominent in upper cloud forests, but they do not appear to dominate well-individualized forest types.
(Hueck and Seibert, 1972, 1981: unit 21; Hueck, 1978: 107-108, 113-114, 128-132, 134-135; Schnell, 1987b: 80, 130-131; Erize *et al.*, 1995: 50).

49.151 Tucumano-Bolivian *Podocarpus* forests
Forests of the upper level of tropical montane forests of the western flank of the southern tropical Andes of Argentina and Bolivia dominated by *Podocarpus parlatorei*, often accompanied by, in particular, *Juglans autralis*, *Crinodendron tucumana*, *Duranta seratifolia*, *Ilex argentina*, *Prunus tucamanensis*, *Xylosoma pubescens*.
(Hueck, 1978: 107-108, 113-114; Ramadori, 1987: 7, 9; Schnell, 1987b: 130-131; Erize *et al.*, 1995: 50).

49.152 Northern Andean *Podocarpus* forests
Cloud forests of the northern tropical Andes dominated by conifers of genus *Podocarpus*, in particular, *Podocarpus oleifolius*, *Podocarpus rospigliosii*, *Podocarpus montanus* accompanied by species of unit 49.13321.
(Hueck, 1978: 128-132, 134-135; Schnell, 1987b: 130-131; Huber and Alarcon, 1988: unit 89 *p.*).

49.1521 *Podocarpus rospigliosii* cloud forests
Podocarpus forests of the lower level of the northern Andean cloud forests of Venezuela and Colombia dominated by *Podocarpus rospigliosii*.
(Hueck, 1978: 128-132, 134-135; Schnell, 1987b: 130-131; Huber and Alarcon, 1988: unit 89 *p.*).

49.1522 *Podocarpus montanus* and *P. oleifolius* cloud forests
Podocarpus forests of the upper level of the northern Andean cloud forests of Venezuela and Colombia dominated by *Podocarpus montanus* or *Podocarpus oleifolius*.
(Hueck, 1978: 128-132, 134-135; Schnell, 1987b: 130-131; Huber and Alarcon, 1988: unit 89 *p.*).

49.16 Andean elfin and dwarf forests
Stunted timberline forests of the tropical Andes, including elfin forests, formed by a luxuriant growth of low evergreen broadleaved trees, usually with dome-shaped crowns and dense foliage laden with masses of epiphytes, comprising mosses, lichens, ferns, orchids and bromeliads, characteristic of relatively sheltered places and high valleys, and dwarf forests, gnarled tree formations of wind-exposed crests and ridges.
(Koepcke, 1961: 167-169, 169-173; Troll, 1968: 24-28; Hueck and Seibert, 1972, 1981: unit 21; Hueck, 1978: 121-122, 123, 124-125, 132-134; Parker and O'Neill, 1980; Parker *et al.*, 1982: 19;

Schnell, 1987b: 81, 127, 129; Ridgely and Tudor, 1989: 20; Fjeldså and Krabbe, 1990: 18, 25; Leo, 1995: 200).

49.161 Eastern Andean elfin and dwarf woodland
Elfin and dwarf timberline forests of the eastern flank of the central tropical Andes of Peru and Bolivia, north of the Andean bend, in part forming the upper tier of upper montane ceja forests formed by trees of genera *Clusia*, *Gynoxys*, *Podocarpus*, *Polylepis*, *Weinmannia*, *Mutisia*, *Oreopanax*, with abundant epiphytes, comprising mosses, lichens, ferns, orchids and bromeliads.
(Herzog, 1923: 80, 185; Hueck, 1978: 121-122, 123; Parker and O'Neill, 1980; Parker *et al.*, 1982: 19; Schnell, 1987b: 127, 129; Ridgely and Tudor, 1989: 20; Fjeldså and Krabbe, 1990: 18, 25; Leo, 1995: 200).

49.162 Western Andean elfin and dwarf woodland
Elfin and dwarf forests of the western flank of the central tropical Andes of Peru, mostly developed in small isolated pockets in valleys at altitudes close to 3000 metres, dominated by an admixture of small trees, by Araliaceae of genus *Oreopanax*, by the Myrtaceae *Eugenia quinqueloba* or by Saxifragaceae of genus *Escallonia*.
(Koepcke, 1961: 167-169, 169-173; Parker, 1981).

49.1621 Western Andean *Eugenia* woodland
Small isolated elfin and dwarf forests of the 3000 metre level of the western flank of the central tropical Andes of Peru dominated by the Myrtaceae *Eugenia quinqueloba*.
(Koepcke, 1961: 168).

49.1622 Western Andean *Oreopanax* woodland
Woods of the western flank of the central tropical Andes of Peru, often fairly open, developed at altitudes of the order of 3000 metres, dominated by dome-crowned Araliaceae of genus *Oreopanax*.
(Koepcke, 1961: 167-168, 169-173; Parker, 1981).

49.1623 Western Andean *Escallonia* woodland
Uncommon, usually fairly open, low woods of the western flank of the central tropical Andes of Peru dominated by Saxifragaceae of genus *Escallonia*.
(Koepcke, 1961: 168-169).

49.163 Northern Andean elfin and dwarf woodland
Elfin and dwarf forests of the northern Andes, in Colombia, Ecuador and Venezuela, with small trees and shrubs of genera *Gynoxis*, *Miconia*, *Polylepis*, *Rapanea*, *Escallonia* and *Weinmannia*.
(Hueck, 1978: 124-125, 127, 132-134; Schnell, 1987b: 80-81; Huber and Alarcon, 1988: unit 90 *p.*; Sarmiento, 1995: 292).

49.17 Andean *Polylepis* woodland and scrubland
Low woods and tall thickets of the high Andean phytogeographical province, of the Puna, of the Paramo and of high Andean slopes dominated by small trees of the Rosaceae genus *Polylepis*, remarkable, in particular, in often occurring at altitudes well above the main tree limit and separated from it by levels devoid of large ligneous vegetation.
(Koepcke, 1961: 180; Ducoing, 1973: 56; Hueck, 1978: 111-112; Parker and O'Neill, 1980; Schnell, 1987b: 138; Fjeldså and Krabbe, 1990: 20, 21, 25; Walter and Breckle, 1991b: 165).

49.171 Paramo *Polylepis* woods
Low woods and tall thickets of the paramos of the Andes of Venezuela, Colombia, Ecuador and Peru dominated by small trees of the Rosaceae genus *Polylepis*, developed above the main timberline.
(Hueck, 1978: 124-128, 137; Schnell, 1987b: 72, 81, 87, 93, 94, 106).

49.1711 Colombo-Venezuelan *Polylepis sericea* woods
Usually small, isolated woods of *Polylepis sericea* of the paramos of northern Colombia and the Merida Andes of Venezuela developed on rocky slopes and in sheltered valleys at altitudes comprised between 3400 and 4200 metres.
(Vuilleumier and Ewert, 1978: 53-55; Hueck, 1978: 127-128; Schnell, 1987b: 72; Goldstein *et al.*, 1994).

49.1712 Colombian *Polylepis cocuyensis* and *P. quadrijuga* woods

Usually small, isolated woods of the Colombian Andes formed by *Polylepis quadrijuga* (*Polylepis boycensis*, *Polylepis cocuyensis*), recorded between 3000 and 3800 metres in the eastern cordillera.
(Hueck, 1978: 127; Schnell, 1987b: 72, 80, 81, 87, 94, 106).

49.1713 Ecuadorian *Polylepis* woods
Low *Polylepis* forests of the Ecuadorian paramo Andes, formed, in particular, by *Polylepis lanuginosa*, developed at altitudes up to 4300 metres, notably in the Chimborazo range.
(Hueck, 1978: 125; Schnell, 1987b: 71, 81).

49.172 Puna and superpuna *Polylepis* woods
Low woods and tall thickets of the high Andean phytogeographical province and of the puna of southern Peru, Bolivia, Chile and north-western Argentina dominated by shrubby-growing trees of the Rosaceae genus *Polylepis*, in particular, by *Polylepis tomentella*, *Polylepis tarapacana*, *Polylepis incana*, generally occurring at altitudes well above the main tree limit and separated from it by levels devoid of large ligneous vegetation.
(Schnell, 1987b: 71, 131, 137, 138, 142, 143, 144, 145).

49.1721 *Polylepis tomentella* woodland
Polylepis tomentella low woods and thickets of the puna and superpuna of Jujuy, southern Bolivia and the altiplano of northeastern Chile, developed at altitudes between 2500 and 4300 metres, often 1000 metres above the main tree limit, with *Fabiana friesii*, *Psila boliviensis*, *Chiliotrichiopsis keidelii*, *Cassia hookeriana*, *Plazia daphnoides*, harbouring, in particular, the scarce orchid *Aa fiebrigii* of Bolivia and Argentina, and the commoner *Aa hieronymi*, probably endemic to the Argentinian Puna. The dominant species is itself locally threatened.
(Cabrera, 1958: 345-346; Cabrera, 1968: 97; Schnell, 1987b: 137, 138, 141; Quintanilla, 1988: 19, 21; Johnson, 1992: 12; Chebez, 1994: 510).

49.1722 *Polylepis tarapacana* woods
Low *Polylepis tarapacana* woodland or scrubland of the high altitudes of the Chilean altiplano, around 4700 metres, of the northern Chilean altiplano, occurring in general at higher altitudes than *Polylepis tomentella* woods.
(Quintanilla, 1988: 19, 21; Gajardo, 1994: units 2A1-2A14, 2A2-2A14).

49.1723 *Polylepis besseri* woods
Low *Polylepis besseri* woods of the prealtiplano slopes and summits of the western cordilleras of the Chilean Andes, developed at altitudes around 4000-4500 metres, in a predominenantly tola-heath environment; the tree stratum reaches a height of about 6 metres, and the undergrowth is dominated by *Fabiana densa*, with *Adesmia spinosissima*, *Chuquiraga rotundifolia*, *Mutisia acuminata*.
(Gajardo, 1994: unit 2A31).

49.1724 Puna *Polylepis incana* stands
Polylepis incana woods and thickets of the dry Bolivian Puna, with abundant *Tillandsia usneoides* and epiphytic *Orthotrichum spp.*.
(Herzog, 1923: 167, 177; Schnell, 1987b: 71).

49.1725 Humid Puna mixed *Polylepis* woods
Polylepis woods and thickets of the humid Puna zone of central and southern Peru and Bolivia, most widespread in the Cordillera Blanca and in the basin of Lake Titicaca, rarer in central Peru, mostly developed between 3000 and 4500 metres. Their species cortège comprises small trees of genera *Buddleia* and *Escallonia*, shrubs of genera *Gnoxys*, *Brachyotum*, *Chuquiraga*, *Vernonia*, epiphytic mistletoes of genera *Tristerix* and *Ligaria*. They harbour a rich, highly specialized fauna including many endemics, notably the cotinga *Zaratornis stresemanni*.
(Koepcke, 1961: 173-178; Parker, 1981; Parker *et al.*, 1982: 22).

49.173 Montane *Polylepis* woods
Low woods and tall thickets of the high Andean subaltiplanar slopes dominated by small trees of the Rosaceae genus *Polylepis*, in particular, *Polylepis australis*.
(Schnell, 1987b: 71, 72, 80, 81).

49.1731 Eastern Andean montane *Polylepis* woodland

Low woods and tall thickets of the upper levels of the yungas forests of the eastern subaltiplanar Andean slopes dominated by small trees of the Rosaceae genus *Polylepis*.
(Schnell, 1987b: 71).

49.17311 Tucumano-Bolivian *Polylepis australis* woodland
Polylepis australis woods of the upper yungas woodland belt of the eastern slopes of the southern tropical Andes of southern Bolivia and Argentina south to Catamarca, with isolated occurrences in the Sierras Grandes de Cordoba, developed at altitudes comprised between 1500 and 3000 metres. The dominant species is locally threatened.
(Cabrera, 1958: 346; Digilio and Legname, 1966: plate 25; Hueck, 1978; Schnell, 1987b: 71, 131; Santos Biloni, 1990: 15; Erize *et al.*, 1995: 50).

49.17312 Bolivian *Polylepis hypoleuca* woods
Low woods and tall thickets of the upper levels of the eastern subaltiplanar Andes of central and northern Bolivia dominated by small trees of the Rosaceae *Polylepis hypoleuca*, developed in drier inner valleys as well as on the more humid eastern and northern slopes, where they form, around 2500 metres, in the upper altitudinal belt of the yungas, a discontinuous belt in contact with lower *Alnus jorullensis* (*Alnus acuminata*) forests, accompanied by an undergrowth that includes *Espeletia spp.* and *Hesperomeles spp.*.
(Herzog, 1923: 145; Hueck, 1978: 122; Schnell, 1987b: 71).

49.1732 Western Andean *Polylepis* woodland
Polylepis woodland, in particular, *Polylepis lanulginosa*, of the oligothermic sylvatic level of the western slopes of the Andes of northwestern Peru and Ecuador, developed just below the main tree limit at altitudes of the order of 3000 metres.
(Koepcke, 1961: 169; Hueck, 1978: 125; Schnell, 1987b: 71-72).

49.1733 Northern Andean montane *Polylepis* woodland
Low woods and tall thickets of the high Andean subparamo slopes of the northern Andes of Colombia and Venezuela, dominated by small trees of the Rosaceae genus *Polylepis*, in particular, formations of *Polylepis quadrijuga* (*Polylepis boyacensis*) of anthropogenic meadow landscapes of Colombia at 3000 to 3800 metres.
(Hueck, 1978: 127; Schnell, 1987b: 72).

49.18 Prepuna and puna *Prosopis* woods
Woods of the southern tropical Andes, in particular of Salta and Jujuy, dominated by the small, spiny *Prosopis ferox* (*Acacia ferox*), often in monospecific stands, characteristic of prepuna gorges at about 3000 metres, dominating the landscape in the valley of Tin-Tin at 2700 metres, where they form their most extensive woods in northwestern Argentina, locally ascending to lower elevations of the puna environments, around 3400-3500 metres.
(Cabrera, 1958: 325; Cabrera, 1968; APN, 1987: 28; Cardich, 1988: 6-7).

49.2 Brazilian shield montane forests

Lower montane rain forests, upper montane rain forests, cloud forests and montane conifer woodland of the Brazilian shield, including the Atlantic cordilleras, the more inland chains that parallel them, the plateaux of southern Brazil and northern Argentina, and isolated, mostly lower ranges of the central and western shield.
(Hueck and Seibert, 1972, 1981: units 25, 32; Sick and Teixeira, 1979; Snow, 1982; Prance, 1982, 1989; Schnell, 1987a, 1987b; Ridgely and Tudor, 1989; Maître *et al.*, 1993: 5-24; Harley, 1995: 20-24; Doumenge *et al.*, 1995; Henderson, 1995; Hamilton *et al.*, 1995; Long, 1995; de Barcellos Falkenberg and Voltolini, 1995).

49.21 Brazilian Atlantic montane forests
Lower montane rain forests, upper montane rain forests, cloud forests of the Atlantic cordilleras of Brazil, including the Serra do Mar and its associated ridges and plateaux, the Serra da Mantiqueira, the Serra dos Orgaos, the Pico da Bandeira and coastal escarpments of the northeastern shield.
(Hueck and Seibert, 1972, 1981: units 25, 32; Sick and Teixeira, 1979; Snow, 1982; Prance, 1982, 1989; Schnell, 1987a, 1987b; Ridgely and Tudor, 1989; Maître *et al.*, 1993: 5-24; Sick, 1993: 10;

Harley, 1995: 20-24; Doumenge *et al.*, 1995; Henderson, 1995; Hamilton *et al.*, 1995; Long, 1995; de Barcellos Falkenberg and Voltolini, 1995).

49.211 Southern Brazilian Atlantic montane forests
Lower montane rain forests, upper montane rain forests and cloud forests of the southern Atlantic cordilleras of Brazil, including the Serra do Mar and its associated ridges and plateaux, the Serra da Mantiqueira, the Serra dos Orgaos and the Pico da Bandeira.
(Hueck, 1978: 173-182).

49.2111 Southern Brazilian Atlantic lower montane forests
Lower montane rain forests of the southern Atlantic cordilleras of Brazil, developed at altitudes up to 1200 metres in the Serra do Mar, to 1400 metres in the Serra dos Orgaos and 1600 metres in the Serra Itatia, dominated by Fabales (*Centrolobium robustum*, *Dalbergia nigra*, *Hymenaea stilbocarpa*, *Piptadenia rigida*, *Piptadenia communis*, *Machaerium spp.*, *Melanoxylon brauna*, *Myroxylon peruiferum*, *Myrocarpus frondosus*), with Bignoniaceae (*Jacaranda*, *Tabebuia*, *Tecoma*), Lauraceae (*Ocotea*, *Nectandra*, *Phoebe*), Meliaceae (*Cabralea*, *Cedrela*), Sapotaceae (*Lucuma laurifolia*), palms, in particular, *Euterpe edulis*, and tree ferns of genera *Alsophila*, *Cyathea* and *Hemitelia*.
(Hueck, 1978: 173-177).

49.2112 Southern Brazilian Atlantic upper montane forests
Upper montane cloud forests of the southern Atlantic cordilleras of Brazil, developed at altitudes superior to 1200 metres in the Serra do Mar, to 1400 metres in the Serra dos Orgaos and to 1600 metres in the Serra Itatia, formed principally by Myrtaceae (*Eugenia*), Proteaceae (*Roupala*), Melastomataceae (*Tipouchina*, *Miconia*), Malpigiaceae, Cunoniaceae (*Weinnmania*) and composites.
(Hueck, 1978: 177-182).

49.212 Northern Brazilian Atlantic montane forests
Montane forests of the relatively low coastal escarpments of the northeastern Brazilian shield, forming the northern cordilleran region of Pernambuco, Alagoas and Sergipe, with *Caesalpinia echinata*, *Apuleia ferrea*, *Piptadenia perigrina*, *Parkia pendula*. *Machaerium firmum*, *Bowdichia spp.*, *Tecoma spp.*, *Cecropia spp.*, *Apeiba spp.*, the palms *Geonoma pohliana*, *Geonoma macroloma*, *Cocos mikania*, *Euterpe edulis*, and tree ferns of genera *Alsophila*, *Cyathea* and *Hemitelia*.
(Hueck, 1978: 170-172).

49.22 Eastern Brazilian brejo forests
Montane forests of the upper levels of the old-fold inland mountains of the Brazilian shield, in particular, of the Serra do Espinjaço-Chapada Diamantina system and of isolated mountains and hills of the northeastern Brazilian shield, within the domain of the caatinga.
(Hueck and Seibert, 1972, 1981: unit 29 *p.*; Sick and Teixeira, 1979; Prance, 1982: 620; Lewis, 1987: 7, 10; Sick, 1993: 10-11; Harley, 1995: 20-24).

49.221 Northeastern Brazilian brejo forests
Montane forests of the northeastern Brazilian shield, within the domain of the caatinga, in the states of Alagoas, Pernambuco, Paraiba, Rio Grande do Norte and Ceara, characteristically formed on eastern-facing elevations, at altitudes of 500 to 1200 metres, constituting a highly fragmented archipelago of small pockets of humid forest.
(Prance, 1982: 620; Harley, 1995: 20).

49.222 Diamantina brejo forests
Brejo forests of the Chapada Diamantina, developed at altitudes comprised between 400 and 1700 metres, very variable in species composition, formed by Anacardiaceae (*Tapirira guianensis*, *Tapirira obtusa*), Euphorbiaceae (*Chaetocarpus echinocarpus*), Flacourtiaceae *Casearia arborea*), Guttiferae (*Vismea guianensis*), Humiriaceae (*Humiriria balsamifera*, *Vantanea obovata*), Leguminoseae (*Piptadenia moniliformis*, *Pseudopiptadenia contorta*, *Cassia ferruginea*, *Hymenaea stigonocarpa*, *Senna acuruensis*), Melastomataceae (*Tibouchina fissinervia*), Rutaceae (*Hortia arborea*), Simaroubaceae (*Simarouba amara*), Styracaceae *Styrax camporum*).
(Hueck and Seibert, 1972: unit 29 *p.*; Prance, 1982: 620; Harley, 1995: 20-24).

49.223 Espinhaço brejo forests
Brejo forests of the Serra do Espinhaço, in Minas Gerais, developed at altitudes comprised between 400 and 1700 metres, very variable in species composition, formed by Anacardiaceae (*Tapirira*

guianensis, *Tapirira obtusa*), Burseraceae (*Xylopia emarginata*, *Protium almecega*), Euphorbiaceae (*Croton urucurana*, *Hieronyma alchorneoides*, *Richeria grandis*), Humiriaceae (*Humiria balsamifera*), Leguminoseae (*Copaifera langsdorffii*), Melastomataceae (*Tibouchina candoleana*), Meliaceae (*Cabralea canjerana*), Nyctaginaceae (*Guapira opposita*), Vochysiaceae (*Vochysia acuminata*).
(Hueck and Seibert, 1972: unit 29 *p.*; Harley, 1995: 21).

49.23 Upper Paranean montane conifer forests
Upland conifer forests, mostly dominated by *Araucaria angustifolia*, sometimes by species of genus *Podocarpus*, of the high levels of the Serra da Mantiqueira and the Serra do Mar, and of the high plateaux of the southeastern extremity of the Brazilian shield, extending inland from the coastal cordillera in Parana, Santa Catarina and northern Rio Grande do Sul, west to the planalto of Misiones.
(Martinez-Crovetto, 1963: 205-209; Hueck and Seibert, 1972, 1981: units 32; Hueck, 1978: 222-254; Sick and Teixeira, 1979; Schnell, 1987a: 295-302; Prance, 1989: 125-126; Sick, 1993: 11; Laclau, 1994: 17; Chebez, 1994: 494; de Barcellos Falkenberg and Voltolini, 1995: 141).

49.231 *Araucaria angustifolia* forests
Upland conifer forests of the coastal cordillera, the high plateaux of southeastern Brazil and the Sierra de Misiones, dominated by the endemic *Araucaria angustifolia*, forming the uppermost canopy with trees of 30-45 metres in height. The second canopy is composed mainly by Lauraceae, including *Cinnamomum sellowianum*, *Nectandra reticulata* and *Ocotea porosa*, as exclusive followers of the araucarias, and *Nectandra grandiflora*, *Ocotea pulchella*, *Ocotea puberula*, *Ocotea acutifolia*, *Ocotea diopyrifolia* and *Phoebe vesiculosa* as selective ones, *Cryptocarya aschersoniana*, *Nectandra lanceolata* and *Ocotea pretiosa* as preferential ones, *Cinnamomum glaziovii* and *Nectandra mesopotamica* as more or less indifferent ones and finally *Enderlicheria paniculata*, *Ocotea catarinensis*, *Ocotea kuhlmanni*, *Ocotea lanata*, *Ocotea lanceolata*, *Persea alba* and *Persea venosa* accidental ones. Further tree species are *Balfourodendron riedelianum*, *Calabrea oblongifolia*, *Cedrela fissilis*, *Holocalyx balansae*, *Ilex paraguariensis*, Myrtaceae, *Nectandra membrianacea*, *Pithecolobium hassleri* and Protaceae. There is a dense undergrowth of *Berberis laurina*, *Drimys winteri*, *Eugenia spp.*, *Fuchsia regia*, *Jacaranda semiserrata*, *Miconia spp.*, *Schinus spinosus*, *Tibouchina spp.*, tree ferns (*Alsophila elegans*, *Dicksonia sellowiana*) and a herbaceous layer composed mainly by sedges and grasses. Characteristic animal species include the jay *Cyanocorax cyaneus*, the furnariid *Leptasthenura setaria*, the parrot *Amazona pretrei* and the threatened howler monkey *Alouatta guariba clamitans* (*Alouatta fusca clamitans*). These forests have been seriously reduced and are gravely threatened. Thus, in Misiones, alone, their surface has decreased from 210000 hectares in 1960 to 1000 hectares in 1993, a reduction of 99.5%.
(Martinez-Crovetto, 1963: 205-209; Hueck, 1978: 222-254; Sick and Teixeira, 1979: 8-9; Schnell, 1987a: 295-302; Prance, 1989: 125-126; Sick, 1993: 11; Di Bitetti *et al.*, 1994; Laclau, 1994: 17; Chebez, 1994: 173-176, 205-209, 437-438, 448, 494; de Barcellos Falkenberg and Voltolini, 1995: 141).

49.232 Upper Paranean *Podocarpus* forests
Woods of *Podocarpus lambertii* of the *Araucaria* forest region of southern Brazil, limited to valleys and basins on moist to humid soils, with a 12-15 metre tall canopy and a dense, species-rich undergrowth with an exuberant herb layer.
(Hueck, 1978: 221, 232, 243-244, 250).

49.24 Central Brazilian montane forests
Montane forests of isolated ranges of the central Brazilian shield, in particular, the mountains of the Brazilian Planalto of Goias, of the Serra do Cachimbo and other mountains of Para, within the domain of the cerrado.
(Hueck and Seibert, 1972: unit 29 *p.*; Hueck, 1978: 315-317).

49.3 Guianan montane forests

Lower montane rain forests, upper montane rain forests, cloud forests, montane palm forests of the mountains of the Guiana Highlands, in particular, of the tepuis of southern Venezuela, western Guyana, southeastern Colombia and northern Brazil.
(Hueck and Seibert, 1972, 1981: units 27, 16 *p.*; Prance, 1982, 1989; Schnell, 1987a, 1987b; Huber and Alarcon, 1988; Ridgely and Tudor, 1989; Maître *et al.*, 1993: 5-24; Doumenge *et al.*, 1995; Henderson, 1995: 13; Hamilton *et al.*, 1995; Long, 1995; Huber, 1995).

49.31 Guianan submontane rain forests
Lower montane, and sometimes basimontane, submesothermic forests mostly of the 400-800 metre level of the mountains of the Guiana Highlands, evergreen or sometimes semideciduous or deciduous, comprising many trees with large membranous leaves, and drip tips.
(Huber, 1995: units 19, 20, 25, 40, 42, 44, 48, 52, 24, 33).

49.311 Western Guianan submontane evergreen rainforests
Lower montane submesothermic evergreen forests of the 400-800 metre level of the mountains of the western Guianan Highlands, developed, in particular, in the Serrania de Imataca, in the Sierra de Lema and the middle Caroni, of the Guaiquinima, the Guanacoco and the Jaua, on the slopes of the Cerro Yapacana, on the slopes and the lower interior plateaux of the Paru massif, on the talus of the Duida-Marahuaca massif, on the western slopes of the Parima uplands, on the lower uplands and talus slopes of the upper Orinoco-Siapa, and, at lower altitudes, on the bauxites of the lower Suapure-Parguaza.
(Huber, 1995: units 19, 20, 25, 40, 42, 44, 48, 52, 33).

49.312 Eastern Guianan submontane rain forests
Lower montane forests of the Kanuku mountains of southern Guyana, dominated by *Manilkara bidentata* accompanied by *Catostemma fragrans*, *Licania laxiflora*, *Eschweilera praeclara*, *Didymopanax morototoni*, including facies with an abundance of *Terminalia guianensis* or of the palm *Orbignya sagotii*.
(Schnell, 1987a: 411).

49.313 Guianan inselberg forests
Dry forests occupying isolated igneous-metamorphic rock outcrops, mostly granitic, constituting inselbergs within the Guianan shield rain forest region or around the periphery of the shield.
(Schnell, 1987a: 265, 267, 268; Huber and Alarcon, 1988: unit 70 *p.*; Huber, 1995: unit 24).

49.3131 Western Guianan inselberg forests
Basimontane and lower montane dry deciduous forests of isolated rocky outcrops of the northern fringe of the western Guiana Highlands, in particular, of insular peaks rising to 200 or 800 metres in elevation, forming the Serrania del Trueno, between the lower Caura and the lower Aro and of granitic inselbergs between the lower Aro and the lower Caroni.
(Huber and Alarcon, 1988: unit 70 *p.*; Huber, 1995: unit 24).

49.3132 Eastern Guianan inselberg forests
Forests occupying isolated igneous-metamorphic rock outcrops, mostly granitic, constituting inselbergs within the eastern Guianan shield rain forest region, with *Eugenia biflora*, *Inga virgultosa*, *Clusia spp.*.

(Schnell, 1987a: 265, 267, 268).

49.32 Guianan montane forests
Montane mesothermic evergreen, or sometimes semideciduous, forests of the 800-1500 metre level of the mountains of the Guiana Highlands, characterized by a distinct montane flora, the prominance of trees with evergreen coriaceous leaves, of epiphytes and of trees with buttresses.
(Huber, 1995: units 21, 26, 27, 29, 34, 36, 38, 41, 43, 45, 50, 53, 31, 49).

49.321 Guianan evergreen montane forests
Montane mesothermic evergreen forests of the 800-1500 metre level of the mountains of the Guiana Highlands, characteristic of the Sierra de Lema and Gran Sabana, of the Guaiquinima, of the summits of Marutani, Ichun, Guanacoco, Sarisariñama, of the eastern slopes of the Sierra de Maigualida, of the Cuchivero-Parguaza uplands, of the Yavi-Yutaje-Guanay complex, of the slopes and lower uplands of the Cuao-Sipapo massif, of the summit of Cerro Yapacana, of the upper interior plateaux and summit of the Paru massif, of the Duida-Marahuaka massif, of sandstones of the Parima uplands, of upper talus slopes of Unturan, Tapirapeco and Neblina.
(Huber, 1995: units 21, 26, 27, 29, 34, 36, 38, 41, 43, 45, 50, 53).

49.322 Guianan semideciduous montane forests
Montane mesothermic semideciduous or semievergreen forests of the 800-1500 metre level of the western slopes of the Sierra de Maigualida and of the Parima uplands, in the Guiana Highlands.
(Huber, 1995: units 31, 49).

49.33 Guianan altimontane cloud forests
Upper montane mesothermic evergreen cloud forests of the 1500-2000 metre level of the mountains of the Guiana Highlands, best developed at the base of the vertical cliffs of tepuis, characterized by short trees with gnarled trunks and branches, flattened crowns, small coriaceous leaves, and an abundance of epiphytes, of the upper Caroni, of the summits of Jaua and Sarisariñama, of the summits of the Sierra de Maigualida, of the summits of the Yavi and Yutaje, of the Cuao-Sipapo massif, of the Duida-Marahuaka massif, of the summits of the Tapirapeco and Neblina.
(Schnell, 1987a: 413; Huber, 1995: units 22, 28, 30, 37, 39, 46, 54).

49.34 Guianan alti-tepui forests
High tepui summital mesothermic or submicrothermic, low-growing, evergreen forests of the 2000-3000 metre level of the mountains of the Guiana Highlands, formed by sclerophyllous, mainly microphyllous trees, limited to the Auyan-tepui and the Chimanta massif in the middle Caroni Roraima complex, and to the summit of the Marahuaka in the Duida complex.
(Huber, 1995: units 23, 47).

49.4 Southern Caribbean montane forests

Montane forests of low, small, isolated mountain ranges of northern Colombia, continental Venezuela and the southern Lesser Antillean islands, developed, within the Caribbean floral region, at relatively low altitude, under the influence of the trade winds, the proximity of the sea, and the Massenerhebung effect; they occur, in particular, in the Serrania de Macuira in Guajira, in the Peninsula de Paraguana, and nearby Sierra de San Luis, the central Cordillera de la Costa of Venezuela, the Cordillera de Turimiquire or de Caripe, the Paria peninsula, Margarita Island and Trinidad. They are extremely rich in endemics, corresponding to a number of postulated refugia.
(Prance, 1982: 615-616; Schnell, 1987a, 1987b; Huber and Alarcon, 1988: units 93, 94, 95, 98, 99, 103, 107, 108, 109, 111; Prance, 1989: 115-117; Walter and Breckle, 1991a: 205-206, 211-213; Doumenge *et al.*, 1995; Hamilton *et al.*, 1995; Long, 1995).

49.41 Southern Caribbean montane rain forests
Forests of the middle slopes of isolated mountain ranges of the Caribbean region of northern South America and the southern Lesser Antillean islands, developed in the altitudinal zone of high rainfall below the cloud belt.
(Huber and Alarcon, 1988: units 93, 98, 103, 107, 111; Prance, 1989: 115; Walter and Breckle, 1991a: 205, 206, 212).

49.411 Guajira-Paraguana basimontane forests
Semideciduous forests of the semiarid middle slopes of the fairly low isolated mountain ranges surrounding the Venezuelan Gulf on the Peninsula de Guajira, the Peninsula de Paraguana, and the Sierra San Luis, low to medium tall, generally fairly open. Participating species include *Acacia glomerosa*, *Inga spp.*, *Maytenus karstenii*, *Eugenia spp.*.
(Huber and Alarcon, 1988: unit 93; Prance, 1989: 115; Walter and Breckle, 1991a: 205, 206, 212).

49.412 Araguan montane rain forests
Evergreen or semievergreen, submontane and montane rain forests of the middle slopes of the central Cordillera de la Costa and the Serrania del Interior, in northern central Venezuela, medium tall to tall, with two to three strata, abundant palms and tree ferns.
(Huber and Alarcon, 1988: units 98, 103; Prance, 1989: 115; Walter and Breckle, 1991a: 205, 206, 212).

49.413 Caripe montane rain forests
Semievergreen rain forests of the middle slopes of the Sierra de Caripe in northeastern Venezuela, medium-tall, with two tree strata and a srongly developed undergrowth, sometimes with a great abundance of lianas.
(Huber and Alarcon, 1988: unit 107; Prance, 1989: 115; Walter and Breckle, 1991a: 205, 206, 212).

49.414 Margarita montane rain forests

Dense, low to medium-tall, one to two strata semievergreen forests of the middle and upper slopes of Margarita island, rich in epiphytes and palms, with *Tabebuia chrysantha*, *Myrcianthes compressa*, *Margaritaria nobilis*, and the endemics *Croton margaritensis* and *Clerodendrum margaritense*.
(Huber and Alarcon, 1988: unit 111; Prance, 1989: 115; Walter and Breckle, 1991a: 205, 206, 212).

49.415 Trinidad montane rain forests
Evergreen forests of the middle slopes of Trinidad, developed between 250 and 760 metres, of somewhat lower stature than the lowland rain forests, dominated by *Byrsonima spicata* and *Licania ternatensis*.
(Richards, 1952: 317, 319, 365; Prance, 1989: 115).

49.42 Southern Caribbean cloud forests
Forests of the higher slopes of isolated mountain ranges of the Caribbean region of northern South America and the southern Lesser Antillean islands, developed in conditions of high atmospheric humidity, at the level of cloud formation.
(Huber and Alarcon, 1988: units 94, 95, 99, 108, 109; Prance, 1989: 115; Walter and Breckle, 1991a: 205, 206, 212, 214).

49.421 San Luis-Paraguana cloud forests
Evergreen cloud forests of upper slopes and summits of the Sierra San Luis, in Falcon, and of the Cerro Santa Ana, on the Paraguana peninsula, dense, medium-tall, with two tree strata and a well-developed undergrowth.
(Huber and Alarcon, 1988: unit 94).

49.422 Central coastal Cordillera cloud forests
Cloud forests of the upper slopes of the Cordillera de la Costa, along the central Venezuelan coast, including the Sierra de Aroa, at the northeastern extremities of the Andes, west of Golfo Triste, and the Serrania del Litoral, along the central coast.
(Huber and Alarcon, 1988: units 95, 99).

49.4221 Aroa cloud forests
Evergreen, submontane coastal cloud forests of the upper slopes of the Sierra de Aroa, dense, medium-tall, with two to three tree strata, and a scant undergrowth.
(Huber and Alarcon, 1988: unit 95).

49.4222 Caracan cloud forests
Submontane and montane, evergreen coastal cloud forests of the upper slopes of the Serrania del Litoral, medium-tall, with two or three tree strata, emergents up to 40 metres, and an extreme abundance of epiphytes.
(Huber and Alarcon, 1988: unit 99).

49.423 Caripo-Parian cloud forests
Coastal cloud forests of the eastern Caribbean coast of Venesuela, in the Turimiquire range of mainland Sucre, northern Anzoategui and northwestern Monagas, and the Peninsula de Paria.
(Huber and Alarcon, 1988: units 108, 109).

49.4231 Caripean cloud forests
Evergreen, submontane coastal cloud forests of the Turimiquire range, very dense, medium-tall, with a dense undergrowth and an abundance of epiphytes, harbouring numerous endemics.
(Huber and Alarcon, 1988: unit 108).

49.4232 Parian cloud forests
Evergreen submontane coastal cloud forests of Cerros Patao and Humo on the Peninsula de Paria, medium-tall, with a scant undergrowth, extremely rich in endemics as well as in species shared only with Trinidad.
(Huber and Alarcon, 1988: unit 109).

49.424 Trinidad upper montane forests
Evergreen forests of the upper slopes of Trinidad, developed between 760 and 880 metres on the Aripo massif, dominated by *Eschweilera trinitensis* and *Richeria grandis*.
(Richards, 1952: 317, 319, 365; Prance, 1989: 115).

49.43 Southern Caribbean elfin forests
Dwarf forests of the upper slopes and summits of isolated mountains of the southern Caribbean region, limited to islands off the northeastern coast of South America.
(Huber and Alarcon, 1988: unit 112; Prance, 1989: 115).

49.431 Margarita elfin forests
Dwarf, up to three metres tall, forests of the summit of Margarita Island, above 750 metres, very dense, formed by *Clusia flava*, the endemics *Blakea monticola* and *Inga macrantha*, *Clidemia hirta*, *Macleania nitida*, *Rapanea guianensis*, *Glomeropitcairnia erectiflora*, and with the endemic *Epidendrum johnstonii*.
(Huber and Alarcon, 1988: unit 112).

49.432 Trinidad elfin forests
Elfin forest of the top of Cerro del Aripo, above 880 metres, on Trinidad, of very small extent, formed by an almost pure consociation of *Clusia intertexta*, accompanied by tree ferns, bromeliads, lianas, mosses and lichens, with a few species apparently restricted to this habitat.
(ffrench, 1976: 10; Prance, 1989: 115).

49.5 Oceanic cloud forests

Montane cloud forests of oceanic islands, in particular, of the Galapagos archipelago and South Trinidad.
(Murphy, 1936: 174; Bowman, 1961: 16-17; Wiggins and Porter, 1971: 22-24; Olson, 1981: 486-487; Schnell, 1987b: 229; Walter and Breckle, 1991b: 266).

49.51 Galapagan *Scalesia* cloud forests
Cloud forests of the Galapagos archipelago, developed in an altitudinal belt extending from 180-200 metres to 400-550 metres, dominated by trees of genus *Scalesia*, accompanied by *Pisonia floribunda* and *Psidium galapageium*, with an accompanying cortège that includes *Borreria laevis*, *Cheilanthes alba*, *Cissampelos pareira*, *Ctenitis pleisosoros*, *Darwiniothamnus tenuifolius*, *Dennstaedtia cicutaria*, *Ionopsis utricularioides*, *Passiflora suberosa*, *Peperomia galapagensis*, *Peperomia galioides*, *Plumago scandens*, *Tillandsia insularis*, *Zanthoxylum fagara*.
(Bowman, 1961: 16-17; Wiggins and Porter, 1971: 22-24; Schnell, 1987b: 229; Walter and Breckle, 1991b: 266).

49.511 Galapagan *Scalesia pedunculata* cloud forests
Cloud forests of the large eastern islands of the Galapagos archipelago, San Cristobal, Santa Maria, San Salvador, Santa Cruz, dominated by *Scalesia pedunculata*.
(Wiggins and Porter, 1971: 22-24; Schnell, 1987b: 229; Walter and Breckle, 1991b: 266).

49.512 Western Galapagan *Scalesia* cloud forests
Cloud forests on the large western islands of the Galapagos archipelago, Fernandina and Isabela, dominated by *Scalesia microcephala* or *Scalesia cordata*. These wetter forests harbour a number of species not occurring in the eastern islands, in particular, *Acalypha parvula* var.*parvula*, *Ambrosia artemisifolia*, *Baccharis gnidifolia*, *Drymaria rotundifolia*, *Duranta dombeyana*, *Eupatorium solidaginoides*, *Froelichia juncea* var. *juncea*, *Gnaphalium vira-vira*, *Hyptis spicigera*, *Linum harmlingi*, *Ipomoea alba*, *Mentha piperita*, *Triumfetta semitriloba*.
(Wiggins and Porter, 1971: 22-24; Schnell, 1987b: 229; Walter and Breckle, 1991b: 266).

49.5121 Galapagan *Scalesia cordata* cloud forests
Cloud forests of Cerro Azul and Volcan Santo Tomas of southern Isabela, south of Istmo Perry, dominated by *Scalesia cordata*.
(Wiggins and Porter, 1971: 22-24, 356-357; Schnell, 1987b: 229; Walter and Breckle, 1991b: 266).

49.5122 Galapagan *Scalesia microcephala* cloud forests
Cloud forests of Fernandina, and of Volcan Alcedo and Volcan Darwin on Isabela north of Istmo Perry, dominated by *Scalesia microcephala*.
(Wiggins and Porter, 1971: 22-24, 358-359; Schnell, 1987b: 229; Walter and Breckle, 1991b: 266).

49.52 South Trinidad cloud forests

Forests of the subtropical South Trinidad Island, at 20° 30' S latitude, and rising to an altitude of 600 metres, formed at relatively low altitudes under oceanic conditions, in large part extinct since the beginning of the 19th Century, now only represented by tree fern formations and by non-forest forming individuals of the probable former dominant, *Colubrina glandulosa*.
(Murphy, 1936: 174; Olson, 1981: 486-487; Sick, 1993: 16).

49.521 South Trinidad *Colubrina* forests

Forests of the subtropical South Trinidad Island, extinct since the beginning of the 19th Century, formerly probably dominated by the still extant *Colubrina glandulosa*.
(Murphy, 1936: 174; Olson, 1981: 486-487; Sick, 1993: 16).

49.522 South Trinidad tree-fern forest

Tall forest-like formations of the subtropical South Trinidad Island, at 20° 30' S latitude, and rising to an altitude of 600 metres, formed by the giant endemic tree fern *Cyathea copelandi*, reaching heights of 5 to 6 metres, now constituting the tallest native arboreal vegetation on the island, decreasing and limited to two broad valleys on the southern side of the island. More low-growing stands of the species are listed in 3C.621
(Murphy, 1936: 174; Olson, 1981: 487; Sick, 1993: 16).

4A. TROPICAL SWAMP AND RIVERINE FORESTS

Edaphically determined forests of the evergreen and deciduous tropical forest zones, developed on hydromorphic, non-saline soils and often characterized by a strong tendancy to monophytism. They include peat swamp tropical forests, fresh water swamp tropical forests, fresh water periodic swamp forests, tropical riverine forests. Woods of phreatophytes, characteristic of tropical and subtropical deserts, are excluded and listed in unit 4B.
(Schnell, 1971; Hueck and Seibert, 1972: units 14, 87 *p.*; Letouzey, 1978; Whitmore, 1978, 1992; Junk, 1983; Schnell, 1987a; Prance, 1989; Ridgely and Tudor, 1989; Rieley and Page, 1990; Lugo, 1990a; Brinson, 1990; Lugo, 1990b; Bacon, 1990; Myers, 1990; Maître *et al.*, 1993: 5-24; Henderson, 1995; Archibold, 1995: 17).

4A.1 Eutropical inundation forests

Swamp and riverine forests of the Amazonian, Atlantic and Caribbeo-Pacific tropical evergreen and semievergreen rain forest regions of South America, developed in contact with terra firme tropical evergreen rain forests.
(Hueck and Seibert, 1972, 1981: units 1-14, 23-24, 26 *p.*; Hueck, 1978: 40-42, 51, 53-54, 56-57, 60-62, 67-75, 82-84, 84-87; Junk, 1983; Schnell, 1987a: 219, 221-222, 222-223, 224, 227-228; Schnell, 1987b: 233-234; Lugo, 1990a; Brinson, 1990; Bacon, 1990; Myers, 1990; Tostain *et al.*, 1992: 16; Archibold, 1995: 17).

4A.11 Amazonian swamp and riverine forests
Swamp and riverine forests of the Amazon basin, of the upper Orinoco-Ventuari, of the right-bank watershed of the Orinoco and of the Orinoco delta, in contact with Amazonian terra firme tropical evergreen or semievergreen rain forests.
(Hueck and Seibert, 1972: units 1 *p.*, 4 *p.*, 5 *p.*, 6 *p.*, 7 *p.*, 12 *p.*, 13 *p.*, 14; Letouzey, 1978: 108-109; Hueck, 1978: 40-42, 51, 53-54, 56-57, 60-62, 67-75, 82-84, 84-87; Junk, 1983; Junk, 1984a: 221; Adis, 1984; Schnell, 1987b: 233-234; Prance, 1989: 117-123; Lugo, 1990a; Brinson, 1990; Bacon, 1990; Myers, 1990).

4A.111 Amazonian seasonal varzea forests
Inundatable rain forests of the banks and floodplain of whitewater rivers of the Amazon and Orinoco systems, within the Amazonian rain forest region, subjected to enormous annual river level fluctuations, associated with large expanses of canarana, robust grassland, along lower Amazonian rivers, adjacent to terra firme forests without an intervening stretch of canarana along the upper Amazon and in other river basins. Tall trees of the varzea forest, reaching heights of 40-45 metres, include *Olmediophaena maxima*, *Apuleia molaris*, *Bombax munguba*, *Sterculia elata*, *Calycophyllum spruceanum*, *Couroupita subsessilis*, *Pithecolobium niopoides*, *Piptadenia pteroclada*, *Platymiscium paraense*, *Pterocarpus ancylocalyx*. The distinctly shaped, very large, *Ceiba pentandra* is indicative of areas of high sedimentation. Water fluctuations can reach an amplitude of 20 metres in the middle basin. Birds of terra firme forest may occupy the varzea during low-water periods, while fish of many species (*Brycon spp.*, *Colossoma spp.*, *Mylossoma spp.*, *Myleus spp.*) feed on the fruit of its trees during high water.
(Richards, 1952: 286-287; Schnell, 1971; Hueck and Seibert, 1972: unit 14; Letouzey, 1978: 108-109; Parker *et al.*, 1982: 14-15; Eiten, 1983: 13; Sioli, 1984a: 132-133, 143, 148, 151; Junk, 1984a: 215-222, 227; Junk, 1984b: 448; Schnell, 1987a: 219, 222-223, 227-228; Rieley and Page, 1990; Brinson, 1990: 127; Sick, 1993: 6, 7; Maître *et al.*, 1993: 16-17; Henderson, 1995: 8, 12, 15-16; Archibold, 1995: 17).

4A.1111 Western Amazonian seasonal varzea forests
Seasonal varzea forests of the western and southwestern sector of the Amazonian region, including all of Peruvian, Ecuadorian and Bolivian Amazonia and, in Brazil, the basin of the right bank tributaries

of the Rio Solimoas-Rio Amazonas, from the Rio Tefe and the Rio Jurua westwards, and the upper basins of the Rio Purus and the Rio Madeira. Characteristic trees include *Piptadenia pteroclada*, *Parkia inundabilis*, *Septotheca tessmannii*, *Coumarouna micrantha*, *Ceiba burchellii*.
(Hueck and Seibert, 1972, 1981: units 6, 8, 9, 14 *p.*; Haffer, 1974: 143-157; Haffer, 1978: 54-64; Hueck, 1978: 56-57, 69-74; Parker *et al.*, 1982: 14-15; Prance, 1989: region 10c; Henderson, 1995: 32-34).

4A.1112 Madeira-Tapajos seasonal varzea forests
Seasonal varzea forests of the south-central sector of the Amazonian region, including the basins of the Rio Purus, the Rio Madeira, the Rio Tapajos and the Rio Xingu-Rio Iriri.
(Hueck and Seibert, 1972, 1981: units 4, 5, 14 *p.*; Haffer, 1974: 70, 143-157; Haffer, 1978: 57-64; Hueck, 1978: 51, 54, 69-74; Prance, 1989: regions 10d, 10b *p.*, 10a *p.*, 10c *p.*; Henderson, 1995: 32-34).

4A.1113 North central Amazonian seasonal varzea forests
Seasonal varzea forests of the north-central sector of the Amazonian region, including the lower basin of the Rio Negro, the left bank watershed of the Rio Branco and the basin of the Rio Trombetas.
(Hueck and Seibert, 1972, 1981: unit 7 *p.*, 14 *p.*; Haffer, 1974: 143-157; Haffer, 1978: 54-64; Hueck, 1978: 69-74; Prance, 1989: region 10b; Emmons, 1990; Henderson, 1995: 32-34).

4A.1114 Rio Negro seasonal varzea forests
Seasonal varzea forests of the northwestern sector of the Amazonian region, south to the Rio Solimoes-Rio Amazonas and the basin of the Rio Japura-Rio Caqueta, including the Rio Solimoes-Rio Negro interfluve, the Rio Negro-Rio Branco interfluve in Brazil, extreme southwestern Venezuelan Amazonas and Colombian Amazonia in the provinces of Amazonas, Caqueta, Vaupes and Guainia, north to the Rio Guaviare.
(Hueck and Seibert, 1972, 1981: units 10, 7 *p.*, 11 *p.*, 28 *p.*, 14 *p.*; Haffer, 1974: 70, 143-157; Haffer, 1978: 58-59; Hueck, 1978: 69-74; Veillon, 1985a: units 7, 4; Huber and Alarcon, 1988: units 48, 50 *p.*; Prance, 1989: regions 10a, 8; Henderson, 1995: 32-34; Huber, 1995: 113, unit 14).

4A.1115 Guianan seasonal varzea forests
Seasonal varzea forests of the Amazonian and Orinocan watersheds within the northern part of the Guianan-eastern Amazonian sector of the Amazonian region, including Venezuelan Guiana, the Orinoco delta, western Amapa and northeastern Para in the basins of the Rio Jari and the Rio Paru.
(Richards, 1952: 317-320; Birot, 1970: 109-110; Hueck and Seibert, 1972, 1981: units 12, 11, 13, 2, 14 *p.*; Haffer, 1974: 143-157; Haffer, 1978: 63; Hueck, 1978: 69-74; Veillon, 1985a: unit 9; Huber and Alarcon, 1988: units 42, 43, 74, 75, 80; Prance, 1989: region 9; Henderson, 1995: 32-34; Maître *et al.*, 1993: 13-15, unit 2; Huber, 1995: 113, units 4, 5, 6, 11).

4A.1116 Belem seasonal varzea forests
Seasonal varzea forests of the southern part of the Guianan-eastern Amazonian sector of the Amazonian region, including the Amazon delta and the Belem region west to the western reaches of the Tocantins basin.
(Hueck and Seibert, 1972, 1981: units 3, 1, 14 *p.*; Haffer, 1974: 143-157; Haffer, 1978: 63; Hueck, 1978: 49, 69-74; Prance, 1989: region 9; Emmons, 1990; Henderson, 1995: 32-34).

4A.112 Amazonian igapo forests
Seasonally flooded rain forests of blackwater and clearwater rivers of the Amazonian and upper Orinoco basin, lower growing, less dense and less species-rich than varzea forests, mostly composed of Myrtaceae, in particular, *Eugenia inundata*, accompanied by Euphorbiaceae (*Alchornea castaneifolia*, *Piranhea trifoliata*), Lecythidaceae (*Allantoma lineata*), Caesalpiniaceae (*Copaifera martii*), Chrysobalanaceae (*Couepia paraensis*, *Licania apetala*), Bignoniaceae (*Tabebuia barbata*), Polygonaceae (*Triplaris surinamensis*, *Symmeria paniculata*), palms (*Leopoldinia pulchra*, *Bactris spp.*) or, in southern Venezuela, by Bombacaceae (*Rhodognophalopsis discolor*), Apocynaceae (*Aspidosperma album*), Guttiferae (*Clusia spathulaefolia*), Sapotaceae (*Glycoxylon inophyllum*) and palms *Mauritia flexuosa*. Igapo forests are characteristic, in particular, of the blackwater Rio Negro and Rio Ipixuna in Brazil, Rio Atabapo on the Colombo-Venezuelan border, Rio Nany in Peru, and of the clearwater Tapajos, Xingu and Tocantins.
(Richards, 1952: 287; Hueck, 1978: 49, 51-52, 57, 61-62, 78; Junk, 1983: 284; Sioli, 1984a: 148, 151; Adis, 1984; Veillon, 1985a: unit 6; Prance, 1989: 121-122; Lewis and Owen, 1989: 4-5; Brinson,

1990: 127; Walter and Breckle, 1991a: 210-211; Sick, 1993: 6; Henderson, 1995: 8, 15-16; Huber, 1995: units 12 *p.*, 15 *p.*, 16 *p.*, 18 *p.*).

4A.1121 Amazonian lower igapo forests
Near-river igapo forests flooded for up to eight months a year, composed of spaced, low tortuous trees and shrubs, about eight metres heigh, on sandy soils, of more close-growing trees 10 to 12 metres high on clay soils. *Borreria capitata*, *Croton spp.*, *Myrciaria dubia* are prominent.
(Adis, 1984: 248-249).

4A.1122 Amazonian upper igapo forests
Igapo forests of the landward belt of inundatable forests, flooded for five to six months a year, under water up to five metres deep, formed of buttressed trees 35 metres high forming an almost closed canopy with four strata and numerous epiphytes. Prominent trees include the Myristicaceae *Virola elongata*, the Lecythidaceae *Eschweilera longipes*, *Eschweilera pachysepala*, the Mimosae *Pithecellobium amplicimum*.
(Adis, 1984: 249-253).

4A.1123 Amazonian island igapo forests
Igapo forests of large blackwater river islands, directly exposed to water level fluxuations and sometimes inundated almost all year round, with a species composition usually fairly similar to that of lower igapo forests, in particular, a dominance of *Eugenia inundata* and *Cocoloba spp.*.
(Adis, 1984: 249-253).

4A.113 Amazonian tidal varzea
Forests of the delta regions of the large rivers of Amazonian South America, the Amazon and the Orinoco, developed on muddy soils, formed by backup of fresh water provoked by tidal movement, extending, in the Amazon delta, to 100 km inland, characterized by the prominence of trees with buttresses and stilt roots and the abundance of palms, in particular, *Astrocaryum murumuru*, *Euterpe oleracea*, *Jessenia bataua*, *Manicaria saccifera*, *Mauritia flexuosa*, *Maximiliana regia*, *Oenocarpus spp.*, *Raphia taedigera*, which may form monospecific forests. Other characteristic species include the leguminose trees *Machaerium lanatum*, *Dalbergia monetaria*, *Cedrelinga catenaeformis* and *Mora paraensis*, the Bombacaceae *Ceiba pentandra* and the liana *Strychnos blackii*.
(Richards, 1952: 284-286; Hueck and Seibert, 1972, 1981: units 1, 13; Hueck, 1978: 40-42, 84-87; Letouzey, 1978: 108-109; Eiten, 1983: 13; Veillon, 1985a: unit 11; Schnell, 1987a: 224; Schnell, 1987b: 233; Huber and Alarcon, 1988: units 42, 43; Prance, 1989: 120; Brinson, 1990: 127; Henderson, 1995: 8, 15-16; Huber, 1995: units 2, 3).

4A.1131 Amazonian palm tidal varzea
Forests of the delta regions of the large rivers of Amazonian South America, the Amazon and the Orinoco, developed on muddy soils, formed by backup of fresh water provoked by tidal movement, dominated by palms, in particular, *Euterpe oleracea*, *Manicaria saccifera*, *Mauritia flexuosa*, *Raphia taedigera*, often in monospecific forests.
(Hueck and Seibert, 1972, 1981: units 1, 13; Letouzey, 1978: 109; Hueck, 1978: 40-42, 84-87; Veillon, 1985a: unit 11 *p.*; Schnell, 1987b: 233; Huber and Alarcon, 1988: units 42, 43, *p.*; Prance, 1989: 120; Brinson, 1990: 127; Henderson, 1995: 8, 15-16; Huber, 1995: units 2, 3, *p.*).

4A.1132 Amazon delta mixed tidal varzea
Multispecific tidal inundated forests of the delta of the Amazon, extending to 100 km inland, characterized by the prominence of trees with buttresses and stilt roots. Characteristic species include the leguminose trees *Machaerium lanatum*, *Dalbergia monetaria*, *Cedrelinga catenaeformis* and *Mora paraensis*, the Bombacaceae *Ceiba pentandra* and the liana *Strychnos blackii*.
(Hueck and Seibert, 1972, 1981: unit 1; Hueck, 1978: 40-42; Prance, 1989: 120; Henderson, 1995: 8, 15-16).

4A.1133 Orinoco delta mixed tidal varzea
Multispecific tidal inundated forests of the delta of the Orinoco formed by Guttiferae (*Symphonia globulifera*, *Vismia macrophylla*), Fabaceae (*Pterocarpus officinalis*), Caesalpiniaceae (*Mora excelsa*), Myristicaceae (*Virola surinamensis*), Clusiaceae (*Symphonia globulifera*), Bignoniaceae (*Tabebuia fluviatilis*), Meliaceae (*Carapa guianensis*, Bombacaceae (*Pachira aquatica*) and palms (*Euterpe oleracea*, *Mauritia flexuosa*, *Manicaria saxifera*, *Bactris spp.*).

(Hueck and Seibert, 1972, 1981: unit 13; Hueck, 1978: 84-87; Veillon, 1985a: unit 11; Huber and Alarcon, 1988: units 42, 43, *p.*; Prance, 1989: 120; Walter and Breckle, 1991a: 215-216; Henderson, 1995: 8, 15-16; Huber, 1995: units 2, 3, *p.*).

4A.114 Amazonian permanent swamp forests
Permanently inundated forests of the Amazon basin, of the upper Orinoco-Ventuari, of the right-bank watershed of the Orinoco and of the Orinoco delta, with low species diversity, most often dominated by palms, especially of genera *Mauritia* and *Euterpe*.
(Letouzey, 1978: 109; Parker *et al.*, 1982: 14-15; Eiten, 1983: 13; Junk, 1983: 284, 287; Schnell, 1987a: 219, 221-222; Huber and Alarcon, 1988: units 43 *p.*, 53; Prance, 1989: 119; Maître *et al.*, 1993: 17; Henderson, 1995: 8, 15-16; Huber, 1995: units 2 *p.*, 12 *p.*, 15 *p.*, 17; Archibold, 1995: 17).
4A.1141 Amazonian palm swamp forests
Permanently inundated forests of the Amazon basin, of the upper Orinoco-Ventuari, of the right-bank watershed of the Orinoco and of the Orinoco delta, dominated by palms.
(Letouzey, 1978: 109; Parker *et al.*, 1982: 14-15; Junk, 1983: 284, 287; Schnell, 1987a: 219, 221-222, 232; Huber and Alarcon, 1988: units 43 *p.*, 53; Prance, 1989: 119; Myers, 1990: 267-271; Maître *et al.*, 1993: 17; Henderson, 1995: 8, 15-16; Huber, 1995: units 2 *p.*, 12 *p.*, 15 *p.*, 17; Archibold, 1995: 17).

4A.11411 Amazonian *Mauritia* swamps
Permanently inundated forests of the Amazon basin, of the upper Orinoco-Ventuari, of the right-bank watershed of the Orinoco and of the Orinoco delta, dominated by palms of genus *Mauritia*, characteristic of permanently inundated floodplain depressions and of the swamp areas developed in the valleys and around the sources of small forest creeks and rivers, particularly widespread in eastern Peru where they cover vast expanses.
(Letouzey, 1978: 109; Parker *et al.*, 1982: 14-15; Junk, 1983: 284, 287; Schnell, 1987a: 219, 221-222; Huber and Alarcon, 1988: units 43 *p.*, 53; Prance, 1989: 119; Myers, 1990: 267-271; Maître *et al.*, 1993: 17; Henderson, 1995: 8, 15-16; Huber, 1995: units 2 *p.*, 12 *p.*, 15 *p.*, 17; Archibold, 1995: 17).

4A.11412 Amazonian species-rich palm swamps
Permanently inundated forests of the Amazon basin, of the upper Orinoco-Ventuari, of the right-bank watershed of the Orinoco and of the Orinoco delta, dominated by palms of mixed species often belonging to genera *Mauritia*, *Raphia*, *Euterpe*.
(Letouzey, 1978: 109; Parker *et al.*, 1982: 14-15; Junk, 1983: 284, 287; Schnell, 1987a: 219, 221-222; Huber and Alarcon, 1988: units 43 *p.*, 53; Prance, 1989: 119; Myers, 1990: 267-271; Maître *et al.*, 1993: 17; Henderson, 1995: 8, 15-16; Huber, 1995: units 2 *p.*, 12 *p.*, 15 *p.*, 17; Archibold, 1995: 17).

4A.1142 Whitewater hardwood swamp forests
Permanently inundated forests of whitewater rivers of the Amazon basin, of the upper Orinoco-Ventuari, of the right-bank watershed of the Orinoco and of the Orinoco delta, dominated by mixed hardwoods, including forests colonizing floating mats.
(Junk, 1983: 284; Huber and Alarcon, 1988: units 43 *p.*, 53; Prance, 1989: 119; Henderson, 1995: 8, 15-16; Huber, 1995: units 2 *p.*, 12 *p.*, 17).

4A.1143 Blackwater and clearwater hardwood swamp forests
Permanently inundated forests of blackwater and clearwater rivers of the Amazon basin, of the upper Orinoco-Ventuari, of the right-bank watershed of the Orinoco, dominated by mixed hardwoods.
(Huber and Alarcon, 1988: unit 53 *p.*; Prance, 1989: 119; Henderson, 1995: 8, 15-16; Huber, 1995: units 12 *p.*, 17 *p.*).

4A.12 Atlantic eutropical inundation forests
Swamp and riverine forests of the Atlantic rain forest region of Brazil.
(Hueck and Seibert, 1972: unit 26 *p.*).

4A.121 Periodically inundated Atlantic eutropical forests
Periodically inundatable and riverine forests of the Brazilian Atlantic rain forest region, in particular, periodically flooded forests of the swales of the extensive dune and beach-ridge systems.
(Hueck and Seibert, 1972: unit 26 *p.*; Schnell, 1987a: 289; De Lacerda *et al.*, 1993: 486).

4A.1211 Rio de Janeiro inundatable coastal forests
Periodically flooded forests of the swales of the restingas of the southern Brazilian rain forest coast, dominated by *Calophyllum brasiliense* and *Symphonia globulifera*, with *Psychotria carthaginsis*,

Rheedia brasiliensis, the bromeliad *Aechmea pineliana*, the palm *Geonoma schottiana* in the understorey.
(Hueck and Seibert, 1972: unit 26 *p.*; De Lacerda *et al.*, 1993: 486).

4A.1212 Bahia inundatable coastal forests
Periodically flooded forests of the swales of the restingas of the northern Brazilian rain forest coast, in the region of Bahia, dominated by *Protium spp.*
(Hueck and Seibert, 1972: unit 26 *p.*; De Lacerda *et al.*, 1993: 486).

4A.1213 Santa Catarina inundatable coastal forests
Forests developed on humid soils in the extreme southern part of the southern Atlantic rain forest region of Brazil, in the state of Santa Catarina, dominated by *Tabebuia umbellata* and *Euterpe edulis*.
(Hueck and Seibert, 1972: unit 26 *p.*; Schnell, 1987a: 289).

4A.1214 Santa Catarina *Richeria* forests
Evergreen forests of humid depressions of the coastal plain of Santa Catarina dominated by the Euphorbiaceae *Richeria australis*.
(Schnell, 1987a: 289).

4A.122 Permanently inundated Atlantic eutropical forests
Permanently flooded forests of the swales of the extensive dune and beach-ridge systems of the Brazilian Atlantic rain forest coasts, dominated by *Tabebuia cassinoides*, with *Symphonia globulifera*, the palm *Bactris setosa* and the fern *Acrostichum danaefolium*.
(Hueck and Seibert, 1972: unit 26 *p.*; De Lacerda *et al.*, 1993: 486).

4A.13 Caribbeo-Pacific eutropical inundation forests
Swamp and riverine forests of the Pacific humid and hyperhumid rain forest regions of Colombia and Ecuador and of the rain forest regions of the northwestern Caribbean coast and hinterland.
(Hueck and Seibert, 1972, 1981: units 23-24 *p.*; Hueck, 1978: 141-145; Schnell, 1987a: 273; Schnell, 1987b: 232; Prance, 1989: 120-121; Maître *et al.*, 1993: 21).

4A.131 Pacific varzea and igapo forests
Inundatable rain forests of the banks and floodplain of rivers of the Pacific humid and hyperhumid rain forest regions of Colombia and Ecuador.
(Hueck and Seibert, 1972, 1981: 20, unit 23; Hueck, 1978: 142-143; Prance, 1989: 121; Maître *et al.*, 1993: 21).

4A.1311 Pacific guandal forests
Seasonally flooded riparian forests of the Pacific rain forests region developed on very poor, undrained acid soils, dominated by *Dialyanthera gracilipes* and *Campnosperma panamensis*.
(Lugo, 1990a: 4-5; Maître *et al.*, 1993: 21).

4A.1312 Rio Atrato catival forests
Seasonally inundated forests of the Rio Atrato flood plain dominated by *Prioria copaifera* accompanied by *Carapa guianensis* and *Virola spp.*, covering vast expanses in the transitional zone between palm riverine forests and terra firme evergreen rain forests.
(Hueck, 1978: 142-143; Maître *et al.*, 1993: 21).

4A.1313 Caribbeo-Pacific riverine palm forests
Seasonally inundatable forests of the Caribbeo-Pacific evergreen rain forest zone, notably of the Atrato valley, dominated by palms, in particular, *Mauritiella pacifica*, *Manicaria saxifera*, *Orbignya cuatrecasana*, *Euterpe cuatrecasana*, *Raphia taedigera*, *Attalea spp.*, in mixed formations or in monospecific stands.
(Hueck and Seibert, 1972, 1981: 20, unit 23; Hueck, 1978: 142-143; Myers, 1990: 269).

4A.1314 Pacific mixed varzea forests
Multispecific inundatable rain forests of the banks and floodplain of whitewater rivers of the Pacific humid and hyperhumid rain forest regions of Colombia and Ecuador, limited to a few small patches.
(Prance, 1989: 121).

4A.132 Pacific tidal varzea forests

Forests of the delta regions of the rivers of the Pacific humid and hyperhumid rain forest regions of Colombia and Ecuador, developed on muddy soils, formed by backup of fresh water provoked by tidal movement, with *Pachira aquatica*, *Pterocarpus officinalis*, *Symphonia globulifera*, *Mora oleifera*, *Tovomita rhizophoroides*, *Iryanthera ulei*, *Brosimum utile*, *Dussia lehmannii*, and the stiltroot palms *Euterpe cuatrecasana*, *Euterpe rhodoxyla*, *Mauritiella pacifica*.
(Schnell, 1987a: 273; Prance, 1989: 121).

4A.14 Caribbeo-Guianan riverine and swamp forests
Swamp and riverine forests of the Atlantic lowlands and hills of Guyana, Surinam, French Guiana and extreme northeastern Amapa, of the Caribbean lowlands of eastern Colombia and Venezuela, of Trinidad, in the watershed of short Atlantic or Caribbean rivers independent of the Orinoco or Amazon basins, developed in contact with Amazonian terra firme tropical evergreen or semievergreen rain forests or with Guianan, Trinidad or Caribbean coastal savannas.
(Richards, 1952: 287; Hueck and Seibert, 1972: unit 12 *p.*; Hueck, 1978: 82; Schnell, 1987a: 260-262; Schnell, 1987b: 233-234; Bacon, 1990; Myers, 1990; Tostain *et al.*, 1992: 16; Maître *et al.*, 1993: 13-15).

4A.141 Guiano-Atlantic riverine and swamp forests
Swamp and riverine forests of the Atlantic lowlands and hills of Guyana, Surinam, French Guiana and extreme northeastern Amapa, in the watershed of short Atlantic rivers independent of the Orinoco or Amazon basins, developed in contact with Amazonian terra firme tropical evergreen or semievergreen rain forests or with Guianan coastal savannas.
(Richards, 1952: 287; Hueck and Seibert, 1972: unit 12 *p.*; Hueck, 1978: 82; Schnell, 1987a: 258, 260-262, 265, 270, 440-443; Schnell, 1987b: 233-234; Bacon, 1990: 214-240; Myers, 1990: 271-272; Tostain *et al.*, 1992: 16; Maître *et al.*, 1993: 13-15).

4A.1411 Guiano-Atlantic mixed swamp forests
Swamp forests of tidal estuaries, permanently and seasonally flooded basins and marshy streamsides of the Atlantic lowlands and hills of Guyana, Surinam, French Guiana and extreme northeastern Amapa, dominated by hardwood species in multispecific or oligarchic dominance.
(Richards, 1952: 287; Schnell, 1987a: 260-261, 270, 441-443; Schnell, 1987b: 233-234; Bacon, 1990: 214-240; Myers, 1990: 271-272; Tostain *et al.*, 1992: 16; Maître *et al.*, 1993: 13-15).

4A.14111 Guiano-Atlantic swamp *Virola-Symphonia* forests
Swamp forests of the Atlantic lowlands and hills of Guyana, Surinam, French Guiana and extreme northeastern Amapa formed by *Virola surinamensis*, *Symphonia globulifera*, *Pterocarpus oficinalis*, *Carapa procera*, *Euterpe oleracea*, tall, up to 40 metres high.
(Schnell, 1987a: 260-261, 441-443; Bacon, 1990: 214-215, 218-219, 240; Tostain *et al.*, 1992: 16; Maître *et al.*, 1993: 13, 15).

4A.14112 Guiano-Atlantic estuarine *Pterocarpus-Bombax* forests
Swamp forests of the Atlantic lowlands of Guyana, Surinam, French Guiana and extreme northeastern Amapa, characteristic, in particular, of estuaries, dominated by *Pterocarpus officinalis* or by *Bombax aquaticum*, sometimes in pure monospecific stands.
(Richards, 1952: 287; Schnell, 1987a: 260-261, 441-443; Schnell, 1987b: 233; Bacon, 1990: 214-215, 218-219, 240).

4A.14113 Guiano-Atlantic swamp *Annona-Andira* forests
Mixed swamp forests of the Atlantic lowlands of Guyana, Surinam, French Guiana and extreme northeastern Amapa dominated by *Annona glabra*, *Andira inermis*, *Triplaris surinamensis*.
(Schnell, 1987a: 441; Bacon, 1990: 214-215, 218-219, 240).

4A.14114 Guiano-Atlantic swamp *Hura* forests
Permanent swamp forests of the Atlantic lowlands and hills of Surinam dominated by *Hura crepitans*
(Schnell, 1987a: 260, 441; Bacon, 1990: 214-215, 218-219, 240; Maître *et al.*, 1993: 14).

4A.14115 Guiano-Atlantic swamp *Triplaris* forests
Mixed swamp-edge forests of the Atlantic lowlands of the Guianas dominated by *Triplaris surinamensis*, accompanied by the smaller *Bonafousia tetrastachya*.
(Schnell, 1987a: 260, 441; Bacon, 1990: 214-215, 218-219, 240).

4A.14116 Guiano-Atlantic palm-rich mixed swamp forests
Mixed swamp forests of the Atlantic lowlands of the Guianas characterized by a dense second tree storey entirely or predominantly formed of palms, in particular, of genus *Manicaria*, with an overstorey formed by species of the previous units, sometimes absent or almost absent.
(Schnell, 1987a: 260-261, 270, 441-443; Myers, 1990: 271-272).

4A.1412 Guiano-Atlantic *Erythrina* swamp forests
Swamp forests of the Atlantic lowlands and hills of Guyana, Surinam, French Guiana and extreme northeastern Amapa dominated by the leguminous tree *Erythrina glauca*, often in almost pure consociations.
(Schnell, 1987a: 441; Bacon, 1990: 214-215, 218-219, 240).

4A.1413 Guiano-Atlantic swamp palm forests
Swamp forests of the Atlantic lowlands of Guyana, Surinam, French Guiana and extreme northeastern Amapa, dominated by palms, in particular, *Euterpe oleracea*.
(Schnell, 1987a: 260-261, 270, 440-443; Schnell, 1987b: 232; Bacon, 1990: 214-215, 218-219, 240; Tostain *et al.*, 1992: 16).

4A.1414 Guiano-Atlantic riverine forests
Riverine forests of the Atlantic lowlands and hills of the Guianas dominated by Caesalpiniaceae of genus *Eperua* or by Mimosae of genus *Inga*.
(Schnell, 1987a: 262, 265; Schnell, 1987b: 233-234; Tostain *et al.*, 1992: 16).

4A.14141 Guiano-Atlantic riverine *Eperua* forests
Riverine forests of the Atlantic lowlands and hills of the Guianas dominated by Caesalpiniaceae of genus *Eperua*, in particular *Eperua falcata*, with *Hymenaea courbaril*, *Bombax aquaticum*, characteristic of the upper course of rivers and of concave, abrupt banks of their meanders.
(Schnell, 1987a: 262; Schnell, 1987b: 233; Tostain *et al.*, 1992: 16).

4A.14142 Guiano-Atlantic riverine *Inga* forests
Riverine forests of the Atlantic lowlands and hills of the Guianas dominated by Mimosae of genus *Inga*, and Euphorbiaceae of genus *Croton*, low-growing, with an abundance of lianas, characteristic of the low, convex banks of river meanders.
(Schnell, 1987a: 262; Schnell, 1987b: 233; Tostain *et al.*, 1992: 16).

4A.1415 Guiano-Atlantic transition marsh forests
Forests of the inundatable upper and inland parts of swamps of the Atlantic lowlands and hills of the Guianas, tall and poorer in palms than the swamp forests of lower ground.
(Richards, 1952: 287; Hueck, 1978: 82; Schnell, 1987a: 258, 440-443; Schnell, 1987b: 233-234; Bacon, 1990: 214-215, 218-219, 240; Myers, 1990: 271-272; Maître *et al.*, 1993: 13-15).

4A.14151 Guianan riverine and swamp *Mora* forests
Forests of Guyana, Surinam and extreme eastern Venezuela, developed along watercourses and in low depressions of the coastal plain, dominated by the Caesalpiniaceae *Mora excelsa*, with *Pterocarpus officinalis*, similar to dry land *Mora* forests, but much richer in palms. Includes permanent swamp forests of Surinam.
(Richards, 1952: 237-238, 287; Hueck, 1978: 82; Schnell, 1987a: 258, 443; Maître *et al.*, 1993: 14; Huber, 1995: 108, unit 5 *p.*).

4A.14152 Guianan transition marsh *Iryanthera* forests
Forests of the inundatable upper and inland parts of swamps of the Atlantic lowlands and hills of the Guianas, dominated by the Myristicaceae *Iryanthera paraensis*, with *Tabebuia ssp.*.
(Schnell, 1987a: 443; Bacon, 1990: 214-215; Myers, 1990: 272).

4A.142 Trinidad swamp and riverine forests
Swamp forests of Trinidad, with two tree strata, rich in palms, including *Bactris major*, *Sabal mauritiiformis*, *Maximiliana caribaea*, and with *Pterocarpus spp.*.
(ffrench, 1976: 10-11; Bacon, 1990; Myers, 1990).

4A.1421 Trinidad mixed swamp forests

Swamp forests of tidal estuaries, permanently and seasonally flooded basins and marshy streamsides of Trinidad dominated by hardwood species in multispecific or oligarchic dominance.
(ffrench, 1976: 10-11; Bacon, 1990: 213-218, 223-227).

4A.14211 Trinidad *Annona-Andira* swamp forests
Mixed swamp forests of Trinidad dominated by *Annona glabra*, *Andira inermis*, *Triplaris surinamensis*.
(ffrench, 1976: 10-11; Bacon, 1990: 213-218, 223-227).

4A.14212 Trinidad *Pterocarpus* swamp forests
Swamp forests of Trinidad dominated by *Pterocarpus officinalis* in pure monospecific stands.
(ffrench, 1976: 10-11; Bacon, 1990: 213-218, 223-227).

4A.1422 Trinidad *Erythrina* swamp forests
Swamp forests of Trinidad dominated by the leguminous tree *Erythrina glauca*, often in almost pure consociations.
(ffrench, 1976: 10-11; Bacon, 1990: 213-218, 223-227).

4A.1423 Trinidad palm swamp forests
Swamp forests of Trinidad dominated by palms, in particular, *Euterpe oleracea*, *Mauritia setigera* or *Roystonea oleracea*.
(ffrench, 1976: 10-11; Bacon, 1990: 213-218, 223-227).

4A.14231 Trinidad *Mauritia* palm swamps
Mauritia setigera-dominated palm groves and palm forests of acid swampy depressions and savannas of Trinidad, with *Euterpe oleracea*, *Roystonea oleracea*, with a dense undergrowth.
(ffrench, 1976: 15).

4A.14232 Trinidad *Roystonea* swamps
Swamp forests of Trinidad dominated by palm *Roystonea oleracea*, forming small groves in the Nariva Swamp.
(ffrench, 1976: 10-11; Bacon, 1990: 213-218, 223-227).

4A.143 Caucan riverine forests
Riverine forests of the lower Cauca-Magdalena basin of Colombia, extending from regions of Pacific and Caribbean evergreen tropical rain forests into areas of Caribbean dry tropical woodland and inundated savannas, formed by trees of genera *Bombax*, *Pterocarpus*, *Symphonia*, *Virola*.
(Hueck and Seibert, 1972, 1981: unit 87 *p.*; Bacon, 1990: 234).

4A.144 Magdalena riverine forests
Inundatable rain forests of the banks and floodplain of whitewater rivers of the lower Magdalena Valley of Colombia.
(Prance, 1989: 121).

4A.145 Maracaiban inundation forests
Swamp and riverine forests, permanently or seasonally flooded, of the southwestern banks of Lake Maracaibo formed by Fabaceae (*Pterocarpus officinalis*, *Erythrina fusca*), Moraceae (*Cecropia peltata*, *Ficus scabrida*) and Euphorbiaceae (*Hura crepitans*, *Sapium spp.*).
(Hueck and Seibert, 1972, 1981: unit 23 *p.*; Hueck, 1978: 144-145; Veillon, 1985a: unit 15; Huber and Alarcon, 1988: unit 10 *p.*).

4A.2 Peri-Amazonian swamp and riverine forests

Swamp and riverine forests of the Amazonian system, the Orinoco system, the San Francisco system, the Caribbean, Pacific and Atlantic tropical coastal rivers located in regions dominated by savanna grassland, tropical scrubland or dry tropical woodland, outside of the main regions of Amazonian, Caribbeo-Pacific or Atlantic evergreen or semievergreen terra firme and inundatable forests, of which, however, they may constitute extensions along river courses.
(Birot, 1970: 92-110; Hueck and Seibert, 1972, 1981: unit 87 in units 31, 41, 42, 43, 46, 47, 48, 49, 59, 60; Schnell, 1987b: 234).

4A.21 Llanos riverine forests
Riverine forests of the Orinoco-Apure-Meta-Guaviare basin, developed mostly as gallery forests in the Llanos, extending into regions of semievergreen monsoon forests and Caribbean dry tropical woodland. Common species include *Allophylus amazonicus*, *Bauhinia tarapotensis*, *Casaria javitensis*, *Jacaranda obtusifolia*, *Palicourea condensata*, *Pterocarpus ulei* and the palm *Mauritia minor*. There are several endemic tree species, including the Chrysobalanaceae *Licania subarachnophylla*.
(Veillon, 1985a: unit 13; Huber and Alarcon, 1988: units 15, 21, 24, 33, 35; Prance, 1989: 122-123).

4A.211 Western llanos riverine forests
Gallery forests of the western and alluvial llanos, semideciduous, in part inundatable, relatively dense and of medium height, with Mimosae (*Pithecellobium saman*), Bombacaceae (*Ceiba pentandra*), Caesalpiniaceae (*Macrolobium spp.*), Bignoniaceae (*Tabebuia rosea*), Combretaceae (*Terminalia obovata*), Fabaceae (*Erythrina glauca*), Cochlospermaceae (*Cochlospermum vitifolium*) and the palm *Mauritia flexuosa*.
(Veillon, 1985a: unit 13; Huber and Alarcon, 1988: unit 15; Prance, 1989: 122-123).

4A.212 Central llanos riverine forests
Gallery forests of the central llanos of Venezuela, semievergreen, generally noninundatable, of low to medium height and with a dense understorey. Characteristic species include *Duguetia riberensis*, *Sclerolobium areum*, *Copaifera pubiflora*, *Trichilia singularis*, *Cocolobia caracassana*, *Licania apetala*, *Machaerium caicarense*, *Lecythis oliaria*, *Olyra longifolia*.
(Huber and Alarcon, 1988: unit 21; Prance, 1989: 122-123).

4A.213 Eastern llanos riverine forests
Gallery forests of the eastern high plain and Monagas llanos of Venezuela, semievergreen, of medium height and dominated by Euphorbiaceae (*Piranthea trifoliata*), Elacourtiaceae (*Homalium racemosum*), Caesalpiniaceae (*Sclerolobium guianense*).
(Huber and Alarcon, 1988: unit 35; Prance, 1989: 122-123; Huber, 1995: unit 9).

4A.214 Orinoco vega riverine forests
Seasonally inundated riverine forests of the Orinoco llanos skirting the western and northwestern piedmont of the Guianan shield of Venezuela and of the right-bank tributaries of the Orinoco indenting the shield in regions of semievergreen monsoon forests, evergreen, of low to medium height, submitted to floods several metres high, species-rich, with, in particular, Combretaceae (*Combretum frangulifolium*), Lecythidaceae (*Gustavia augusta*), Fabaceae (*Pterocarpus spp.*, *Etaballia dubia*), Mimosaceae (*Albizia corymbosa*, *Inga spp.*), Anacardiaceae (*Spondias mombin*), Euphorbiaceae (*Mabea nitida*), Flacourtiaceae (*Homalium racemosum*), Sapotaceae (*Pouteria orinocoensis*), Polygonaceae (*Symmeria paniculata*), Caesalpiniaceae (*Copaifera pubiflora*, *Campsiandra laurifolia*), Lecythidaceae (*Eschweilera tenuifolia*) and palms (*Astrocaryum aculeatum*).
(Huber and Alarcon, 1988: unit 24; Prance, 1989: 122-123; Huber, 1995: unit 10).

4A.215 Meta riverine forests
Gallery forests, noninundated, of the aeolian llanos of the Meta and Cinaruco basins of Meta, Casanare, Arauca and southern Apure, with *Caraipa llanorum*, *Ceiba pentandra*, *Chaunochiton angustifolia*, the endemic Lecythidaceae *Gustavia acuta*, and the palm *Mauritia flexuosa*.
(Huber and Alarcon, 1988: unit 33; Prance, 1989: 122-123).

4A.22 Guianan shield riverine forests
Riverine and swamp forests, mostly gallery forests, of savanna or tropical scrubland enclaves within the Guiano-Amazonian evergreen rain forest region of the Brazilian shield.

4A.221 Upper Branco riverine forests
Riverine and swamp forests and thickets, mostly gallery forests and thickets, of the central Guianan shield, on the western Guianan plateau of Guiana and Roraima, in particular, of the upper Rio Branco basin watercourses. They constitute the habitat of the threatened antbird *Cercomacra carbonaria*.
(Hueck and Seibert, 1972, 1981: unit 12-57 *p.*; Ridgely and Tudor, 1994: 309; Wege and Long, 1995).

4A.222 Eastern Guianan riverine forests
Riverine and swamp forests and thickets, mostly gallery forests and thickets, of the tropical savannas of the eastern Guianan plateau and the Paru and Jari basins.

(Hueck and Seibert, 1972, 1981: units 2-57, 12-57, *p.*).

4A.23 Brazilian shield riverine forests
Riverine and swamp forests and thickets, mostly gallery forests and thickets, of the cerrado and caatinga regions of the Brazilian shield drained by watercourses of the Amazon, Sao Francisco, Parnaiba systems, or by lesser watercourses of the Maranhao-Piaui-Ceara coast.
(Hueck and Seibert, 1972, 1981: units 43-87, 46-87, 48-87, 49-87).

4A.231 Caatingan riverine forests
Riverine forests of the caatinga dry tropical woodland regions of northeastern Brazil, forming gallery forests, lagoon-side forests and high watertable woods, composed by more or less deciduous Caesalpiniaceae (*Hymenaea*, *Caesalpinia*), Fabaceae (*Bowdichia*, *Erythrina*), Mimosae (*Acacia*), Bignoniaceae and Bombacaceae.
(Hueck, 1978: 331-332; Schnell, 1987b: 14; Lewis, 1987: 10, plate 2; Prance, 1989: 122).

4A.232 Cerrado riverine forests
Riverine and swamp forests and thickets, mostly gallery forests and thickets, of the cerrado region of the Brazilian shield drained by watercourses of the Amazon, Sao Francisco, Parnaiba systems. Forests of Goias show floristic and faunistic affinities with Atlantic forests. Constituting tree species include *Cariniana estrellensis*, *Chlorophora tinctoria*, *Hirtella martiana*, *Ilex paraguariensis*, *Licania gardneri*, *Dulacia singularis*, *Qualea ingens*, *Tabebuia caraiba*, *Ternstroemia candolleana*, *Xylosma venosum*, *Mauritia* palms, and, in southern stands, in Sao Paulo, *Cyclolobium vecchii*, *Sebastiana klotzschiana*. The curassow *Crax fasciolata*, the tapaculo *Scytalopus novacapitalis*, the furnariid *Philydor dimidiatus*, the parulid *Basileuterus leucophrys* are endemic, the streamcreeper *Lochmias nematura* is characteristic.
(Hueck and Seibert, 1972, 1981: unit 46-87; Prance, 1989: 122-123; Sick, 1993: 11, 12).

4A.24 Mojos-Pantanal riverine forests
Riverine and swamp forests, mostly gallery forests, of the southwestern periphery of the Brazilian shield, distributed principally in the Mojos region of northeastern Bolivia and in the Pantanal area of western Mato Grosso and Mato Grosso do Sul and of extreme eastern Bolivia and northeastern Paraguay.
(Herzog, 1923: 110-129; Hueck and Seibert, 1972, 1981: units 47-87, 58; Hueck, 1978: 444-445; Loureiro *et al.*, 1982: 341-348; Schnell, 1987a: 397-399; Schnell, 1987b: 250; Archibold, 1995: 65).

4A.241 Mojos riverine forests
Riverine and swamp forests, mostly gallery forests, of savanna regions of the upper Madeira-Namore-Guapore basin of northeastern Bolivia, located in an area of transition between Amazonian, Andean yungas and Paranean-Chacoan forests, with *Chlorophora tinctoria*, *Hura crepitans*, *Cassia multijuga*, *Andira inermis*, *Triplaris caracasana*, *Machaerium angustifolium*, *Erythrina spp.*, *Genipa americana*, *Cedrela fissilis*, *Antronium urundeuva*, *Ochroma lagopus*, *Swietenia spp.*, *Bertholetia excelsa*, *Hevea braziliensis*.
(Herzog, 1923: 110-129; Hueck and Seibert, 1972, 1981: unit 47-87; Hueck, 1978: 296; Schnell, 1987a: 397-399).

4A.242 Pantanal riverine forests
Riverine and swamp forests, mostly gallery forests, of the Pantanal of western Mato Grosso, Mato Grosso do Sul, eastern Bolivia and northeastern Paraguay, and of the valleys that rise from it into the Brazilian shield, developed in a region of transition between the cerrado of the adjacent Brazilian shield and the Chaco, with *Spondias lutea*, *Cassia spp.*, *Vochysia spp.*, *Triplaris formicosa*, *Ficus spp.*, *Inga spp.*, *Cecropia spp.* and palms (*Bactris spp.*, *Copernicia spp.*).
(Hueck and Seibert, 1972: unit 58; Hueck, 1978: 444-445; Loureiro *et al.*, 1982: 341-348; Schnell, 1987b: 250; Archibold, 1995: 65).

4A.25 Brazilian Atlantic riverine forests
Riverine and swamp forests and thickets, mostly gallery forests and thickets, of dry tropical woodland areas of the coastal fringe of Atlantic Brazil, in particular, in the Agreste and the dry sections of the coastal forest zone.
(Hueck and Seibert, 1972, 1981: units 25 *p.*, 44 *p.*).

4A.26 Tropical Pacific riverine forests
Riverine and swamp forests and thickets, mostly gallery forests and thickets, of the region of transition between Pacific evergreen forests and Pacific coastal deserts, of the lowlands and low western Andean slopes of Ecuador and northern Peru.
(Hueck and Seibert, 1972, 1981: units 23 *p.*, 33 *p.*).

4A.27 Peri-Amazonian palm riverine forests
Palm-dominated swamp and riverine forests of the Amazonian system, the Orinoco system, the San Francisco system, the Caribbean, Pacific and Atlantic tropical coastal rivers located in regions dominated by savanna grassland, tropical scrubland or dry tropical woodland, outside of the main regions of Amazonian, Caribbeo-Pacific or Atlantic evergreen or semievergreen terra firme and inundatable forests.
(Huber, 1995: 115-116, unit 17; Schnell, 1987b: 234; Myers, 1990: 272).

4A.271 Peri-Amazonian *Mauritia* palm groves
Palm groves and palm forests dominated by the palm *Mauritia flexuosa* (*Mauritia vinifera*), characteristic of swampy depressions and inundatable terrains of the tropical seasonal forest and savanna zones of South America, in particular, of the Colombo-Venezuelan llanos and Guianan savannas, north of the Amazonian forest zone, as well as of the Brazilian shield and its southwestern periphery, south of the Amazonian forest zone.
(Schnell, 1987a: 380, 382; Hueck and Seibert, 1972, 1981: units 29 *p.*, 30, 31, 47 *p.*, 58 *p.*; Hueck, 1978: 297; Loureiro *et al.*, 1982: 344; Schnell, 1987b: 234; Lewis and Owen, 1989: 4-5; Myers, 1990: 272; Henderson, 1995: 72-74).

4A.2711 Paraneo-Amazonian *Mauritia* palm groves
Mauritia flexuosa (*Mauritia vinifera*)-dominated palm groves and palm forests of swampy depressions of the seasonal semideciduous forest zone of the western Brazilian shield and its periphery, characteristic in particular of the Santa Cruz-Trinidad savanna region of northeastern Bolivia, of the Guapore valley in adjacent Brazil, of the southern Brazilian shield and the periphery of the Pantanal. They harbour the endemic, highly distinctive furnariid palmcreeper *Berlepschia rikeri*, the palm swift *Reinarda squamata* and numerous parrots, including the macaws *Anodorhynchus hyacinthinus*, *Ara arauna*, *Ara macao*, *Ara chloroptera*, *Ara severa*, and the maracañas *Propyrrhura maracana* and *Orthopsittaca manilata*.
(Schnell, 1987a: 380, 382; Hueck and Seibert, 1972, 1981: units 29 *p.*, 30, 31, 47 *p.*, 58 *p.*; Hueck, 1978: 297; Loureiro *et al.*, 1982: 344; Rizzini *et al.*, 1991: 141; Sick, 1993: 11, 12; Henderson, 1995: 72-74).

4A.2712 Colombo-Venezuelan llanos *Mauritia* palm groves
Mauritia flexuosa (*Mauritia vinifera*)-dominated palm groves and palm forests of swampy depressions and inundatable savannas of the Colombo-Venezuelan llanos.
(Hueck and Seibert, 1972, 1981: unit 60 *p.*; Hueck, 1978: 85; Schnell, 1987a: 382, 409, 410, 417, 418, 424; Huber and Alarcon, 1988: unit 35; Huber, 1995: unit 9).

4A.2713 Interior Guianan *Mauritia* palm groves
Mauritia-dominated palm groves and palm forests of swampy depressions, riverine galleries and inundatable grasslands of the Guianan shield savannas of the interior of the Guianas, northern Brazil and southeastern Venezuela.
(Hueck and Seibert, 1972, 1981: unit 57 *p.*; Lewis and Owen, 1989: 4-5).

4A.272 *Sabal* palm groves
Sabal mauritiaeformis-dominated palm groves and palm forests of swampy depressions of the seasonal semideciduous forest zone of the Colombo-Venezuelan llanos.
(Hueck and Seibert, 1972, 1981: unit 60 *p.*; Hueck, 1978: 442, 443).

4A.273 Wax palm forests and groves
Forests of the caatinga and agreste regions of northeastern Brazil dominated by the wax palm *Copernicia cerifera*, often in pure or almost pure stands, forming gallery forests along permanent and temporary watercourses, water-fringing woods around permanent or temporary lagoons and woods or stands in basins with high phreatic water. They are abundantly distributed in the coastal states from Maranhao to Pernambuco and in Bahia, less abundant in Alagoas and Sergipe. They are particularly characteristic of the Maranhao Baixada, and of the gallery forests of the Paranaiba, of the Acarau, of the Rio Paixe, of the Rio Piranha and of the Sao Francisco and its tributaries.

(Hueck, 1978: 323, 332-333, 335-336; Prance, 1989: 122; Myers, 1990: 272; Sampaio, 1995: 48, 50).

4A.274 *Butia* swamp palm forests
Rare forests of *Butia capitata* occupying inundatable soils of the margins of lagoons and basins of eastern Uruguay and southern Brazil, with a total world surface of about 700 km².
(Muñoz *et al.*, 1993: 28, 68-71).

4A.275 Colombian *Scheelea* palm riverine forests
Gallery forests and basin forests of the drier areas of Colombia formed by pure stands of the palm *Scheelea magdalena*.
(Myers, 1990: 272).

4A.3 Paranean riverine forests

Riverine forests of the Parana-Paraguay-Uruguay basin, extending from the subtropical semievergreen forest regions of southern Brazil, Misiones and southeastern Paraguay into the Mesopotamian Park region or northern Espinal, the humid eastern Chaco, the central Chaco and the northern Pampa.
(Martinez-Crovetto, 1963: 195-199; Ragonese and Castiglioni, 1968: 148; Hueck and Seibert, 1972, 1981: units 29 *p.*, 87 in units 34, 35, 37, 62, 63; Myers, 1990: 272).

4A.31 Upper Paranean riverine forests
Riverine forests of the upper Parana-Uruguay basin, forming galleries within the subtropical semievergreen forest regions of southern Brazil, Misiones and southeastern Paraguay, with the leguminous *Adenanthera macrocarpa*, *Copaifera langsdorfi*, *Erythrina cristagalli*, *Inga marginata*, *Inga uruguensis*, the laurels *Nectandra falcifolia*, *Ocotea acutifolia*, the Sapotaceae *Pouteria gardneriana*, *Inga*, the Proteaceae *Roupala cataractarum* and, in the understorey, Rubiaceae *Faramea cyanea*, and legumes of genus *Calliandra*.
(Martinez-Crovetto, 1963: 195-199; Dimitri, 1974; Santos Biloni, 1990; Tressens *et al.*, 1994; Laclau, 1994; Erize *et al.*, 1995: 39-41).

4A.32 Middle and lower Paranean mixed riverine forests
Species-rich gallery forests, of tropical or subtropical affinities, lining the rivers of the Parana-Uruguay system, prolonging, with a progressively impoverished cortège, the semievergreen forests of the upper Parana-Uruguay basins, south to the delta.
(Hueck, 1978: 291, 366).

4A.321 Northern Mesopotamian riverine forests
Riverine forests of the Parana-Uruguay system, developed within the subtropical savanna regions of western Misiones, northern Corrientes (gallery forests of the Parana and Uruguay from Misiones to the mouth of Riachuelo al Este) and south-eastern Paraguay.
(Martinez-Crovetto, 1963: 195-199; Hueck, 1978: 291; Carnevali, 1994: unit 32).

4A.322 Middle Mesopotamian riverine forests
Mixed riverine forests of the Parana-Uruguay systems, developed within the Mesopotamian Park region and adjacent Uruguay, in the area of the northern Espinal.
(Hueck, 1978: 291; Crespo, 1982: 3; Navas, 1982: 37; Gallardo, 1982: 67; Muñoz *et al.*, 1993: 26-27).

4A.323 Chaco riverine forests
Mixed riverine forests of the Chaco in the Parana-Paraguay-Pilcomayo-Bermejo river system, constituting connecting corridors between the Paranean forests and the lower Yungan pre-Andean forests.
(Hauman, 1947: 81-84; Ragonese and Castiglioni, 1968: 147, 153, 154; Morello and Adamoli, 1974: 40, 103, 104, 108, 121; Hueck, 1978: 29; Carnevali, 1994: unit 28).

4A.3231 Eastern Chacoan riverine forests
Mixed riverine forests of the Parana-Paraguay-Pilcomayo-Bermejo river system, developed within the dry tropical woodland regions of the humid eastern Chaco and, locally, of the central Chaco.
(Ragonese and Castiglioni, 1968: 147; Morello and Adamoli, 1974: 40, 103, 104, 108, 121; Hueck, 1978: 29; Carnevali, 1994: unit 28).

4A.3232 Western Chacoan *Tecoma* riverine forests
Mixed riverine forests of the rivers of the Chaco Serrano formed by *Tecoma stans*, *Tecoma garrocha*, *Erythrina falcata*, *Salix humboldtiana*.
(Hauman, 1947: 81-84; Ragonese and Castiglioni, 1968: 153, 154).

4A.3233 Western Chacoan cebil gallery forests
Tall, dense, gallery forests of the western, pre-yungan, Chaco dominated by the Mimosae *Anadenanthera macrocarpa* (*Piptadenia macrocarpa*) and *Parapiptadenia excelsa* (*Piptadenia excelsa*), with *Pterogyne nitens*, *Tipuana tipu*, of yungan affinities.
(Ragonese and Castiglioni, 1968: 153-154; Hueck, 1978: 273; Schnell, 1987b: 33; Santos Biloni, 1990: 16-18).

4A.324 Lower Paranean monte blanco forests
Mixed riverine forests of the lower Parana-Uruguay river system, developed within the Pampa warm humid temperate grassland region, species-rich, exuberant, formed by subtropical species of genera *Ocotea*, *Nectandra*, *Rapanea*, *Symplocos*, *Pouteria*, *Lonchocarpus*, *Inga*, *Ficus* and of Myrtaceae, with numerous lianas and epiphytes, formerly widespread on higher ground of the delta, in particular, of the middle and lower delta, now mostly replaced by plantations and cultivation.
(Hueck, 1978: 366).

4A.33 Paranean single-dominance riverine forests
Single-species dominated riverine forests of the middle and lower Parana-Uruguay river system, less rich in tropical species than the forests of unit 4A.32, with a generally more southern area of prevalence, and developed on usually somewhat more acid substrates.
(Ragonese and Castiglioni, 1968: 148; Hueck, 1978: 291, 365-366).

4A.331 Paranean *Salix humboldtiana* forests
Sauzales, riverine forests of the middle and lower Parana-Uruguay system formed by *Salix humboldtiana*, mostly characteristic of the upper delta, locally of the Mesopotamian region, of islands of the Parana, of the Parana-Paraguay delta.
(Ragonese and Castiglioni, 1968: 148; Hueck, 1978: 291, 365; Cabrera and Zardini, 1978: 4; Santos Biloni, 1990: 136; Carnevali, 1994: unit 38).

4A.332 Paranean *Tessaria* forests
Alisales, riverine forests of the lower and middle Parana-Uruguay system formed by *Tessaria integrifolia*, characteristic of the delta, also present in small patches in the Mesopotamian region.
(Ragonese and Castiglioni, 1968: 148; Hueck, 1978: 291, 365; Carnevali, 1994: unit 37).

4A.333 Paranean *Pithecolobium* forests
Timbozales, riverine forests of the lower Parana-Uruguay system formed by *Pithecolobium multiflorum*, mostly characteristic of humid depressions of the large islands of the upper delta.
(Hueck, 1978: 365-366).

4A.334 Paranean *Sapium* forests
Lecheronales, riverine forests of the lower Parana-Uruguay system formed by *Sapium haematospermum*, limited to the upper delta where they form narrow galleries along channels and around marshes of the islands.
(Hueck, 1978: 366).

4A.335 Paranean *Erythrina* forests
Seibales, riverine forests of the lower and middle Parana-Uruguay system formed by *Erythrina crista-galli*, mostly characteristic of the lower delta, where they form open woods with a luxuriant undergrowth of tall herbs, also present in small patches in the Mesopotamian region, on low terraces of the Parana and its main tributaries.
(Hueck, 1978: 291, 366; Gallardo, 1982: 67; Lugo, 1990a: 4-5; Carnevali, 1994: unit 30).

4A.336 *Myrcianthes* riverine and swamp forests
Single-species dominated riverine and swamp forests of the humid Chaco and middle and lower Parana-Uruguay river system dominated by *Myrcianthes cisplatensis*.

(Ragonese and Castiglioni, 1968: 148; Muñoz *et al.*, 1993: 172-173).

4A.34 Paranean riverine palm groves
Palm-dominated riverine and high-watertable forests of the middle and lower Parana-Uruguay river system and of the eastern and northern Chaco.
(Hueck and Seibert, 1972: units 34, 35 *p.*; Hueck, 1978: 292, 366; Schnell, 1987b: 35; Myers, 1990: 272; Carnevali, 1994: unit 36).

4A.341 Caranday palm groves
Groves and savanna woods of *Copernicia australis* of the central and eastern Chaco, mostly, but not only, associated with edges of waterbodies, old riverbeds and alluvial complexes, generally developed on substrates with high groundwater levels and on saline soils, often with a dense gramineous ground layer, a sparse understorey of low trees, shrubs and subshrubs, and colonies of terrestrial bromeliads.
(Hueck and Seibert, 1972: units 34, 35 *p.*; Hueck, 1978: 292; Schnell, 1987b: 35; Myers, 1990: 272; Carnevali, 1994: unit 36).

4A.342 *Arecastrum* riverine palm groves
Riverine groves formed by *Arecastrum romanzoffianum* of the upper middle Paraguay lowlands, with rare representatives in the lower Parana-Uruguay system.
(Hueck, 1978: 292, 366; Myers, 1990: 272).

4A.343 Paraguayan *Bactris* riverine forests
Riverine groves of the upper middle Rio Paraguay and of the eastern Chaco of Paraguay dominated by palms of genus *Bactris* (*Bactris anizitzii*, *Bactris bidentata*, *Bactris inundata*), forming dense, frequently flooded, gallery forests.
(Myers, 1990: 272).

4A.344 Paraguayan *Scheelea* riverine forests
Riverine forests of wetlands of the upper middle Rio Paraguay system dominated by *Scheelea parviflora*.
(Myers, 1990: 272).

4A.4 Subtropical desert riverine forests

Swamp and riverine forests of the hot desert regions of South America, the coastal and western Andean deserts on the Pacific watershed and the Monte desert in the Atlantic lowlands and tablelands.
(Hueck and Seibert, 1972, 1981: unit 87 in units 39, 51, 69).

4A.41 Monte riverine forests
Riverine forests of the southern Espinal and the Monte, developed mostly in the basins of the Rio Colorado-Rio Atuel and of the Rio Negro-Rio Limay, with southern outliers in the Rio Chubut system and Patagonia. Forests formed by *Salix humboldtiana* are typically riverine. Riverside or dry river bed forests formed by phreatophytes of genera *Prosopis* or *Acacia* are listed in unit 4B.
(Morello, 1958: 72, 89-91; Hueck and Seibert, 1972, 1981: unit 87 in 51, 52; Schnell, 1987b; Santos Biloni, 1990: 136).

4A.411 Southern and central Monte sauzales
Inundatable riverine woods of the central and southern Monte deserts and semideserts formed by *Salix humboldtiana*, widespread and extensive, in particular along the Rio San Juan, the Rio Desaguadero, the Rio Colorado, the Rios Neuquen and Limay, the Rio Negro, the course of which they entirely line, extending south to the Rio Chubut, where they are limited to a stretch between Trelew and Gaiman and the area of Las Plumas.
(Morello, 1958: 89-91; Santos Biloni, 1990: 136).

4A.412 Northern Monte sauzales
Salix humboldtiana riverine woods of the northern Monte deserts and semideserts, formed along rivers devoid of inundation plains, relatively uncommon and exiguous, appearing, in particular, along the Rio Salado between Catamarca and La Rioja, in the basins of Chilecito, of Andalgala, of Huelfin and along the Rio Santa Maria.
(Morello, 1958: 89-91; Santos Biloni, 1990: 136).

4A.42 Sechuro-Atacaman riverine forests

Gallery forests and woods of the rivers crossing the Sechura and Atacama deserts of Peru and northern Chile, formed by *Salix humboldtiana*, *Tessaria integrifolia*, *Schinus molle*, *Bulnesia retamo*, *Prosopis juliflora*, and, in the north of Chile, *Prosopis tamarugo*. Accompanying shrubs belong to genera *Baccharis*, *Lycium*, *Capparis*, *Acacia*.

(Koepcke, 1961: 141-142; Hueck and Seibert, 1972, 1981: unit 87 in 68-70; Hueck, 1978: 436).

4B. DRY TROPICAL WOODLAND

Forests and woodlands of dry tropical regions, of simpler structure and considerably lower species richness than rain and monsoon forests, often characterized by a relatively low, open canopy. Included are varied formations known as closed dry forests, open dry forests, savanna woodland, wooded savanna, thorn forest, thorn woodland, "tropical scrub", "bushland", as well as formations of phreatophytes of tropical and subtropical deserts.
(Morello, 1958: 74-87; Koepcke, 1961: 140-145, 193-195, 203-205, 205-208, 221-224; Ragonese and Castiglioni, 1968; Morello and Adamoli, 1968, 1974; Schnell, 1971, 1987a, 1987b; Hueck and Seibert, 1972, 1981: units 30, 31, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46 *p.*, 47 *p.*, 48 *p.*, 50 *p.*; Morello *et al.*, 1971; Hueck, 1978; Letouzey, 1978; Cabrera and Willink, 1980; Lewis and Pire, 1981; Sarmiento, 1983; Caldera, 1985; Huber and Alarcon, 1988; Prance, 1989; Rieley and Page, 1990; Maître *et al.*, 1993: 5-24; Huetz de Lemps, 1994; Burkart *et al.*, 1994; Daniele and Natenzon, 1994: units 2, 4, 5, 6, 7, 16; Murphy and Lugo, 1995; Sampaio, 1995; Gentry, 1995; Ceballos, 1995; Medina, 1995; Holbrook *et al.*, 1995; Erize *et al.*, 1995).

4B.1 Caribbean dry woodland

Closed dry forests, open dry forests, savanna woodland, wooded savanna, thorn forest, thorn woodland of continental Caribbean South America and the southern Caribbean islands.
(Hueck and Seibert, 1972, 1981: units 41, 42; Hueck, 1978: 345-356; Cabrera and Willink, 1980: 46; Voous, 1983: 14, 17, 19-21; Caldera, 1985: 39, 41, 42; Schnell, 1987b: 23-27; Huber and Alarcon, 1988: units 3 *p.*, 8, 16, 34, 60, 62 *p.*; Gentry, 1995: 153, 168-188; Ceballos, 1995: 202-203; Medina, 1995: 221-242; Holbrook *et al.*, 1995: 243-276).

4B.11 Colombo-Venezuelan dry woodland
Open woodland of the Carribean coastal regions of Colombia and Venezuela, and of their continental shelf islands, dominated by or rich in thorny umbrella-crowned, mostly microphyllous deciduous trees, often leafless for more than six months of the year, 6 to 10 metres high, mostly Caesalpiniaceae, Mimoseae, Fabaceae, Zygophyllaceae, Burseraceae, Bignoniaceae.
(Hueck and Seibert, 1972, 1981: units 41, 42; Hueck, 1978: 345-356; Cabrera and Willink, 1980: 46; Veillon, 1985a: units 18, 19; Caldera, 1985: 39, 41, 42; Schnell, 1987b: 23-27; Huber and Alarcon, 1988: units 3 *p.*, 8, 16, 34, 60, 62 *p.*; Gentry, 1995: 153, 168-188; Medina, 1995: 221-242; Holbrook *et al.*, 1995: 243-276).

4B.111 Colombo-Venezuelan thorn woodland
Open woodland of the driest area of the Caribbean coasts of Colombia and Venezuela, in particular, of the Golfo de Venezuela and the Guajira peninsula, and of inland hills of Lara formed by thorny umbrella-crowned, Caesalpiniaceae, Mimoseae and Theophrastaceae, in particular, *Caesalpinia coriacea*, *Cercidium praecox*, *Prosopis juliflora*, *Acacia tortuosa*, *Acacia flexuosa*, *Acacia macrantha*, *Jacquinia asiculata*, accompanied, in particular, by columnar cacti.
(Hueck and Seibert, 1972, 1981: units 41, 42; Hueck, 1978: 345-356; Cabrera and Willink, 1980: 46; Veillon, 1985a: unit 19; Caldera, 1985: 39, 41, 42; Schnell, 1987b: 23-27; Huber and Alarcon, 1988: unit 62 *p.*; Gentry, 1995: 153, 168-188; Medina, 1995: 221-242; Holbrook *et al.*, 1995: 243-276).

4B.112 Colombo-Venezuelan mixed dry deciduous woodland
Open woodland of the Caribbean lowlands and hills of Colombia and Venezuela, developed in areas of less extreme drought stress than those of unit 4B.111, with two tree strata, rich in thorny umbrella-crowned trees, formed by Zygophyllaceae, in particular, *Bulnesia arborea*, Bignoniaceae, notably *Tabebuia serratifolia*, *Tabebuia chrysantha* and other *Tabebuia spp.*, Fabaceae of genera *Machaerium* and *Lonchocarpus*, Capparaceae (*Capparis coccolobifolia*, *Capparis brasiletto*) and Burseraceae, particularly *Bursera simaruba* and *Bursera tomentosa*.

(Hueck and Seibert, 1972, 1981: unit 41; Hueck, 1978: 345-356; Cabrera and Willink, 1980: 46; Veillon, 1985a: unit 18; Caldera, 1985: 39, 41, 42; Schnell, 1987b: 23-27; Huber and Alarcon, 1988: units 8, 16, 34, 60; Gentry, 1995: 153, 168-188; Medina, 1995: 221-242; Holbrook *et al.*, 1995: 243-276).

4B.1121 Western Colombo-Venezuelan dry deciduous woodland
Open xerophile woodland of the Caribbean lowlands and hills of Colombia and the basin of Lake Maracaibo in Venezuela, of low to medium height, 12 to 15 metre tall, with the Zygophyllaceae *Bulnesia arborea*, the Boraginaceae *Bourreria cumanensis*, the Fabaceae *Myrospermum frutescens*, the Mimosae *Piptadenia flava* and *Acacia glomerosa*, the Caesalpiniaceae *Copaifera venezuelana*, the Hernandiaceae *Gyrocarpus americanus*, the cactus *Cereus griseus*, the Theophrastaceae *Jacquinia pungens*, the Malpighiaceae *Malpighia glabra*.
(Hueck and Seibert, 1972, 1981: unit 41; Hueck, 1978: 345-356; Cabrera and Willink, 1980: 46; Veillon, 1985a: unit 18; Caldera, 1985: 39, 41, 42; Schnell, 1987b: 23-27; Huber and Alarcon, 1988: unit 8; Gentry, 1995: 153, 168-188; Medina, 1995: 221-242; Holbrook *et al.*, 1995: 243-276).

4B.1122 Lara-Falcon deciduous forests
Dry deciduous forests of the Lara-Falcon hills, 8-15 metres tall, relatively open with dense undergrowth, formed by *Tabebuia billbergii*, *Tabebuia chrysea*, *Bulnesia arborea*, *Bourreria cumanensis*, *Cesania corriaria*, *Pereskia guamacho*, *Prosopis juliflora*.
(Hueck, 1978: 159-160; Veillon, 1985a; Huber and Alarcon, 1988: unit 60).

4B.1123 Central Venezuelan deciduous forests
Dry deciduous forests of the central upper llanos of Venezuela, in Cojedes and Guarico, fairly low, dense, with a dense undergrowth and a single tree stratum formed by *Tabebuia billbergii*, *Godmania aesculifolia*, *Spondias mombin*, *Bourreria cumanensis*, *Cordia spp.*, *Bursera simaruba*, *Cochlospermum vitifolium*, *Hura crepitans*, *Enterolobium cyclocarpum*, *Chlorophora tinctoria*.
(Huber and Alarcon, 1988: unit 16).

4B.1124 Eastern Venezuelan Caribbean deciduous forests
Dry deciduous forests of the eastern upper llanos of Venezuela, in extreme eastern Guarico and Anzoategui, fairly low, dense, with a dense undergrowth and a single tree stratum formed by *Tabebuia serratifolia*, *Tabebuia billbergii*, *Capparis odoratissima*, *Bourreria cumanensis*, *Erythroxylum havanense*, *Pithecellobium tortum*, *Pithecellobium oblongum*, *Guapira pacurero*.
(Huber and Alarcon, 1988: unit 34).

4B.113 Los Testigos dry woodland
Low, dry woodland of rocks of Los Testigos, islets on the continental shelf of northeastern Venezuela, and of the Paria peninsula, with two tree strata reaching 8 to 10 metres in height, and emergents to 15 metres, formed by *Ficus obtusifolia*, *Ficus citrifolia*, *Casearia tremula*, *Capparis odoratissima*, *Senna occidentalis*, *Myrcianthes fragrans*, *Cestrum alternifolium*.
(Huber and Alarcon, 1988: unit 3).

4B.12 Southern Antillean dry woodland
Dry woodland of Bonaire and Curaçao, represented by fragments on Curaçao, better preserved on Bonaire, where it is constituted most notably by umbrella-crowned trees of genus *Bursera*, gnarled trees of genus *Hematoxilon*, thorny acacias of genus *Prosopis*, accompanied by tree cacti, *Opuntia* cacti, and other cacti.
(Hueck and Seibert, 1972, 1981: units 42; Voous, 1983: 14, 17, 19-21).

4B.2 Southern tropical dry woodland

Dry tropical woodland of the Brazilian shield and its periphery, including zonal dry woodland and thorn woodland of the caatinga and the agreste, developed under annual rainfall inferior to 1000 mm, sclerophyllous woodland and savanna woodland of the Cerrado region and of the southwestern edge of the Brazilian shield in the Mojos, Chiquitos and Pantanal regions, edaphic dry woodland of the Atlantic façade of the Brazilian shield.
(Herzog, 1923: 110-119; Hueck and Seibert, 1972, 1981: units 43, 44, 46, 47, 48, 49, 58, 72; Hueck, 1978: 193-195, 294-345, 444; Cabrera and Willink, 1980: 56-60, 70-72; Sarmiento, 1983: 245-252, 271-273; Schnell, 1987a: 326-399; Schnell, 1987b: 5-22, 250, 265-266; Lewis, 1987: 7-10; Walter and Breckle, 1991b: 120, 139-140, 206-207; Sick, 1993: 11-14; Sampaio, 1995: 36-38, 46-59; Ceballos, 1995: 202-203; Harley, 1995: 14-20).

4B.21 Brazilian shield caatinga dry woodland

Dry woodland, very dry woodland and thorn woodland, deciduous, of the norteastern sector of the Brazilian shield, in the northeastern coastal states and Bahia, developed under arid or semiarid conditions, with annual rainfall mostly between 300 and 750 mm per year, locally below 250 mm, and with 7-8, locally 4-6 or 9-11 dry months. Characteristic trees composing the relatively diverse xerophytic woods include *Schinopsis brasiliensis*, *Astronium urunduva*, *Spondias tuberosa*, *Zizyphus joazeiro*, *Zollernia ilicifolia*, *Myroxylon peruiferum*, *Tabebuia caraiba*, *Tabebuia avellanedae*, *Erythrina velutina*, *Parkinsonia aculeata*, *Torresea cearaensis*, *Bursera leptophloeos*, *Licania rigida*, *Aspidosperma pyrifolia*, the pachycaulous Bombacaceae *Cavanillesia arborea*, *Ceiba pubiflora*, the palms *Orbignya speciosa*, *Copernicia cerifera*, *Syagrus spp.* and the arborescent cacti *Cereus jamacaru*, *Cereus squamosus*, *Cephalocereus dybowskii*. Succulents and bromeliads are abundant. Caatinga communities harbour a number of endemic birds including the tinamou *Crypturellus noctivagus zabele*, the guan *Penelope jacucaca*, the parakeet *Aratinga cactorum* and the extremely endangered macaws *Cyanopsitta spixii* and *Anodorhynchus leari*.

(Hueck and Seibert, 1972, 1981: units 43, 44; Hueck, 1978: 319-340; Sick and Teixeira, 1979: 10-11; Cabrera and Willink, 1980: 70-72; Eiten, 1983: 18-19; Sarmiento, 1983: 252; Schnell, 1987b: 5-22; Lewis, 1987: 7-8, plate 2; Rizzini *et al.*, 1991: 123-134; Walter and Breckle, 1991b: 120, 206-207; Sick, 1993: 13-14; Sampaio, 1995: 36-38, 46-59; Ceballos, 1995: 202-203; Harley, 1995: 14-15).

4B.211 Caatinga thorn forests

Deciduous, xerophytic low thorn forests of the northeastern Brazilian shield, constituting the main caatinga woodland habitat, formed by much-branched spiny trees with tortuous trunks, leafless for months, the bare branches and trunks having a light grey colour that gives the formation its name of "caatinga", or white forest, with a canopy attaining a height of 7-15 metres, developed on soils usually deeper than those occupied by thorn scrubs of units 3B.221 and 73.33, over crystalline rock substrates. The main tree constituents, many of which store water in their trunk or modified root systems, include Anacardiaceae (*Schinopsis brasiliensis*, *Astronium urundeuva*, *Spondias tuberosa*, Burseraceae (*Bursera leptophloeos*), Caesalpiniaceae (*Caesalpinia pyramidalis*, *Cassia spp.*), Mimoseae (*Anadenanthera macrocarpa*, *Mimosa spp.*, *Pithecellobium spp.*), Euphorbiaceae (*Cnidosculus phyllacanthus*), Fabaceae (*Luetzelburgia auriculata*), Apocynaceae (*Aspidosperma pirifolium*), palms (*Syagrus coronata*) and cacti (*Cereus spp.*).

(Hueck, 1978: 319-340; Schnell, 1987b: 5-22; Lewis, 1987: 7-8, plate 2; Walter and Breckle, 1991b: 206-207; Sampaio, 1995: 36-38, 46-59).

4B.212 Caatinga tall dry forests

Tall, dense, multi-strata arboreal caatinga forest, with canopy 15-30 metres high, lacking the abundance of thorns of the forests of unit 4B.211, mostly limited to areas of deep water-retaining soil and to the climatically more humid eastern and southern fringes, with *Tabebuia avellanedae*, *Aspidosperma pyrifolium*, *Astronium urundeuva*, *Cavanillesia arborea*.

(Hueck, 1978: 319-340; Schnell, 1987b: 5-22; Lewis, 1987: 7-8, plate 2; Walter and Breckle, 1991b: 206-207; Sampaio, 1995: 36-38, 46-59).

4B.213 Caatinga thorn-scrub woodland

Low, dry shrubby woodland of the northeastern Brazilian shield occupying deep sandy soils, with open canopy 5-8 metres high, mostly formed by spiny leguminous trees and large shrubs, completely deciduous during the dry season, of Mimosae (*Piptadenia obliqua*), Fabaceae (*Dalbergia cearensis*) and Caesalpiniaceae (*Poeppigia procera*), and by tall cacti (*Cereus jamacaru*, *Cereus squamosus*, *Cephalocereus dybowskii*).

(Hueck, 1978: 319-340; Schnell, 1987b: 5-22; Lewis, 1987: 7-8, plate 2; Walter and Breckle, 1991b: 206-207; Sampaio, 1995: 36-38, 46-59).

4B.22 Brazilian shield cerrado dry woodland

Sclerophyllous woodland and savanna woodland of the central, western and southern Brazilian shield, extending to the northeastern shield on sandstone plateaux and tablelands, and as small outliers in Sao Paulo state, mostly open and of low stature, with trees 8-12 metres high and occasional taller ones, a substantial shrub layer and an herb layer rich in legumes and grasses. A large number of species of trees participate in the composition of cerrado woodlands. Caesalpiniaceae, Fabaceae, Mimosea, Vochysiaceae, Bignoniaceae are well represented. Common trees include *Bowdichia virgilioides*, *Qualea parviflora*, *Sclerolobium paniculatum*, *Terminalia fagifolia*, *Byrsonima coccolobifolia*, *Machaerium opacum*, *Salvertia convallariodora*, *Dalbergia violacea*, *Caryocar brasiliense*, *Dimorphandra mollis*, *Pterodon pubescens*, *Kielmeyera coriacea*, *Annona crassiflora*, *Qualea*

grandiflora, *Qualea multiflora*, *Vochysia thyrsoidea*, *Agonandra brasiliensis*, *Xylopia grandiflora*, *Curatella americana*, *Tabebuia alba*, *Tabebuia caraiba*, *Platypodium elegans*, *Bombax spp.*, *Aspidospeerma tomentosum*, *Casearia sylvestris*, *Erythroxylum suberosum*, *Hymenaea sygonocarpa*, *Palicurea rigida*, *Tocoyena formosa*, palms. Remarkable is an assembly of subterraneous trees with trunks branching below the surface and emerging branches not exceeding 0.5 metres, in particular, *Andira humilis*, *Anacardium humile*, *Jacaranda decurrens*, *Calliandra brevicaulis*. Succulents and bromeliads are rare. These formations constitute the woodland element of the cerrado savanna complex (unit 96.5). The more closed (cerradao) extreme and the savanna woodland (cerrado) types have slightly diverging compositions. Sparser forms of the second provide the ligneous element in campo cerrado (wooded savanna) and in arborescent campo sujo (tree savanna). Cerrado woodland communities are very rich in endemic species, notably of birds, among them, parrots (*Amazona xanthops*), tyrannids (*Casiornis fusca*), corvids (*Cyanocorax cyanopogon*). Brazilian cerrado is one of the fastest disappearing habitats in the world.
(Eiten, 1963; Hueck and Seibert, 1972, 1981: units 46, 48, 49; Romariz, 1974: 37-43; Hueck, 1978: 301-319; Sick and Teixeira, 1979: 9-10; Cabrera and Willink, 1980: 56-60; Eiten, 1983: 16-17; Sarmiento, 1983: 245-252; Schnell, 1987a: 326-399; Lewis, 1987: 8-9, plate 1; Rizzini *et al.*, 1991: 86-94; Walter and Breckle, 1991b: 120, 139-140; Sick, 1993: 11-12; Willis and Oniki, 1993: 32; Harley, 1995: 15-20).

4B.221 Brazilian shield cerradao woodland
Sclerophyllous woodland of the central, western and southern Brazilian shield, with a total ligneous cover of more than 40 % and trees to 10-15 metres high, with a rich and varied shrub and grassland component. The cortège of trees is large and varied with geography and stational conditions. Important trees may include, in particular, *Hirtella glandulosa*, *Aspidosperma macrocarpon*, *Bowdichia virgilioides*, *Sclerolobium paniculatum*, *Xylopia sericea*, *Magonia pubescens*.
(Hueck, 1978: 301-319; Sarmiento, 1983: 245-252; Schnell, 1987a: 326-399; Lewis, 1987: 8-9, plate 1; Walter and Breckle, 1991b: 139-140; Harley, 1995: 15-20).

4B.222 Brazilian shield cerrado savanna woodland
Savanna woodlands of the central, western and southern Brazilian shield, and of sandstone plateaux and tablelands of the caatinga region of the northeastern Brazilian shield, with a total ligneous cover of 15 % - 40 % and trees to 6-8 metres high. Their species composition is quite similar to that of unit 4B.221 and equally variable, with location and growing conditions. *Aspidosperma spp.*, *Curatella americana*, *Kielmeyera coriacea*, *Qualea grandiflora*, *Salvertia convalladora* may be prominent.
(Hueck, 1978: 301-319; Sarmiento, 1983: 245-252; Schnell, 1987a: 326-399; Lewis, 1987: 8-9, plate 1; Walter and Breckle, 1991b: 139-140; Harley, 1995: 15-20).

4B.23 Atlantic restinga woodland
Xerophytic edaphic woodland of secondary dunes and inner beach ridge belts of the Atlantic coast of Brazil between Punta de Sao Roque and Rio Grande do Sul, of relatively low stature, not exceeding 10-15 metres, with a composition somewhat similar to that of restinga myrtle and clusia thickets (units 16.23411, 16.26412). Restinga woodland is a highly threatened habitat. It harbours several endemics, in particular, the tyrannid *Phylloscartes kronei* and the hummingbird *Phaethornis idaliae*.
(Hueck and Seibert, 1972, 1981: unit 72; Hueck, 1978: 193-195; Schnell, 1987a: 31; Schnell, 1987b: 264-266; Lewis, 1987: 10, plate 1; Prance, 1989: 128; Rizzini *et al.*, 1991: 73-83; Willis and Oniki, 1992: 158-161, 164-165; De Lacerda *et al.*, 1993: 487-488; Sick, 1993: 13).

4B.231 Janeiran restinga woodland
Xerophytic woodland of secondary dunes and inner beach ridges of the central Atlantic coast of Brazil, in particular, of the Cabo Frio area in Rio de Janeiro, 10-15 metres tall, with *Clusia spp.*, *Condolia buxifolia*, *Myrrhinium atropurpureum*, *Pouteria psammophila*, *Ormosia nitida*, *Rhoedia brasiliensis*, *Protium spp.*, *Cupania spp.*, *Andira frondosa*.
(Hueck, 1978: 192-194; Schnell, 1987b: 264; De Lacerda *et al.*, 1993: 487-488; Sick, 1993: 13).

4B.232 Catarinian restinga woodland
Xerophytic woodland of secondary dunes and inner beach ridge belts of the Atlantic coast of southern Brazil, in Sao Paulo, Santa Catarina and Rio Grande do Sul, particularly on the seafront of the large lagoons of extreme southern Brazil, dominated by *Brotium spp.*, *Cocoloba spp.*, *Pisonia spp.*, *Schinus spp.*, *Cupania spp.*, *Pithecolobium spp.*, *Tabebuia umbellata*, *Myrcia dichrophylla*, *Ocotea pulchella*, *Ficus organensis*, *Inga striata*, *Aspidosperma pyriocollum*, *Roupala spp.*.

(Hueck, 1978: 194-196; Schnell, 1987b: 265; Willis and Oniki, 1992: 158-161, 164-165; Sick, 1993: 13).

4B.233 Pernambuco-Bahian restinga woodland
Xerophytic woodland of the restingas of northern Brazil, under a drier climate than those of southern Brazil, with, in particular, *Myrcia spp.*, *Cassia uniflora*, *Andira nitida*, *Manilkara salzmanii*, *Tabebuia rosea-alba*.
(Hueck, 1978: 192; Schnell, 1987b: 266; Lewis, 1987: 10, plate 1; Prance, 1989: 128; Sick, 1993: 13).

4B.24 Mojos-Pantanal dry woodland
Xerophytic woodland and savanna woodland of the southwestern periphery of the Brazilian shield in the Mojos and Chiquitos savanna regions, and in the Pantanal swamp region, of mixed Cerradoan and Chacoan affinities.
(Herzog, 1923: 110-119; Hueck and Seibert, 1972, 1981: units 47, 58; Hueck, 1978: 294-301, 444; Sarmiento, 1983: 271-273; Schnell, 1987a: 397-399; Schnell, 1987b: 250; Walter and Breckle, 1991b: 120, 143).

4B.241 Mojos-Chiquitos dry woodland
Xerophytic woodland and savanna woodland of the southwestern periphery of the Brazilian shield in the Mojos and Chiquitos savanna regions. The Mojos-Chiquitos area, under Amazonian, low Andean, Chacoan and Cerradoan influences, harbours, besides grasslands, a complex array of woodland patches, and wooded savannas, many of which are palm formations, listed in unit 4B.25, others semievergreen or semideciduous forests, included in units 47 or 48. The entities referrable to this unit can be broadly divided into two groups, individualized in the subunits that follow.
(Herzog, 1923: 110-119; Hueck and Seibert, 1972, 1981: unit 47; Hueck, 1978: 294-301; Sarmiento, 1983: 272-273; Schnell, 1987a: 397-399).

4B.2411 Mojos savanna dry woodland
Tall dry deciduous "arboleda" woodland of the Mojos and Chiquitos savanna region in which the Bignoniaceae *Tabebuia suberosa* and the Dilleniaceae *Curatella americana* are the commonest species. In some areas tree growth is limited to termite mounds.
(Herzog, 1923: 110-119; Hueck, 1978: 296; Sarmiento, 1983: 272; Schnell, 1987a: 399).

4B.2412 Mojos thorn woodland
Dense thorny "chaparral" woodland of the Mojos savanna region, dominated by leguminous trees of genera *Acacia*, *Cassia* and *Mimosa*, accompanied by thorny shrubs and cacti.
(Herzog, 1923: 110-119; Hueck, 1978: 296; Sarmiento, 1983: 272).

4B.2413 Chiquitos dry woodland
Xerophytic woodland of sterile crests of the Velasco hills, or Sierra de Chiquitos, with an open canopy about 8 metres high, formed by *Curatella americana*, *Brosimum gaudichaudii*, *Byrsonima cydoniaefolia*, accompanied, in particular, by dwarf palms with subterranean trunks, among them, *Diplothemium littorale*.
(Hueck, 1978: 300).

4B.242 Pantanal dry woodland
Xerophytic woodland and savanna woodland of the Pantanal swamp region, very similar in appearance, component tree species diversity and species spectrum to Brazilian shield cerradao and cerrado woodland, likewise displaying a range of densities from woodland (cerradao) to open wooded savanna. Common trees include *Luhea divaricata*, *Erythroxylum suberosum*, *Qualea spp.*, *Magonia pubescens*, *Pterodon spp.*, *Bowdichia spp.*, *Plathymenia reticulata*, *Curatella americana*, *Hymenaea spp.*, *Caryocar brasiliensis* and, locally, *Cordia glabrata*, *Dipteryx alata*, *Tabebuia spp.*, *Inga spp.*, *Simaruba spp.*.
(Hueck and Seibert, 1972, 1981: unit 58; Hueck, 1978: 444; Loureiro *et al.*, 1982: 340-341; Sarmiento, 1983: 271-272; Schnell, 1987b: 250; Walter and Breckle, 1991b: 120, 143).

4B.25 Southern tropical palm savanna woods
Dryland palm woods of savanna areas of the Brazilian shield and its periphery, developed in dry woodland and thorn woodland caatinga regions of the northeastern shield or in cerrado sclerophyllous

woodland and savanna woodland of the central and western shield and its southwestern periphery in the Mojos and Chiquitos.
(Herzog, 1923: 110-119; Hueck and Seibert, 1972, 1981: units 47, 48; Hueck, 1978: 193-195, 294-345, 444; Schnell, 1987a: 326-399; Schnell, 1987b: 5-22, 250, 265-266; Sick, 1993: 11-14; Sampaio, 1995: 36-38, 46-59).

4B.251 Northeastern Brazilian shield babaçu woods
Dryland palm woods dominated by *Orbignya martiana* of the northeastern Brazilian shield in the states Maranhao and Piaue, developed in an area of transition between Amazonian forest and caatinga woodland, under annual precipitations of 1500 to 2200 mm.
(Hueck and Seibert, 1972, 1981: unit 48; Hueck, 1978: 340-345; Schnell, 1987a: 247-248; Rizzini *et al.*, 1991: 119-120).

4B.252 Mojos-Chiquitos palm savanna woods
Dryland palm woods of savanna areas of the southwestern periphery of the Brazilian shield, in the Mojos and Chiquitos regions, dominated by *Acrocomia totai*, *Attalea princeps*, *Copernicia alba* or *Orbignya phalerata*, with a more xerophytic accompanying cortège than the similar woods of unit 48.26.
(Herzog, 1923: 110-119; Hueck and Seibert, 1972, 1981: unit 47; Hueck, 1978: 296-299, 300-301; Schnell, 1987a: 397).

4B.2521 Mojos savanna palm woods
Dryland palm woods of savanna areas of the southwestern periphery of the Brazilian shield, in the Mojos depression, occupying, in particular, elevated ground in inundatable grasslands, dominated by *Acrocomia totai*, *Attalea princeps* or *Copernicia alba*.
(Herzog, 1923: 110-119; Hueck, 1978: 296-299; Schnell, 1987a: 397).

4B.2522 Chiquitos palm woods
Dryland palm woods of the Velasco hills, or Sierra de Chiquitos, in the Amazon-Parana interfluve dominated by the very tall columnar palm *Orbignya phalerata*, forming islands in open savannas.
(Herzog, 1923: 110-119; Hueck, 1978: 300-301).

4B.3 Guiano-Amazonian dry woodland and heath-forests

Xerophytic woodland of edaphic enclaves and savanna regions of northern South America, including the Amazonian basin, the Orinocan basin, the Guianan shield and the coastal plains of the Guianas, in particular, savanna woodland of the interior Guianan savannas, of the llanos, of Amazonian enclave savannas, of the coastal plains of the Guianas, and white sand woodland of the Amazonian rain forest zone.
(Hueck and Seibert, 1972, 1981: units 15, 46 *p.*, 50, 57 *p.*, 59 *p.*, 60; Hueck, 1978: 57, 62-67, 82-86, 439-443; Cabrera and Willink, 1980: 63; Sarmiento, 1983: 253-271; Schnell, 1987a: 233-235, 236-241, 258-259, 400-407, 408-411, 419-437, 438-443; Huber and Alarcon, 1988: units 19, 22, 32, 38, 49, 55, 67, 68, 76, 128, 137; Prance, 1989: 126-127; Huber, 1995: units 51, 74, 82).

4B.31 Orinoco-Amazonian savanna and dry woodland
Xerophytic woodland of savanna regions of interior northern South America, including the llanos of the Orinocan basin, the savannas of the central Guianan shield and Amazonian enclave savannas, similar in physiognomy to Brazilian shield cerrado woodland, but with a much impoverished species cortège, dominated by a very few, constant tree species, notably, the Dilleniaceae *Curatella americana*, the Fabaceae *Bowdichia virgilioides* and Malpighiaceae of genus *Byrsonima*.
(Hueck and Seibert, 1972, 1981: units 46 *p.*, 57 *p.*, 59 *p.*, 60; Hueck, 1978: 439-443; Cabrera and Willink, 1980: 63; Sarmiento, 1983: 253-271; Schnell, 1987a: 233-235, 400-407, 408-411, 419-437; Huber and Alarcon, 1988: units 19, 22, 32, 38, 55, 67, 68, 76).

4B.311 Llanos savanna woodland
Xerophytic savanna woodland of the llanos of the Orinocan basin, forming small woodland pockets in grass savanna landscapes, or more scattered wooded savanna groves, almost invariably dominated by *Curatella americana*, *Bowdichia virgilioides* and *Byrsonima crassifolia*, accompanied by a few additional species, in particular, *Byrsonima coccolobaefolia*, *Piptadenia peregrina*, *Roupala*

complicata, sometimes, in somewhat denser woods, *Licania pyrifolia*, *Copaifera officinalis*, *Cochlospermum vitifolium*, *Cassia moschata*.
(Hueck and Seibert, 1972, 1981: units 46 *p.*, 59 *p.*, 60; Hueck, 1978: 439-443; Cabrera and Willink, 1980: 63; Sarmiento, 1983: 253-261; Schnell, 1987a: 423-426; Huber and Alarcon, 1988: units 19, 22, 32, 38, 67, 68, 76).

4B.312 Guianan shield savanna woodland
Xerophytic savana woodland of the savannas of the Guianan shield, including the Gran Sabana, the savannas of the upper Rio Branco basin and the savannas of inland southern Surinam, Guyana, French Guiana and adjacent Brazil, dominated, like those of the llanos, by a very few cerrado species, *Curatella americana*, *Bowdichia virgilioides*, *Byrsonima crassifolia*, *Byrsonima verbascifolia*, *Palicourea rigida*.
(Richards, 1952: 324-325; Aubréville, 1961: 93; Hueck and Seibert, 1972, 1981: unit 57 *p.*; Hueck, 1978: 439; Sarmiento, 1983: 264-267; Schnell, 1987a: 409-410).

4B.313 Amazon basin enclave savanna woodland
Xerophytic savanna woodland of savanna enclaves within the Amazon basin hylaea and of xeric buttes of the Amazon basin, physiognomically and floristically closely allied to the cerrado woodland of the Brazilian shield, with a much impoverished species cortège, somewhat richer, however, than that of the llanos and Guianan shield savanna woods of units 4B.311 and 4B.312, with, in particular, *Curatella americana* (mostly absent in Venezuelan Amazonas), the Vochysiaceae *Qualea grandiflora* and *Salvertia convallariodora*, the Fabaceae *Bowdichia virgilioides*, *Aeschynomene paniculata* and *Derris spruceana*, *Byrsonima verbascifolia*, the Apocynaceae *Hancornia speciosa* and *Plumeria spp.*.
(Hueck and Seibert, 1972, 1981: units 46 *p.*, 57 *p.*; Sarmiento, 1983: 269-271; Schnell, 1987a: 233-235, 400-407; Huber and Alarcon, 1988: unit 55; Huber, 1995: unit 77).

4B.314 Guianan shield enclave dry woodland
Xerophytic woodland and savanna woodland of edaphic or microclimatic enclaves within moist evergreen or semievergreen forest regions of the Guianan shield, in particular, basimontane low, dry deciduous forests of the 300-500 metre level of the lower Ocamo valley in Venezuelan Amazonas, apparently a result of a local rain shadow effect, dry, 6-8 metre tall savanna woodland of the eastern piedmont of Cerro Guaiquinima, developed on acid sandy soils, open savanna woodland, 4-6 metres tall, of the 300-800 metres level of the Guanay-Cuao massif.
(Huber and Alarcon, 1988: units 128, 137, 143; Huber, 1995: units 51, 74, 82).

4B.32 Guiano-Amazonian white sand heath-forests
Evergreen xerophytic forests of the Amazonian basin and the Guianas installed on oligotrophic, leached white sand soils, lower, more open and more species-poor than sympatric evergreen rain forests, with a tendency to single dominance or oligodominance, physiognomically characterized by the prevalence of gnarled trunks and small scleromorphic leaves, with a patchy canopy 5-15 metres high and emergents at 20 metres ("caatinga woodland"), or a closed canopy 20-30 metres tall ("caatinga forest"). White sand forests, heath-forests locally known as Amazonian caatinga, campina forests, campirana, pseudo-caatinga, wallaba forests or sandy-belt forests, are very rich in local endemics, both floristically and faunistically, in particular, a number of Amazonian forest bird species are restricted to them.
(Rodrigues, 1961; Hueck and Seibert, 1972, 1981: unit 15; Hueck, 1978: 57, 62-67, 82-86; Schnell, 1987a: 236-241; Huber and Alarcon, 1988: unit 49; Prance, 1989: 126-128; Ridgely and Tudor, 1989; Whitmore, 1992: 19-20; Henderson, 1995; Huber, 1995: unit 15 *p.*).

4B.321 Upper Rio Negro white sand forests
Very extensive white sand heath-forests of the upper Rio Negro region, in western Amazonia, with *Caroycar gracile*, *Compsoneura debilis*, *Hevea camporum*, *Hevea rigidifolia*, *Phyllanthus atabapoensis*, *Aldina discolor*, *Lissocarpa benthamii*, *Eperua purpurea* and the palm *Barcella odora*. The rare antbird *Myrmeciza disjuncta* and the seedeater *Dolospingus fringilloides* are characteristic bird species.
(Hueck and Seibert, 1972, 1981: unit 15; Hueck, 1978: 62-67; Haffer, 1978: 58; Schnell, 1987a: 236-241; Huber and Alarcon, 1988: unit 49; Prance, 1989: 126-128; Ridgely and Tudor, 1989: 407; Whitmore, 1992: 19-20; Henderson, 1995; Huber, 1995: unit 15 *p.*).

4B.322 Eastern Amazonian white sand forests

White sand forests of the Guianan-eastern Amazonian sector of the Amazonian region, including the Belem region west to the western reaches of the Tocantins basin, the Guianas, Amapa and northeastern Para in the basins of the Rio Jari and the Rio Paru.
(Richards, 1952: 36, 230, 240-243; Hueck, 1978: 83; Schnell, 1987a: 258; Prance, 1989: 126-127; Whitmore, 1992: 20).

4B.3221 Guianan wallaba forests
White sand forests of the Guianas, in particular, oligarchic wallaba forests, dominated by *Eperua falcata*, which accounts for 75 % of large-diameter trees, accompanied by *Castostemma fragrans* and *Licania buxifolia*, *Eperua grandiflora*, 30 metres tall, densely packed, with few buttressed trees and lianas, with a dense shrub layer.
(Richards, 1952: 36, 230, 240-243; Hueck, 1978: 83; Schnell, 1987a: 258; Prance, 1989: 126; Whitmore, 1992: 20).

4B.3222 Belem white sand forests
White sand forests of the southern part of the Guianan-eastern Amazonian sector of the Amazonian region, west to the western reaches of the Tocantins basin, known, in particular, from the left bank of the Tocantins at 4°S.
(Prance, 1989: 127).

4B.323 Cachimbo white sand forests
White sand forests of the south-central sector of the Amazonian region, including the basins of the Rio Purus, the Rio Madeira, the Rio Tapajos and the Rio Xingu-Rio Iriri, known, in particular, from the headwaters of Rio Iriri, at 55° W, 9° S latitude, with a species cortège comprising an admixture of white sand species and cerrado species, in particular, *Caryoca brasiliensis* and *Parinari obtusifolia*.
(Prance, 1989: 127).

4B.324 Central Amazonian white sand forests
White sand forests of the north-central sector of the Amazonian region, including the lower basin of the Rio Negro, the left bank watershed of the Rio Branco and the basin of the Rio Trombetas.
(Hueck and Seibert, 1972, 1981: unit 15; Hueck, 1978: 62-67; Schnell, 1987a: 236-241; Prance, 1989: 126-128).

4B.3241 Lower Rio Negro white sand forests
White sand forests of the western part of the north-central sector of the Amazonian region, in the lower basin of the Rio Negro, below the confluent with the Rio Branco, and of the Rio Amazonas between the Rio Coari in the west, the Rio Madeira and the Rio Jalapu in the east, in the area of influence of the Manaus, Imeri and Guianan centres of endemism.
(Hueck and Seibert, 1972, 1981: unit 15; Hueck, 1978: 62-67; Schnell, 1987a: 236-241; Prance, 1989: 126-128).

4B.3242 Trombetas white sand forests
White sand forests of the eastern part of the north-central sector of the Amazonian region, including the left bank watershed of the Rio Branco and the basin of the Rio Trombetas, with a floral cortège characteristic of the Trombetas centre of endemism.
(Hueck and Seibert, 1972, 1981: unit 15; Hueck, 1978: 62-67; Schnell, 1987a: 236-241; Prance, 1989: 126-128).

4B.325 Western Amazonian white sand forests
White sand forests of the western and southwestern sector of the Amazonian region, including all of Peruvian, Ecuadorian and Bolivian Amazonia and, in Brazil, the basin of the right bank tributaries of the Rio Solimoas-Rio Amazonas, from the Rio Tefe and the Rio Jurua westwards, and the upper basins of the Rio Purus and the Rio Madeira, known, in particular, from the Chapada dos Parecis in Rondonia, with a species cortège formed, notably, by genera *Abolboda*, *Clusia*, *Humiria*, *Paepalanthus*, *Retiniphyllum*, *Syngonanthus*, *Ternstroemia*, *Tovomita*, *Xyris*, from Peruvian Amazonia, from the Sao Paulo de Olivença area and from Acre.
(Hueck and Seibert, 1972, 1981: unit 15; Hueck, 1978: 57; Schnell, 1987a: 236-241; Prance, 1989: 126-128).

4B.33 Coastal Guianan savanna woods and dry forests

Xerophytic savanna forests and savanna woods of the savannas of the coastal plains of the Guianas, developed on a variety of alluvial deposits mostly sandy substrates, including white sands, outside of the main rain forest environment.
(Richards, 1952: 324-325; Hueck and Seibert, 1972, 1981: unit 50; Hueck, 1978: 83; Sarmiento, 1983: 267-269; Schnell, 1987a: 259, 438-443).

4B.331 Coastal Guianan savanna woods
Open woods of the savannas of the coastal plains of the Guianas, formed by small trees that include the widespread *Curatella americana*, and a cortège otherwise fairly different from that of Brazilian shield cerrados, comprising, in particular, *Eugenia compta*, *Scleria bracteata*.
(Richards, 1952: 324-325; Schnell, 1987a: 259, 438-443).

4B.332 Coastal Guianan white sand *Humiria* woods
Very low, open, shrubby xerophytic savanna woods of the savannas of the coastal plains of the Guianas, developed on white sands, formed by *Humeria floribunda*, accompanied by *Clusia nemorosa*.

(Richards, 1952: 324-325; Schnell, 1987a: 259, 438-443).

4B.333 Coastal Guianan dry forests
Tall xerophytic savanna forests of the coastal plains of the Guianas formed by, notably, *Catostemma fragrans*, *Licania spp.*, *Swartzia spp.* and Sapotaceae.
(Richards, 1952: 324-325; Schnell, 1987a: 259, 438-443).

4B.4 Tropical Pacific dry woodland

Dry tropical woodland of the tropical Pacific lowlands, in the region of transition between the Pacific evergreen and semievergreen rain forest zone and the Pacific coastal deserts, of the western slopes of the Andes bordering the northern part of the Pacific coastal deserts and of the Galapagos islands.
(Koepcke, 1961: 140-145, 193-195, 203-205, 205-208; Bowman, 1961: 14-16, 18; Wiggins and Porter, 1971: 19-22; Hueck and Seibert, 1972, 1981: unit 33; Cabrera and Willink, 1980: 46-47; Schnell, 1987a, 1987b: 48-49, 114-133, 226-229; Gentry, 1995).

4B.41 Ecuadoro-Peruvian Pacific dry woodland
Dry tropical woodland of the tropical Pacific lowlands, in the region of transition between the Pacific evergreen and semievergreen rain forest zone and the Pacific coastal deserts and of the western slopes of the Andes bordering the northern part of the Pacific coastal deserts.
(Koepcke, 1961: 140-145, 193-195, 203-205, 205-208; Hueck and Seibert, 1972, 1981: unit 33 *p.*; Parker *et al.*, 1982: 24; Parker and Carr, 1992: 38-42, 54-55, 157-161; Schnell, 1987b: 48-49, 109-111, 114-133, 129, 146-153; Gentry, 1995).

4B.411 Ecuadoro-Peruvian Pacific tall dry woodland
Tall, relatively dense, dry deciduous forests of the tropical Pacific lowlands of Ecuador and northern Peru dominated by Bombacaceae, Bignoniaceae, Fabaceae, Mimosae, accompanied by Burseraceae, Bignoniaceae, Anacardiaceae, Annonaceae, Apocynaceae, Meliaceae, Lauraceae, Moraceae, Myrtaceae. Important genera include *Bombax* (*Ceiba*), *Erythrina*, *Bursera*, *Tabebuia*, *Loxopterygium*. These forests have become extremely rare.
(Koepcke, 1961: 193-195; Parker *et al.*, 1982: 24; Parker and Carr, 1992: 38-42, 54-55, 157-161).

4B.412 Ecuadoro-Peruvian Pacific light dry woodland
Dry deciduous woodland of the tropical Pacific lowlands of Ecuador and northern Peru, lower and more open than those of unit 4B.411, dominated by *Loxopterygium huasango*, with a much greater southern extension, to about 8° S, with outposts to 10° S.
(Koepcke, 1961: 195; Parker *et al.*, 1982: 24; Parker and Carr, 1992: 38-42, 54-55, 157-161).

4B.413 Ecuadoro-Peruvian Pacific thorn woodland
Dry woods, thorn forests and shrubby woods of the tropical Pacific lowlands of Ecuador and northern Peru dominated by *Prosopis juliflora* or *Acacia macrantha* with *Capparis spp.*, relatively widespread and constituting the principal habitat of a large cortège of bird species endemic or near-endemic to the northern Peruvian-southern Ecuadorian transition zone, including the parrot *Forpus coelestis*, the hummingbird *Amazilia amazilia*, the woodpecker *Veniliornis callonotus*, the furnariid *Synallaxis*

stictothorax, the tyrannids *Tyrannus niveigularis*, *Tumbezia salvini*, *Myiodynastes bairdi*, *Myiarchus semirufus*, the jay *Cyanocorax mystacalis*, the wrens *Campylorhynchus fasciatus*, *Thryothorus superciliaris*, the mockingbird *Mimus longicaudatus*, the icterids *Dives warszewiczi*, *Icterus graceannae*.
(Koepcke, 1961: 140-145; Parker *et al.*, 1982: 23-24; Parker and Carr, 1992: 38-42, 54-55, 157-161).

4B.414 Ecuadoro-Peruvian Pacific savanna woodland
Open savanna woodland of the dry tropical Pacific lowlands of Ecuador and northern Peru dominated by *Prosopis juliflora*, *Capparis mollis*, sometimes with *Bombax spp.*, *Loxopterygium huasango*.
(Koepcke, 1961: 203-205; Parker *et al.*, 1982: 14).

4B.415 Ecuadoro-Peruvian Pacific succulent-thorn park woodland
Dry woodland of the tropical Pacific lowlands of Ecuador and northern Peru transitional to cactus desert, formed by *Bursera graveolens*, *Acacia macracantha*, *Parkinsonia aculeata*, *Prosopis juliflora*, *Schinus molle*, *Bombax spp.*, *Clusia spp.*, *Oreopanax spp.* and arborescent cacti, including *Armatocereus cartwrightianus*, *Neoraimondia spp.*.
(Koepcke, 1961: 205-208).

4B.42 Galapagos dry woodland
Dry tropical woodland of the transition zone of the Galapagos Islands, extending to altitudes of about 100 metres on the south side of islands, of about 200-300 metres on the lee side, developed landwards and upwards from the arid zone cactus semideserts of unit 73.32, formed by *Bursera graveolens*, accompanied by *Piscidia erythrina*, by somewhat lower *Acacia macrantha* (*Acacia tortuosa*), *Erythrina carthagenensis*, *Pisonia floribunda* and arborescent cacti and by tall shrubs comprising, in particular, *Croton scouleri*, *Maytenus octogona*.
(Bowman, 1961: 15-16, 18; Wiggins and Porter, 1971: 19-22; Cabrera and Willink, 1980: 46-47; Schnell, 1987b: 226-229).

4B.5 Inner Andean dry woodland

Rain shadow or föhn generated dry woodlands, rich in cactus, of inner valleys of the tropical and subtropical Andes of Venezuela, Colombia, Peru, Bolivia and northwestern Argentina, developed in contact with cardonales and xerophytic scrubs of unit 73.4, with a tree and tall shrub cortège that comprises *Prosopis juliflora* (*Neltuma juliflora*), *Pithecolobium dulce*, *Poponax tortuosa* (*Acacia tortuosa*), *Cercidium praecox*, *Fagara culantrillo* (*Zanthoxylum culantrillo*), *Dodonaea viscosa*, *Thevetia peruviana*, *Bursera simaruba*, in diverse combinations. In the northern Andes they are related to Caribbean dry woodlands of unit 4B.1, in the northern central Andes to tropical Pacific woods of unit 4B.4, and in the southern tropical Andes to Chacoan woods of unit 4B.6.
(Morello, 1958: 74-87; Walter, 1962: Table 4; Hueck and Seibert, 1972: 40; Hueck, 1978: 356-363; Parker *et al.*, 1982; Vervoorst, 1982: 11; Schnell, 1987b: 83, 84, 109-111, 127; Walter and Breckle, 1991b: 165, 250).

4B.51 Inner northern-Andean dry woodland
Rain shadow or föhn generated dry woodlands of inner valleys of the northern tropical Andes, north of the Huancabamba depression, at about 5° S, in Colombia and Venezuela, in particular, in the upper Cauca valley, between the central and western cordilleras of Colombia, the upper Magdalena valley between the central and eastern cordilleras, the upper Catatumbo basin of Colombia, and the upper Chama basin in the Venezuelan Cordillera de Merida.
(Walter, 1962: Table 4; Hueck and Seibert, 1972: 40; Hueck, 1978: 356-363; Schnell, 1987b: 83, 84, 109-111, 127; Walter and Breckle, 1991b: 165, 250).

4B.511 Colombian Andean interior dry woodlands and forests
Open, low sclerophyllous forests of interior Andean valleys of the main northern Andean system, in Colombia, in particular, of the Magdalena, Cauca, Patia, Sucio, Chicamocha, Dagua rivers, formed by *Cercidium praecox*, *Dodonaea viscosa*, *Fagara culantrillo*, *Pithecolobium dulce*, *Poponax tortuosa*, *Prosopis juliflora* and *Thevetia peruviana*.
(Hueck, 1978: 356-363; Schnell, 1987b: 83, 84, 109-111, 127).

4B.512 Venezuelan Andean interior dry woodlands and forests

Low, open, sclerophyllous forests of interior valleys of the northeasternmost spurs of the Andes, in Venezuela, in particular, of the upper Motatan and Chama valleys, with *Bursera simaruba*, *Prosopis juliflora*, *Lemaireocereus griseus*, *Opuntia caribaea*.
(Hueck, 1978: 356-363; Schnell, 1987b: 83, 84, 109-111, 127).

4B.52 Inner central-Andean dry woodland
Rain shadow or föhn generated dry woodlands of inner valleys of the central tropical Andes, between the Huancabamba depression, at about 5° S, and the Andean bend, at about 18° S latitude, in particular, of the Marañon, Hullaga and Apurimac valleys, with *Acacia macracantha*, *Banisteria leiocarpa*, *Bauhinia weberbauerii*, *Bombax ruizii*, *Caesalpinia tinctoria*, *Caesalpinia corymbosa*, *Cassia chrysocarpa*, *Cercidium praecox*, *Dodonaea viscosa*, *Jacaranda acutifolia*, *Jatropha weberbaueri*, *Piptadenia colibrina*, *Schinus molle*, arborescent cacti and *Puya* bromeliads.
(Walter, 1962: Table 4; Hueck and Seibert, 1972: 40; Hueck, 1978: 356-363; Parker *et al.*, 1982; Schnell, 1987b: 83, 84, 109-111, 127; Walter and Breckle, 1991b: 165, 250).

4B.53 Inner southern-Andean dry woodland
Dry woodlands, mostly formed by phreatophytes, of rain shadow and föhn-subjected inner valleys of the southern tropical Andes, between the Andean bend in Bolivia, at about 18°S latitude, and La Rioja, at about 29°S, extending into dry Monte basins of the Cuyo Andes of San Juan and Mendoza.
(Morello, 1958: 74-87; Walter, 1962: Table 4; Hueck and Seibert, 1972: 40; Hueck, 1978: 356-363; Schnell, 1987b: 83, 84, 109-111, 127; Walter and Breckle, 1991b: 165, 250).

4B.531 East Bolivian Andean interior dry woodlands and forests
Open, low, sclerophyllous woods and forests of the upper valleys of the Pilcomayo, the Rio Grande and the headwaters of Rio Beni, with strong affinities with the sclerophyllous vegetation of the neighbouring Chaco, formed by *Prosopis juliflora*, *Prosopis kuntzei*, *Aspidosperma quebracho-blanco*, *Schinopsis quebracho-colorado*, *Schinus dependens*, *Jodina rhombifolia*, *Loxopterygium brachypterum*, *Pentapanax angelicifolius*, *Celtis spp.*, with an undergrowth constituted by shrubs of genera *Acacia*, *Mimosa*, *Jatropha*, *Capparis* and arborescent cacti, including columnar or candelabra *Cereus* cacti and dendroid *Pereskia* cacti.
(Herzog, 1923: 140-176; Hueck, 1978: 357-359).

4B.532 Argentinian inner-Andean algarrobales
Forests and woods of phreatophytes of genus *Prosopis*, in particular, *Prosopis nigra*, *Prosopis alba*, *Prosopis flexuosa*, *Prosopis chilensis*, of the valleys and basins of interior Andean valleys between 25° S and 30° S, developed in a Monte semidesert environment, accompanied by Chaco elements, including *Celtis spinosa*, *Geoffroea decorticans*, *Jodina rhombifolia*, *Atamisquea emarginata*, *Grabowskia duplicata*, *Cercidium praecox*, *Suaeda divaricata*, *Maytenus viscifolia* and Monte shrubs.
(Morello, 1958: 74-87; Hueck, 1978: 357-358).

4B.5321 Tucumano-Saltenian interior Andean algarrobo forests
Forests of *Prosopis alba* and *Prosopis nigra* of the Calchaqui and Santa Maria basins of the Andes of Salta and Tucuman, developed in the environment of the longitudinal inner valleys prepuna and extreme northern Monte deserts and semideserts of unit 73.44.
(Morello, 1958: 74-77; Hueck, 1978: 357-358).

4B.53211 Multispecificic Tucumano-Saltenian Andean algarrobales
Multidominant *Prosopis* forests of the Calchaqui and Santa Maria basins of the Andes of Salta and Tucuman constituting a more humid variant of the inner Andean algarrobales, developed at the side of permanent watercourses, relatively species-rich, with four to six dominants, sometimes with two tree strata, numerous epiphytes and climbers. The cortège includes *Celtis spinosa*, *Geoffroea decorticans*, *Jodina rhombifolia*, *Acacia caven*, *Schinus bumelioides*, *Schinus polygamus*, *Caesalpinia gilliesii*, *Clematis hilarii*, *Tillandsia xiphioides*.
(Morello, 1958: 74-87; Hueck, 1978: 357-358).

4B.53212 Paucispecificic Tucumano-Saltenian Andean algarrobales
Paucidominant *Prosopis* forests of the Calchaqui and Santa Maria basins of the Andes of Salta and Tucuman constituting a drier variant of the inner Andean algarrobales, with one or two species in the upper stratum, few epiphytes and climbers, and an undergrowth rich in elements of the Monte *Larrea* communities, including *Larrea cuneifolia* and *Larrea divaricata*, halophytes, in particular *Suaeda divaricata*, and *Opuntia* cacti.

(Morello, 1958: 74-87; Hueck, 1978: 357-358).

4B.5322 Catamarcan interior Andean algarrobo forests
Forests of *Prosopis flexuosa* and *Prosopis alba* with *Bulnesia retama*, *Cercedium praecox*, of the Salina de Pipanaco and Rio Colorado basin of southern Catamarca and extreme northern La Rioja.
(Morello, 1958: 74-87; Hueck, 1978: 357-358).

4B.5323 Mendozo-Riojan algarrobo forests
Forests of *Prosopis flexuosa* of the Valles de Vinchina and Jagüe, forests of *Prosopis alba* and *Prosopis nigra* of the Campo de Velazco, both in La Rioja, and isolated *Prosopis* woods of Mendoza, constituting the southernmost representatives of inner Andean tropical woodland.
(Hunziker, 1952: 176; Morello, 1958: 74-87; Roig, 1982: 69, 74, 76).

4B.533 Argentinian inner-Andean *Acacia visco* arcales
Dry woods of gorges, inner valleys and Monte basins of the Andes of Jujuy, Salta, Tucuman, Catamarca and La Rioja, developed in stations with permanent phreatic water available, dominated by the often tall phreatophyte *Acacia visco*, in monospecific stands or accompanied by *Prosopis alba*, *Prosopis flexuosa*, *Prosopis nigra*, *Prosopis chilensis*, *Buddleja tucumanensis*, *Geoffroea decorticans*, *Celtis spinosa*, *Maytenus viscifolia*, *Schinus molle* var. *areira*, *Schinus polygamus*, *Jodina rhombifolia*, *Lithrea molleoides*.
(Morello, 1958: 87-89; Santos Biloni, 1990: 88-89).

4B.6 Chacoan and peri-Chacoan dry woodland

Subtropical xerophytic forests and woods of the Chacoan floral province, most characteristic of the dry Chaco, extending to the humid Chaco, the Espinal, the Monte and the Pampas. The region is very rich in endemics, including an exceptional number of mammals, comprising the peccary *Catagonis wagneri*, the armadillos *Cabassous chacoensis*, *Chaetophractus villosus*, *Chlamyphorus retusus*, nine species of tuco-tucos of genus *Ctenomys* and eight small rodents of family Muridae.
(Herzog, 1923: 81-82, 84-105; Hauman, 1947; Burkart, 1947; Martinez Crovetto and Piccinini, 1951; Cabrera, 1953; Morello, 1958; Cano and Movia, 1967; Ragonese and Castiglioni, 1968; Morello and Adamoli, 1968, 1974; Morello *et al.*, 1971; Hueck and Seibert, 1972, 1981: units 34, 35, 36, 37, 38, 39, 45; Hueck, 1978: 255-294, 447-448; Ragonese and Piccinini, 1976; Cabrera and Willink, 1980: 72-79; Lewis and Pire, 1981; Vervoorst, 1982: 10-11; Covas, 1982; Roig, 1982; Gallardo, 1982; Navas, 1982; Crespo, 1982; Schnell, 1987b: 28-41; Burkart *et al.*, 1994: 4-5, 8-15, 28-29; Daniele and Natenzon, 1994: units 2, 4, 5, 6, 7, 16; Carnevali, 1994: 64-108; Ceballos, 1995: 202-203; Erize *et al.*, 1995: 60-95, 112-121).

4B.61 Chacoan quebracho and palosantal forests
Tall, climax sclerophyllous forests of the Chaco and its peripheral regions dominated by the Anacardiaceae *Schinopsis quebracho-colorado*, *Schinopsis balansae*, *Schinopsis haenkeana*, the Apocynaceae *Aspidosperma quebracho-blanco*, known as "quebrachos", or the Zygophyllaceae *Bulnesia sarmientoi*, the "palosantal".
(Herzog, 1923: 81-82, 84-105; Hauman, 1947: 73-79; Cabrera, 1953: 122-126; Ragonese and Castiglioni, 1968; Morello and Adamoli, 1968, 1974; Ragonese and Piccinini, 1976; Hueck, 1978: 255-294; Cabrera and Willink, 1980: 72-79; Lewis and Pire, 1981; Vervoorst, 1982: 10-11; Roig, 1982; Schnell, 1987b: 28-41; Rizzini *et al.*, 1991: 146; Burkart *et al.*, 1994: 8-15, 28-29; Carnevali, 1994: 64-108; Erize *et al.*, 1995: 60-95).

4B.611 *Schinopsis balansae* forests
Tall sclerophyllous forests of the Chaco dominated by the simple-leaved *Schinopsis balansae*, constituting the typical climactic dry forest of the humid eastern Chaco, comprising, as accompanying trees, *Astronium balansae*, *Aspidosperma quebracho-blanco*, *Ruprechtia laxiflora* (*Ruprechtia polystachya*), *Gleditsia amorphoides*, *Caesalpinia paraguariensis*, *Celtis spinosa*, *Tabebuia impetiginosa*, *Schinus fasciculatus*. Fully-developed forests of this unit have become extremely rare.
(Ragonese and Castiglioni, 1968: 144-145, 147; Morello and Adamoli, 1974: 103; Hueck, 1978: 267; Cabrera and Willink, 1980: 72; Vervoorst, 1982: 10-11; Eskuche, 1982: 45; Rizzini *et al.*, 1991: 146; Carnevali, 1994: unit 32; Erize *et al.*, 1995: 71).

4B.612 *Schinopsis quebracho-colorado* forests

Tall sclerophyllous forests of the Chaco dominated by the compound-leaved *Schinopsis quebracho-colorado* (*Schinopsis lorentzii*), constituting the typical climactic dry forest of the dry western Chaco, comprising, as accompanying trees, *Aspidosperma quebracho-blanco*, *Caesalpinia paraguariensis*, *Prosopis kuntzei*, *Geoffroea decorticans*, *Zizyphus mistol*, *Jodina rhombifolia*, *Cercidium australe*, the bottle-shaped tree *Chorisia insignis* and the small palm *Trithrinax campestris*.
(Herzog, 1923: 81-82, 84-105; Morello, 1958: 134-135; Ragonese and Castiglioni, 1968: 148-151; Morello and Adamoli, 1974: 106; Hueck, 1978: 255-294; Cabrera and Willink, 1980: 73; Vervoorst, 1982: 10-11; Schnell, 1987b: 28-41; Burkart *et al.*, 1994: 10-12; Erize *et al.*, 1995: 61-63).

4B.613 Mixed *Schinopsis* forests
Tall, sclerophyllous forests of the region of transition between the eastern humid Chaco and the western dry Chaco, in the zone of optimal co-existence of the three quebrachos, *Schinopsis quebracho-colorado*, *Schinopsis balansae* and *Aspidosperma quebracho-blanco*, dominated by mixed stands of *Schinopsis quebracho-colorado*, *Schinopsis balansae* and their hybrid, the highly polymorphic-leaved *Schinopsis heterophylla*, with *Aspidosperma quebracho-blanco*, *Caesalpinia paraguariensis*, *Prosopis kuntzei*, *Patagonula americana*.
(Ragonese and Castiglioni, 1968: 149; Morello and Adamoli, 1974: 107).

4B.614 *Schinopsis haenkeana* forests
Sclerophyllous forests of the western, montane, Chaco, limited to the slopes of sub-Andean ranges and of the Sierras Pampeanas, at altitudes comprised between 500 and 1500 metres, in Bolivia, Jujuy, Salta, Tucuman, Catamarca, La Rioja, Santiago del Estero, Cordoba, San Luis and San Juan, dominated by *Schinopsis haenkeana*, with *Fagara cocos*, *Lithrea ternifolia*, *Ruprechtia apetala*, *Chorisia insignis*, *Aspidosperma quebracho-blanco*.
(Herzog, 1923: 81-82, 84-105; Morello, 1958: 135; Ragonese and Castiglioni, 1968: 152-154; Ragonese and Piccinini, 1976; Hueck, 1978: 255-294; Cabrera and Willink, 1980: 73; Vervoorst, 1982: 10; Roig, 1982: 68; Schnell, 1987b: 28-41; Burkart *et al.*, 1994: 29; Erize *et al.*, 1995: 68).

4B.615 *Aspidosperma quebracho-blanco* forests
Tall sclerophyllous forests of the Argentinian, Bolivian and Paraguayan Chaco dominated by *Aspidosperma quebracho-blanco*, distributed in both the western, dry, Chaco and the eastern, humid, Chaco, more common in the first, accompanied by *Schinopsis quebracho-colorado* or *Schinopsis balansae*, *Jodina rhombifolia*, *Prosopis kuntzei*, *Caesalpinia paraguariensis*.
(Herzog, 1923: 81-82, 84-105; Morello, 1958: 135; Ragonese and Castiglioni, 1968: 151; Morello and Adamoli, 1974: 104-107; Hueck, 1978: 255-294; Roig, 1982: 85; Schnell, 1987b: 28-41).

4B.616 *Bulnesia sarmientoi* forests
Tall, xerophyllous forests of the western Chaco, distributed in Salta, Chaco and Formosa and in neighbouring Bolivia and Paraguay, dominated by *Bulnesia sarmientoi* accompanied by *Aspidosperma quebracho-blanco*, *Schinopsis quebracho-colorado*, *Bumelia obtusifolia*, *Caesalpinia paraguariensis*, *Prosopis alba*, *Prosopis nigra*, *Zizyphus mistol*, *Cercidium australe*, *Prosopis kuntzei*, *Prosopis ruscifolia*, *Cereus coryne*. These forests are characteristic, in particular, of the Impenetrable.
(Herzog, 1923: 81-82, 84-105; Ragonese and Castiglioni, 1968: 151; Morello and Adamoli, 1974: 104; Hueck, 1978: 255-294; Schnell, 1987b: 28-41; Erize *et al.*, 1995: 71).

4B.62 Chacoan *Prosopis*, *Acacia* and *Geoffroea* woodland
Dry woods and thorn forests of the Chaco and its peripheral regions dominated by Mimosae of genera *Prosopis* or *Acacia*, or by the Fabaceae *Geoffroea*, constituting serial communities, secondary communities or halophile communities within the Chaco, often representing the main woodland communities in presteppic or semidesert regions on the periphery of the Chaco.
(Herzog, 1923: 81-82, 84-105; Hauman, 1947; Burkart, 1947; Cabrera, 1953; Morello, 1958; Cano and Movia, 1967; Ragonese and Castiglioni, 1968; Morello and Adamoli, 1968, 1974; Morello *et al.*, 1971; Hueck, 1978: 255-294, 447-448; Cabrera and Willink, 1980: 72-79; Lewis and Pire, 1981; Vervoorst, 1982: 10-11; Covas, 1982; Roig, 1982; Gallardo, 1982; Navas, 1982; Crespo, 1982; Schnell, 1987b: 28-41; Muñoz *et al.*, 1993: 26; Erize, 1993: 163-172; Burkart *et al.*, 1994: 4-5, 8-15, 28-29; Carnevali, 1994: 64-108; Erize *et al.*, 1995: 60-95, 112-121).

4B.621 Chacoan algarrobo woodland
Dry woods and thorn forests of the Chaco and of the Espinal dominated by the Mimosae *Prosopis alba* or *Prosopis nigra*, sometimes *Prosopis flexuosa*. Within the Chaco, they are mostly characteristic of

low ground and saline soils, also occurring in nonsaline environments as secondary formations. In peri-Chacoan areas they may constitute the climax community.
(Herzog, 1923: 81-82, 84-105; Castellanos and Perez-Moreau, 1944: 103; Hauman, 1947; Cabrera, 1953; Morello, 1958: 136; Ragonese and Castiglioni, 1968: 148; Morello and Adamoli, 1974; Hueck, 1978: 276-277; Cabrera and Willink, 1980: 72-76; Lewis and Pire, 1981: 30; Roig, 1982: 84-85; Schnell, 1987b: 30-31; Erize, 1993: 164-165; Burkart *et al.*, 1994: 3, 13; Carnevali, 1994: 64-108; Erize *et al.*, 1995: 63, 87).

4B.6211 Chaco *Prosopis alba* woodland
Dry woods and thorn forests of the Chaco, mostly characteristic of the western part of the eastern Chaco and of saline soils, dominated by *Prosopis alba* and *Prosopis nigra*, accompanied by *Caesalpinia paraguariensis*, *Geoffroea decorticans*, *Prosopis ruscifolia*, *Prosopis vinalillo*, and scrub of *Acacia spp.*, *Mimosa spp.*, *Atalisquea emarginata*, *Grabowskia duplicata*, *Maytenus vitis-idaea*, with *Suaeda divaricata* and terrestrial bromeliads, in particular *Bromelia hieronymi*, *Dyckia spp.*.
(Morello and Adamoli, 1974: 103-109; Lewis and Pire, 1981: 30; Schnell, 1987b).

4B.6212 Chaco *Prosopis nigra* woodland
Dry woods and thorn forests of the Chaco, mostly characteristic of the eastern part of the eastern Chaco on low ground and saline soils, extending to adjacent Campos, dominated by *Prosopis nigra* accompanied by *Prosopis affinis* and sometimes *Aspidosperma quebracho-blanco*.
(Morello and Adamoli, 1974: 103-109; Lewis and Pire, 1981: 30; Burkart *et al.*, 1994: 8; Carnevali, 1994: units 35, 74).

4B.6213 Espinal algarrobo woodland
Prosopis forests and woodland of the northern Pampean Espinal, of which they constitute the main woodland type, formed by *Prosopis alba* and *Prosopis nigra*, accompanied by abundant *Acacia caven* and by *Schinus longifolia*, *Schinus spp.*, *Geoffroea decorticans*. These forests have been almost entirely destroyed.
(Cabrera and Willink, 1980: 76; Erize, 1993: 164-165; Burkart *et al.*, 1994: 13; Daniele and Natenzon, 1994: unit 6).

4B.6214 Western pre-Pampean *Prosopis flexuosa* woods
Dry woods and thorn forests of the western Pampean region, in particular of the Llanura Puntana dominated by *Prosopis flexuosa*, with *Jodina rhombifolia*, *Setaria leiantha*, *Maytenus spinosa*, and a shrub layer formed by *Larrea divaricata* or *Lycium spinosum*.
(Roig, 1982: 84-85).

4B.622 Nandubay woodland
Thorn woods and forests of Chacoan regions dominated by the Mimosae *Prosopis affinis*, particularly typical of the Mesopotamian Espinal (district of the Nandubay), also distributed in the western, humid Chaco and the Campos. These woods have been very reduced and non-degraded stands are now rare.
(Cabrera and Willink, 1980: 75-76; Crespo, 1982: 2-3; Navas, 1982: 37; Muñoz *et al.*, 1993: 26; Erize, 1993: 166-169; Burkart *et al.*, 1994: 3, 4; Carnevali, 1994: units 33, 39, 73; Erize *et al.*, 1995: 87).

4B.6221 Northern Espinal *Prosopis affinis* woodland
Prosopis affinis thorn forests of the Mesopotamian Espinal, of which they constitute the main woodland type (district of the Nandubay), often dense and multi-stratum, with *Prosopis nigra*, *Aspidosperma quebracho-blanco*, *Bumelia obtusifolia* as most constant accompaniers of the dominant in the upper stratum, and often *Schinus longifolius*, *Acacia caven*, *Geoffroea decorticans*, *Acacia atramentaria*, *Celtis spinosa*, *Tabebuia nodosa*. They extend east into adjacent Uruguay and west into the northeastern Pampean Espinal, in its region of transition to the Chaco.
(Burkart, 1947: 113-117; Cabrera and Willink, 1980: 75-76; Lewis and Pire, 1981: 35; Crespo, 1982: 2-3; Navas, 1982: 37; Muñoz *et al.*, 1993: 26; Erize, 1993: 166-169; Burkart *et al.*, 1994: 3, 4; Carnevali, 1994: unit 39; Erize *et al.*, 1995: 87).

4B.6222 Eastern Chaco *Prosopis affinis* woodland
Thorn woods and forests of the eastern Chaco dominated by *Prosopis affinis*, 6-7 metres high, almost monospecific, with, as uncommon accompaniers, *Acacia caven*, *Acacia bonariensis*, *Chrysophyllum marginatum*, *Celtis spinosa*, *Schinus fasciculatus*.
(Carnevali, 1994: unit 33).

4B.6223 Campos *Prosopis affinis* woodland
Savanna woods of the Campos dominated by *Prosopis affinis* with *Acacia caven* and rare shrubs that include *Morrenia odorata*, *Passiflora coerulea*, *Dolychandra cynachoides*.
(Carnevali, 1994: unit 73).

4B.623 *Prosopis ruscifolia* vinalares
Dry woods and thorn forests (vinalares) of the Chaco and its peripheral regions dominated by the Mimosae *Prosopis ruscifolia*, a colonist of both dry and humid perturbed or unstable environments, in expansion, occupying considerable surfaces in the northern Chaco, in particular in Formosa.
(Morello *et al.*, 1971).

4B.624 Chacoan *Acacia caven* woodland
Dry woods and thorn forests of the Mesopotamian Espinal, of the eastern Chaco, of hills and low mountains of the western, montane, Chaco dominated by the Mimosae *Acacia caven*.
(Hueck, 1978: 365; Roig, 1982: 69; Muñoz *et al.*, 1993: 26, 46-47; Burkart *et al.*, 1994: 4, 13; Carnevali, 1994: unit 34; Erize *et al.*, 1995: 56, 80).

4B.6241 Espinal *Acacia caven* woodland
Dry, generally low woods of the Mesopotamian Espinal, adjacent Uruguay and older and higher islands in the upper Parana delta, dominated by the deciduous *Acacia caven*, usually with a well developed grassy ground layer.
(Hueck, 1978: 365; Muñoz *et al.*, 1993: 26, 46-47; Burkart *et al.*, 1994: 13).

4B.6242 Eastern Chaco *Acacia caven* woodland
Dry thorn savanna woods of the eastern Chaco, dominated by the deciduous *Acacia caven*, 2-6 metres high, often monospecific or with a few accompanying species.
(Carnevali, 1994: unit 34).

4B.6243 Western Chacoan *Acacia caven* woodland
Very low dry thorn woods of hills and low mountains of the western, montane, Chaco dominated by the Mimosae *Acacia caven*, mostly a secondary invader of cleared Chaco woodland.
(Roig, 1982: 69; Erize *et al.*, 1995: 56).

4B.625 *Prosopis caldenia* woodland
Dry, fairly open, forests of the Pampean Espinal, extending to the Monte and enclaves in the Pampa dominated by the tall Mimosae *Prosopis caldenia* (calden), accompanied by *Prosopis nigra*, *Prosopis flexuosa*, *Jodina rhombifolia*, *Geoffroea decorticans*, *Condalia microphylla*, *Schinus fasciculatus* and a ground layer formed by coarse grasses, *Larrea divaricata*, *Prosopis alpataco*. These woods are an important refuge for a number of faunal elements, in particular, the Felidae *Felis concolor*, *Felis geoffroyi*, *Felis yaguaroundi*, *Felis colocolo*.
(Morello, 1958: 139; Cano and Movia, 1967: 12, 28-32, 34, Figs. 20, 21, 22, 29, 30, 34; Cabrera and Willink, 1980: 76; Covas, 1982: 54; Roig, 1982: 83-84, 76; Santos Biloni, 1990: 94-95; Burkart *et al.*, 1994: 20; Erize *et al.*, 1995: 87-90, 118-119).

4B.626 Chacoan chañarales
Low thorn woods of the Chaco and its peripheral regions, in particular, the Pampean Espinal and the Monte, dominated by the Fabaceae *Geoffroea decorticans*, often in pure sociations, tolerant of very salty soils. They extend south to the Monte of Neuquen and Rio Negro.
(Morello, 1958: 92; Cano and Movia, 1967: 23, 30, Fig. 24; Lewis and Pire, 1981: 118; Roig, 1982: 82; Muñoz *et al.*, 1993: 26).

4B.627 Chacoan itinales
Dry woods of the Chaco and its peripheral regions, in particular, of the eolian central Chaco, in the region of coexistence of *Schinopsis balansae* and *Schinopsis quebracho-colorado*, dominated by *Prosopis kuntzei*, sometimes in almost pure formations.
(Morello and Adamoli, 1974: 119).

4B.63 Chacoan peripheral woods
Dry woods characteristic of the margins of the Chaco, in particular, of the Andean margin and of extensions of the Chacoan vegetation into adjacent semidesert or steppe regions, dominated by species of genera *Celtis*, *Maytenus*, *Lithraea*, *Cochlospermum*.
(Herzog, 1923: 81-82, 84-105; Hauman, 1947; Burkart, 1947; Cabrera, 1953; Ragonese and Castiglioni, 1968: 153-154; Hueck, 1978: 255-294, 447-448; Ragonese and Piccinini, 1976; Cabrera and Willink, 1980: 72-79; Lewis and Pire, 1981; Vervoorst, 1982: 10-11; Covas, 1982; Roig, 1982; Schnell, 1987b: 28-41; Santos Biloni, 1990: 16-18, 46; Burkart *et al.*, 1994: 4-5, 8-15, 28-29; Carnevali, 1994: 64-108; Erize *et al.*, 1995: 60-95, 112-121).

4B.631 Chacoan *Celtis* forests
Forests of the western, pre-Andean margin of the Chaco and of the Espinal and its extensions into the Pampa steppic region dominated by Ulmaceae of genus *Celtis*.
(Cabrera and Zardini, 1978: 2; Hueck, 1978; Erize *et al.*, 1995: 87).

4B.6311 Tala-mistol western Chaco forests
Dense transitional forests of the western Chaco in regions with annual precipitation of 600-800 mm and in localities of favourable phreatic conditions, dominated by *Celtis spp.* and *Zizyphus mistol*, devoid of palms and with scarce arborescent cacti.
(Hueck, 1978: 270-271).

4B.6312 La Plata talares
Forests of old fluviatile dunes of the Rio de la Plata and of the maritime dunes of the Pampa region, forming southern extensions of the Chacoan and northern Espinal floras into the Pampa steppic area, dominated by *Celtis spinosa*, accompanied by *Scutia buxifolia*, *Jodina rhombifolia*, *Acacia caven*, *Schinus longifolia*, *Sambucus australis* and very rich, abundantly flowering, shrub and herb layers that comprise the bushes *Cassia corymbosa*, *Sestrum parquii*, *Porliera microphylla*, *Acacia bonariensis*, the grasses *Bromus catharticus*, *Melica macra*, *Paspalum notatum*, the herbs *Dichondra repens*, *Cucurbitella asperata*.
(Hueck, 1978: 446; Cabrera and Zardini, 1978: 2-3; Covas, 1982: 54; Erize *et al.*, 1995: 87).

4B.632 Sierra Pampeana *Lithraea* forests
Dry deciduous woods of the middle slopes of the Sierras Pampeanas dominated by the anacardid molle de beber, *Lithraea molleoides* (*Lithraea ternifolia*), reaching 1500 metres on ubacs, 1000 metres on adrets, on slopes formed by a single, often monospecific tree stratum, much richer and better developed in ravines, with *Ruprechtia apetala*, *Maytenus boaria*, *Bougainvillea stipitata*, *Fagara coco*.
(Ragonese and Castiglioni, 1968: 153-154; Roig, 1982: 68; Burkart *et al.*, 1994: 29).

4B.633 Chacoan *Cochlospermum* forests
Dry, relatively low, woods of the western montane Chaco dominated by the endangered palo de papel *Cochlospermum tetraporum* (*Cochlospermum zahlbruckneri*, *Maximiliana argentinensis*), relatively rare, limited to low gypsum hills of the preyungan fringe of Salta, Jujuy, and Bolivia.
(Ragonese and Castiglioni, 1968: 153-154; Santos Biloni, 1990: 16-18, 46; Chebez, 1994: 497).

4B.64 Chacoan palm groves
Dry land forests and woods of the Chacoan floral province, including the dry Chaco, the humid Chaco, the Espinal and the Pampas, dominated by palms, in particular, the endemic *Butia yatay*.
(Herzog, 1923: 81-82, 84-105; Hauman, 1947; Burkart, 1947; Martinez Crovetto and Piccinini, 1951; Cabrera, 1953; Ragonese and Castiglioni, 1968; Morello and Adamoli, 1968, 1974; Hueck, 1978: 265-270, 292-294; Cabrera and Willink, 1980: 72-76; Lewis and Pire, 1981; Covas, 1982; Roig, 1982; Gallardo, 1982; Navas, 1982; Crespo, 1982; Schnell, 1987b: 35; Muñoz *et al.*, 1993: 28; Erize, 1993: 173-176; Burkart *et al.*, 1994: 4-5, 8-15, 28-29; Carnevali, 1994: 64-108; Erize *et al.*, 1995: 60-95, 112-121).

4B.641 Yatay palm groves
Woodlands, savanna woodlands and palm groves dominated by the yatay palm, *Butia yatay*, characteristic of the Mesopotamian Espinal, with outposts in the northern Pampean Espinal and the eastern Chaco, occurring in Entre Rios, Corrientes, southwestern Misiones, eastern Santa Fe and western Uruguay, often developed on well-drained sandy soils, with an undergrowth usually constituted by grasses, notably *Paspalum notatum* and *Axonopus compressus*, sometimes by shrubs (*Baccharis spp.*), formerly very extensive, today reduced to very few relict stands, the largest of which are in El Palmar National Park, near Colon, Entre Rios.

(Burkart, 1947: 117-120; Martinez Crovetto and Piccinini, 1951; Martinez-Crovetto, 1963: 205; Hueck and Seibert, 1972: unit 37 *p.*; Hueck, 1978: 292; Cabrera and Willink, 1980: 76; Crespo, 1982: 3; Navas, 1982: 36; Gallardo, 1982: 66, 70-75; Schnell, 1987b: 35; Muñoz *et al.*, 1993: 28, 72-73; Erize, 1993: 172-173; Burkart *et al.*, 1994: 5; Carnevali, 1994: units 27a, 69).

4B.642 Chacoan *Trithrinax* groves
Dryland woods of the Chacoan floral province, in particular, of the Mesopotamian and northern Pampean Espinal, of the southeastern semiarid Chaco and of the transition between Chaco and Monte, of the piedmont of the eastern Sierras Pampeanas, dominated by tall arborescent *Trithrinax campestris*. They are particularly prominent in the mountainous regions of Cordoba and San Luis, with extensive stands, sometimes dense, at the foot of the Sierra de Comechingones in San Luis. These formations have considerably regressed and are now vulnerable.
(Morello, 1958: 135-136; Cabrera and Willink, 1980: 72, 76; Roig, 1982: 69; Santos Biloni, 1990: 68-69; Erize, 1993: 174-175; Burkart *et al.*, 1994: 5, 12, 13; Erize *et al.*, 1995: 87, 92, 95).

4B.643 Dryland *Copernicia* palm groves
Dryland groves of palms of genus *Copernicia*, notably, *Copernicia australis*, of the central and eastern Chaco, less common than the riverine forests of unit 4A.341, associated, in particular, with calcareous buttes.
(Hueck, 1978: 292; Loureiro *et al.*, 1982: 346; Schnell, 1987b: 35; Myers, 1990: 272; Carnevali, 1994: unit 36).

4B.65 Chacoan cardonales
Open woodland of the Chaco dominated by tall arborescent cacti, in particular, *Stetsonia coryne* (*Cereus coryne*), characteristic of saline soils, often accompanied by *Prosopis* brush.
(Hauman, 1947; Cabrera, 1953; Morello, 1958: 136; Ragonese and Castiglioni, 1968: 151; Morello and Adamoli, 1968, 1974; Hueck, 1978: 255-294; Lewis and Pire, 1981: 18-19; Schnell, 1987b: 28-32; Erize *et al.*, 1995: 63).

4B.7 Pacific desert woodland

Xerophytic woods of the coastal deserts of Pacific South America, limited to fogbound hills and high watertable sites.
(Koepcke, 1961: 140-145, 193-195, 203-205, 205-208, 221-224; Walter, 1962: 381-392; Walter, 1968: 181; Hueck and Seibert, 1972: 69 *p.*, 70; Hernandez, 1973: 36-43; Ducoing, 1973: 39-40; Hueck, 1978; Parker *et al.*, 1982: 12-13, 25; Rauh, 1985: 251-254; Schnell, 1987b: 42-53; Quintanilla, 1988: 14, map unit B2; Walter and Breckle, 1991b: 254-261; Gajardo, 1994: 1A2-1A21).

4B.71 Pacific loma woodland
Woods of the coastal deserts of Peru formed under the influence of the garua, coastal mists and fogs generated by the juxtaposition of the cold Humboldt Current and the hot subtropical desert coastlands.
(Koepcke, 1961: 221-224; Walter, 1962: 381-392; Walter, 1968: 181; Hueck and Seibert, 1972: 69 *p.*, 70; Hernandez, 1973: 36-43; Ducoing, 1973: 39-40; Parker *et al.*, 1982: 12-13, 25; Rauh, 1985: 251-254; Schnell, 1987b: 42-53; Walter and Breckle, 1991b: 254-261).

4B.711 Peruvian wood lomas
Relict loma forests of Atiquipa, near Chala in southern Peru, dominated by the evergreen sclerophyllous Myrtaceae *Eugenia ferreyrai*, forming a closed, about 8 metre high, canopy.
(Walter, 1962: 381-392; Walter, 1968: 181; Hueck and Seibert, 1972: 69 *p.*, 70; Hernandez, 1973: 36-43; Ducoing, 1973: 39-40; Parker *et al.*, 1982: 12-13, 25; Rauh, 1985: 251-254; Schnell, 1987b: 42-53; Walter and Breckle, 1991b: 254-261).

4B.712 Peruvian park lomas
Very open, rocky and boulder-strewn park-like woods of Peruvian lomas formed by low *Caesalpinia tinctoria*, *Capparis prisca*, *Acacia macrantha*, *Carica candicans*, covered with mosses, liverworts and vascular epiphytes, notably *Peperomia crystallina*, *Sicyos bederoa* and ferns of genus *Polypodium*, accompanied by large shrubs, in particular *Croton spp.*.
(Walter, 1962: 381-392; Walter, 1968: 181; Hueck and Seibert, 1972: 69 *p.*, 70; Hernandez, 1973: 36-43; Ducoing, 1973: 39-40; Parker *et al.*, 1982: 12-13, 25; Rauh, 1985: 251-254; Schnell, 1987b: 42-53; Walter and Breckle, 1991b: 254-261).

4B.72 Tamarugal *Prosopis* woodland
Natural woodland remnants of *Prosopis tamarugo*, with *Distichlis spicata*, *Eupatoria tarapacana*, *Tessaria absinthioides*, *Cressa truxillensis*, *Prosopis strombulifera*, *Prosopis alba*, *Atriplex atacamensis*, persisting in the Tamarugal desert of northern Chile, main breeding habitat of the recently described conebill *Conirostrum tamarugense*.
(Reiche, 1907: 126; Johnson and Millie, 1972; Quintanilla, 1988: 14, map unit B2; Ridgely and Tudor, 1989: 209-210; Fjeldså and Krabbe, 1990: 596; Gajardo, 1994: 1A2-1A21; Estades and Lopez-Calleja, 1995).

4B.8 Central Chilean Acacia and Prosopis woodland

Open woodland and savanna woodland of the mediterranean xerophyllous scrub zone of the Chilean central valley, distributed mostly between the Limari river and the Laja river, dominated by the deciduous phreatophytes *Acacia caven* or *Prosopis chilensis*; brushy *Acacia caven* matorral communities, notably of surrounding slopes of the Chilean central valley or of the coastal cordillera, are listed in unit 32.
(Reiche, 1907: 125; Schmithusen, 1956; Oberdorfer, 1960: 33-34; Ducoing, 1973: 64-65; Hueck, 1978: 374-376; Rundel, 1981: 187-188; Gajardo, 1994).

4B.81 Central Chilean *Acacia caven* espinares
Open woodland communities of central Chile, variable in species composition but with a characteristic physiognomy, formed by *Acacia caven*, *Maytenus boaria*, *Proustia cuneifolia* over a dense herb layer with, in certain areas, a dense shrub layer. Common among species present are *Baccharis linearis*, *Cestrum parqui*, *Solanum tomatilla*, *Bromus berterianus*, *Muehlenbeckia hastulata*, *Medicago hispida*, *Avena barbata*, *Vulpia megalura*, *Erodium cicutarium*.
(Gajardo, 1994: 3B6-3B62, 3B7-3B62, 3B5-3B81, 3B7-3B81, 3B8-3B81, 3B10-3B81).

4B.82 *Prosopis chilensis*-*Schinus* stands
Very rare, relictual remnants of open, dry woodland formed by *Prosopis chilensis*, *Schinus polygamus*, *Pleocarphus revolutus*, with *Trichocereus coquimbanus*, commonly with *Gutierrezia resinosa*, *Opuntia ovata*, *Porlieria chilensis*, *Proustia ilicifolia*, *Proustia cuneifolia*, restricted to the northern extreme of Central Chile.
(Gajardo, 1994: 3A2-3B51, 3B5-3B51; Arroyo *et al.*, 1994: 56).

4B.83 *Prosopis chilensis*-*Acacia caven* stands
Open woodlands of central Chile formed of *Prosopis chilensis* and *Acacia caven* with *Baccharis paniculata*, *Porlieria chilensis*, *Proustia cuneifolia*, *Bromus berterianus*, *Cynara cardunculus*.
(Gajardo, 1994: units 3B5-3B61, 3B6-3B61).

4B.84 Central Chilean *Acacia caven* canyon stands
Very local clumps of *Acacia caven* occupying alluvions at the bottom of large canyons of central Chile, between about 31° S and 33° S, and the coastal deserts and interior llanos flowering desert, between 26° 30' S and 27° 30' S, very altered by human activity and invaded by exotic species. *Atriplex repanda*, *Prosopis chilensis*, *Muehlenbeckia hastulata*, *Geoffroea decorticans* are commonly present.
(Gajardo, 1994: units 1C14-3B59, 1C15-3B59, 1D16-3B59, 3B5-3B59).

4B.9 Polynesian dry woodland

Sophora toromiro woodland or savanna woodland of Easter Island, extinct as a community apparently since the end of the 19th century, the leading species, itself, now on the verge of extinction or extinct in the wild. When extant, the formation is thought to have been similar to dry *Sophora chrysophylla* savanna woodland of the Hawaiian Islands. Annual precipitations on the island mostly range between 1000 and 1500 millimetres, with occasional dry months and drier years.
(Skottsberg, 1922a: 73-74; Skottsberg, 1928: 488-491, 491-492; CNF, 1976).

4C. MANGROVE FORESTS AND THICKETS

Tropical intertidal mud forests and thickets formed by mangroves and their associates. In South America, mangals occur along the coasts of the Caribbean Sea, the Atlantic and the Pacific. All are Atlantic-type mangals, species-poor formations of *Rhizophora racemosa*, *Rhizophora mangle*, *Rhizophora harrisonii*, *Avicennia germinans* (*Avicennia nitida*), *Avicennia schaueriana*, characteristic of the west coast of Africa as well as of the tropical Pacific and Atlantic coasts of the Americas, with *Laguncularia racemosa*, *Conocarpus erectus*, *Drepanocarpus lunulatus*, *Hibiscus tiliaceus*, *Acrostichum aureum*, *Acrostichum danaeifolium*.
(Richards, 1952: 299-306; Koepcke, 1961: 121-122; Schnell, 1971: 798-841; Hueck and Seibert, 1972; Chapman, 1975: 16-18; Hueck, 1978; Gonzalez, 1978; Schnell, 1987b: 253-261; Clark, 1990; Lugo, 1990b; Maître *et al.*, 1993: 5-24; Tomlinson, 1994; Archibold, 1995; Stanley, 1995: 15-16; Hurtado, 1995: 133-134; Diegues *et al.*, 1995: 73-74).

4C.1 Pacific American mangrove forests and thickets

Communities formed by mangroves and their associates along the tropical Pacific coasts of the mainland of South America, south to extreme northern Peru, and in the Galapagos archipelago.
(Koepcke, 1961: 121-122; Hueck and Seibert, 1972; Hueck, 1978; Schnell, 1987b: 260-261; Tomlinson, 1994; Hurtado, 1995: 133-134).

4C.11 Colombo-Ecuadorian mangrove forests
Communities of mangroves and their associates of the Pacific coast of Colombia mostly between Cape Corrientes and Bahia de Ancon de Sardinas, with outposts in Ecuador south to Bahia de Caraquez, most species-rich among South American mangroves and forming tall forests, constituted by *Rhizophora mangle* with the Pacific endemics *Rhizophora samoensis*, *Rhizophora brevistyla* (*Rhizophora harrisonii p.*) and the Colombian and Central American endemic *Pelliciera rhizophorae*, accompanied by, in particular, *Avicennia germinans* (*Avicennia nitida*), *Avicennia bicolor*, *Conocarpus erectus*, *Laguncularia racemosa*.
(Hueck and Seibert, 1972; Hueck, 1978: 145-147; Schnell, 1987b: 260; Tomlinson, 1994: 42, 206, 304-309, 334-340; Hurtado, 1995: 133-134).

4C.111 Colombo-Ecuadorian *Avicennia* mangrove forests
Mangrove forests of the coasts of Colombia and northern Ecuador dominated by *Avicennia germinans* or *Avicennia bicolor*.
(Tomlinson, 1994: 205-206).

4C.1111 Colombo-Ecuadorian *Avicennia germinans* forests
Mangrove forests of the coasts of Colombia and northern Ecuador dominated by *Avicennia germinans*, sometimes with a dominated, discontinuous understorey of *Avicennia bicolor*.
(Tomlinson, 1994: 205-206).

4C.1112 Colombo-Ecuadorian *Avicennia bicolor* forests
Mangrove forests of the coasts of Colombia and northern Ecuador dominated by *Avicennia bicolor*, forming on the landward side of *Rhizophora* belts.
(Tomlinson, 1994: 206).

4C.112 Colombo-Ecuadorian *Rhizophora* mangrove forests
Often tall mangrove forests of the coasts of Colombia and northern Ecuador dominated by *Rhizophora spp.*, in particular *Rhizophora mangle*, *Rhizophora racemosa* or *Rhizophora harrisonii*, attaining heights up to 30 m.
(Tomlinson, 1994: 335; Hurtado, 1995: 133-134).

4C.113 Colombo-Ecuadorian *Laguncularia* mangrove forests
Mangrove forests of the coasts of Colombia and northern Ecuador dominated by *Laguncularia racemosa*.
(Tomlinson, 1994: 220).

4C.114 Colombo-Ecuadorian *Conocarpus* mangrove forests
Mangrove forests of the coasts of Colombia and northern Ecuador dominated by *Conocarpus erectus*.
(Tomlinson, 1994: 232).

4C.115 Colombo-Ecuadorian *Pelliciera* mangrove forests
Mangrove forests of the coasts of Colombia and northern Ecuador dominated by *Pelliciera rhizophoreae*, near-endemic, taxonomically isolated, small to medium-sized mangrove of the Pacific coast of Colombia, where it is limited to Buenaventura Bay; the world distribution of this single species in the family Pellicieraceae, possibly allied to Theaceae, extends north along the Pacific coast of the North American continent to Costa Rica, with isolated occurrences, recently discovered, in the mangrove forests of the Caribbean coast of South America (unit 4C.2).
(Tomlinson, 1994: 304-309).

4C.12 Gulf of Guayaquil mangrove forests
Communities of mangroves, including high mangrove forest, occupying the shores and estuaries of the Gulf of Guayaquil, south to Malpelo at 3° 30' S on the Tumbes coast of extreme northern Peru, constituted mainly by *Rhizophora mangle*; this species represents 95 % of the mangroves in these communities, although *Avicennia germinans* (*Avicennia nitida*), *Conocarpus erectus*, *Laguncularia racemosa* occur south to the southern limit of the formation in Peru.
(Koepcke, 1961: 121-122; Hueck and Seibert, 1972; Hueck, 1978: 145-146; Schnell, 1987b: 260; Hurtado, 1995: 133-134).

4C.13 Galapagos mangrove thickets
Bush or small tree communities of the Galapagos Islands constituted by *Rhizophora mangle*, *Avicennia germinans*, *Conocarpus erecta* and *Laguncularia racemosa*, habitat of the endemic Darwin finch *Camarhynchus heliobates* of Isabela and Fernandina.
(Wiggins and Porter, 1971: 17).

4C.131 Galapagos soft bottom mangrove thickets
Bush or small tree communities of *Rhizophora mangle*, *Avicennia germinans*, *Conocarpus erecta* and *Laguncularia racemosa*, installed on muds or soft sands subjected to daily tidal fluctuations, of the coasts of the Galapagos Islands.
(Wiggins and Porter, 1971: 17).

4C.132 Galapagos lava mangrove brush
Shrub communities of *Rhizophora mangle*, rooted in the cracks of bare, almost sand-free lava of, in particular, Punta Espinosa, Fernandina Island.
(Wiggins and Porter, 1971: 17).

4C.2 Caribbeo-Atlantic mangrove forests and thickets

Mangrove communities on the Caribbean and Atlantic coasts of South America south to the mouth of the Aranangua River, at 29°S, on the Serra do Mar coast of Santa Catarina in southern Brazil, with *Avicennia germinans* (*Avicennia nitida*), *Avicennia schaueriana* (*Avicennia tomentosa*), *Laguncularia racemosa*, *Conocarpus erecta* and *Rhizophora mangle*.
(Richards, 1952: 301-306; Hueck and Seibert, 1972, 1981: unit 88; Hueck, 1978: 42, 46-47, 84, 147-148, 188-191; Schnell, 1987b: 254-259; Tostain *et al.*, 1992: 13; Junk, 1993: 717-721; Tomlinson, 1994; Stanley, 1995: 15-16; Diegues *et al.*, 1995: 73-74).

4C.21 Caribbeo-Atlantic *Avicennia* mangrove forests
Mangrove forests of the Caribbean and Atlantic tropical coasts of South America dominated by the sometimes very tall *Avicennia germinans* (*Avicennia nitida*) and/or *Avicennia schaueriana* (*Avicennia tomentosa*) with *Laguncularia racemosa*, *Rhizophora spp.*, *Drepanocarpus lunatus*.
(Richards, 1952: 301-306; Hueck, 1978: 147-148, 188-191; Schnell, 1987b: 254-259; Tomlinson, 1994).

4C.22 Caribbeo-Atlantic *Rhizophora* mangrove forests
Mangrove forests of the Caribbean and Atlantic tropical coasts of South America dominated by *Rhizophora spp.*, forming, in particular, an outer belt, towards open water, in Caribbean, Amazonian and southern Brazilian mangrove formations, also colonizing estuaries and the lower course of rivers, in particular, in the Guianan region.
(Richards, 1952: 301-306; Hueck, 1978: 147-148, 188-191; Schnell, 1987b: 254-259; Tomlinson, 1994).

4C.221 Caribbeo-Atlantic *Rhizophora* tall mangrove forests
Tall, up to ten metres high, mangrove forests of the Caribbean and Atlantic tropical coasts of South America dominated by *Rhizophora spp.*, of, mostly, the outer belt of mangrove forests along open sea coasts and in brackish, or sometimes fresh, estuaries and tidal rivers.
(Richards, 1952: 301-306).

4C.222 Caribbeo-Atlantic *Rhizophora* pioneer mangrove scrubs
Mangrove formations of the Caribbean and Atlantic tropical coasts of South America constituted mainly by young plants of *Rhizophora mangle* growing on almost continually submerged soil, accompanied by seedlings of *Avicennia spp.* and *Laguncularia racemosa*, by *Spartina alterniflora*, or, in the Caribbean, by marine angiosperms such as *Thalassia testudinum* and *Halodule manatorum*.
(Richards, 1952: 301-306).

4C.23 Caribbeo-Atlantic *Laguncularia* mangrove thickets
Mangrove formations of the Caribbean and Atlantic tropical coasts of South America, often shrubby, dominated by *Laguncularia racemosa*, forming in general as the landward fringe of *Rhizophora* or *Avicennia* mangrove forests, well developed also in the southernmost part of the range in Brazil.
(Richards, 1952: 303; Hueck, 1978: 147-148, 188-191; Schnell, 1987b: 254-259; Tomlinson, 1994: 220).

4C.24 Caribbeo-Atlantic *Conocarpus* mangrove forests
Mangrove forests of the Caribbean and Atlantic tropical coasts of South America dominated by *Conocarpus erecta*, often forming, in particular, an inner belt in Caribbean and Amazonian mangrove formations.
(Richards, 1952: 301-306; Hueck, 1978: 147-148, 188-191; Schnell, 1987b: 254-259; Tomlinson, 1994: 232-233).

5 . BOGS AND MARSHES

Mire communities, for the most part turfogenic, of sedges, grasses, rushes, bryophytes and their associated species; tall helophyte fringes of water bodies. Complex systems of raised bogs, blanket bogs, rich fens, acidic fens, transition mires, characterized by the presence of these communities, but also including formations otherwise typical of sections 22, 31, 37, 44. Spring systems.

51. RAISED BOGS

Highly oligotrophic, strongly acidic communities composed mainly of sphagnum growing on, and forming, peat and deriving moisture and nutrients only from rainfall (ombrotrophic). They form only in cool climates with heavy rainfall. They are limited to the subantarctic zone and the mountains and hills of the nemoral zone in Tierra del Fuego and the Chilean Fjordland. Their independance from ground water is the result either of upward growth or of changes in the water table. Bogs harbour, in addition to sphagnum, the major component of their formation, a small number of highly specialised, acidophilous vascular plant, lichen and animal species.

51.1 Magellanic Sphagnum bogs

Raised bogs of the deciduous and, more locally, evergreen, forest zones of Tierra del Fuego, extreme southern continental Patagonia and the Chilean Fjordland dominated by *Sphagnum magellanicum*, associated with scarce phanerogams among which *Empetrum rubrum*. *Marsipposperma grandiflorum*, *Carex banksii*, *Carex curta*, *Carex magellanica*, *Gunnera magellanica*, *Perezia lactucoides*, *Pernettya pumila*, *Tetroncium magellanicum*, *Astelia pumila*, *Drosera uniflora*, *Pinguicula antarctica*.
(Pisano, 1971b: 113-115; Moore, 1983: 27; Archibold, 1995: 328-329; Pisano, 1983: 295-329).

51.2 Magellanic mixed moss bogs

Raised bogs of Tierra del Fuego, and the Chilean Fjordland, characteristic of flat low-altitude areas with high rainfall, in which *Sphagnum magellanicum* is replaced by caespitose and mat-forming mosses of genera *Breutelia*, *Bryum*, *Chorisdontium*, *Dicranoloma*, *Philonotis*, *Polytrichum*, *Racomitrium*, with an associated flora very similar to that of unit 51.11, except for the prominance of ferns of genus *Hymenophyllum*, in particular, *Hymenophyllum pectinatum*, *Hymenophyllum secundum*, *Hymenophyllum tortuosum*.
(Pisano, 1983: 315).

51.3 Magellanic liverwort bogs

Raised bogs of Tierra del Fuego and the Chilean Fjordland in which the ground stratum is dominated by caespitose cushion-forming Hepaticae, giving to the surface of the bog an undulating and irregular micro-relief, generally fairly thinly overlying a rocky substratum, in areas of very high precipitation.
(Pisano, 1983: 315).

52. BLANKET BOGS

Communities similar to raised bogs, on flat or gently sloping ground with poor surface drainage, in oceanic climates with heavy rainfall. The Magellanic moorland, Magellanic "tundra" or "antarctic tundra", a unique major ecosystem restricted to southern South America and subantarctic islands, although not strictly equivalent to the northwest European blanket bogs, shares with them the conditions of mild oceanic climate and high precipitation and seems best placed in this unit. Absence of permafrost, high annual average temperature (5.9°-9° C) and very high annual precipitation (465-7400 mm) are completely atypical of tundra. The communities of grasses and shrubs that constitute Magellanic moorland are limited, within our area, to Isla de los Estados, the southern Chilean archipelago, from the Cape Horn archipelago and Navarrino Island to Madre de Dios Island, south-western Tierra del Fuego, the Brunswick and Munoz Gamero peninsulas.
(Hueck and Seibert, 1972: unit 81; Moore, 1979, 1983; Pisano, 1983).

52.1 Magellanic cushion shrub blanket bogs

Bogs of the Magellanic region constituted by a low and dense herbaceous and subshrubby blanket-like cover, with a fairly flat microrelief, composed of cushion-forming and caespitose phanerogams associated with relatively few bryophytes, dominated by *Donatia fascicularis* and *Astelia pumila*, characteristic of areas comprised between sea level and 20 metres under annual precipitation over 2000 mm. The cortège of cushion plants includes *Bolax caespitosa*, *Caltha dioneifolia*, *Drapetes muscosus*, *Gaimardia australis*, *Phyllachne uliginosa*, *Oreobolus obtusangulus*.
(Moore, 1983: 29; Walter and Breckle, 1986; Gajardo, 1994: units 7C13-7C131, 7C11-7C131).

52.2 Magellanic bryophyte blanket bogs

Blanket bogs of the Magellanic region formed by carpets of mat- and cushion-forming liverworts, mosses and lichens, with scarce phanerogams, mostly represented by caespitose cushion-shaped and rosette plants, graminoids and dwarf shrubs. The most important liverwort genera include *Adelanthus*, *Anisotachis*, *Austrolophozia*, *Jamesonniella*, *Lepicolea*, *Lepidozia*, *Leptoscyphus*, *Neolepidozia*, *Plagiochila*, *Pleurocladopsis*, *Schistochila*, *Triandrophyllum*, *Tylimanthus*, *Vetaforma*. The moss cortège is constituted by genera *Breutelia*, *Bryum*, *Chorisodontium*, *Conogostum*, *Ticranoloma*, *Distichophyllum*, *Eriopus*, *Philonotus*, *Racomitrium*. Lichens are represented by several species of genera *Cladonia* and *Sphaerophorus*.
(Pisano, 1983: 312).

52.3 Magellanic graminoid blanket bogs

Blanket bogs of the Magellanic region dominated by short or medium-tall graminoids on soils wet or soaked throughout the year.
(Pisano, 1983: 305, 320-322; Moore, 1983: 29-30).

52.31 Magellanic carpet-grass blanket bogs
Blanket bogs of the Magellanic region dominated by grasses, the carpet-forming *Cortaderia pilosa* and the bunch-forming *Festuca antarctica* associated to constitute a dense sod overlying a dense peaty mud. Prominent accompanying graminoids include *Carex microglochin*, *Juncus scheuchzerioides*, *Rostkovia magellanica*, *Uncinia tenuis*. Lichens of genus *Cladonia* and bryophytes are common.
(Pisano, 1983: 305, 320-322; Moore, 1983: 29-30).

52.32 Magellanic bunch-sedge blanket bogs
Blanket bogs of the Magellanic region dominated by bunch-growing sedges associated with graminose, caespitose cushion- and rosette-forming species, liverworts and mosses. They are generally dominated by *Schoenus antarcticus*, sometimes associated with *Schoenus andina* and *Carpha alpina* var. *schoenoides*. Other prominent bunch-growing sedges and graminoids are *Marsippospermum*

grandiflorum, *Carex magellanica*, *Juncus stipulatus*, *Uncinia tenuis* and *Carex microglochin*. *Sphagnum magellanicum* and *Racomitrium lanuginosum* are frequent components of the ground stratum.
(Pisano, 1971b: 99, Moore, 1983: 29).

52.33 Maritime tussock-grass blanket bogs

Blanket bogs of the offshore islands south of Tierra del Fuego dominated by the medium-tall to very tall, *Poa flabellata*, producing a dense cover up to two metres tall, formed of tussocks with intermingling crowns over a relatively deep peat soil. Only *Crassula moschata* associates with the dominant species. *Poa flabellata* bogs harbour colonies of albatrosses (*Diomedea melanophris*, *Diomedea chrysostoma*), of petrels (*Macronectes giganteus*), of shearwaters (*Puffinus griseus*, *Procellaria aequinoctialis*), of storm petrels (*Garrodia nereis*) and of penguins (*Eudyptes crestatus*, *Spheniscus magellanicus*). They are reported from the Diego Ramirez group, Isla Noir, the San Ildefonso group and Staten Island.
(Pisano, 1983: 320-321; Moore, 1983: 30).

53. WATER-FRINGE VEGETATION

Communities of the margins and of the floating rafts of lakes, rivers, and brooks, or of eutrophic marshes and swamps, based on sociations of large graminoid, juncoid or broad-leaved plants, for the most part helophytes.
(Cabrera, 1958, 1964, 1968; Oberdorfer, 1960; Koepcke, 1961; Vervoorst, 1967; Cabrera and Zardini, 1978; Moore, 1983; Junk, 1983, 1984a, 1993; Junk and Howard-Williams, 1984; Schnell, 1987b; Denny, 1993: 16-25; Junk, 1993; Muñoz *et al.*, 1993; Carnevali, 1994; Tressens *et al.*, 1994; Calleja, 1994; Archibold, 1995).

53.1 Graminoid water fringe and swamp beds

Communities of the margins of lakes, rivers, and brooks, or of eutrophic marshes and swamps, based on sociations of tall graminoid helophytes, usually species-poor, growing in stagnant or slowly flowing water of fluctuating depths, and sometimes on waterlogged ground. The leafy, closely-packed growth of the dominant species forms a dense, imbricated cover, and precludes much light passage to lower strata. They can be classified according to the dominant species, which gives them a distinctive appearance.
(Cabrera, 1964: 76-81).

53.11 *Typha* beds
Water-fringe and swamp communities dominated by tall graminoid Typhaceae, of genus *Typha*, usually very dense and extremely species-poor and sometimes almost pure. In southern temperate and desert regions of South America, they constitute, along with juncoid *Scirpus* beds of unit 53.21, the main reedbed habitats.
(Koepcke, 1961: 137-138; Cabrera, 1964: 77, 79, 83; Carnevali, 1994: unit 22a).

53.111 Temperate *Typha* beds
Typha-dominated water-fringe and swamp communities of northern Patagonia, the southern Andes and mediterranean Chile formed by, in particular, *Typha angustifolia* or *Typha domingensis*.
(Oberdorfer, 1960: 12; Cabrera, 1964: 77, 79, 83; Crespo and Perez-Moreau, 1969: 14-16).

53.112 Pampean *Typha* beds
Typha-dominated water-fringe and swamp communities of the Pampa region formed by, in particular, *Typha domingensis*, *Typha latifolia* or *Typha subulata*, constituting an important habitat for the avifauna, though of more restricted distribution than the juncoid *Scirpus* beds of unit 53.21.
(Cabrera, 1964: 77, 79, 83; Vervoorst, 1967: 151-152; Cabrera and Willink, 1980: 50-51; Erize *et al.*, 1995: 104).

53.113 Chacoan *Typha* beds
Typha-dominated water-fringe and swamp communities of the subtropical Chaco and its peripheral regions of floristic and faunistic influence, including the Monte, the Espinal the Pantanal and the Mojos, formed by, in particular, *Typha domingensis* and *Typha latifolia*, in often very dense, very tall, up to three metres, stands.
(Cabrera, 1964: 77, 79, 83; Lewis and Pire, 1981: 21; Carnevali, 1994: unit 22a).

53.114 Pacific desert *Typha* beds
Typha-dominated water-fringe and swamp communities of the coastal deserts of Pacific South America, formed by *Typha domingensis*, an important habitat for, in particular, a specialized avifauna which it largely shares with the juncoid *Scirpus* beds of unit 53.21, extending, very locally, on the western slopes of the Andes to about 3000 metres.
(Koepcke, 1954: 46-48; Koepcke, 1961: 137-138; Hughes, 1970: 231, 239).

53.115 Tropical lowland *Typha* beds
Typha-dominated water-fringe and swamp communities of tropical regions of South America formed by, in particular, *Typha domingensis*, of limited importance in an area where floating mats of unit 53.4 constitute the main graminoid reedbed habitat, except in semiarid regions such as the northeastern Brazilian plateau.
(Cabrera, 1964: 77, 79, 83; Schnell, 1987b: 14, 264; Tostain *et al.*, 1992: 14).

53.116 Tropical Andean *Typha* beds
Typha-dominated water-fringe and swamp communities of the high northern tropical Andes, in particular, of Lake Tota and the Savana de Bogota, forming the principal habitat of the wren *Cistothorus apolinari*.
(Ridgely and Tudor, 1989: 88-89; Fjeldså and Krabbe, 1990: 542).

53.12 Graminaceous reedbeds
Water fringe and swamp communities dominated by tall, very tall or medium tall Poaceae, belonging to subfamilies Bambusoideae, Arundinoideae, Panicoideae (Paniceae, Andropogoneae), Pooideae.
(Cabrera, 1964: 79; Heywood, 1978: 286-288; Carnevali, 1994: unit 21).

53.121 Bambusoid reedbeds
Water-fringing and swamp communities dominated by bambusoid grasses, of tropical and subtropical distribution, in particular, by *Zizaniopsis bonariensis*, a constituent of tall pirizales in the Pampa and humid Chaco regions, or by the smaller *Leersia hexandra*, *Luziola leiocarpa*, *Oryza spp.*.
(Cabrera, 1964: 79; Vervoorst, 1967: 152-153; Cabrera and Zardini, 1978: 4; Carnevali, 1994: unit 21).

53.122 Arundinoid reedbeds
Water-fringing and swamp communities dominated by arundinoid grasses, in particular by the extremely tall *Cortaderia selloana*, by *Cortaderia rudiuscula* or by the introduced *Phragmites australis* and *Arundo donax*.
(Morello, 1958: 119, 123; Koepcke, 1961: 138; Cabrera, 1964: 79; Cabrera and Zardini, 1978: 76-77).

53.123 Panicoid reedbeds
Water-fringing and swamp communities dominated by panicoid grasses, in particular Paniceae of genus *Panicum* (*Panicum grumosum*, *Panicum chloroleucum*) or Andropogonideae of genera *Erianthus* and *Imperata*.
(Morello, 1958: 119; Cabrera, 1964: 79; Cabrera and Zardini, 1978: 5, 142-145; Walter and Breckle, 1991c: 398-399).

53.124 Pooid reedbeds
Water-fringing and swamp communities dominated by pooid grasses, generally relatively gracile, in particular, by *Glyceria multiflora*, characteristic, notably, of ditches of the Pampas.
(Cabrera and Zardini, 1978: 5; Walter and Breckle, 1991c: 392).

53.125 Chloridoid reedbeds
Water-fringing and swamp communities dominated by chloridoid grasses, in particular, Sporoboleae of genera *Muhlenbergia* (*Muhlenbergia asperifolia* or *Sporobolus* (*Sporobolus maximus*), characteristic of inundatable river course edges and permanent waterholes of the Monte deserts and semideserts.
(Morello, 1958: 119, 123; Heywood, 1978: 288).

53.13 Sedge beds
Formations of graminoid perennial Cyperaceae of genera *Carex*, *Cyperus*, *Rhynchospora*, *Scirpus*, *Cladium* occupying the sides of watercourses, the edge or the entirety of humid depressions, oligotrophic mires and rich fens, on ground that can be dry for part of the year.
(Cabrera, 1958, 1964, 1968; Oberdorfer, 1960; Koepcke, 1961; Vervoorst, 1967; Cabrera and Zardini, 1978; Moore, 1983; Junk, 1983, 1984a, 1993; Junk and Howard-Williams, 1984; Schnell, 1987b; Denny, 1993: 16-25; Junk, 1993; Muñoz *et al.*, 1993; Carnevali, 1994; Tressens *et al.*, 1994; Calleja, 1994; Archibold, 1995).

53.131 *Scirpus giganteus* beds

Water-fringing and swamp communities dominated by the tall, sharp-leaved graminoid *Scirpus giganteus*, forming, in particular, large beds in the delta of the Parana and the Plata estuary.
(Cabrera, 1964: 79; Vervoorst, 1967: 153; Cabrera and Zardini, 1978: 4-5).

53.132 Waterfringe and swamp *Cyperus* beds
Formations dominated by large perennial Cyperaceae of genus *Cyperus*, in particular by the extremely tall *Cyperus giganteus*, or by smaller, medium-tall species, such as *Cyperus articulatus*.
(Cabrera, 1964: 79; Schnell, 1987b: 236; Junk, 1993: 703; Carnevali, 1994: unit 19).

53.1321 Giant *Cyperus* beds
Formations dominated by the extremely tall *Cyperus giganteus*, characteristic, notably, of the western Chaco where it constitutes the most usual water margin vegetation in the esteros, forming pure or almost pure colonies up to three metres tall, of the Pantanal, of the savannas of Bolivia and of the coastal regions of the Guianas.
(Cabrera, 1964: 79; Schnell, 1987b: 236; Junk, 1993: 703; Carnevali, 1994: unit 19).

53.1322 Large *Cyperus* beds
Formations dominated by large perennial Cyperaceae of genus *Cyperus* other than the extremely tall *Cyperus giganteus*, in particular by *Cyperus articulatus*, *Cyperus grandifolius*, *Cyperus laevigatus*, mostly characteristic of tropical South America, including the Galapagos Islands, often tolerant of brackish or salt water.
(Wiggins and Porter, 1971: 796-809; Schnell, 1987b: 14; Junk, 1993: 717, 720).

53.133 Tall *Rhynchospora* beds
Formations dominated by large perennial Cyperaceae of genus *Rhynchospora*, in particular by *Rhynchospora corymbosa*, typical, notably, of shallow waters of the western Chaco, forming beds of medium height, of the order of one metre.
(Cabrera, 1964: 79; Carnevali, 1994: unit 18).

53.134 *Cladium* beds
Water-fringing and swamp communities dominated by sedges of genus *Cladium*, in particular, *Cladium mariscus* of the Peruvian coastal lowlands, installed on drier ground than *Typha* and *Scirpus* beds, providing an important habitat for seed-eating emberizids of genera *Sporophila* and *Neorhynchus*, and probably for the rail *Neocrex erythrops*.
(Koepcke, 1954: 47; Koepcke, 1961: 138).

53.135 Waterfringe and swamp *Carex* beds
Formations of social sedges of genus *Carex*, usually dominated by one species that can be either tussock-forming or bed-forming, in particular, beds of *Carex riparia* var. *chilensis*, up to two metres tall, of the lower Parana system, of *Carex pseudocyperus* var. *polysticha* or *Carex tweediana* of Pampean regions, and *Carex* beds of the high northern Andes.
(Cabrera, 1964: 79; Cabrera and Zardini, 1978: 154; Junk, 1993: 717).

53.136 Waterfringe and swamp *Fuirena* beds
Formations of social sedges of genus *Fuirena*, in particular, *Fuirena robusta*, an occasional dominant of water-fringing pirizales, in particular in the humid Chaco and the Bolivian savannas.
(Cabrera, 1964: 79; Cabrera and Zardini, 1978: 154; Schnell, 1987b: 236; Carnevali, 1994: 61).

53.14 Thurniaceid beds
Beds of Thurniaceae, family of one genus and three species nearly endemic to the Guiana shield, in particular, colonies of *Thurnia polycephala*, sometimes very large, occupying the banks of blackwater rivers of the upper Orinoco and Negro basins.
(Heywood, 1978: 292-293; Huber, 1995: 160).

53.15 *Eryngium* waterfringe beds

Water-fringing and swamp communities dominated by Apiaceae of genus *Eryngium*, in particular, *Eryngium pandanifolium*, *Eryngium eburneum*, with large rosettes of linear lanceolate leaves very similar to those of monocots, usually serrated.
(Cabrera, 1964: 80-81; Cabrera and Zardini, 1978: 459-461).

53.2 Juncoid water fringe and swamp beds

Communities of the margins of lakes, rivers and brooks, or of eutrophic marshes and swamps, based on sociations of tall juncoid helophytes. Their leafless or needle-leaved stems provide a cover almost devoid of horizontal strata, often permitting the passage of light to the lowest strata.
(Cabrera, 1964: 82-90).

53.21 Juncoid *Scirpus* beds
Communities of the margins of lakes, rivers and brooks, or of eutrophic marshes and swamps, dominated by tall juncoid Cyperaceae of genus *Scirpus*, in particular, *Scirpus californicus* and *Scirpus americanus*, intolerant of drying, tolerant of water circulation, often installed in fairly deep water.
(Koepcke, 1961: 137-138; Cabrera, 1964: 82-87; Cabrera and Zardini, 1978; Quintanilla, 1988: 15, 21; Carnevali, 1994: unit 20).

53.211 Temperate juncoid *Scirpus* beds
Scirpus-dominated communities of the margins of lakes, rivers and brooks, or of eutrophic marshes and swamps of Tierra del Fuego, Patagonia, the Chilean Fjordland, the southern Andes and mediterraneo-Valdivian Chile formed by tall juncoid Cyperaceae of genus *Scirpus*, generally *Scirpus californicus* (*Scirpus riparius*, *Scirpus tereticulmis*).
(Oberdorfer, 1960: 74, 148; Cabrera, 1964: 82-87; Barros, 1969: 48-50; Moore, 1983: 326).

53.212 Pampa juncoid *Scirpus* beds
Scirpus-dominated communities of the margins of lakes and rivers or of eutrophic marshes and swamps of the Pampas, formed by tall juncoid Cyperaceae of genus *Scirpus*, mostly by the tule *Scirpus californicus*, constituting huge beds that are an essential habitat for, in particular, the avifauna, or by *Scirpus americanus*.
(Cabrera, 1964: 82-87; Vervoorst, 1967: 148-151; Cabrera and Zardini, 1978: 161-162; Erize *et al.*, 1995: 104).

53.213 Chacoan juncoid *Scirpus* beds
Scirpus-dominated communities of the margins of lakes and rivers or of eutrophic marshes and swamps of the Chaco and its peripheral regions of floristic and faunistic influence, including the Espinal, the Monte, the Pantanal and the Mojos, formed by tall juncoid Cyperaceae of genus *Scirpus*.
(Cabrera, 1964: 82-87; Lewis and Pire, 1981: 21; Carnevali, 1994: unit 20).

53.2131 Chacoan *Scirpus californicus* beds
Scirpus-dominated communities of the margins of mostly freshwater lakes and rivers or of eutrophic marshes and swamps of the Chaco and its peripheral regions of floristic and faunistic influence, including the Espinal, the Pantanal and the Mojos, formed by tall juncoid Cyperaceae of genus *Scirpus*, mostly by *Scirpus californicus*, constituting beds up to three metres tall, in waters to one metre deep, sometimes accompanied by *Scirpus lacustris* ssp. *validus*.
(Cabrera, 1964: 82-87; Lewis and Pire, 1981: 21; Carnevali, 1994: unit 20).

53.2132 Monte *Scirpus americanus* communities
Hygro-halophile communities of permanent lightly saline marshes of the Monte dominated by *Scirpus americanus* with *Scirpus olneyi*, *Juncus balticus*, *Eleocharis rostellata*.
(Morello, 1958: 127).

53.2133 Monte *Scirpus asper* communities
Hygro-halophile communities of permanent strongly saline marshes of the Monte dominated by *Scirpus asper* with *Juncus acutus*.
(Morello, 1958: 127).

53.214 Pacific desert juncoid *Scirpus* beds
Scirpus-dominated communities of the margins of lagoons and rivers or of eutrophic marshes, swamps and oases of the coastal and western Andean deserts of Pacific South America formed by tall juncoid Cyperaceae of genus *Scirpus*, mostly *Scirpus americanus* or *Scirpus californicus*. They constitute an essential habitat for a specialized avifauna, in particular, the tyrannid *Tachuris rubrigastra* and the furnariid *Phleocryptes melanops*, each represented by an endemic race in the Peruvian desert, and by a different one in the Loa basin, all restricted to this habitat and to the sympatric graminoid *Typha* beds of unit 53.114.
(Koepcke, 1954: 46-47; Koepcke, 1961: 138; Hughes, 1970: 231, 239; Quintanilla, 1988: 15, 21).

53.215 Tropical high Andean juncoid *Scirpus* beds
Scirpus-dominated communities of the margins of lakes and rivers or of eutrophic marshes and swamps of the high tropical Andes, forming, in particular, enormous reedbeds around the large lakes Junin and Titicaca, also well represented around lesser bodies of water. They constitute the exclusive habitat of the endemic tyrannid *Tachuris rubrigastra alticola* and furnariid *Phleocryptes melanops schoenobaenus*.
(Koepcke, 1954: 91; Koepcke, 1961: 138).

53.2151 Lake Titicaca *Scirpus tatora* beds
Beds of the endemic *Scirpus tatora*, often very extensive, occupying protected bays of Lake Titicaca. The largest beds, covering 300 km², are at Puno Bay. Open, mosaic parts of these beds constitute the breeding habitat of the threatened endemic grebe *Rollandia microptera*.
(Löffler, 1968: 68; Schnell, 1987a: 79; Schnell, 1987b: 139, 150, Fig. 56; Fjeldså and Krabbe, 1990: 66-67; Junk, 1993: 715-716).

53.2152 Lake Junin *Scirpus* beds
Scirpus-dominated communities of the margins of Lake Junin, covering immense expanses, constituting, in particular, the breeding habitat of the threatened endemic grebe *Podiceps taczanowskii*.
(Koepcke, 1954: 91; Koepcke, 1961: 138; Fjeldså and Krabbe, 1990: 70).

53.2153 Central Andean lesser lake juncoid *Scirpus* beds
Scirpus-dominated communities of the margins of lakes, other than Lake Titicaca and Lake Junin, of streams and of marshes of the high central and southern tropical Andes, comparatively uncommon except for those of some relatively large lakes of the Jauja region in Junin, and of the Tungasuca area in Cuzco.
(Koepcke, 1954: 91; Koepcke, 1961: 138; Fjeldså and Krabbe, 1990: 70).

53.2154 Northern Andean juncoid *Scirpus* beds
Scirpus-dominated communities of the margins of lakes and rivers or of eutrophic marshes and swamps of the high northern tropical Andes, in particular, of Lake Tota and the Savana de Bogota, forming, with the *Typha* beds of 53.116, the habitat of the wren *Cistothorus apolinari*.
(Ridgely and Tudor, 1989: 88-89; Fjeldså and Krabbe, 1990: 542).

53.216 Tropical juncoid *Scirpus* beds
Scirpus-dominated communities of the margins of lakes and rivers or of eutrophic marshes and swamps of the tropical regions of South America, of limited extent.
(Cabrera, 1964: 82-87).

53.217 Easter Island *Scirpus paschalis* beds
Beds of tall *Scirpus californicus* var. *paschalis* (*Scirpus riparius* var. *paschalis*) of the crater lake and streams of Easter Island, growing to a height of 3-4 metres in the crater lake.
(Skottsberg, 1922a: 69-70; Skottsberg, 1928: 500-501).

53.22 *Eleocharis* beds
Low, often extensive and very homogeneous formations dominated by rush-like Cyperaceae of genus *Eleocharis*, in particular, tidal swards of the Rio de la Plata formed by *Eleocharis bonariensis* and *Spilanthes stolonifera*.
(Cabrera, 1964: 88; Cabrera and Zardini, 1978: 5; Walter and Breckle, 1991c: 390).

53.23 Tall rush swamps
Communities of watercourse and water body margins, of swamps and mires dominated by tall *Juncus acutus* in almost monospecific beds, characteristic of somewhat saline soils, distributed, notably, in the Pampas and in the Monte, where they may line large watercourses (Rio Limay) and form a belt of vegetation on the saline alluvial banks (salitrales) of smaller watercourses. *Juncus acutus* may also be a dominant in more varied humid meadows or salt meadows of units 37 or 15.
(Morello, 1958: 123, 127; Cabrera, 1964: 88; Vervoorst, 1967: 136-137; Cabrera and Zardini, 1978: 184-187).

53.3 Broad-leaved waterfringe communities

Communities of the margins of lakes, rivers, and brooks, or of eutrophic marshes and swamps, based on sociations of large broad-leaved plants, for the most part helophytes. They often form more lax colonies than those of the graminoid helophytes, permitting more light penetration to lower strata and a greater development of interstitial floating communities.
(Cabrera, 1964: 71-76; Heywood, 1978; Carnevali, 1994: 62).

53.31 Alismatid waterfringe communities
Communities of the margins of lakes, rivers, and brooks, or of eutrophic marshes and swamps, based on sociations of large broad-leaved water plantains of family Alismataceae, or of related families.
(Cabrera, 1964: 71-72; Heywood, 1978: 269-277).

53.311 Arrowhead communities
Emergent communities dominated by species of genus *Sagittaria*, in particular, *Sagittaria montevidensis*, with large, arrow-shaped leaves.
(Cabrera, 1964: 71).

53.312 *Echinodorus* waterfringe communities
Communities of the margins of lakes, rivers, and brooks, or of eutrophic marshes and swamps, dominated by tall, large-leaved species of genus *Echinodorus*, in particular, *Echinodorus grandiflorus*.
(Cabrera, 1964: 71-72, 81).

53.32 Zingiberaceid waterfringe and swamp communities
Communities of the margins of lakes, rivers, and brooks, or of eutrophic marshes and swamps, based on sociations of broad-leaved arrowroots and ginger lilies of families Marantaceae, Cannaceae or Zingiberaceae.
(Cabrera, 1964: 72-73; Heywood, 1978: 296-301; Carnevali, 1994: 59, unit 22b).

53.321 Arrowroot beds
Waterside formations dominated by large, large-leaved Marantaceae, in particular, of genus *Thalia*, notably *Thalia multiflora* and *Thalia geniculata*, forming very extensive beds in various parts of tropical and subtropical South America, notably in the humid Chaco, the upper Paranean region, the Guianas.
(Cabrera, 1964: 72, 80; Schnell, 1987a: 84, 441; Schnell, 1987b: 250; Carnevali, 1994: unit 22b).

53.322 Ginger lily beds
Communities of the margins of lakes, rivers, and brooks, or of eutrophic marshes and swamps, dominated by broad-leaved ginger lilies of family Zingiberaceae, in particular, the introduced, widely naturalized, *Hedychium coronarium*, or species of genus *Costus* (*Costus arabicus*).
(Cabrera, 1964: 72; Huber, 1995: 148).

53.33 Araceid waterfringe and swamp communities
Communities of the margins of lakes, rivers, eutrophic marshes and swamps, based on sociations of broad-leaved palustrine members of the family Araceae, restricted to the Lasioideae (*Montrichardia*), the Philodendroideae, the Colocasioideae and the Aroideae.
(Heywood, 1978: 307-309; Schnell, 1987b: 237; Mabberley, 1993: 39; Huber, 1995: unit 86).
53.331 Amazonian *Montrichardia* communities

Helophytic communities of the Amazon basin dominated by the very large, arborescent, Araceae *Montrichardia arborescens*, lining pools or watercourses, covering immense surfaces, in almost pure stands, on inundatable muds of the tidal Amazon delta.
(Junk, 1983: 284; Schnell, 1987b: 235-237).

53.332 Orinoco *Montrichardia* communities
Marshy meadows of permanently flooded openings of the lower Orinoco delta, sometimes floating, dominated by *Montrichardia arborescens*, with *Thalia geniculata*, *Typha domingensis*, *Cyperus giganteus*, *Heliconia psittacorum*, *Costus arabicus*, *Renealmia alpina*.
(Huber and Alarcon, 1988: unit 47 *p.*; Huber, 1995: 148, unit 86 *p.*).

53.333 Guianan *Montrichardia* communities
Helophytic communities of the Guianas dominated by *Montrichardia arborescens*, covering considerable expanses in the coastal regions.
(Schnell, 1987b: 235-237).

53.34 Pontederiaceid waterfringe communities
Communities of the margins of lakes, rivers, and brooks, or of eutrophic marshes and swamps, based on sociations of broad-leaved rooted, erect emergent Pontederiaceae, in particular, *Pontederia lanceolata*.
(Cabrera, 1964: 72; Heywood, 1978: 309-311).

53.35 Dicot waterfringe and swamp communities
Communities of the margins of lakes, rivers, and brooks, or of eutrophic marshes and swamps, based on sociations of broad-leaved dicots, in particular, of families Polygonaceae, Onagraceae, Asteraceae.
(Cabrera, 1964: 73-76).

53.351 *Polygonum* waterfringe and swamp communities
Beds of medium or tall *Polygonum*, in particular, *Polygonum acuminatum*, *Polygonum punctatum*, *Polygonum hydropiperoides*, *Polygonum galapagense*, *Polygonum opelousanum*, *Polygonum spetabile*, of shallow waters and wet soils, often forming fringes around pools, ponds, lakes or along streams, often alongside reedbeds or *Scirpus* beds.
(Skottsberg, 1922a: 70-71; Skottsberg, 1928: 500; Cabrera, 1964: 73-74; Wiggins and Porter, 1971: 236-240; Cabrera and Zardini, 1978: 240; Schnell, 1987b: 250).

53.352 *Ludwigia* waterfringe and swamp communities
Communities of the margins of lakes, rivers, eutrophic marshes and swamps dominated by large, broad-leaved, erect, herbaceous or subshrubby, perennial Onagraceae of subfamily Jussiaeeae, notably of genus *Ludwigia*, widespread in tropical, subtropical and warm temperate regions of South America.
(Cabrera, 1964: 74; Wiggins and Porter, 1971: 709-711; Schnell, 1987b: 14).

53.353 Composite waterfringe and swamp communities
Communities of the margins of lakes, rivers, eutrophic marshes and swamps dominated by broad-leaved Asteraceae mostly of genus *Senecio* (*Senecio bonariensis*, *Senecio icoglossus*), also of genera *Gymnocoronis* (*Gymnocoronis spilanthoides*) or *Bidens* (*Bidens laevis*).
(Cabrera, 1964: 73-76).

53.36 Pteridophyte waterfringe and swamp communities
Communities of the margins of lakes, rivers, and brooks, or of eutrophic marshes and swamps, dominated by ferns, horsetails or quillworts.
(Huber and Alarcon, 1988: unit 46; Huber, 1995: 148, unit 85).

53.361 Fern swamps
Broad-leaved marsh meadows developed on permanently waterlogged organic soils dominated by ferns and sedges growing in dense one- to two-metre tall swards. *Blechnum serrulatum*, *Acrostichum aureum*, *Cyperus articulatus*, *Scleria spp.* are characteristic.
(Huber and Alarcon, 1988: unit 46; Huber, 1995: 148, unit 85).
53.362 *Equisetum* beds

Tall or low, often extensive, homogeneous, usually inundated formations dominated by species of genus *Equisetum*, in particular, the very tall *Equisetum giganteum* of coastal Peru, reaching a height of more than two metres.
(Koepcke, 1961: 138).

53.4 Floating reedbeds

Communities of helophytes and hydrophytes forming rafts or islands floating at the surface of watercourses or standing water bodies of tropical and subtropical South America, dominated by tall graminoid plants that are free-floating, rooted in the raft or rooted in the substrate through long trailing stems.
(Cabrera, 1964: 56-67; Howard-Williams and Junk, 1976; Cabrera and Zardini, 1978: 4; Junk, 1984a: 226-228; Junk and Howard-Williams, 1984: 271, 272; Junk, 1993: 688-689; Carnevali, 1994: units 23, 25 *p.*; Calleja, 1994: 256; Huber, 1995: 138-140, unit 86).

53.41 Embalsados
Soil-retaining floating islands of the great esteros and lagoons of the Chaco and neighbouring regions, formed by the evolution of camalotales or the growth of lake-edge vegetation, dominated by tall graminoid species, accompanied by a great variety of marshland and aquatic plants, climbers and a few shrubs and small trees. They provide an important habitat for many animal species, among them the threatened deer *Blastocerus dichotomus*.
(Cabrera, 1964: 62-67; Moreno, 1993: 8; Carnevali, 1994: unit 23).

53.411 Chaco *Cyperus-Fuirena* embalsados
Soil-retaining floating islands of the great esteros and lagoons of the Chaco dominated by *Cyperus giganteus*, *Fuirena rubusta*, *Scirpus cubensis*, *Scirpus lacustris* ssp. *validus*, *Cephalanthus glabratus*, associated with *Luziola peruviana*, *Leersia hexandra*, *Panicum laxum*, *Imperata braziliensis* and marsh species including *Erigeron tweediei*, several species of genera *Eryngium* and *Ludwigia* (*Jussieua*), orchids of genus *Habenaria*, Eriocaulaceae such as *Eriocaulon magnum*, by aquatic pontederiads, among which *Eichhornia crassipes*, *Eichhornia azurea*, *Pontederia lanceolata*, *Pontederia subovata* and ferns (*Salvinia herzogii*), by creepers (*Mikania periplocifolia*, *Oxypetalum macrolepis*, *Vigna longifolia*, *Rhabdadenia ragonesei*).
(Cabrera, 1964: 62-67; Carnevali, 1994: unit 23).

53.412 Chaco *Typha* embalsados
Soil-retaining floating islands of the extreme northeastern Chaco and neighbouring regions, dominated by *Typha doming ensis*, with emergent *Typha latifolia* and a lower stratum constituted by *Fuirena robusta*, *Baccharis salicifolia*, *Eleocharis acutangula*, *Ceratopteris pteridoides*.
(Carnevali, 1994: unit 23 *p.*).

53.413 Pantanal embalsados
Floating islands of floodplains of the Pantanal of Mato Grosso covering hundreds of square kilometres during high-water periods, formed by *Paspalum repens*, *Scirpus cubensis*, *Cyperus giganteus*, *Eichhornia crassipes*, *Eichhornia azurea*.
(Cabrera, 1964: 62; Junk, 1993: 703).

53.42 Amazonian floating islands
Floating islands (matupas, sudds) of rivers, floodplains and floodplain lakes of the central Amazonian region submitted to considerable amplitude of waterlevel changes, soil-retaining, formed by *Paspalum repens*, *Echinochloa polystachya*, *Oryza perennis*, *Leersia hexandra*, *Luziola spruceana*, *Hymenachne amplexicaulis*, *Scirpus cubensis*, *Eleocharis variegata*, *Rhynchospora spp.* with the aquatic *Pistia stratiotes*, *Eichhornia crassipes*, *Salvinia auriculata*, *Neptunia oleracea*, *Ipomoea aquatica*, many swamp plants, the riverside woody Araceae *Montrichardia arborescens*, climbers, occasional terrestrial shrubs and small trees.
(Howard-Williams and Junk, 1976: 115-116; Junk, 1983: 273-277, 281-284; Junk, 1984a: 226-228; Junk and Howard-Williams, 1984: 271, 272, 274, 275-276; Junk, 1993: 688-689).

53.43 Graminoid camalotales

Mostly soil-free floating rafts, often large, of the watercourses of the Parana basin of South America and their floodplains, dominated by the robust, free-floating grass *Panicum elephantipes*, associated with the grasses *Paspalum repens*, *Echinochloa polystachya* (*Echinochloa spectabilis*), sometimes *Oplismenopsis najada*, and the pontederiads *Eichhornia azurea*, *Eichhornia crassipes*, *Pontederia rotundifolia* (*Reussia rotundifolia*), *Pontederia subovata* (*Reussia subovata*). Many other free-floating species may accompany the dominants, in particular *Pistia stratiotes*, *Hydromystria laevigatum* (*Limnobium laevigatum*, *Hydromystria stolonifera*), *Salvinia auriculata*, *Salvinia rotundifolia*, *Salvinia herzogii*, *Salvinia sprucei*, *Salvinia minima* and small free-floating macrophytes, of genera *Lemna*, *Spirodela*, *Wolffia*, *Wolffiella*, *Azolla*, *Riccia*, *Ricciocarpus*.

(Cabrera, 1964: 56-61; Burkart, 1969: 332-334, 373-374; Palacios and Burkart, 1969: 282-284; Sanchez and Burkart, 1969: 337-339; Cabrera and Zardini, 1978: 4, 138, 142; Junk, 1984a: 226-228; Junk and Howard-Williams, 1984: 271, 272; Best, 1984: 375; Junk, 1993: 688-689; Carnevali, 1994: unit 25 *p.*; Calleja, 1994: 256).

53.44 Orinoco floating grasslands

Floating meadows of the lower Orinoco delta formed by *Eichhornia crassipes* and *Paspalum fasciculatum*.

(Huber and Alarcon, 1988: unit 47 *p.*; Huber, 1995: 148, unit 86 *p.*).

54. FENS, TRANSITION MIRES AND SPRINGS

Small-sedge and related communities of fens, transition mires and quaking bogs; vegetation of springs.

54.1 Springs

Gushing springs (rheocrenes), spring basins (limnocrenes) and seepages (helocrenes) and the communities closely associated with them and dependant on the peculiar microclimatic and hydrological situation created by the spring. These comprise the specialized spring communities as well as the fen communities (unit 54.2) or other communities that are interwoven with them.
(Oberdorfer, 1960: 152; Ellenberg, 1988; Leser, 1994: 429).

54.11 Temperate springs
Springs of temperate watercourses of South America, characteristic of hill and mountain regions of the Magellanic region, Patagonia, mediterranean Chile, the Pampas, the temperate Andes, the temperate and subtropical deserts. Small herbs of genus *Caltha* (*Caltha appendulicata*, *Caltha andicola*), of genus *Ourisia* (*Ourisia racemosa*, *Ourisia coccinea*), of genus *Pinguicula* (*Pinguicula magellanica*) are typical of their communities.
(Oberdorfer, 1960: 152; Koepcke, 1961: 128-132; Schubert, 1991; Leser, 1994: 429).

54.12 Tropical lowland springs
Springs of tropical lowlands, hills, plateaux and low mountain ranges of South America.
(Fittkau, 1976; Sioli, 1984a; Furch, 1984: 168-169).

54.121 Tropical sciaphile lowland springs
Springs within tropical forests of South America, in a densely shaded environment, with a scarcity or absence of aquatic palustrine plants.
(Fittkau, 1976; Sioli, 1984a).

54.122 Tropical heliophile lowland springs
Springs of tropical regions of South America, emerging in open areas, with direct exposure of the water to sunlight.
(Fittkau, 1976; Sioli, 1984a: 157-162).

54.13 Tropical mountain springs
Springs of the major mountain ranges of tropical South America, in particular, of the Andes and the Serra do Mar.
(Koepcke, 1961: 130-132).

54.131 Tropical mountain suprasylvatic springs
Rheocrenes, limnocrenes and helocrenes of nonglaciated areas of the extrasylvatic zones of the high altitudes of the major mountain ranges of tropical South America, in particular, of the puna and paramo plateaux.
(Koepcke, 1961: 131-132).

54.132 Tropical mountain glacier springs
Glacier-fed springs of the very high altitudes of the high tropical Andes, very cold and poor in nutrients.
(Koepcke, 1961: 132; Leser, 1994: 429).

54.133 Tropical mountain forest springs
Springs of the mountain forest belts of the major mountain ranges of tropical South America, in particular, of the Andes and the Serra do Mar.
(Koepcke, 1961: 131-132).

54.2 Temperate fens and transition mires

Wetlands of temperate regions of South America mostly or largely occupied by peat-forming or tufa-forming plant communities, usually constituted by small sedges, rushes and bryophytes, occupying soils permanently waterlogged, with a soligenous or topogenous, nutrient-poor, water supply, a water table at, or slightly above or below, the substratum, and infra-aquatic peat formation, or developed at the surface of oligotrophic or meso-oligotrophic water reaching a level above, sometimes well above, the substratum, providing little or no mineral or nutrient supply, with characteristics intermediate between those of soligenous and topogenous mires and those of strictly ombrogenous bogs.
(Oberdorfer, 1960: 146, 163-164; Ellenberg, 1963, 1988; Pisano, 1971b: 113-114; Westhoff and den Held, 1975; Dierssen, 1978; Moore, 1983: 27, 335, 337; Succow and Jeschke, 1990).

54.21 Temperate transition mires

Wetlands mostly or largely occupied by peat-forming plant communities developed at the surface of oligotrophic or meso-oligotrophic water reaching a level above, sometimes well above, the substratum, providing little or no mineral or nutrient supply. Their characteristics are thus intermediate between those of soligenous and topogenous mires and those of strictly ombrogenous bogs. In large systems, the most prominent communities are swaying swards, floating carpets or quaking mires formed by medium sized or small sedges, associated with sphagnums or brown mosses. They are accompanied by aquatic and amphibious communities (unit 22) and by formations transitional to these on the one hand, to fens (units 54.22, 54.23), bogs (unit 51) or humid grasslands (unit 37) on the other; sphagnum buttes (unit 51), in particular, are often an important feature. Transition mires form mostly as colonists of oligotrophic ponds and lakes, large bog pools or laggs. Outside of transition mire systems, their communities can be found in bog hollows (unit 51), in blanket bogs (unit 52), in depressions of fens (units 54.22, 54.23), in spring systems (unit 54.1), in humid heaths (unit 31.1) and a few other habitats.

(Ellenberg, 1963, 1988; Pisano, 1971b: 113-114; Dierssen, 1978; Moore, 1983: 27, 335, 337; Succow and Jeschke, 1990).

54.211 Magellanic *Marsippospermum* transition mires

Transition mires of the deciduous forest zone of Tierra del Fuego and southern mainland Patagonia, fed partly by a mineral-rich ground-water table situated 30-50 cm below the surface, dominated by the rush *Marsippospermum grandiflorum* in dense swards, with cushions of mosses, in particular *Sphagnum*, liverworts, several species of sedges of genus *Carex* and *Carpha alpina*, *Cortaderia pilosa*, *Festuca contracta*, *Rostkovia magellanica*, *Schoenus antarcticus*.
(Pisano, 1971b: 113-114; Moore, 1983: 27).

54.212 Magellanic *Carex-Tetroncium* transition mires

Transition mires of the deciduous forest zone of Tierra del Fuego and southern mainland Patagonia, and of adjacent areas, dominated by *Carex magellanica*, *Tetroncium magellanicum* and *Schoenus andinus*, with *Sphagnum magellanicum*, *Gunnera magellanica*, *Drosera uniflora*, *Viola tridentata*, *Anagalus alternifolia*, *Astelia pumilia*, *Caltha appendiculata*.
(Oberdorfer, 1960: 162; Pisano, 1971b: 114).

54.22 Temperate acidic fens

Topogenous or soligenous valley, basin or spring mire systems fed by waters poor in bases. The water level is at or near the surface of the substratum and peat formation is infra-aquatic. The mire communities, mostly dominated by small sedges and brown mosses or sphagnum, may, in large fen systems, be accompanied by acidocline wet grasslands, large sedge beds and reed or related communities. Sphagnum hummocks (unit 51) form locally and transition mires (unit 54.21) or aquatic (unit 22), and spring (unit 54.1) communities colonize small depressions. Acidic fen communities also occur on small surfaces or within mosaics in other ecosystems, in particular in typical humid grasslands (unit 37), humid woodlands and thickets (unit 44), decalcified dune slacks (unit 16.3) and spring systems (unit 54.1). Their presence can be indicated by codes from this unit used in conjunction with the relevant main codes.
(Oberdorfer, 1960: 146, 163-164; Ellenberg, 1963, 1988; Pisano, 1971b: 114; Dierssen, 1978; Moore, 1983: 27, 335, 337; Succow and Jeschke, 1990).

54.221 Magellanic acidic fens
Infra-aquatic peat-forming fens of the Magellanic region formed by communities of sedges, grasses, herbs and brown mosses, with *Carex gayana*, *Carex curta*, *Carex atropicta*, *Carex fuscula*, *Carex macloviana*, *Carex microglochin*, *Carex decidua*, *Poa fuegiana*, and many mosses of genera *Drepanocladus*, *Campylum*, *Calliergon*, *Mnium*.
(Oberdorfer, 1960: 163-164; Moore, 1983: 27, 332-340).

54.222 Valdivian acidic fens
Infra-aquatic fens of the Valdivian region and the temperate Andes dominated by *Carex macloviana*, with *Primula magellanica*, *Armeria elongata*, *Cinclidium stygium*.
(Oberdorfer, 1960: 146, 162).

54.23 Temperate rich fens
Wetlands mostly or largely occupied by peat- or tufa-producing small sedge and brown moss communities developed on soils permanently waterlogged, with a soligenous or topogenous base-rich, nutrient-poor, often calcareous water supply, and with the water table at, or slightly above or below, the substratum. Peat formation, when it occurs, is infra-aquatic.
(Oberdorfer, 1960; Ellenberg, 1963, 1988; Dierssen, 1978; Succow and Jeschke, 1990).

54.3 Tropical and subtropical lowland fens

Peat-forming, low-growing, sedge, grass, rush and moss communities of the lowland and hill tropical zones of South America. Such formations are rare in the tropics, they occur in anomalous conditions such as highly oceanic climates and high altitudes. High altitude communities are, for the most part, integrated in mosaics with dry-land formations and have been incorporated with them in unit 3C.
(Succow and Jeschke, 1990; Junk, 1993).

54.31 Subtropical oceanic island fens
Mires of subtropical oceanic islands of South America, in particular, *Campylopus turficola* bogs of the crater lake of Easter Island, in part raised, in part constituted of infra-aquatic formations in water holes within *Scirpus* beds.
(Skottsberg, 1928: 501).

54.32 Continental tropical lowland fens
Peat-forming, low-growing, sedge, grass, rush and moss communities of the lowland and hill tropical zones of continental South America.
(Succow and Jeschke, 1990; Junk, 1993).

6 . INLAND ROCKS, SCREES AND SANDS

Azonal communities colonizing rock cracks, unstable screes, permanent snow and ice, non-desert inland sands, caves and volcanic features.

61. SCREES

Vegetated or sparsely vegetated and frequently unstable areas of stones, boulders or rubble on steep slopes, produced by erosion in mountainous terrain. They are characteristic of high mountains in all zones, extending to lower altitudes in the sub-antarctic and mediterranean zones; a very few communities form in lowland areas elsewhere. Desert screes are included in 7.

61.1 Tropical mountain screes

Screes, vegetated or sparsely vegetated and frequently unstable areas of stones, boulders or rubble on steep slopes of high mountains of tropical South America.

61.11 Tropical Andean screes
Screes of the tropical Andes, including the northern tropical or paramo Andes, the central tropical Andes or northern puna Andes of Peru and Bolivia and the southern tropical Andes, extending from the bend of the Andes to the northern limit of the mediterranean Andes of Chile and of the Cuyo Andes of Argentina.

61.12 Brazilian shield mountain screes
Screes of the tropical mountains of the Brazilian shield, including those of the Atlantic coastal cordillera, notably the Serra do Mar, of the Serra do Espinhaço and Chapada Diamantina system, of the Goias Planalto mountains and of the Mato Grosso Planalto mountains.

61.13 Guianan shield mountain screes
Screes of the mountains of the Guianan shield, including the high tepuis of southeastern Venezuela, western Guyana and northern Brazil, and lesser mountain ranges or inselbergs.

61.14 Southern Caribbean mountain screes
Screes of the mountain ranges of the Caribbean coast of Colombia and Venezuela, and of its immediate hinterland, including the mountains of Falcon, the central Venezuelan coast Cordillera de la Costa, the eastern Venezuelan Cordillera de Caripe, and of the higher mountains of the southern near-coastal Caribbean islands, in particular, Margarita and Trinidad.

61.2 Tropical lowland screes

Screes, vegetated or sparsely vegetated and frequently unstable areas of stones, boulders or rubble on steep slopes of hills or scarps of the lowlands and plateaux of tropical South America.

61.3 Temperate mountain screes

Screes, vegetated or sparsely vegetated and frequently unstable areas of stones, boulders or rubble on steep slopes of high mountains of temperate regions of South America, characteristic of the sub-antarctic and temperate Patagonian, mediterranean and Cuyo Andes.

61.31 Magellanic alpine screes
Screes of the alpine zone of Tierra del Fuego and the southern mainland Andes occupied by *Grammitis magellanica*, *Hymenophyllum falklandicum* and *Polystichum andinum*.
(Moore, 1983).

61.32 Northern temperate Andean screes
Screes of the northern Patagonian Andes, of the mediterranean Andes of Chile and of the Cuyo Andes of Argentina.

61.4 Temperate lowland screes

Screes, vegetated or sparsely vegetated and frequently unstable areas of stones, boulders or rubble on steep slopes of hills, scarps and terraces of the lowlands and plateaux of temperate South America.

61.5 Tropical insular screes

Scree communities of tropical and subtropical oceanic islands, including talus slope communities of the craters of Easter Island, dominated by the ferns *Microlepia strigosa* and *Polypodium phymatodes*. (Skottsberg, 1928: 498-500).

62. INLAND CLIFFS AND EXPOSED ROCKS

Cliffs, rock faces, limestone pavements of South America, the plant communities that colonize their cracks and surfaces, and their associated animal communities.

62.1 Tropical mountain cliffs and exposed rocks

Cliffs, rock faces, limestone pavements of high tropical mountains of South America, the plant communities that colonize their cracks and surfaces, and their associated animal communities.

62.11 Tropical Andean cliffs and exposed rocks
Commmunities of mosses, lichens, ferns, lycopodes and angiosperms colonizing cliffs, rock pavements, exposed rocks and rock clefts of the tropical Andes, including the northern tropical or paramo Andes, the central tropical Andes or northern puna Andes of Peru and Bolivia and the southern tropical Andes, extending from the bend of the Andes to the northern limit of the mediterranean Andes of Chile and of the Cuyo Andes of Argentina.

62.111 Northern Andean cliff and exposed rock communities
Cliff and exposed rock commmunities of the paramo Andes, including the Andes of Venezuela, Colombia and Ecuador, north of the Huancabamba depression. Communities of the Colombian Eastern Cordillera, colonizing bare rock surfaces between 3000 and 4500 metres comprise *Asplenium spp.*, *Draba spp.*, *Elaphoglossum spp.*, *Escallonia spp.*, *Luzula spp*.
(Schnell, 1987b: 102).

62.112 Central and southern Andean rock communities
Cliff and exposed rock commmunities of the tropical Andes of Peru, Bolivia, Chile and Argentina, south of the Huancabamba depression and north of the mediterranean and Cuyo Andes, outside of the desert and semidesert puna environments.
(Cabrera, 1958).

62.12 Brazilian shield montane rock communities
Communities of mosses, lichens and bryophytes colonizing rocks of the mountains of Atlantic Brazil, of the Serra do Espinhaço and Chapada Diamantina system, of the Goias Planalto and Mato Grosso Planalto mountains, in particular, moss and sphagnum carpets (*Polytrichum spp.*, *Sphagnum spp.*), lichens, (*Cora pavonina*), lycopods and ferns (*Elaphoglossum spp.*, *Polypodium spp.*) on rocks of the Serra dos Orgaos and the Serra Itatiaia.
(Schnell, 1987b: 287-288).

62.13 Guiana shield high mountain rock communities
Cliffs, rock faces, sandstone pavements of high mountains of the Guiana shield, including the high vertical cliffs, sandstone tabletops and granitic summits of the high tepuis of southeastern Venezuela, western Guyana and northern Brazil, and lesser mountain ranges or inselbergs.
(Huber, 1995: 157-159, units 102, 99 *p.*, 100 *p.*, 101 *p.*).

62.131 Tepui tabletop open rock communities
Pioneer communities colonizing summital sandstone pavements and outcrops of the high tepuis of the Roraima system and associated eastern Venezuelan tepui systems, and of the Chimanta massif, formed by cyanobacteria, crustaceous and frutescent lichens of genera *Siphula*, *Caloplaca*, *Xanthoparmelia*, *Usnea* and bromeliads including many endemic species of genera *Lindmania*, *Navia*, *Brocchinia*.
(Huber, 1995: 158-159, unit 102).

62.132 Tepui granite summit communities
Pioneer communities colonizing the hump-like rocky boulders of the summits of granitic tepuis formed by scattered clumps of *Racinaea spiculosa* with cyanobacteria, lichens and small cushions of moss.
(Huber, 1995: 158-159, unit 102).

62.133 Tepui cliff communities
Pioneer communities of the high vertical cliffs of high tepuis dominated by rosette-forming monocots, including Bromeliaceae, Liliaceae, Eriocaulaceae, Xyridaceae, Rapateaceae.
(Huber, 1995: 158-159, unit 102).

62.134 Guiana shield inselberg rock communities
Pioneer communities of bare rock surfaces of lajas and other granite and gneiss outcrops of the Guianan shield and its fringe, formed by cyanobacteria, ephemeral colonies of *Utricularia*, *Genlisea*, low herbs and sedges, grasses, Xyridaceae, Rubiaceae and bromeliads.
(Huber, 1995: 157-158, units 99 *p.*, 100 *p.*, 101 *p.*).

62.14 Southern Caribbean montane rock communities
Communities of mosses, lichens and bryophytes colonizing rocks of the non-Andean mountains of Caribbean South America, including the mountains of Falcon, the central Venezuelan coast Cordillera de la Costa, the eastern Venezuelan Cordillera de Caripe, and of the higher mountains of the southern near-coastal Caribbean islands, in particular, Margarita and Trinidad.

62.2 Tropical lowland cliffs and exposed rocks

Cliffs, rock faces, limestone pavements of hills and scarps of the lowlands and plateaux of tropical South America, the plant communities that colonize their cracks and surfaces, and their associated animal communities. Tropical lowland cliffs are uncommon, of reduced size, mostly limited to semiarid zones and they rarely develop specialized associated communities.

62.3 Temperate mountain cliffs and exposed rocks

Cliffs, rock faces, limestone pavements of the mountains of the temperate, southern part of South America, the plant communities that colonize their cracks and surfaces, and their associated animal communities.

62.31 Temperate Andean cliffs and exposed rocks
Cliffs, rock faces, limestone pavements, chasmophyte and rock slab communities of the Patagonian Andes, the mediterranean Andes of Chile and the Cuyo Andes of Argentina.

62.32 Temperate non-Andean mountain communities
Cliffs, rock faces, limestone pavements of mountains and high hills of temperate South America not belonging to the main Andean system, including, in particular, the isolated Sierra de Tandil and the Sierra de la Ventana of the southern Pampa region, which harbour rock-crevice fern communities comprised of *Adianthum spp.*, *Pellaea spp.*, *Blechnum spp.*, *Woodsia spp.*, *Notholaena spp.*, *Cheilanthes spp.* generally accompanied by *Lycopodium saururus*.
(Soriano *et al.*, 1992: 385).

62.4 Temperate lowland cliffs and exposed rocks

Cliffs, rock faces, limestone pavements of hills, scarps and terraces of the lowlands and plateaux of temperate South America, the plant communities that colonize their cracks and surfaces, and their associated animal communities.

62.5 Oceanic island inland rock communities

Rocks of the interior of tropical, subtropical or warm temperate oceanic islands and the communities of mosses, lichens and bryophytes that colonize them, including, in particular, those of the Galapagos Islands, Malpelo Island, the Juan Fernandez Islands, the San Felix archipelago, Fernando de Noronha, South Trinidad and the Martin Vaz islands, Easter Island and Sala y Gomez.

62.51 Galapagos inland cliffs and exposed rocks
Communities of mosses, lichens and bryophytes colonizing rocks of the interior of islands of the Galapagan archipelago, in particular, lichen communities on exposed lava rock surfaces above the cloud zone from about 525-550 metres altitude to the highest peaks, at 1700 metres.
(Wiggins and Porter, 1971).
62.52 South Trinidad inland cliffs and exposed rocks

Communities of mosses, lichens and bryophytes colonizing interior rocks of South Trinidad.

62.53 Easter Island rock communities
Communities occupying water-retaining crevices of the rocks of Easter Island dominated by *Cyperus brevifolius* (*Kyllinga brevifolia*) or by ferns, in particular, *Polypodium phymatodes* or *Microlepia strigosa*, with the endemic *Doodia paschalis*.
(Christensen and Skottsberg, 1920b: 48; Skottsberg, 1928: 498).

62.54 Juan Fernandez inland cliffs and exposed rocks
Communities of mosses, lichens and bryophytes colonizing rocks of the interior of islands of the Juan Fernandez archipelago.

63. ETERNAL SNOW AND ICE

High mountain zones occupied by glaciers or by perennial snow. They are inhabited by algae and invertebrates.
(Koepcke, 1954: 84-85).

63.1 Snow packs

Quasi-permanent snow packs, in particular in avalanche corridors.

63.2 Rock glaciers

Glacier-like tongues of angular tallus extending out from a cirque and slowly moving downslope under the effect of gravity and of underlying, fully covered, interstitial ice. They occur in the Andes.
(John, 1983: 61; Whittow, 1984).

63.3 True glaciers

Masses of snow and ice formed by the consolidation under pressure of snow falling on high ground, moving outward and downward from the zone of accumulation to lower ground.
(Whittow, 1984; Clark, 1990).

63.31 Tropical glaciers
Glaciers of high tropical mountains.
(John, 1983: 59; Whittow, 1984; Clark, 1990).

63.311 Equatorial glaciers
Glaciers of high tropical volcanoes of Ecuador, situated above 4400-4700 metres, developed under a regime of precipitations decreasing with altitude.
(John, 1983: 59; Whittow, 1984; Clark, 1990).

63.312 Peruvian glaciers
Glaciers of the high tropical Andes of Peru, Bolivia and Colombia developed at altitudes above 4800-5500 metres, under a regime of precipitations increasing with altitude, induced by moisture-laden east winds.
(John, 1983: 59; Whittow, 1984; Clark, 1990).

63.32 Central Andean glaciers
Glaciers of the dry high Andes of Chile and Argentina characterized by the presence of penitents, spikes of ice formed by the melting of the glacier surface during a completely dry abrasion period.
(John, 1983: 60; Whittow, 1984; Clark, 1990).

63.33 Patagonian glaciers
Glaciers of the southern Andes of Chile and Argentina formed at low altitudes in high precipitation climates, covering about 25000 km².
(John, 1983: 61; Whittow, 1984; Clark, 1990).

64. INLAND SAND DUNES

Sand bodies of eolian origin, possessing constructional relief and separated from the coast and its dune cordons by nondunal habitats, developed within the subantarctic, nemoral, steppic, warm-temperate humid, mediterranean or subdesert steppe zones, and, occasionally, in the tropical zone. They support a vegetation which differs markedly from coastal sand dune communities. Desert sands are excluded and listed under section 7.
(Flint, 1971).

64.1 Temperate inland dunes

Inland dunes of the temperate non-desert regions of South America, in particular of the Patagonian and Pampa steppe zones and of the nemoral, lauriphyllous and xerophyllous forest zones. They include palaeo-coastal dunes, constituted by dune cordons marking former seashores, fluvio-glacial dunes, formed of quartzic sands originating in redeposited and reworked glacial drift and outwash, fluviatile dunes, lacustrine dunes and inland dunes formed under mediterranean climates.

64.11 Patagonian steppe inland dunes
Inland dunes and sand deposits of the steppe region of southern and western Patagonia and of adjacent forest zones or forest ecotones, in particular extensive dune systems of the east end of Lago Argentino, in the ecotone between western Patagonian steppe and Patagonian semidesert.
(Walter and Breckle, 1991c: 411).

64.12 Pampa inland dunes
Inland dunes of the warm-temperate Pampa steppe zone.
(Soriano *et al.*, 1992: 374, 373).

64.121 Eastern Pampa inland dunes
Inland dunes of the flooding, rolling and southern Pampas, most characteristic of the flooding Pampa.
(Vervoorst, 1967: 158-159; Cabrera and Zardini, 1978: 395-396; Soriano *et al.*, 1992: 374; Muñoz *et al.*, 1993: 90-91, 100-101).

64.122 Western Pampa inland dunes
Inland dunes of the inland or western Pampa region of southern Cordoba, northeastern La Pampa and northwestern Buenos Aires.
(Cabrera and Willink, 1980: 81; Soriano *et al.*, 1992: 373; Burkart *et al.*, 1994: 21; Erize *et al.*, 1995: 104).

64.2 Tropical inland dunes

Inland dunes of the tropical non-desert regions of South America.

64.21 Tropical lowland inland dunes
Dunes of the savanna, dry woodland or semideciduous forest zones of the periphery of the Amazon basin, south to the Chaco and the Espinal, in particular of the Santa Cruz-Trinidad savannas of Bolivia, of dry Andean interior valleys, of the Aeolian plains of Colombia and Venezuela, of the eastern Chaco, as well as of enclaves within the rain forests zones of the Amazon basin, in particular, in white sand regions.
(Herzog, 1923: 121; Hueck and Seibert, 1981: 34, unit 40; Medina and Sarmiento, 1981: 635; Sarmiento, 1983: 262-263; Huber, 1985: 52, 53; Carnevali, 1994: 33).

64.22 Tropical Andean lacustrine dunes
Dunes of high Andean lakes, in particular, of Lake Titicaca.
(Koepcke, 1961: 136).

65. CAVES

Natural caves, cave systems, underground waters and subterranean interstitial spaces. Caves and their associated waters (65.1-65.7) harbour varied, but paucispecific, communities of animals, fungi and algae that are restricted to them (troglobiont organisms), or are physiologically and ecologically capable of conducting their entire life cycle within them (troglophile organisms), or are dependent on them for part of the life cycle (subtroglophile organisms). Underground waters not associated with caves (stygon, 65.7) and interstitial spaces (65.8, 65.9) harbour distinctive faunas.
(Pavan, 1958; Koepcke, 1961: 136; Thinès and Tercafs, 1972; Ginet and Decou, 1977; Vornatscher, 1979; Neuherz, 1979; Passauer, 1979; Camacho, 1992; Tercafs, 1992; Iliffe, 1992; Chapman, 1993; Leser, 1994).

65.1 Troglobiont vertebrate caves

Caves harbouring communities that include troglobic amphibians or fish, limited worldwide to a very small number of highly distinctive organisms, mostly relict forms of extremely limited distribution, including 15 species of amphibians, limited to North America and Europe, and about 38 species of fishes belonging to 13 families, notably, Cyprinidae, Gobiidae, Bythitidae, Pimelodidae, Characidae, Cobitidae, Amblyopsidae, Clariidae, Ictaluridae, Trichomycteridae, Ophidiidae, Synbranchidae. South American representatives are limited to characiform and siluriform fishes.
(Pavan, 1958; Thinès and Tercafs, 1972: 55-64; Ginet and Decou, 1977; Banister, 1985; Camacho, 1992; Chapman, 1993: 37).

65.11 Characid caves
Caves of South America harbouring communities that include troglobic Characidae, in particular, Brazilian caves harbouring the extremely rare *Stygichthys typhlops*.
(Thinès and Tercafs, 1972: 55; Chapman, 1993: 37).

65.12 Catfish caves
Caves of South America harbouring communities that include troglobic siluriform fishes of families Pimelodidae and Trichomycteridae.
(Thinès and Tercafs, 1972: 56-57; Chapman, 1993: 37).

65.121 Pimelodid catfish caves
Caves of South America harbouring communities that include troglobic siluriform fishes of family Pimelodidae.
(Thinès and Tercafs, 1972: 57; Langecker, 1992).

65.1211 *Pimelodella* caves
Caves of Sao Paulo state, notably Areias and Bombas caves, harbouring communities that include the troglobic siluriform fish *Pimelodella kronei*.
(Pavan, 1958; Thinès and Tercafs, 1972: 57; Langecker, 1992).

65.1212 *Caecorhamdia* caves
Caves of South America harbouring communities that include troglobic siluriform fishes of genus *Caecorhamdia*, in particular, *Caecorhamdia urichi* and *Caecorhamdia brasiliensis*.
(Thinès and Tercafs, 1972: 57).

65.122 Trichomycterid catfish caves
Caves of South America harbouring communities that include troglobic siluriform fishes of family Trichomycteridae, in particular, Umalayanta cave of Bolivia harbouring *Trichomycterus chaberti*.
(Thinès and Tercafs, 1972: 57).

65.2 Troglophile vertebrate caves

Caves of South America essential to parts of the life-cycle of vertebrate troglophiles or subtroglophiles (elective periodic trogloxenes).
(Pavan, 1958; Koepcke, 1961: 136; Ginet and Decou, 1977; Camacho, 1992; Tercafs, 1992; Chapman, 1993).

65.21 Bird caves
Caves of South America essential to parts of the life-cycle of avian troglophiles or subtroglophiles (elective periodic trogloxenes).
(Snow, 1961, 1962, 1985; Koepcke, 1961: 136; Gonzalez, 1978: 135-139; Tercafs, 1992: 494-495; Sick, 1993: 14-15; Chantler and Driessens, 1995).

65.211 Guacharo caves
Caves of tropical South America occupied by the nocturnal, fruit-eating, echo-locating, taxonomically isolated oilbird or guacharo, *Steatornis caripensis*, sparsely distributed in western Guiana, Venezuela, Colombia, Ecuador, Peru and Trinidad.
(Snow, 1961, 1962, 1985; Koepcke, 1961: 136; Gonzalez, 1978: 135-139; Tercafs, 1992: 494-495; Sick, 1993: 14-15).

65.212 Swift caves
Caves of South America essential to parts of the life-cycle of troglophile or subtroglophile swifts, in particular *Streptoprocne zonaris* and *Streptoprocne biscutata*.
(Sick, 1993: 14-15; Chantler and Driessens, 1995).

65.22 Bat caves
Caves of South America, under normally oxygenated, buffered microclimates, generally large and crossed by watercourses or excavated near epigean watercourses, with permanent or temporary colonies of bats. All families of South American Chiroptera, except the very paucispecific Thyropteridae, include cave-dwelling species. Mormoopidae, Desmodontidae and Natalidae roost primarily in caves. A few Emballonuridae, Molossidae and one of the two species of Furentidae are also cave roosters. Several Phyllostomidae and Vespertilionidae, and one of the two species of Noctilionidae, are versatile roosters that use caves as well as other shelters.
(Stebbings, 1984: 797-799, 804-807; Eisenberg, 1989: 73-232; Redford and Eisenberg, 1992: 69-133; Barquez *et al.*, 1993).

65.23 Troglophile rodent caves
Caves of northern South America harbouring troglophile populations of the Venezuelian and Trinidadian heteromyoid pocket mouse *Heteromys anomalus*.
(Chapman, 1993: 37).

65.3 Troglobiont invertebrate caves

Caves harbouring communities that include no troglobiont amphibians or fish, but include troglobiont invertebrates, limited worldwide to a relatively small number of species belonging to a limited number of groups, and including remarkable relict species.
(Pavan, 1958; Thinès and Tercafs, 1972: 64-70; Ginet and Decou, 1977; Camacho, 1992; Chapman, 1993: 34-37).

65.4 Troglophile invertebrate caves

Caves harbouring communities that include no troglobiont organisms, but include troglophile invertebrates. Generally, they are caves crossed by watercourses or with rich trophic substratum, excavated in limestone afforested zones.
(Pavan, 1958; Ginet and Decou, 1977; Camacho, 1992; Chapman, 1993).

65.5 Subtroglophile invertebrate caves

Caves essential to parts of the life-cycle (quiescence period) of invertebrate subtroglophiles (elective periodic trogloxenes), such as Lepidoptera, Diptera, Hymenoptera, Coleoptera; in general they are stably cool (or warm) and humid caves.
(Pavan, 1958; Ginet and Decou, 1977; Camacho, 1992; Chapman, 1993).

65.6 Atroglozoocoenotic caves

Caves devoid of significant troglobic or troglophile zoocoenoses, and not harbouring significant subtroglophiles.
(Pavan, 1958; Ginet and Decou, 1977; Camacho, 1992; Chapman, 1993).

65.7 Stygal biocoenoses

Communities harboured by ground waters (stygon), not including those of cave waters. They are constituted by mostly small, elongated forms, including bacteria, protozoans, turbellarians, rotatorians, nematodes, copepods and amphipods.
(Camacho, 1992; Chapman, 1993; Leser, 1994).

65.71 Anchihaline biocoenoses
Communities occupying anchialine (or anchihaline) habitats, underground bodies of more or less saline water, usually with a restricted exposure to open air, always with more or less extensive subterranean connections to the sea. They show noticeable marine as well as terrestrial influences. They are varied, located within either volcanic or limestone bedrock. Distinctive communities of anchialine stygobionts, mostly crustaceans, have been discovered, in particular, on the Galapagos Islands, on San Andres Island (Colombia), on Bonaire, Curaçao and Aruba. One species of anchilhaline fish, in genus *Ogilbia*, is known from the Galapagos Islands.
(Iliffe, 1992: 619-627; Camacho, 1992; Chapman, 1993).

65.72 Interstitial phreatic biocoenoses
Communities of stygobiont invertebrates and vertebrates, highly distinctive, occupying eustygal habitats, interstitial water saturating porous sediments below the water table. The siluriform fish *Phreatobius cisternarum* of Marajo Island, in the Amazon delta, troglobiont or stygobiont belonging to the family Trichomycteridae, is probably a member of such phreatic communities.
(Thinès and Tercafs, 1972: 56-57; Camacho, 1992; Chapman, 1993).

65.8 Hyporheic interstitial biocoenoses

Rhythrostygal (potamostygal) communities of stygobiont organisms, mostly fresh-water mites and small crustaceans, occupying interstitial water in sand and gravel sediments accompanying running water courses.
(Camacho, 1992; Chapman, 1993).

65.9 Subterranean interstitial biocoenoses

Communities occupying the compartment of the subterranean ecosystem in direct contact with the lower horizon of the soil, at a depth ranging from a few centimeters to a few meters, in the interconnected microspaces of the colluvions or the fissures of the superficial zones of the bedrock, harbouring distinctive interstitial assemblies of troglobiont invertebrates, comprising coleoptera, myriapods, isopods, spiders, pseudoscorpions.
(Camacho, 1992; Chapman, 1993).

66. VOLCANIC FEATURES

Sites and products of recent volcanic activity harbouring distinct biological communities.

66.1 Volcanic summital communities

Specialized, pauci-specific communities restricted to the summital zone of South American volcanoes, reported in particular, at altitudes above 4600 metres, from the 6887 metre high Ojos del Salado, the highest active volcano in the world, formed by lichens, mosses and a limited number of highly singular insects.
(Halloy *et al.*, 1991: 6, 11).

66.2 Crater communities

Specialized, paucispecific communities occupying the interior slopes of active South American volcanoes.

66.3 Barren lava fields

Almost bare lava formations of volcanoes, colonized by, besides communities listed in units 3, 4, 61 or 62, lichens and invertebrates.
(Whitten and Brooks, 1972; Whittow, 1984; Clark, 1990).

66.4 Volcanic ash and lapilli fields

Exposed deposits of pyroclastic rocks, fragmental volcanic material blown into the atmosphere by explosive activity, including pumus, scoriae, bombs, pelées hair, together with the pioneer assemblies of specialized species that may colonize them.
(Whitten and Brooks, 1972).

66.5 Lava tubes

Caves formed by hollow basaltic tubes resulting from the cooling of the surface of lava flows whose moulten interior continued to flow. They may be colonized by anchihaline communities of unit 65.71.
(Whittow, 1984).

66.6 Fumaroles, solfataras and mofettes

Orifices in volcanic areas emitting hot or cold gases and vapours. Their very extreme environment is colonized by paucispecific but highly distinct communities. Included are steam vents (fumaroles), vapour and hot sulphurous gas vents (solfatares), paint pots, porridge pots and mud volcanoes, as well as cold carbon dioxide, methane and nitrogen vents (mofettes), that emit directly into the open atmosphere; marine and subterraneous vents have been included in units 11 and 65, respectively. Solfatara activity occurs in the Andes, in particular around the Nevado Ojos del Salado and in the southern Andes, in the Galapagos Islands at San Felix.
(Whitten and Brooks, 1972; Whittow, 1984; Clark, 1990).

66.7 Thermal springs

Acid or alkaline springs heated by geothermal energy, located in regions of present or past volcanic activity, producing a continuous flow of water at temperatures significantly above the air temperature. Springs and tepid pools at temperatures below 50° C may host a few species of specialized animals, those at temperatures between 50° C and 75° C harbour blue-green algae that may form conspicuous mats, those at temperatures above 75° C are inhabited only by heterotrophic bacteria; the margins of

the springs and the water-saturated substrates may host distinctive biotic communities, including superior plants. Geysers and hot soils may be associated with thermal springs.
(Whitten and Brooks, 1972; Clark, 1990).

66.8 Geysers

Springs from which heated water and steam is ejected, sometimes violently, at periodic intervals, in active or recently active volcanic regions. Within the South American region, geysers are reported from the Andes, in particular, from the Ojos del Salado volcano. The proximal zone of geysers may host distinctive communities of lower plants and invertebrates.
(Whitten and Brooks, 1972; Clark, 1990; Halloy *et al.*, 1991: 11).

7 . DESERTS

Unvegetated or sparsely vegetated formations of geographically significant extent, developed under arctic, temperate or tropical climates in extreme conditions of low precipitation and high evaporation. Included are all shrub-dominated, grass-dominated or succulent-dominated communities exposed to arid or very arid conditions, typically with annual precipitation inferior to 200 mm, and, as semideserts, shrub-dominated or succulent-dominated, including arborescent succulent-dominated, communities, usually strongly lacunar, formed under semiarid conditions, with annual precipitation that may reach 500 mm or 600 mm. Grass-dominated communities constituted under the latter conditions and representing encroachments of steppes characteristic of neighbouring regions are listed under 3, while all communities that comprise a reasonably continuous, closed or open, stratum of trees, other than arborescent succulents, are listed under 4, most often under 4B. Communities dependent on permenant or temporary surface water are excluded and listed in units 15, 2, 3 or 5; nonarborescent communities dependent on phreatic water are included in unit 7.
(Shmida, 1985; Rieley and Page, 1990; Walter and Breckle, 1991a; Demangeot, 1994).

72. CONTINENTAL COOL DESERTS AND SEMIDESERTS

Interior continental deserts or semideserts of temperate areas beyond the reach of moisture-laden winds ("déserts d'éloignement") and rain-shadow deserts or semideserts lying on the leeward side of high mountain ranges which intercept the rain-bearing winds ("déserts d'abri"). They are limited in South America to the low or moderate altitude Patagonian semideserts and to the high altitude Puna deserts and semideserts.
(Birot, 1970: 349-350; Hueck and Seibert, 1972: units 66, 67, 64 *p.*, 51 *p.*, 84 *p.*; Hueck, 1978: 436-439, 448-449; West, 1983a, 1983g; Soriano, 1983; Soriano *et al.*, 1983; Schnell, 1987b: 134-153; Schultz, 1988: 224-225; Rieley and Page, 1990: 51-52; Walter and Breckle, 1991b: 162-168; Walter and Breckle, 1991c: 394, 405-419; Allan and Warren, 1993; Demangeot, 1994: 125-126; Archibold, 1995: 96, 106).

72.1 Patagonian semideserts

Rain-shadow semideserts covering, in southern and western Argentina, a surface of 150000 square kilometres, or 3% of the world's deserts and semideserts, extending over most of the provinces of Santa Cruz and Chubut, irradiating northwards in the Andean approaches of extreme western Rio Negro, Neuquen and Mendoza. The vegetation, characteristically strongly lacunar, is structured by small shrubs, many of them composites, and by hard bunchgrasses, of genus *Stipa*, in particular.
(Walter, 1968: 711-718; Birot, 1970: 349-350; Hueck and Seibert, 1972: units 66, 67, 64 *p.*, 51 *p.*; Hueck, 1978: 448-449; West, 1983a, 1983g; Soriano, 1983; Soriano *et al.*, 1983; Schultz, 1988: 224-225; Rieley and Page, 1990: 51-52; Walter and Breckle, 1991c: 405-419, 421-422; Demangeot, 1994: 125-126; Archibold, 1995: 96, 106).

72.11 Santacruzian semideserts

Semideserts of the Santacruzian subdistrict, southern part of the Central district of the Patagonian botanical province, extending between 46° S and 51° S, from the Atlantic to the Andes, characterized in particular by *Nassauvia glomerulosa* and *Verbena tridens*.
(Hueck and Seibert, 1972: unit 66 *p.*; Soriano *et al.*, 1983; Walter and Breckle, 1991c: 405-419).

72.111 Santacruzian semidesert dwarf scrub

Open dwarf scrub of alluvial plains, plateaux, till plains, rounded moraines and gentle slopes of the Santacruzian semidesert with a cover mostly inferior to 40 %, dominated by the low dwarf shrub *Nassauvia glomerulosa* accompanied by *Acantholippia seriphioides*, *Chuquiraga aurea*, *Chuquiraga kingii*, *Brachyclados caespitosus*, *Azorella spp.*, *Mulinum microphyllum*, the bunchgrasses *Stipa speciosa*, *Stipa humilis*, *Stipa chrysophylla*, *Stipa neaei*, *Stipa psylantha*, *Stipa subplumosa*, abundant in some facies, and in rills or depressions, *Verbena tridens*.
(Soriano *et al.*, 1983; Walter and Breckle, 1991c: 405-419).

72.112 Santacruzian semidesert scrub

Shrublands and thickets developed locally on low plateaux, basaltic hills in premontane areas, in muddy coastal plains and around endoreic basins of the Santacruzian semideserts.
(Soriano *et al.*, 1983; Walter and Breckle, 1991c: 450-451).

72.1121 Santacruzian Atlantic verbena semidesert scrub

Open shrubland and thickets of the low plateaux of the Atlantic coastlands of the Santacruzian semideserts, formed by *Verbena tridens* accompanied by *Nardophyllum obtusifolium*, *Berberis cuneata*, *Lycium chilense*, bunchgrasses, cushion plants and small perennial herbs of the genera *Viola*, *Calceolaria*, *Nassauvia*, *Perezia*.
(Soriano *et al.*, 1983: 450-451; Walter and Breckle, 1991c: 412).

72.1122 Santacruzian hill mixed semidesert scrub

Sparse scrub of hills of the Santacruzian semideserts covered by a basaltic mantle, formed by a varied assembly of shrubs, with no clear dominance, among which *Verbena tridens*, *Verbena ligustrina*, *Anarthrophyllum rigidum*, *Schinus polygamus*, *Nardophyllum obtusifolium*, *Lycium chilense*, *Berberis heterophylla* are the most frequent.
(Soriano *et al.*, 1983: 451).

72.1123 South-western Santacruzian *Nardophyllum* semidesert scrub
Scrub installed on glacial deposits of the southwestern Santacruzian semideserts, at moderate altitudes with relatively low temperatures and favourable water conditions, dominated by *Nardophyllum obtusifolium* accompanied by *Festuca pallescens*.
(Soriano *et al.*, 1983: 451).

72.12 Chubutian semideserts
Semideserts of the Chubutian subdistrict, northern part of the Central district of the Patagonian botanical province, extending from 46° S northwards to a line running from 39° S, in Neuquen to 45° S in interior Chubut, including, in addition, the Valdez peninsula, the Carlos Ameghino isthmus and the coastal area east of Rio Chico and Rio Chubut, south of Golfo Nuevo and north of Cabo Razo, characterized in particular by *Nassauvia glomerulosa* and *Chuquiraga avellanedae*.
(Walter, 1968: 711-718; Hueck and Seibert, 1972: unit 66 *p.*; Daciuk, 1977; Speck *et al.*, 1982; Soriano *et al.*, 1983; Walter and Breckle, 1991c: 405-419).

72.121 Chubutian *Chuquiraga-Nassauvia* semideserts
Sparse, low scrub of the plains, plateaux, hills and coastlands of the Chubutian semidesert, with a cover usually inferior to 35%, formed by the hemispheric shrub *Chuquiraga avellanedae*, variously accompanied by the shrubs *Colliguaya integerrima*, *Chuquiraga hystrix*, *Chuquiraga erinacea*, *Prosopis denudans*, *Lycium ameghinoi*, *Lycium chilense*, *Berberis cuneata*, *Verbena ligustrina*, *Nardophyllum obtusifolium*, *Pleurophora patagonica*, *Suaeda divaricata*, *Atriplex lampa*, *Schinus johnstoni*, the dwarf cushony, pebble-like *Nassauvia glomerulosa*, *Nassauvia ulicina*, and the grasses *Stipa speciosa*, *Stipa humilis*, *Poa ligularis*.
(Soriano, 1956: 328-329; Walter, 1968: 716-717; Soriano *et al.*, 1983; Walter and Breckle, 1991c: 405-419).

72.1211 Chubutian *Chuquiraga* hedgehog semideserts
Chubutian plateau and hill semideserts dominated by the hemispheric shrub *Chuquiraga avellanedae* accompanied by other shrubs of medium size, up to about one metre in height.
(Walter, 1968: 716-717; Soriano *et al.*, 1983; Walter and Breckle, 1991c: 405-419).

72.1212 Chubutian *Nassauvia* dwarf cushion semideserts
Chubutian plateau and hill semideserts dominated by the dwarf, cushony, pebble-like *Nassauvia glomerulosa*, *Nassauvia ulicina*.
(Walter, 1968: 716-717; Soriano *et al.*, 1983; Walter and Breckle, 1991c: 405-419).

72.1213 Chubutian *Prosopis* brushy semideserts
Chubutian plateau and hill semideserts colonized by patches or thickets of tall shrubs, up to two metres in height, such as *Prosopis denudans*, *Lycium ameghinoi*, *Berberis cuneata*, *Verbena ligustrina*.
(Walter, 1968: 716-717; Soriano *et al.*, 1983; Walter and Breckle, 1991c: 405-419).

72.122 Chubutian basin semideserts
Low scrub, often extremely sparse, of the lowlands of the Rio Chico Valley and the Sarmiento Basin, dominated by *Nassauvia glomerulosa* or *Nassauvia ulicina* and *Chuquiraga avellanedae*, with an admixture of halophytic species or halophytic communities, comprising *Atriplex lampa*, *Atriplex sagittifolium*, *Frankenia patagonia*; the shrubs *Lycium ameghinoi*, *Prosopis denudans* var. *patagonia*, *Nicotiana ameghinoi* and the endemic *Ameghinoa patagonia* occur in some subcommunities.
(Soriano *et al.*, 1983: 450; Walter and Breckle, 1991c: 405-419).

72.13 San Jorge semideserts
Semideserts of the San Jorge Gulf district of the Patagonian botanical province, forming a narrow strip along the Gulf of San Jorge between Cabo Razo and Punta Casamayor, characterized in particular by the abundance of *Trevoa patagonica*.
(Hueck and Seibert, 1972: unit 67; Soriano *et al.*, 1983; Walter and Breckle, 1991c: 405-419).

72.131 San Jorge *Trevoa* semidesert scrub
Dense scrub, with a cover of up to 60%, of the slopes bordering San Jorge Gulf, including Montemayor, Del Castillo and Espinosa Plateaux, dominated by *Trevoa patagonica* associated with *Colliguaya integerrima*, accompanied by various other shrubs, including *Mulinum spinosum*, *Adesmia campestris*, *Ephedra ochreata*, *Anarthrophyllum rigidum*, *Shinus polygamus*, *Lycium chilense* an herb layer dominated by *Stipa spp.*, with *Calceolaria polyrrhiza*, *Calceolaria lanceolata*, *Silene magellanica*, *Cerastium arvense*, *Sisyrinchium striatum*, *Huanaca acaulis*, *Amisinckia hispida*, *Plagiobotrys calandrinioides*, *Perezia recurvata*, *Microsteris gracilis*, *Onothera contorta* var. *divaricata*, *Erodium cicutarium*, *Vulpia dertonensis*, *Galium spp.*, *Stellaria media*, *Phacelia magellanica* and a few climbers, *Magallana porifolia*, *Loasa argentina*, *Mutisia retrorsa*.
(Soriano *et al.*, 1983: 452; Walter and Breckle, 1991c: 405-419).

72.132 San Jorge plateau semideserts
Dwarf scrub, subjected to severe winds of the upper Del Castillo Plateau south of Pico Salamanca, composed of low shrubs of *Adesmia campestris*, *Senecio flaginoides*, *Nardophyllum obtusifolia* and cushions of *Brachyclados caespitosus*, *Mulinium microphyllum*, *Benthamiella patagonica*, *Cruckshanksia glacialis* interspersed with steppic communities of abundant *Festuca pallescens*, *Festuca argentina*, *Poa ligularis* with *Stipa speciosa*, *Stipa humilis*; carpet-forming *Larrea ameghinoi*, the southernmost representative of its genus, is present.
(Soriano *et al.*, 1983: 452; Walter and Breckle, 1991c: 405-419).

72.14 Western Patagonian semideserts
Semideserts of the Occidental district of the Patagonian botanical province, situated in a strip 100-120 km wide extending in latitude from 39° S in Neuquen south to Lake Buenos Aires in Santa Cruz, bordered in the west by the high Andean vegetation, the subantarctic forest and the fescue steppe zones of the Andes and Andean piedmont, in the east by the Chubutian and Santacruzian semideserts; they are dominated by tussock grasses with linear spiny leaves interspersed with often cushion-like shrubs.
(Soriano, 1956: 325-328; Hueck and Seibert, 1972: unit 64 *p.*; Speck *et al.*, 1982; Soriano *et al.*, 1983: 441-448; Walter and Breckle, 1991c: 405-419).

72.141 Western Patagonian semidesert *Mulinum* mixed scrub
Open communities occupying most of the western Patagonian semidesert, formed by the cushion shrubs *Mulinum spinosum*, *Adesmia campestris*, *Senecio filagenoides*, and the tussock-grasses ("coirones") *Stipa speciosa*, *Stipa humilis*, *Stipa ibari*, *Stipa chrysophylla*, *Stipa psylantha*, *Stipa neaei*, *Stipa subplumosa*, *Stipa sorianoi*, accompanied by the grasses *Poa ligularis*, *Bromus setifolius*, *Hordeum comosum*, *Festuca argentina*, *Poa lanuginosa* and the shrubs *Lycium chilense*, *Verbena ligustrina*, *Acantholippia seriphioides*, *Schinus polygamus*, *Nardophyllum obtusifolium*, isolated bushes of *Berberis cuneata* and *Berberis heterophylla*, hard cushion plants *Azorella caespitosa*, *Brachyclados caespitosus*, softer cushions of *Adesmia spp.*, *Acaena spp.*, *Verbena spp.*, and the southernmost representatives of the Cactacae, including *Maihuenia patagonica*, *Austrocactus spp.*, *Pterocactus spp.*; many perennial herbs occur throughout the region as well as some annuals, although they are often severely reduced by grazing.
(Soriano, 1956: 326; Walter, 1968: 715-717; Soriano *et al.*, 1983; Walter and Box, 1983i: 433; Walter and Breckle, 1991c: 405-419).

72.142 Western Patagonian semidesert brushes
Distinctive, often single-species dominated brush communities occurring within the western Patagonian semidesert, either in edaphically divergent stations or as regional features.
(Soriano, 1956: 327; Soriano *et al.*, 1983).

72.1421 Western Patagonian semidesert *Nassauvia* scrub
Western Patagonian semidesert brush communities dominated by the columnar composite *Nassauvia axillaris*.
(Soriano, 1956: 327; Soriano *et al.*, 1983).

72.1422 Western Patagonian semidesert *Corynabutilon* scrub
Western Patagonian semidesert brush communities dominated by the greyish *Corynabutilon bicolor*, occurring locally within the narrow western margin of the Patagonian semidesert zone.
(Soriano, 1956: 327; Soriano *et al.*, 1983).

72.1423 Western Patagonian semidesert *Sapium* scrub

Semidesert brush communities dominated by *Sapium patagonicum*, occurring locally in the central part of the western Patagonian semidesert zone.
(Soriano, 1956: 327; Soriano *et al.*, 1983).

72.1424 Western Patagonian semidesert calafate scrub
Western Patagonian semidesert brush communities dominated by *Berberis cuneata* or *Berberis heterophylla*, occurring locally, in particular as continuous shruby strips along terraces or valleys.
(Dimitri, 1977; Soriano *et al.*, 1983).

72.15 Payunian semideserts
Semideserts of the Payunia district of the Patagonian botanical province, extending in a narrow strip along the pre-Andean ranges of northern Neuquen and Mendoza, occupying, in the north of their range, limited ecotopes within a predominently monte vegetation, characterized by a floral cortège rich in Patagonian elements.
(Hueck and Seibert, 1972: units 64 *p.*, 51 *p.*; Soriano *et al.*, 1983; Walter and Breckle, 1991c: 405-419, 421-422).

72.2 Puna deserts and semideserts

High deserts and semideserts, nearly devoid of vegetation or occupied by sparse, low, xeric shrub and grass communities, extending from 30° S to 15° S, with outposts to about 7° S, situated in the highlands of Peru, Bolivia, Chile and Argentina, between the two great chains of the Andes at elevations ranging from 3500 metres (3000 metres in the south) to 4300 metres (3700 metres in the south), subjected to strong winds, extreme temperature fluctuations, intense solar radiation and low irregular precipitation ranging from less than 100 mm to 400 mm annually. There is a high degree of endemism, including, in particular, the genera *Parastrephia*, *Lampaya*, *Chersodoma*, *Eustrephiopsis*, *Oreocereus*, *Lophopappus*, *Hemimunroa*, *Anthobryum*, *Chiliotrichiopsis*, *Urmenetea*. The range of puna vegetation is classically divided into three parts, the "wet puna" or "moist puna" in the north and east, the "dry puna" forming a central zone, narrow in the north and broad in the south, under semiarid climates, with precipitation between 100 and 400 mm, the "desert puna" or Puna de Atacama, occupying a very dry, rather narrow belt in the southwest, under arid climates, with annual precipitation below 100 mm. The desert puna and the southern, Argentinian, part of the dry puna are mostly dominated by deserts or by shrub semideserts included in this unit. The moist puna is mostly dominated by steppic grasslands included in unit 3C.14. The northern part of the dry puna, or "puna de la tola", of the Peruvian, Bolivian and northeastern Chilean altiplano, is mostly dominated by ericoid evergreen shrub heaths, or tolares, included in unit 3C.12. A few semidesert shrub communities also occur in the northern dry puna and have been included here, as have been, conversely, specialized azonal grasslands or tolares developed within the semidesert environment of Argentinian puna. Very high Andean communities, occurring in the range of the deserts and semideserts of this unit, at altitudes situated above them, are predominantly grasslands or cushion heaths and are listed in units 3C.14 and 3C.13, respectively.
(Hunziker, 1952: 176-179; Cabrera, 1958, 1968; Troll, 1959, 1968; Hueck and Seibert, 1972: unit 84 *p.*; Hueck, 1978: 436-439; Cabrera and Willink, 1980: 87-88; Mares *et al.*, 1985: 204-205; Gonzalez *et al.*, 1986; Schnell, 1987b: 119, 134-153; Walter and Breckle, 1991b: 162-168; Walter and Breckle, 1991c: 394; Allan and Warren, 1993; Haene *et al.*, 1993; Gajardo, 1994: region 2A; Burkart *et al.*, 1994: 25-27; Daniele and Natenzon, 1994: unit 14; Erize *et al.*, 1995: 156).

72.21 Puna shrub semideserts
Puna semidesert communities of the Puna de Atacama, the Argentinian rain-shadow dry puna area and occasional locations within the northern, altiplano, tola puna dominated by open assemblies of small-leaved, nonericoid, mostly deciduous or aphyllous shrubs.
(Hunziker, 1952: 177-178; Cabrera, 1958: 340-349; Cabrera, 1968; Ducoing, 1973: 53, 54; Schnell, 1987b: 137-138, 138-140; Cabrera and Willink, 1980: 87-88; Walter and Breckle, 1991b: 165; Haene *et al.*, 1993; Gajardo, 1994: region 2A; Burkart *et al.*, 1994: 26; Erize *et al.*, 1995: 156).

72.211 *Fabiana-Psila-Adesmia* puna semideserts
Open, deciduous, succulent-poor dwarf semidesert scrub forming the dominant climax community of the Argentinian Salteno-Jujuyan puna and of the western fringe of the Chilean desert puna dominated by the Solanaceae *Fabiana densa* with *Baccharis boliviensis* (*Psila boliviensis*), *Adesmia horridiuscula*, *Junellia seriphioides*, *Baccharis incarum*, *Senecio viridis*, *Acantholippia hastulata*, *Tetraglochin cristatum*, *Nardophyllum armatum*, *Ephedra breana*, *Adesmia spinosissima*.

(Cabrera, 1958: 340-346; Cabrera, 1968: 100; Cabrera and Willink, 1980: 87-88; Walter and Breckle, 1991b: 165; Gajardo, 1994: unit 2A4-2A41; Burkart *et al.*, 1994: 26; Erize *et al.*, 1995: 156).

72.2111 *Fabiana densa* puna semideserts
Facies of the Argentian and Chilean *Fabiana densa-Baccharis boliviensis-Adesmia horridiuscula* semidesert scrubs dominated by *Fabiana densa*.
(Cabrera, 1958: 340-342).

72.2112 Southern *Tetraglochin* puna semideserts
Facies of the Argentian *Fabiana densa-Baccharis boliviensis-Adesmia horridiuscula* semidesert scrubs dominated by the spiny-leaved Rosaceae *Tetraglochin cristatum*, accompanied by *Adesmia horridiuscula*, *Baccharis incarum* var. *lejia*, *Baccharis polifolia*, *Nardophyllum armatum*, *Acantholippia hastulata*, frequently with other shrubs, in particular, *Fabiana densa*, *Psila boliviensis*, *Adesmia spinosissima*. In very stony places *Tetraglochin cristatum* may form pure stands.
(Cabrera, 1958: 343).

72.2113 *Acantholippia* puna semideserts
Facies of the Argentian *Fabiana densa-Baccharis boliviensis-Adesmia horridiuscula* semidesert scrubs dominated by *Acantholippia hastulata*, sometimes accompanied by *Artemisia copa*, *Adesmia horridiuscula*, *Chuquiraga atacamensis* or other shrubs, colonizing very sandy-stony slopes.
(Cabrera, 1958: 343).

72.2114 *Adesmia horridiuscula* puna semideserts
Facies of the Argentian *Fabiana densa-Baccharis boliviensis-Adesmia horridiuscula* semidesert scrubs dominated by *Adesmia horridiuscula* frequently accompanied by *Fabiana bryoides* or by the puna endemic *Artemisia copa*. Many other species may be present, in particular, *Acantholippia hastulata*, *Mulinum crassiflorum*, *Opuntia atacamensis*, *Nicotiana petunioides*, *Cristaria andicola*, *Phacelia viscosa*, *Hoffmansegia gracilis*, *Phacelia cumingii*, *Viola spegazzinii*, *Stipa frigida*.
(Cabrera, 1958: 343).

72.2115 *Fabiana denudata* puna semideserts
Facies of the Argentian *Fabiana densa-Baccharis boliviensis-Adesmia horridiuscula* semidesert scrubs in which *Fabiana denudata* replaces the similar *Fabiana densa* and dominates.
(Cabrera, 1958: 343).

72.2116 *Chuquiraga atacamensis* puna semideserts
Facies of the Argentian *Fabiana densa-Baccharis boliviensis-Adesmia horridiuscula* semidesert scrubs dominated by widely spaced shrubs of *Chuquiraga atacamensis* accompanied by *Junellia seriphioides* and a few herbs.
(Cabrera, 1958: 343).

72.2117 *Baccharis incarum* puna semideserts
Facies of the Argentian *Fabiana densa-Baccharis boliviensis-Adesmia horridiuscula* semidesert scrubs dominated by *Baccharis incarum* var. *lejia*.
(Cabrera, 1958: 345).

72.212 *Psila-Krameria* puna semideserts
Open semidesert scrubs of higher elevations and rocky slopes of the Argentinian Salteno-Jujuyan puna dominated by *Baccharis boliviensis* (*Psila boliviensis*) accompanied by the very branched, linear-leaved, lily-flowered pygmy shrub *Krameria iluca*, by the jasmine-flowered *Menodora pulchella*, by various spiny shrubs of genus *Adesmia* (*Adesmia nordenskjoldii*, *Adesmia leucopogon*, *Adesmia spinosissima*, *Adesmia horridiuscula*), by *Cassia hookeriana*, *Fabiana spp.* (*Fabiana friesii*, *Fabiana denudata*, *Fabiana densa*), *Satureja parviflora*, *Buddleja hieronymi*, shrubby *Mutisia orbignyana* and *Mutisia ledifolia*, *Ephedra breana*, by cacti, notably, the cushion-forming *Opuntia atacamensis*, *Parodia schwebsiana*, *Lovibia sp.*, and, on rocky slopes, the tall columnar cactus *Trichocereus poco*. Many grasses and herbs occupy spaces between the shrubs, among which, *Stipa leptostachya*, *Pennisetum chilense*, *Deueuxia antoniana*, *Aristida asplundii*, *Aristida enodis*, *Poa spp.*, *Solanum chamaesarachidium*, *Astragalus garbancillo*, *Hypochoeris meyeniana*, *Dichondra argentea*, *Cardionema ramosissima*.
(Cabrera, 1958: 346-347; Cabrera, 1968; Schnell, 1987b: 137-138; Erize *et al.*, 1995: 156).

72.213 Southeastern puna semideserts
Open semidesert scrubs constituting the climax semidesert community of the extreme south of the puna region, in La Rioja and Catamarca, at altitudes up to 3700 metres, with *Ephedra breana*, *Verbena seriobrioides*, *Nardophyllum armatum*, *Lampayo schickendantzii*, *Lycium fuscum*, *Lycium decipiens*, *Ephedra multiflora*, *Tetraglochin cristatum*, *Lepidophyllum tola*, *Nassauvia axilaris*; patches of *Stipa speciosa*, *Stipa leptostachya*, other herbs and *Opuntia spp.* often occupy spaces between the shrubs. *Ephedra breana* or *Ephedra multiflora*, in particular, may form pure stands.
(Hunziker, 1952: 177-178; Haene *et al.*, 1993: 10-11, 15).

72.214 Atacama *Fabiana bryoides* deserts
Very open desert scrubs of the Puna de Atacama and of the region of the great Andean salt basins formed by the most xerophytic elements of the high Andean flora, *Fabiana bryoides*, *Parastrephia lepidophylla*, *Mulinum crassifolia*, *Stipa frigida*, *Artemisia copa*, *Fabiana denudata*, *Phacelia viscosa*, *Stipa chrysophylla*.
(Gajardo, 1994: 2A5-2A51, 2A6-2A51).

72.215 Altiplano semideserts
Open semidesert communities of the altiplano of Peru, Bolivia and extreme northeastern Chile, developed within the range of the tola puna or of the grassland moist puna, dominated by small-leaved, nonericoid, mostly deciduous or aphyllous shrubs.
(Koepcke, 1954: 81-82; Koepcke, 1961: 183-185; Parker *et al.*, 1982: 20; Gajardo, 1994: 2A3-2A32).

72.2151 *Tetraglochin* altiplano semideserts
Semideserts of the Peruvian and Bolivian altiplano dominated by sparse formations of the Rosaceae *Tetraglochin strictum*.
(Koepcke, 1954: 81; Koepcke, 1961: 183-185).

72.2152 *Chuquiraga* altiplano semideserts
Sparse semidesert communities of the Peruvian and Bolivian altiplano formed by *Chuquiraga spinosa*, *Baccharis spp.*, *Senecio spp.*, *Tafalla spp.*.
(Koepcke, 1954: 81-82; Koepcke, 1961: 185).

72.2153 Precordilleran *Fabiana* semideserts
Open semidesert scrubs of the high pre-altiplanician precordillera or Cordillera Central of Chile formed by *Babiana densa* and *Tagetes multiflora*, with *Ephedra breana*, *Fabiana viscosa*, *Atriplex imbricata*, *Baccharis boliviensis*, *Senecio graveolens* and many annuals.
(Gajardo, 1994: 2A3-2A32).

72.22 Semidesert puna tola heaths
Azonal communities of the semiarid dry puna of Argentina dominated by evergreen ericoid scale-leaved shrubs of the composite genus *Parastrephia*, occupying sandy depressions, dune fields, river and lake terraces, dejection cones, with subterranean water near the surface.
(Hunziker, 1952: 178; Cabrera, 1958: 355; Cabrera, 1968; Schnell, 1987b: 138, 331-332; Walter and Breckle, 1991b: 165; Haene *et al.*, 1993: 11, 15; Erize *et al.*, 1995: 156).

72.221 Salteno-Jujuyan tolares
Parastrephia lepidophylla- and *Parastrephia phylicaeformis*-dominated semidesert tola heaths of sandy depressions, dune fields, river and lake terraces of the puna of the southern tropical Andes, at altitudes of about 3600-4000 metres.
(Cabrera, 1958: 355; Cabrera, 1968; Cabrera and Willink, 1980: 88; Schnell, 1987b: 138, 331-332; Burkart *et al.*, 1994: 26; Walter and Breckle, 1991b: 165; Gajardo, 1994: units 2A5-2A51, 2A6-2A51, *p.*; Erize *et al.*, 1995: 156).

72.222 Riojo-Catamarcan tolares
Tola heaths of the La Rioja and Catamarca puna, at 3000-3700 metres, colonizing dejection cones and valley bottoms where water occurs near the surface dominated by *Parastrephia lepidophylla* (*Lepidophyllum tola*) and *Baccharis grisebacchii*, constituting isolated southernmost outposts of the tolar communities.
(Hunziker, 1952: 178; Schnell, 1987b: 152; Haene *et al.*, 1993: 11, 15).

72.23 Puna desert grasslands

Bunchgrass steppes of the dry puna, developed in environments dominated by puna desert and semidesert scrub communities, limited to edaphically favourable enclaves and to areas of transition to alti-Andean communities.
(Cabrera, 1958: 357; Schnell, 1987b: 138; Walter and Breckle, 1991b: 165).

72.231 Puna *Pennisetum* steppes
Steppic grasslands of humid sandy soils of the dry puna dominated by the highly desert-adapted *Pennisetum chilense*.
(Cabrera, 1958: 357; Schnell, 1987b: 138; Walter and Breckle, 1991b: 165; Erize *et al.*, 1995: 155).

72.232 Puna *Panicum chloroleucum* steppes
Steppic grasslands of dry sandy soils and shifting dunes of the dry puna dominated by *Panicum chloroleucum*, related to Monte and coastal dune grasslands.
(Cabrera, 1958: 357; Walter and Breckle, 1991b: 165).

72.233 Puna *Festuca chrysophylla* steppes
Communities typical of the puna sector of the Alti-Andino zone of the high, desertic, Andes of northern Chile south of the Altiplano, between about 19° 20'S and nearly 23°S, dominated by *Festuca chrysophylla*, with *Fabiana bryoides*, *Adesmia horrida*, with *Azorella compacta*, *Baccharis incarum*, *Conyza deserticola*, *Pycnophyllum molle*, *Chuguiraga spinosa*, *Parastrephia quadrangularis*, occasionally *Lampaya medicinalis*.
(Gajardo, 1994: units 1B10-2B23=2A23, 2A2-2A23, 2A5-2A23).

72.24 Puna cactus semideserts
Open, deciduous dwarf shrub puna semideserts rich in succulents, mostly hedgehog, creeping or globular Cactaceae, on warm, dry, stony slopes. Included are, in particular, the *Oreocereus celsianus* facies of the *Psila* shrub communities, and cushion deserts of *Opuntia ignescens*.
(Cabrera, 1958: 345; Cabrera, 1968; Schnell, 1987b: 137-138; Walter and Breckle, 1991b: 165).

72.241 Puna *Oreocereus* semideserts
Puna and superpuna deserts and semideserts dominated by tubular cacti of genus *Oreocereus*, in particular, *Oreocereus celsianus* forming facies within *Psila boliviensis* shrub communities.
(Cabrera, 1958: 349).

72.242 Puna *Opuntia* deserts
Puna and superpuna deserts and semideserts dominated by cushion-forming cacti of genus *Opuntia*, in particular, *Opuntia ignescens*, characteristic of the altiplano of Peru, Bolivia and northern Chile, at altitudes between 3300 and 4500 metres.
(Hoffmann, 1989: 37, 246).

72.25 Puna xerohalophile communities
Puna semidesert communities dominated by halophytic shrubs, in particular, low sparse shrub communities of the high Andean altiplano of northern Chile, above 4000 metres altitude and between 19° 20'S and nearly 23°S.
(Schnell, 1987b: 136; Walter and Breckle, 1991b: 167; Gajardo, 1994: region 2A6).

72.26 Puna saxicolous communities
Cliff and exposed rock commmunities of the puna deserts and semideserts formed by robust bromeliads, pteridophytes, bryophytes and lichens.
(Cabrera, 1958).

72.261 Puna fern and herb rock-crack communities
Communities of xerophytic ferns or herbaceous plants of the puna Andes occupying fissures, chasms and cracks of rocks where humidity accumulates. Characteristic species include the ferns *Woodsia crenata*, *Asplenium gilliesii*, *Cheilanthes prinata*, *Pellaea nivea*, *Notholaena areguipensis* and flowering plants, notably, the suffrutescent *Eupatorium azangaroense*, *Stevia minor*, *Calceolaria santolinoides*, *Peperomia peruviana*, *Melandryum friesii*.
(Cabrera, 1958: 347).

72.262 Puna bromeliad rock communities

Communities of robust bromeliads, notably *Deuterocohnia strobilifera* or *Puya hofstenii* among rocks, or species of genus *Tillandsia*, including *Tillandsia lanuginosa*, *Tillandsia pusilla*, *Tillandsia viresecns* forming greyish carpets on rocks of the puna Andes.
(Cabrera, 1958: 347-349).

72.263 Puna lycopode rock communities
Communities of rocks of the puna Andes formed by lycopodes, in particular, by *Selaginella sellowii* of the southern puna Andes.
(Cabrera, 1958: 347).

72.264 Puna lichen and moss rock communities
Communities of mosses or lichens colonizing bare rocks of the puna Andes, in particular, *Acarospora altoandina*, *Parmelia subcongruens*, *Parmelia farinosa*, *Caloplaca altoandina*, *Caloplaca subnitida*, *Umbilicaria haplocarpa*.
(Cabrera, 1958: 347-349).

72.27 Bare Puna deserts
High puna deserts and semideserts devoid of vegetation.
(Hunziker, 1952; Gajardo, 1994: regions 2A, 1B).

72.271 Puna sand dunes
Bare sand dunes of high puna deserts and semideserts.
(Gajardo, 1994: regions 2A, 1B).

72.272 Puna rock deserts
Expanses of bare exposed rock, or of rocky or pebbly substrates, devoid of vegetation, of high puna deserts and semideserts.
(Gajardo, 1994: regions 2A, 1B).

72.273 Puna salt flats
Expanses of bare exposed sediments, with salt efflorescences, devoid of vegetation, of high puna deserts and semideserts.
(Gajardo, 1994: regions 2A, 1B).

73. HOT DESERTS AND SEMIDESERTS

Sunny deserts and arid shrublands developed under tropical or subtropical climates. Most characteristically and extensively, they are situated within the horse latitudes, the 30°-35° belts of high atmospheric pressure zones or Hadley cells producing low precipitation and high insolation. The Argentinian Monte is the South American representative of these zonal deserts, present on all continents, although it is also partly rain shadow induced and extends southwards into the temperate region and northwards into inner montane valleys of the tropical Andes. Under anomalous local conditions of rain shadow or trade wind regimes, arid shrublands or succulent and arborescent succulent communities may form in other parts of the tropics. They are physiognomically similar to the horse latitude semideserts and have been included in this unit.
(Morello, 1958; Hueck and Seibert, 1972: units 40 *p.*, 51, 71; Evenari, 1985: 1-22; Shmida, 1985; Mares *et al.*, 1985; Schnell, 1987b: 36-41; Rieley and Page, 1990; Demangeot, 1994; Archibold, 1995: 96-97, 105-106).

73.1 Monte deserts and semideserts

Subtropical to warm temperate sunny deserts and semideserts of interior Argentina extending from 27° S - 28° S to 44° 20' S, in inner basins of the northwestern Andes of Catamarca and La Rioja, in the Precordillera, the Sierras Pampeanas and the basins of the Cuyo Andes of San Juan, Mendoza and San Luis, in eastern Neuquen, central Rio Negro and northeastern Chubut, bordered on the west and the south by the Andes and the Patagonian semidesert and on the east by the dry tropical woodlands of the Chaco and the Espinal, with which they form a mosaic in the arid Chaco of southern La Rioja, southwestern Santiago del Estero, eastern Catamarca, western Cordoba and northern San Luis. They are in part horse-latitude deserts, in part rain-shadow deserts. *Larrea* semidesert scrubs constitute their main and most characteristic communities. They occupy the entire expanse of deserts and semideserts included in this unit, but also occur farther north in longitudinal interior valleys of the Andes of Tucuman and south-central Salta, north to 24° 35' S, in areas where they are enclaved in, and mingle with, cardonales and thorn scrubs of the prepuna. These northern *Larrea* communities, as well as the psammophile, halophile and gypsophile communities that accompany them, traditionally regarded as forming an extreme northern Monte, have been united with the prepuna formations in the inner Andean unit 73.44. Within the range of the communities included in section 73.1, three sections can be distinguished. The central section, constituting the central Monte, principally located in the basins, the Precordillera and Sierras Pampeanas of San Juan, Mendoza and western San Luis, and in the adjacent mosaic ecotone of the arid Chaco, is the driest and lies in the typical subtropical horse latitudes of 30° S to 35° S. Annual rainfall drops in places below 100 mm. The northern section, in the basins of La Rioja and Catamarca, lies north of the horse latitudes in an area of transition towards the tropical regime of Tucuman, Salta and Jujuy, with higher, predominately summer, precipitations limited by a rain shadow effect. The southern section, in southern Mendoza, Rio Negro, Neuquen and Chubut, lies in a warm temperate region with a mediterranean, winter rain, regime, and the drying effect of föhn winds.
(Hunziker, 1952; Morello, 1958; Walter, 1968: 704-711; Hueck and Seibert, 1972: units 51, 39 *p.*; Ragonese and Piccinini, 1977; Hueck, 1978: 447-448; Cabrera and Willink, 1980: 77-79; Vervoorst, 1982; Roig, 1982: 65-94; Mares *et al.*, 1985; Shmida, 1985; Los Andes, 1988; Walter and Breckle, 1991b: 247-250; Walter and Breckle, 1991c: 402, 421-422; Haene *et al.*, 1993; Burkart *et al.*, 1994: 22-23; Daniele and Natenzon, 1994: units 12 *p.*, 7 *p.*; Erize *et al.*, 1995: 112-121).

73.11 Monte semidesert scrubs
Semidesert communities of the Monte dominated by evergreen or drought-deciduous xerophytic shrubs.
(Morello, 1958: 6, 93-118; Walter, 1968: 704-711; Ragonese and Piccinini, 1977: 51; Hueck, 1978: 447-448; Cabrera and Willink, 1980: 77-79; Vervoorst, 1982: 11-13; Mares *et al.*, 1985; Schnell, 1987b: 36-41; Walter and Breckle, 1991b: 247-250; Haene *et al.*, 1993: 10; Burkart *et al.*, 1994: 22-23; Erize *et al.*, 1995: 112-121).

73.111 Monte *Larrea* scrub
Jarillares, arid shrublands of the Monte dominated by the evergreen Zygophyllaceae *Larrea divaricata* or *Larrea cuneifolia*, accompanied by *Larrea nitida*, *Larrea ameghinoi*, *Zuccagnia punctata*, *Bulnesia retama*, *Monttea aphylla*, *Mimosa ephedroides*, *Trichomaria usillo*, *Cassia rigida*, *Cassia aphylla*, *Bougainvillea spinosa*, *Cercidium praecox*, *Prosopis alpataco*, *Prosopis globosa*, *Prosopis torquata*, *Bredemeyera colletioides*, 1 to 3 metre tall, representing the principal climax constituent of the Monte semideserts on fine sediments.
(Morello, 1958: 93-103; Walter, 1968: 704-711; Ragonese and Piccinini, 1977: 51; Hueck, 1978: 447-448; Cabrera and Willink, 1980: 77-79; Vervoorst, 1982: 11-13; Mares *et al.*, 1985; Schnell, 1987b: 36-41; Walter and Breckle, 1991b: 247-250; Haene *et al.*, 1993: 10; Burkart *et al.*, 1994: 22-23; Erize *et al.*, 1995: 113).

73.1111 Northern Monte *Larrea* scrubs
Arid shrublands of the northern Monte, in Catamarca and La Rioja, developed under relatively less arid conditions and a tendency to a summer regime of precipitation, dominated by *Larrea divaricata* or, more rarely, *Larrea cuneifolia*, accompanied by *Zuccagnia punctata*, *Cassia rigida*, *Prosopis torquata*, *Mimosa ephedroides*, *Cercidium praecox*, *Bulnesia retama*, *Cassia aphylla*. Ground cacti of subgenus *Cylindropuntia* (*Opuntia paediophila*, *Opuntia strobiliformis*, *Opuntia glomerata*) are frequent.
(Hunziker, 1952: 173-175; Morello, 1958: 93-103; Vervoorst, 1982: 11-13; Mares *et al.*, 1985; Haene *et al.*, 1993: 10).

73.11111 Northern Monte pedemontane *Larrea* scrubs
Tall, relatively dense shrublands of the northern Monte, in Catamarca and La Rioja, developed in the 1000 to 2300 metre altitudinal level, dominated by *Larrea divaricata*, with *Zuccagnia punctata*, *Cercidium praecox* and *Bulnesia retama*.
(Hunziker, 1952: 173-174; Morello, 1958: 102; Haene *et al.*, 1993: 10).

73.11112 Northern Monte high montane *Larrea* scrubs
Low, open shrublands of the northern Monte, in Catamarca and La Rioja, developed in the 2300-3000 metre altitudinal level, dominated by *Larrea divaricata*, with *Larrea nitida*, *Gochnatia glutinosa*, *Flourensia polyglada*.
(Hunziker, 1952: 174-175; Morello, 1958: 102; Haene *et al.*, 1993: 10).

73.1112 Central Monte *Larrea* scrubs
Arid shrublands of the central Monte, in San Juan, Mendoza, San Luis and adjacent regions, developed under extremely arid conditions in inter-Andean basins in the Precordillera and in the Sierras Pampeanas, often very sparse and desertic, dominated by *Larrea cuneifolia* or by *Larrea divaricata*.
(Morello, 1958: 93-103; Ragonese and Piccinini, 1977: 51; Roig, 1982: 65-81; Covas, 1982: 54; Mares *et al.*, 1985).

73.11121 Central Monte *Larrea cuneifolia* scrubs
Arid shrublands of the central Monte dominated by *Larrea cuneifolia*, characteristic, in particular, of the Cuyo inter-Andean basins, their lower and middle slopes and their dune systems, of the Ishigualasto desert and the slopes of the Sierras Pampeanas, of the slopes of the Cuyo Precordillera and of the Huayquerias.
(Morello, 1958: 93-103; Ragonese and Piccinini, 1977: 51; Roig, 1982: 65-81; Mares *et al.*, 1985).

73.11122 Central Monte *Larrea divaricata* scrubs
Arid shrublands of the central Monte dominated by *Larrea divaricata*, less widespread than the scrubs of unit 73.11121, characteristic, in particular, of the upper slopes of the Cuyo inter-Andean basins and of the pampas of the Cuyo Precordillera.
(Morello, 1958: 93-103; Roig, 1982: 66-80; Mares *et al.*, 1985).

73.1113 Southern Monte *Larrea* scrubs
Arid shrublands of the southern Monte, in southern Mendoza, Neuquen, Rio Negro and Chubut, developed under higher precipitation than those of unit 73.1112, with an increasingly mediterranean pattern of winter rains southwards, dominated by *Larrea divaricata* or *Larrea cuneifolia*, sometimes accompanied by *Larrea nitida* or, south of 37° 54' S, by the Patagonian *Larrea ameghinoi*.
(Morello, 1958: 93-103; Mares *et al.*, 1985).

73.11131 Southern Monte *Larrea divaricata* scrubs
Arid shrublands of the southern Monte dominated by *Larrea divaricata*, with *Prosopis alpataco*, *Bougainvillea spinosa* and *Schinus polygamus*, characteristic, in particular, of the escarpments of mesetas, extending south to the southern limits of the Monte.
(Morello, 1958: 100-101, 106).

73.11132 Southern Monte *Larrea cuneifolia* scrubs
Arid shrublands of the southern Monte dominated by *Larrea cuneifolia* accompanied by *Monttea aphylla*, characteristic, in particular, of the tops of mesetas.
(Morello, 1958: 100).

73.112 Central Monte *Bulnesia* scrubs
Arid shrublands of the central Monte, mostly widespread in San Juan, dominated by *Bulnesia retama*, accompanied by, in particular, *Cercidium praecox*, *Atriplex lithophila* and therophytes, notably, *Calandrinia fasciculata*, often very open, 2-3 metres tall.
(Morello, 1958: 94; Roig, 1982: 73-74, 80).

73.113 Monte rillside scrub
Xerophytic shrub communities lining drainage rills of the Monte, in which water runs for a few days per year, with *Zuccagnia punctata*, *Bredemeyera colletioides*, *Ximenia americana*, *Baccharis salicifolia*, *Celtis spinosa*, *Acacia furcatispina*, *Acacia aroma*.
(Morello, 1958: 124).

73.114 Monte *Lycium* scrub
Xerophytic shrublands of the basins of the Cuyu Monte dominated by *Lycium tenuispinosum*.
(Roig, 1982: 77).

73.12 Monte psammophile communities
Psammophile communities of the Monte deserts and semideserts, including animal communities of unvegetated mobile dunes, and communities formed by dense carpets of post-rain blooming therophytes and geophytes, with a diffuse stratum of shrubs and perennial herbs. Gramineous therophyte communities comprising *Bouteloua barbata*, *Sporobolus pyramidatus*, *Eragrostis megastachya*, *Setaria verticillata* are of more or less annual occurrence, while dicot communities, with, in particular, *Nicotiana cavanillesii* and *Portulaca fulgens* may be of more irregular appearance. Both may occupy mobile dunes. Geophyte and hemicryptophyte communities are restricted to interdunal swales and fixed dunes. They include *Zephyranthella spp.*, *Amaryllis spp.* (*Jatropha peiranoi*, *Hoffmannseggia falcaria*, *Heliotropium spp.*, *Ipomoea spp.*.
(Morello, 1958: 6, 120-121; Roig, 1982: 76, 80-82; Covas, 1982: 54; Mares *et al.*, 1985; Burkart *et al.*, 1994: 23; Erize *et al.*, 1995: 114).

73.13 Monte halophytic shrublands
Xero-halophyte communities of the Monte semideserts with *Atriplex spp.* (*Atriplex lampa*, *Atriplex argentina*, *Atriplex spegazzinii*, *Atriplex undulata*), *Suaeda spp.*, *Allenrolfea spp.*, shrubby *Prosopis spp.*, Zygophyllaceae (*Plectrocarpa tetracantha*).
(Hunziker, 1952: 176; Morello, 1958; Walter, 1968: 706; Roig, 1982: 77; Covas, 1982: 54; Mares *et al.*, 1985).

73.14 Monte gypsum communities
Mixed communities of shrubs, perennial forbs, annuals and grasses of gypseous substrates of the Monte semideserts, characterized by *Halophytum ameghinoi*, *Polygala hieronymi*, *Atriplex argentina*, accompanied by the perennial herb *Allionia incarnata*, the annual *Sclerophylax spinescens* and the caespitose grass *Sporobolus pyrimaditus*.
(Morello, 1958: 129; Cabrera and Zardini, 1978; Kiesling *et al.*, 1994).

73.15 Monte saxicolous communities
Cactus and rock bromeliad communities of rocky scarps of the Monte semideserts, with the columnar cacti *Trichocereus terscheckii*, *Trichocereus strigosus*, the opuntia cacti *Opuntia glomerata*, *Opuntia sulphurea*, the bromeliads *Dyckia velazcana*, *Dyckia chaguar*, *Deuterocohnia schreiteri*, *Deuterocohnia longipetala*, the lycopode *Selaginella peruviana* and xerophyte ferns of genera *Pellaea*, *Notholaena* and *Cheilanthes*.
(Morello, 1958; Roig, 1982: 66-68; Mares *et al.*, 1985; Schnell, 1987b: 39).

73.16 Monte phreatophyte grasslands
Tall hygrophile or hygro-halophile pajonal grasslands of the Monte deserts and semideserts, dependent on phreatic water lying no deeper than 2.5 metres, dominated by sclerophytic grasses, in particular, *Sporobolus maximus* or grasses of genera *Cortaderia*, *Panicum*, *Bouteloua*, *Muhlenbergia*, *Polypogon*. Similar communities, often monospecific, lining permanent watercourses and waterbodies are listed in unit 53. Swamp or inundatable communities of saline soils are listed in unit 15.42.
(Morello, 1958: 119-120; Burkart *et al.*, 1994: 22-23).

73.161 Monte mixed phreatophyte grasslands
Steppic grasslands of the Monte semideserts developed on sites with near-surface ground water, formed, in particular, by *Bouteloua lophostachya*, *Muhlenbergia asperifolia* with *Cortaderia rudiuscula*, *Panicum chloroleucum*, *Polypogon elongatus*, *Sporobolus phleoides*.
(Morello, 1958: 119-120; Schnell, 1987b: 39; Coupland, 1992d: 364).

73.162 Monte *Sporobolus maximus* phreatophile grasslands
Tall halo-phreatophile pajonal grasslands of the Monte deserts and semideserts dominated by *Sporobolus maximus*, widespread from basins to upper slopes, lining, in particular, zones of near-surface saline sediments.
(Morello, 1958: 119-120; Burkart *et al.*, 1994: 22-23).

73.2 Western Andean deserts and semideserts

Deserts and semideserts of the western slopes of the Western Cordillera of Peru and northern Chile, comprising areas of extreme desert at the lowest altitudes, extending upward to the upper limits of the arid temperate zone where they merge into tropical alti-Andean communities (3C) or cool deserts (72). They compose a typical complex desert, formed under the combined influence of latitudinal high pressures, rain shadow effects and cold current proximity. They intergrade with the coastal garua deserts of 74.
(Koepcke, 1961: 178-217, 232-235; Hueck and Seibert, 1972: units 33 *p.*, 82 *p.*; Parker *et al.*, 1982: 12-13, 21; Rauh, 1985; Schnell, 1987b: 119-124; Walter and Breckle, 1991b: 264-265; Demangeot, 1994: 129-130; Gajardo, 1994: subregion 1B).

73.21 Western Andean rock deserts
Lower altitudinal belt of the deserts of the western slopes of the Western Cordillera of Peru and northern Chile, with a vertical amplitude varying from about 100 metres in the north to more than 1000 metres in the south, and an upper limit reaching in places an elevation of more than 2000 metres, formed mostly by extreme, barren, deserts, with vegetation limited to oases in valleys where water is available, or into which garua fogs creep from the coast.
(Koepcke, 1961: 232-235; Rauh, 1985; Schnell, 1987b: 119-124; Walter and Breckle, 1991b: 264-265).

73.211 Western Andean bare rock deserts
Deserts of the lower western slopes of the Western Cordillera of Peru and northern Chile, composed of debris, rock fragments and blocks, nearly completely devoid of vegetation.
(Koepcke, 1961: 232; Rauh, 1985).

73.212 Western Andean ash deserts
Deserts of the western slope of the Western Cordillera of Peru, in the regions of the volcanoes El Misti and Chachani, extending from 800 to 1200 metres, formed by barren ash, with white-ash barkhans.
(Koepcke, 1961: 234; Rauh, 1985; Schnell, 1987b: 119).

73.213 Western Andean rock desert *Tillandsia* communities
Rocky slope communities of the deserts of the lower western slopes of the Western Cordillera of Peru and northern Chile, limited to valleys reached by coastal garua, formed by *Tillandsia latifolia*, *Tillandsia paleacea*, *Tillandsia purpurea*, shared with the coastal deserts of unit 74, and by *Tillandsia tectorum*, limited to the western Andean rock deserts of 73.21.
(Rauh, 1985).

73.22 Western Andean succulent deserts

Deserts of the western slopes of the Western Cordillera of Peru and northern Chile, developed above the rock deserts, in areas of slightly higher water availability, occupying an altitudinal belt comprised between 500-700 metres and 2400 metres, dominated by arborescent columnar cacti, forming cardonales, by spherical cacti and by succulent shrubs with poikilohydrous ferns of genera *Cheilanthes* and *Pellaea*, and *Selaginella peruviana*.
(Koepcke, 1961: 208-217; Ducoing, 1973: 34-36; Hernandez, 1973: 54-56; Cabrera and Willink, 1980: 91; Rauh, 1985; Schnell, 1987b: 119-124; Walter and Breckle, 1991b: 264-265; Demangeot, 1994: 129-130).

73.221 Western Andean arborescent cacti deserts
Deserts of the western slopes of the Western Cordillera of Peru and northern Chile, developed above the rock deserts, in areas of slightly higher water availability, occupying an altitudinal belt comprised between 500-700 metres and 2400 metres, dominated by tall arborescent columnar or candelabra cacti.
(Koepcke, 1961: 208-217; Ducoing, 1973: 34-36; Hernandez, 1973: 54-56; Rauh, 1985; Schnell, 1987b: 119-124; Hoffmann, 1989; Walter and Breckle, 1991b: 264-265; Demangeot, 1994: 129-130).

73.2211 Lower western Andean arborescent cacti deserts
Sparse communities of cacti formed in the lower, driest reaches of the cactus deserts of the western slopes of the Western Cordillera of Peru, in contact with the barren deserts of 73.21.
(Rauh, 1985; Schnell, 1987b: 119-124; Walter and Breckle, 1991b: 264-265).

73.22111 *Armatocereus* lower western Andean cactus deserts
Sparse *Armatocereus procerus*-dominated communities forming the lower belt of the cactus deserts in the central part of the western Andean sierra deserts, at altitudes of about 700-800 metres.
(Koepcke, 1961: 214-215; Rauh, 1985: 262; Schnell, 1987b: 112; Walter and Breckle, 1991b: 264).

73.22112 *Neoraimondia gigantea* western Andean cactus deserts
Often very sparse communities dominated by the very tall *Neoraimondia gigantea*, accompanied by a very limited species cortège, in particular *Melocactus peruvianus*, characteristic of low, dry cactus deserts of northern Peru.
(Rauh, 1985: 245, 261; Schnell, 1987b: 121-122; Walter and Breckle, 1991b: 264).

73.2212 Middle western Andean arborescent cacti deserts
Communities of cacti or cacti and shrubs constituting the mid-altitude belt of the cactus deserts of the western slopes of the Western Cordillera of Peru and northern Chile.
(Rauh, 1985; Schnell, 1987b: 119-124).

73.22121 *Neoraimondia roseiflora* western Andean cactus deserts
Communities of the middle elevations of the cactus belt of the deserts of the western slopes of the Western Cordillera of Peru, developed in central Peru at altitudes of 800-1000 metres, dominated by the tall columnar *Neoraimondia roseiflora*.
(Koepcke, 1961: 209-213; Rauh, 1985: 262-263; Schnell, 1987b: 122).

73.22122 *Neoraimondia arequipensis* western Andean cactus deserts
Communities of the middle elevations of the cactus belt of the deserts of the western slopes of southern Peru, dominated by the tall columnar *Neoraimondia arequipensis*.
(Koepcke, 1961: 209; Schnell, 1987b: 122).

73.22123 *Browningia* western Andean cactus deserts
Communities of the cactus belt of the deserts of the western slopes of the Western Cordillera, dominated by the vulnerable tall, candelabra-like arborescent cactus *Browningia candelaris*, limited to southern Peru and northern Chile, north to the region of Lima and south to about 20° S in Tarapaca, developed mostly on rocky substrates, at middle altitudes of 1000-1200 metres, locally reaching 3300 metres.
(Koepcke, 1961: 215-216; Ducoing, 1973: 34; Rauh, 1985: 262-263, 265; Schnell, 1987b: 122; Quintanilla, 1988: 17, map unit IIa; Hoffmann, 1989: 38-39, 72-73; Gajardo, 1994: unit 1B7-1B71).

73.2213 Upper western Andean arborescent cacti deserts
Communities of cacti and shrubs formed in the upper reaches of the cactus deserts of the western slopes of the Western Cordillera of Peru and northern Chile, grading into the high-altitude semideserts of 72.2.

(Rauh, 1985; Schnell, 1987b: 119-124; Walter and Breckle, 1991b: 264).

73.22131 *Espostoa* western Andean cactus deserts
Communities of the upper elevations of the cactus belt of the deserts of the western slopes of the Western Cordillera of northern and central Peru, developed at altitudes of 1200-2000 metres, dominated by the tall columnar *Espostoa melanostele*.
(Koepcke, 1961: 213-214; Rauh, 1985: 262, 264; Schnell, 1987b: 122).

73.22132 *Armatocereus* upper western Andean cactus deserts
Communities of the upper elevations of the cactus belt of the deserts of the western slopes of the Western Cordillera of Peru dominated by tall or very tall columnar cacti of genus *Armatocereus* (*Weberbauerocereus*), in particular *Armatocereus rauhii* (*Weberbauerocereus rauhii*), *Armatocereus fascicularis ([Weberbauerocereus fascicularis*, *Trichocereus fascicularis*, *Cereus weberbaueri*), *Armatocereus matucanensis*, *Armatocereus riomajensis*.
(Britton and Rose, 1937b: 66-67, 141-142; Koepcke, 1961: 215, 216; Rauh, 1985: 262, 265; Schnell, 1987b: 119-120; Hoffmann, 1989: 39, 132-133; Innes and Glass, 1992: 25-26).

73.22133 *Corryocactus* western Andean cactus deserts
Communities of the upper elevations of the cactus belt of the deserts of the western slopes of the Western Cordillera of southern Peru and northern Chile, dominated by the tall columnar cactus *Corryocactus brevistylus* (*Cereus brevistylus*).
(Rauh, 1985: 262, 265; Schnell, 1987b: 119-120; Hoffmann, 1989: 39, 132-133).

73.22134 Upper Loa *Trichocereus* deserts
Open formations of the upper basin of the Rio Loa dominated by the tall columnar cactus *Trichocereus atacamensis* (*Echinopsis atacamensis*, ?*Trichocereus pasacana*).
(Hoffmann, 1989: 41, 82-83).

73.222 Western Andean scrubby cacti deserts
Deserts of the western slopes of the Western Cordillera of Peru and northern Chile, developed above the rock deserts, in areas of slightly higher water availability, occupying an altitudinal belt comprised between 500-700 metres and 2400 metres, dominated by spherical, tubular or arbustive, procumbent or erect, cacti.
(Koepcke, 1961: 208-217; Ducoing, 1973: 34-36; Hernandez, 1973: 54-56; Rauh, 1985; Schnell, 1987b: 119-124; Hoffmann, 1989; Walter and Breckle, 1991b: 264-265; Demangeot, 1994: 129-130).

73.2221 *Islaya* western Andean cactus deserts
Sparse *Islaya grandis* communities formed on gravels of valley borders, at about 900 metres, in the southern part of the western Andean sierra deserts, in particular, in the Rio Majes valley, where it is accompanied by *Larrea divaricata*.
(Rauh, 1985: 363).

73.2222 *Haageocereus* western Andean cactus deserts
Communities of the middle elevations of the cactus belt of the deserts of the western slopes of the Western Cordillera of Peru, dominated by erect or semidecumbent species of genus *Haageocereus*, in particular, *Haageocereus aureispinus*-dominated communities of central Peru, developed above the *Neoraimondia roseiflora* communities at altitudes of 1000-1200 metres and merging with them in the 800-1000 metre altitude range.
(Rauh, 1985: 262-263; Cullmann *et al.*, 1986: 184-185).

73.2223 Western Andean *Arequipa* deserts
Deserts of the high western slopes of the Western Cordillera of Peru and northern Chile, at about 2500-3000 metres, occupied by colonies of cacti of genus *Arequipa* (*Oreocereus*, *Borzicactus*) in particular, *Arequipa hempeliana*, *Arequipa australis*, *Arequipa leucotricha*, *Arequipa variicolor*.
(Koepcke, 1961: 208-217; Ducoing, 1973: 34-36; Hernandez, 1973: 54-56; Rauh, 1985; Schnell, 1987b: 119-124; Hoffmann, 1989: 38, 40, 78-79; Walter and Breckle, 1991b: 264-265; Demangeot, 1994: 129-130).

73.224 Upper western Andean *Carica-Jatropha* deserts
Communities of the upper elevations of the succulent belt of the deserts of the western slopes of the Western Cordillera of central Peru at altitudes of 1900-2400 metres, dominated by the succulent

Caricaceae *Carica candicans* and Euphorbiaceae *Jatropha macrantha*, accompanied by other succulents, including cacti, *Peperomia spp.*, in particular *Peperomia nivalis*, *Pilea serpyllacea*, the euphorb *Cnidoscolus basiacanthus*, by poikilohydrous ferns of genera *Cheilanthes* and *Pellaea*, and by *Selaginella peruviana*.
(Koepcke, 1961: 208-209; Rauh, 1985: 262; Schnell, 1987b: 121; Walter and Breckle, 1991b: 264).

73.225 Western Andean cactus and shrub semideserts
Mixed cactus and shrub communities of the middle and upper belts of the succulent deserts of central Peru, southern Peru and northern Chile, extending from about 1600 metres to over 2500 metres, comprising, in southern Peru, at and near the lower limit, formations of *Browningia spp.*, *Weberbauerocereus spp.*, *Neoraimondia spp.*, *Armatocereus riomajensis* with shrubs such as *Diplostephium tacorense*, *Franseria fruticosa*, *Jatropha macrantha*, *Ficus sp.* and near the upper limit, in pockets forming transition to evergreen grasslands or scrubs, immediately below the tola-heaths, *Corryocactus puquiensis*.
(Koepcke, 1961: 215-217; Rauh, 1985: 263-264; Quintanilla, 1988: 17; Gajardo, 1994: unit 1B7-1B71 *p.*).

73.23 Western Andean grass and shrub semideserts
Shrub, grass or forb semideserts of the upper levels of the western slopes of the Western Cordillera of Peru and northern Chile, at altitudes of the order of 2500 metres to 3500 metres, forming a transition between the drier subtropical succulent deserts of the lower elevations and the cool deserts and semideserts of the puna or alti-Andean steppes and shrublands.
(Koepcke, 1961: 195-205, 276-278; Hueck and Seibert, 1972: unit 82 *p.*; Parker *et al.*, 1982: 12-13, 21; Schnell, 1987b: 50, 120; Walter and Breckle, 1991b: 257, 265).

73.231 Western Andean shrub semideserts
Shrub semideserts of the upper levels of the western slopes of the Western Cordillera of Peru and northern Chile.
(Koepcke, 1961: 195-196, 199-201, 202-203; Ducoing, 1973; Hernandez, 1973: 56; Rauh, 1985: 264).

73.2311 Central Peruvian rain-green shrub semideserts
Drought-deciduous shrub semideserts of the upper levels of the western slopes of the Western Cordillera of Peru, developed above the *Carica-Jatropha* belt and below evergreen woodlands or alti-Andean communities.
(Koepcke, 1961: 195-196).

73.2312 Southern Peruvian rain-green shrub semideserts
Drought-deciduous dwarf shrub and forb semideserts of volcanic ash substrates in the upper levels of the western slopes of the Western Cordillera of southern Peru, with *Franseria fruticosa*, *Enselia canescens*, *Diplostephium tacorense*, *Senecio idiopappus*, developing in distinctive belts at altitudes comprised between 800 and 3900 metres, locally descending lower and grading, at their upper limit, into tola-heaths.
(Koepcke, 1961: 199-201, 202-203; Rauh, 1985: 263-264).

73.2313 Chilean Andean spiny shrub deserts
Desert small spiny shrub and succulent communities, poor in cacti, replacing the columnar cactus deserts south of 20° S latitude, extending south to 25° S on the western slopes of the Western Cordillera of the Chilean Andes, in areas of abundant alluvial deposits and low marginal precipitation induced by the high Andean winter, also distributed in prepuna slopes of the upper Loa basin and the Cordillera de Domeyko, south to 26° S.
(Ducoing, 1973: 38; Hernandez, 1973: 56; Rauh, 1985: 264; Gajardo, 1994: units 1B81, 1B82, 1B86, 1B91).

73.23131 Chilean Andean *Adesmia atacamensis* deserts
Desert small spiny shrub communities dominated by *Adesmia atacamensis*, with *Coldenia atacamensis* or *Calandrinia salsoloides*, widespread in a belt along the western slopes of the Western Cordillera of the Chilean Andes between 20° S and 25° S latitude, and in prepuna slopes of the upper Loa basin and the Cordillera de Domeyko, south to 26° S.
(Ducoing, 1973: 38; Hernandez, 1973: 56; Rauh, 1985: 264; Gajardo, 1994: units 1B8-1B83, 1B9-1B83, 1B10-1B83, 1B8-1B84).

73.23132 Chilean Andean *Philippiamra-Hoffmanseggia* deserts
Desert small spiny shrub and succulent communities of the western slopes of the Western Cordillera of the Chilean Andes, mostly between 20° S and 26° S, extending somewhat farther north into the domaine of the Andean cactus deserts, dominated by the Portulacaceae *Philippiamra pachyphylla* with the composite *Hoffmanseggia ternata*.
(Gajardo, 1994: units 1B7-1B81, 1B8-1B81).

73.23133 Chilean Andean *Atriplex imbricata* deserts
Desert small spiny shrub and succulent communities of the western slopes of the Western Cordillera of the Chilean Andes, the upper Loa basin and the Cordillera de Domeyko, between 20° S and 26° S, ascending into the region of the Andean salares, dominated by the Chenopodiaceae *Atriplex imbricata* with *Coldenia atacamensis* or *Cristaria andicola* and *Ephedra breana*.
(Gajardo, 1994: units 1B8-1B82, 1B9-1B82, 1B8-1B86, 1B10-1B86, 2A6-1B86).

73.23134 Chilean Andean *Acantholippia* deserts
Desert small spiny shrub and succulent communities of the Chilean Andes, in the upper Loa basin and the region of the great Andean salares, between 21° 30' S and 28° S, dominated by the spiny Verbenaceae *Acantholippia punensis* with *Franseria meyeniana* and *Coldenia atacamensis*.
(Gajardo, 1994: units 1B9-1B91, 1B12-1B91).

73.2314 Chileno-Peruvian Andean shrub deserts
Shrub semideserts of the upper levels of the western slopes of the Western Cordillera of southern Peru and northern Chile, north of 20° S, formed in association with the southernmost extension of Andean cactus semideserts, often constituting the transition between them and puna communities; many species of high montane tropical affinities reach their southern limit within the communities of this unit. *Adesmia spinosissima* and *Verbena gynobasis* are characteristic dominants.
(Koepcke, 1961: 195-196, 199-201, 202-203; Rauh, 1985: 264; Gajardo, 1994: units 1B7-1B72, 1B7-1B73).

73.232 Western Andean rain-green grass semidesert
Semideserts of the western slopes of the Western Cordillera of central Peru, north of the Ica desert, harbouring ephemeral grasslands, mostly composed of annuals, green only during rains.
(Koepcke, 1961: 198).

73.233 Western Andean rain-green forb semidesert
Semideserts of the western slopes of the Western Cordillera of Peru, harbouring ephemeral non graminoid herb communities, green only during rains.
(Koepcke, 1961: 199-201, 202-203).

73.3 Equatorial deserts and semideserts

Scrub or arborescent cactus semidesert communities developed in equatorial or subequatorial regions, far from the horse latitude high pressure belts, under local conditions of high aridity induced by the effect on the air flow of low mountains or mountainous islands, reducing annual rainfall to values as low as those characteristic of the subtropical deserts, or by regionl peculiarities of the global atmospheric circulation, provoking high interannual irregularities in precipitations. Semideserts formed under similar conditions in the rain shadow of the high equatorial Andes have been listed with other inner Andean formations in unit 73.4.
(Wiggins and Porter, 1971: 19-20; Hueck and Seibert, 1972: units 40 *p.*, 43 *p.*, 71; Walter, 1979: 56-58; Parker *et al.*, 1982; Schnell, 1987b: 1-41; Huber and Alarcon, 1988; Walter and Breckle, 1991a: 205-207; Sampaio, 1995: 36).

73.31 Caribbean semideserts
Cardonales, cactus thickets, cactus woodlands, cactus scrubs, cactus "steppes", espinares of the north coast of Colombia and Venezuela, developed under conditions of very low and somewhat irregular annual rainfall, generally inferior to 500 mm and often inferior to 200 mm, with up to 11.5 dry months, and high factors of variability, corresponding to semiarid or arid conditions, mostly in coastal areas situated in the lee of offshore islands, in particular on the Guajira peninsula, along the shores of the Gulf of Venezuela, on the Paraguana peninsula and in the Falcon and Lara interior, along the central coast of Venezuela, on the Araya and Paria peninsula and on the southern Caribbean islands, with the tall columnar and organ-pipe cacti *Cereus griseus*, (*Lemaireocereus griseus*, *Ritterocereus griseus*)

Cereus deficiens (*Ritterocereus deficiens*, *Lemaireocereus deficiens*), *Cephalocereus moritzianus*, the dendroid cactus *Pereskia guamacho*, the thicket-forming cacti *Opuntia caribaea*, *Opuntia wentiana*, the globose cacti *Melocactus caesius*, *Mammilaria simplex*, and with *Prosopis juliflora*, *Ceasalpinia coriaria*, *Croton spp.*, *Hyptis spp.*, *Cercidium praecox*, *Jatropha gossypiifolia*.
(Britton and Rose, 1937a: 15-17, 49, 116; Britton and Rose, 1937b: 38-39, 87-88, 94-96; Hueck and Seibert, 1972: unit 71; Hueck, 1978: 345-356; Walter, 1979: 56-58; Veillon, 1980a: 20; Veillon, 1980b: 26; Veillon, 1980c: 30; Veillon, 1985a: unit 19; Caldera, 1985: 39, 41, 42; Schnell, 1987b: 23-27; Huber and Alarcon, 1988: units 7, 62, 2 *p.*; Walter and Breckle, 1991a: 205-207).

73.32 Galapagos cactus semidesert
Open cactus woodlands or scrubs of the arid coastal zone of the Galapagos Islands, occupying the coastal plains of the larger islands, up to altitudes of 80-120 metres on southern faces, up to 200 or 300 metres on lee sides, as well as the whole surface of small islands, formed by arborescent cacti *Jasminocereus thouarsii*, *Brachycereus nesioticus*, *Opuntia echios*, *Opuntia galapageia*, *Opuntia helleri*, *Opuntia megasperma*, with *Croton scouleri*, *Bursera graveolens*, *Maytenus octogona*. These communities, developed on the equator under anomalous conditions of high aridity, with annual rainfall mostly below 100 mm, generated mostly by offshore passage of the cold waters of the Humboldt Current, are submitted to seasonal fogs and constitute a coastal semidesert climatically related to the Atacama-Peruvian deserts. This semidesert is included in 73 rather than 74 because of its equatorial location and the close physiognomic and taxonomic relations of its vegetation with that of other formations of 73.3, in particular the Caribbean cactus semidesert of 73.31. Because of high floral and faunal endemism, this unit can be subdivided into several island-specific communities.
(Bowman, 1961; Wiggins and Porter, 1971: 19-20; Walter and Breckle, 1991b: 266).

73.33 Caatinga semideserts
Semideserts of the driest parts of the caatinga region of northeastern Brazil, mostly developed in areas of erratic rainfall with an annual average of less than 500 mm, occupied by a low, sparse, scrub rich in cacti, formed, in particular, by *Callandria depauperata* and *Pilosocereus gounellei*.
(Hueck and Seibert, 1972: unit 43 *p.*; Hueck, 1978: 319-330; Lewis, 1987: 7-8, plate 2; Schnell, 1987b: 5-19; Walter and Breckle, 1991b: 206-207; Sampaio, 1995: 36-38, 46-59).

73.4 Intra-Andean deserts and semideserts

Xerophytic shrublands and cardonales of rain-shadow or föhn generated islands of high aridity in inner valleys and on eastern slopes of the tropical and subtropical Andes of Venezuela, Colombia, Peru, Bolivia and northwestern Argentina. The communities are often dominated by columnar or opuntia cacti, by terrestrial bromeliads or, very locally, by *Larrea* (northwestern Argentina, Tarija region of Bolivia). The prepuna semideserts of northwestern Argentina are intra-Andean semideserts but they are in geographical continuity with the horse latitude Monte, with which they share communities.
(Morello, 1958; Walter, 1962: Table 4; Hueck and Seibert, 1972: unit 40 *p.*; Hueck, 1978: 356-363; Cabrera and Willink, 1980: 76-77; Veillon, 1980a, 1980b, 1980c; Parker *et al.*, 1982; Schnell, 1987b: 4, 41, 83, 84, 109-111, 127, 146-147; Huber and Alarcon, 1988: unit 91; Walter and Breckle, 1991b: 165, 250; Burkart *et al.*, 1994: 23).

73.41 Northern intra-Andean semideserts
Xerophytic shrublands and cardonales of rain-shadow or föhn generated islands of high aridity in inner valleys and on eastern slopes of the tropical and subtropical Andes of Venezuela and Colombia, in particular, of the upper Chama basin in the Venezuelan Cordillera de Merida, where they are dominated by the tall organ-pipe cactus *Cereus griseus*, (*Lemaireocereus griseus*, *Ritterocereus griseus*), with the thicket-forming *Opuntia caribaea* and *Opuntia wentiana*, and with *Prosopis spp.*.
(Hueck and Seibert, 1972, 1981: unit 40 *p.*; Hueck, 1978: 360-361; Veillon, 1980a, 1980b, 1980c; Schnell, 1987b: 82, 84, 110; Huber and Alarcon, 1988: unit 91).

73.42 Ecuadorio-Peruvian intra-Andean semideserts
Xerophytic shrublands and cardonales of rain-shadow or föhn generated islands of high aridity in inner valleys and on eastern slopes of the tropical and subtropical central Andes of Peru and, formerly, at least, Ecuador, in particular, of the Marañon basin, the upper Huallaga basin, with tall columnar *Cereus spp.* and xerophytic *Capparis*, *Cordia*, *Acacia*, *Prosopis* shrubs.
(Hueck and Seibert, 1972, 1981: unit 40 *p.*; Hueck, 1978: 359; Parker *et al.*, 1982: 23; Schnell, 1987b: 41, 126-127, 146).

73.43 Bolivian intra-Andean semideserts

Xerophytic shrublands and cardonales of rain-shadow or föhn generated islands of high aridity in inner valleys and on eastern slopes of the tropical and subtropical central Andes of Bolivia, in particular, in the Pilcomayo, Rio Grande and Bermejo systems, formed by tall columnar cacti, small cacti and terrestrial bromeliads, and, very locally, in the Tarija region of the Bermejo system, with *Larrea divaricata*.

(Herzog, 1923: 153-176; Morello, 1958: 8, 14; Hueck and Seibert, 1972, 1981: unit 40 *p.*; Hueck, 1978: 357, 359; Schnell, 1987b: 41, 146-147; Walter and Breckle, 1991b: 250).

73.44 Northwestern Argentinian intra-Andean semideserts

Subtropical deserts and semideserts of longitudinal inner valleys of the northwestern Argentinian Andes, between 23° S and 27° S - 30° S, with a juxtaposition of typically inner Andean arborescent cactus formations, mostly characteristic of slopes and plateaux, and of Monte *Larrea* scrubs, mostly confined to sandy valley bottoms, or, in the north, with the first only. They are rain shadow deserts dessicated by föhn winds, developed in the Quebrada de Humahuaca of Jujuy, the Quebrada de las Cuevas, the Tin-Tin plateau, the Valle Calchaqui and the Valle de Santa Maria in Salta and western Tucuman, the upper Valle de Santa Maria, the Valle de Cajon, the Belen basin in Catamarca, interdigitating farther south, in particular on the slopes of the sierras de Famatina and de Velasco with northern Monte communities of unit 73.1.

(Hunziker, 1952; Morello, 1958; Hueck and Seibert, 1972: units 40 *p.*, 51 *p.*; Hueck, 1978: 357, 447-448; Cabrera and Willink, 1980: 76-77; Vervoorst, 1982: 11-13; Mares *et al.*, 1985; Shmida, 1985; APN, 1987; Schnell, 1987b: 36-41, 131-132; Cardich, 1988; Walter and Breckle, 1991b: 165, 247-250; Walter and Breckle, 1991c: 402, 421-422; Haene *et al.*, 1993; Burkart *et al.*, 1994: 23; Daniele and Natenzon, 1994: unit 12 *p.*; Erize *et al.*, 1995: 112-121, 163-167).

73.441 Prepuna cardonales

Arborescent cactus communities of longitudinal inner valleys of the Andes of northwestern Argentina, developed between 1000 and 3400 metres of altitude in xeric subpuna valleys of the eastern cordillera of Salta and Jujuy, in particular, the Quebradas de Humahuaca, Lizoite, Santa Victoria and the upper valley of the Rio Calchaqui, on the Tin-Tin plateau, and, accompanied by Monte-type communities that they mostly replace altitudinally, on the prepuna slopes of the longitudinal inner Andean trough of the Valle Calchaqui, the Valle de Santa Maria, the Cajon Valley, the Belen basin and the northern Andalgala basin, in Salta, eastern Tucuman and Catamarca, with southern insular outposts in La Rioja. They are formed by the tall columnar cacti *Trichocereus pasacana* and *Trichocereus terscheckii*, accompanied by a shrubby undergrowth of variable density, sometimes very sparse, formed by species of the deciduous thorn scrub of unit 73.4421, of the *Larrea* scrub of unit 73.4422, of the evergreen scrub of unit 73.4423, of saxicolous communities of unit 73.443 or, at their upper limit of distribution, by puna species.

(Morello, 1958: 110-117; Cabrera, 1958: 345; Cabrera, 1968; Hueck, 1978: 357; Cabrera and Willink, 1980: 76-77; Vervoorst, 1982: 12, 13; APN, 1987: 26-28; Schnell, 1987b: 131-132; Cardich, 1988: 1-7; Grassi, 1989: 18; Walter and Breckle, 1991b: 165; Burkart *et al.*, 1994: 23; Halloy *et al.*, 1994: 42; Erize *et al.*, 1995: 163-167).

73.4411 Thorn scrub cardonales

Typical prepuna arborescent *Trichocereus* communities of inner valleys of the Andes of northwestern Argentina accompanied by a shrub layer formed by species of the deciduous thorn scrub of unit 73.4421, characteristic of the xeric subpuna valleys of the eastern cordillera of Salta and Jujuy, in particular, the Quebradas de Humahuaca, Lizoite, Santa Victoria and the upper valley of the Rio Calchaqui, of parts of the Tin-Tin plateau and of stony or rocky slopes of the Valle Calchaqui, the Valle de Santa Maria, the Cajon Valley, the Belen basin and the northern Andalgala basin.

(Morello, 1958: 110-117; Hueck, 1978: 357; Cabrera and Willink, 1980: 76-77; Vervoorst, 1982: 12, 13; APN, 1987: 26-28; Schnell, 1987b: 131-132; Cardich, 1988: 1-7; Grassi, 1989: 18; Walter and Breckle, 1991b: 165; Burkart *et al.*, 1994: 23; Halloy *et al.*, 1994: 42; Erize *et al.*, 1995: 163-167).

73.4412 *Larrea* scrub cardonales

Arborescent *Trichocereus* communities of inner valleys of the Andes of northwestern Argentina accompanied by a shrub layer formed by *Larrea divaricata* and other species of the *Larrea* scrub of unit 73.4422, characteristic of sandy or stony-sandy expanses of the Tin-Tin plateau and of stony-sandy gentle slopes and washes of the Valle Calchaqui, the Valle de Santa Maria, the Cajon Valley, the Belen basin and the northern Andalgala basin.

(Morello, 1958: 110-117; APN, 1987: 26-28).

73.4413 Prepuna evergreen scrub cardonales
Arborescent *Trichocereus* communities of upper slopes of inner valleys of the Andes of northwestern Argentina accompanied by an evergreen shrub layer formed by an admixture of species of Monte and puna affinities characteritic of unit 73.4423.
(Morello, 1958: 110-117).

73.4414 Saxicolous cardonales
Chasmophytic arborescent *Trichocereus* communities of inner valleys of the Andes of northwestern Argentina accompanied by saxicolous bromeliad and sensitive fern communities of unit 73.443.
(Morello, 1958: 110-117).

73.4415 Puna scrub cardonales
Stands of the very tall prepuna arborescent cactus *Trichocereus pasacana* accompanied by the *Fabiana densa-Psila boliviensis-Adesmia horridiuscula* shrub communities, at the upper altitudinal limit of occurrence of the cactus, around 3500 metres.
(Cabrera, 1958: 345; Cabrera, 1968).

73.442 Prepuna and southern inner Andean scrubs
Semidesert scrub communities of the longitudinal inner valleys of the northwestern Argentinian Andes, in Jujuy, Salta and Tucuman.
(Morello, 1958: 6, 93-118; Hueck, 1978: 447-448; Cabrera and Willink, 1980: 76-77-79; Vervoorst, 1982: 11-13; Mares *et al.*, 1985; Schnell, 1987b: 36-41; APN, 1987; Cardich, 1988; Walter and Breckle, 1991b: 247-250; Walter and Breckle, 1991c: 402, 421-422; Haene *et al.*, 1993: 10; Burkart *et al.*, 1994: 22-23; Erize *et al.*, 1995: 112-121).

73.4421 Prepuna deciduous thorn scrubs
Xerophytic shrublands of coarse detritic slopes of the prepuna, characteristic of longitudinal inner valleys of the northern Argentinian Andes, in particular, of the Valle Calchaqui, the Valle de Santa Maria, and the quebradas of Salta and Jujuy, extending on the slopes of the Campo de Arenal, the Sierra del Ataja, the Sierra Zapata, the Sierra de Velasco, the Sierra Famatina, to about 30° S. Constituent species include deciduous Zygophyllaceae, in particular, *Bulnesia schickendantzii*, *Plectocarpa tetracantha*, *Plectocarpa rougesii*, deciduous shrubs of other families, notably *Bougainvillea spinosa*, *Ximenia americana*, *Prosopis alpataco*, *Prosopis torquata*, *Prosopis globosa*, and cacti of genera *Opuntia* (*Opuntia vulpina*, *Opuntia bruchii*, *Opuntia paediophila*, *Opunta glomerata*, *Opuntia geometrica*, *Opuntia sulphurea*, *Opuntia weberi*) and *Tephrocactus*.
(Morello, 1958: 103-110; APN, 1987: 28; Erize *et al.*, 1995: 163-167).

73.44211 *Bulnesia schickendantzii* campo negro scrub
Xerophytic deciduous shrublands of the prepuna dominated by the deciduous Zygophyllaceae *Bulnesia schickendantzii*.
(Morello, 1958: 108).

73.44212 *Plectocarpa rougesii* rodajillal scrub
Xerophytic deciduous shrublands of the prepuna dominated by the deciduous Zygophyllaceae *Plectocarpa rougesii*, sometimes covering vast stony surfaces in almost monospecific formations.
(Morello, 1958: 108).

73.44213 Prepuna *Prosopis* scrub
Xerophytic deciduous shrublands of the prepuna dominated by shrubby *Prosopis*, in particular, *Prosopis alpataco*, *Prosopis torquata*, *Prosopis globosa*.
(Morello, 1958: 108).

73.44214 *Gochnatia-Bougainvillea* scrub
Xerophytic deciduous shrublands of the prepuna dominated by *Gochnatia glutinosa* and *Bougainvillea spinosa*.
(Morello, 1958: 108).

73.44215 Prepuna aphyllous scrub
Xerophytic deciduous shrublands of the prepuna dominated by aphyllous shrubs, in particular, *Cassia aphylla*.

(Morello, 1958: 108).

73.4422 Salteno-Tucumanian *Larrea* scrub
Jarillares, arid shrublands of the longitudinal inner Andean valleys of Salta and Tucuman, forming a northern extension of Monte communities enclaved in the prepuna semideserts, characteristic, in particular, of the valleys Calchaqui and de Santa Maria and of the Tin-Tin plateau, dominated by the evergreen Zygophyllaceae *Larrea divaricata*, accompanied by *Monttea aphylla*, *Bougainvillea spinosa*, *Cercidium andicola*, *Lycium spp.* and by mats of cacti of genera *Opuntia*, *Tephrocactus*.
(Morello, 1958: 93-103; Vervoorst, 1982: 11-13; APN, 1987: 28; Burkart *et al.*, 1994: 22-23; Erize *et al.*, 1995: 112-121).

73.4423 Prepuna scarp evergreen scrub
Very open xerophytic shrublands of higher, steep, slopes (faldeas) of the prepuna semideserts of northwestern Argentina, south to the Sierra de Famatina, where they are in contact with southern puna communities, developed between 2500-2600 metres and 3300-3400 metres, formed by an admixture of Monte and puna elements, mostly evergreen resinous, ericoid or heterophyllous shrubs, in particular, *Acantholippia deserticola*, *Verbena juniperina*, *Verbena seriphioides*, *Verbena aspera*, *Ephedra breana*, *Fabiana densa*, *Lycium decipiens*, *Lycium ciliatum*, *Adesmia horrida*, *Adesmia inflexa*, *Bougainvillea spinosa*, *Baccharis angulata*, *Justicia platicarpa*, *Dicliptera scutellata*, *Chuquiraga erinacea*, *Bredemeyera microphylla*, *Opuntia microdisca*.
(Hunziker, 1952: 177-178; Morello, 1958: 117-119; APN, 1987: 28; Haene *et al.*, 1993: 10-11, 15).

73.4424 Prepuna rillside scrub
Mostly deciduous xerophytic shrub communities lining drainage rills in which water runs for a few days per year within the drought-deciduous prepuna thorn scrub environment of the deserts and semideserts of longitudinal inner valleys of the Andes of northwestern Argentina and their southern extension on prepuna slopes of the basins of the northern Monte, formed by *Acacia furcatispina*, *Acacia aroma*, *Acacia caven*, *Mimozyganthus carinata*, *Cercidium praecox*, *Hyaloseris rubicunda*, *Zuccagnia punctata*, *Mimosa farinosa*, *Bougainvillea spinosa*, *Caesalpinia gilliesii*.
(Morello, 1958: 123).

73.443 Prepuna saxicolous communities
Cactus, bromeliad and xerophytic fern communities of rocky scarps of the longitudinal valleys of the Andes of northern Argentina, in particular of the quebradas of Salta and Jujuy and of the Valle Calchaqui-Valle de Santa Maria complex, often associated with cardonales. Constituents include the cacti *Trichocereus schickendantzii*, *Trichocereus andalgalensis*, *Trichocereus strigosus*, *Trichocereus huascha*, *Opuntia glomerata*, *Opuntia sulphurea*, *Opuntia weberii*, *Opuntia bruchii*, *Opuntia vulpina*, *Opuntia strobiliformis*, *Opuntia geometrica*, *Cereus aethiops*, *Gymnocalicium delaetii*, the bromeliads *Dyckia velazcana*, *Deuterocohnia schreiteri*, *Deuterocohnia longipetala*, *Abromeitiella abstrusa*, *Abromeitiella brevifolia*, *Abromeitiella lorentziana*, *Tillandsia gilliesii*, *Tillandsia aizoides*, *Tillandsia bryoides*, *Tillandsia pedicellata*, the pteridophytes *Selaginella peruviana*, *Pellaea nivea*, *Pellaea ternifolia*, *Notholaena squamosa*, *Notholaena buchtienii*, *Notholaena aurea* and *Cheilanthes pruinata*.
(Morello, 1958: 110-117; Schnell, 1987b: 39).

73.444 Tucumano-Saltenian inner Andean psammophile communities
Psammophile communities of inner Andean valleys of Salta and Tucuman, in particular, of the Santa Maria Valley, comprising assemblies of post summer-rain blooming therophytes and geophytes, with a diffuse stratum of shrubs and perennial herbs. Among characteristic plants are the brilliantly blooming *Amaryllis tucumana* and *Ipomoea calchaquina*.
(Morello, 1958: 6, 120-121; Mares *et al.*, 1985; Burkart *et al.*, 1994: 23; Erize *et al.*, 1995: 114).

73.445 Tucumano-Saltenian inner Andean halophyte communities
Xero-halophyte communities of inner Andean valleys of Salta and Tucuman, in particular, of the Valle Calchaqui - Valle de Santa Maria complex.
(Morello, 1958; Walter, 1968: 706; Mares *et al.*, 1985).

74. COASTAL DESERTS

Deserts of the west coasts of continents, under the influence of cold ocean currents, mostly within subtropical or tropical regions, almost without measurable rainfall but with high relative humidity in the form of fogs and mists. The Atacama Desert, extending along the western coast of South America from about 3° S to about 30° S, is the most characteristic expression of this habitat class in the world. It is largely an absolute, unvegetated, desert; moisture, in the form of fogs and mists ("garua") condensing locally, especially on coast-facing escarpments, allows the development of scanty communities of cyanobacteria, lichens, bromeliads, succulents, annuals, geophytes and a few shrubs and trees; occasional rains associated with near-coastal invasions of warm waters from the north ("el niño" rains) may provoke a flush of flowering of otherwise dormant annuals and geophytes. Those communities that include a significant tree layer are listed under 4B.
(Koepcke, 1961: 193-235; Walter, 1962: 381-392; Johnson, 1965: 19; Hueck and Seibert, 1972: units 33 *p.*, 68, 69, 70; Ducoing, 1973: 23-40; Hernandez, 1973: 36-51; Walter, 1979: 116; Parker *et al.*, 1982: 12-13, 23, 25; Rauh, 1985; Rieley and Page, 1990: 52; Walter and Breckle, 1991b: 254-266; Allan and Warren, 1993: 144-146; Demangeot, 1994: 128-129; Archibold 1995: 95-106).

74.1 Peruvian-Chilean garua deserts

Coastal deserts of Peru and Chile under the influence of the garua, coastal mists and fogs generated by the juxtaposition of the cold Humbold Current and the hot subtropical desert coastlands, extending from about 8° S to 28° S, constituting the Atacama desert in the broad sense. Species-rich ephemeral annual vegetations, perennial communities and unvegetated areas coexist in a mosaic fashioned by the intensity and distribution of the garuas, themselves regulated by the coastal orography.
(Koepcke, 1961: 217-235; Walter, 1962: 381-392; Walter, 1968: 181; Hueck and Seibert, 1972: units 69 *p.*, 70; Hernandez, 1973: 36-43; Ducoing, 1973: 39-40; Parker *et al.*, 1982: 12-13, 25; Rauh, 1985: 246-257; Schnell, 1987b: 42-53; Walter and Breckle, 1991b: 254-261; Gajardo, 1994: subregions 1C13, 1C14).

74.11 Unvegetated garua deserts

Sand, clay, stone or salt deserts of the coasts of Peru and northern Chile, devoid of vegetation, including barkhans ("medanos"), ergs, regs and hamadas, rocky outcrops and slopes.
(Koepcke, 1961: 232-235; Walter, 1962: 381-392; Hernandez, 1973: 36-43; Ducoing, 1973: 39-40; Rauh, 1985: 246-257; Schnell, 1987b: 42-53; Walter and Breckle, 1991b: 254-261).

74.12 *Tillandsia* garua deserts

Deserts of Peru and northern Chile occupied by colonies of bromeliads of genus *Tillandsia*, subsisting solely on atmospheric humidity brought by the garua fogs, with reduced, often invisible roots having no water-uptake function, distributed between 8° S and 20° S in flat sand deserts, in coastal sand dunes, on the seaward slopes of the coastal cordillera and, locally, on the landward side of the coastal cordillera at the edge of the western Andean rock deserts.
(Koepcke, 1961: 230-231; Walter, 1962: 381-392; Rauh, 1985: 246-257; Schnell, 1987b: 42-53; Walter and Breckle, 1991b: 254-261).

74.121 *Tillandsia latifolia* garua deserts

Garua deserts dominated by *Tillandsia latifolia* which covers vast areas of flat sands and coast-facing slopes, up to about 600 metres, in areas reached by moisture-bearing sea breezes.
(Koepcke, 1961: 230; Rauh, 1985: 248; Schnell, 1987b: 52; Walter and Breckle, 1991b: 257).

74.122 *Tillandsia purpurea* garua deserts

Garua deserts dominated by *Tillandsia purpurea* growing singly or in groups or strands, retaining microdunes.
(Rauh, 1985: 248; Walter and Breckle, 1991b: 257).

74.123 *Tillandsia paleacea* garua deserts
Garua deserts dominated by the low-lying, strand-forming *Tillandsia paleacea*, characteristic, in particular, of sandy loamy terraces of central Peru.
(Koepcke, 1961: 231; Walter, 1962: 381-392; Rauh, 1985: 248; Schnell, 1987b: 52; Walter and Breckle, 1991b: 257-259).

74.124 *Tillandsia recurvata* garua deserts
Garua deserts dominated by the long-strand forming *Tillandsia recurvata*, relatively rare in the region, localized around Trujillo and in the Lima area.
(Rauh, 1985: 248; Walter and Breckle, 1991b: 257).

74.125 *Tillandsia werdermannii* garua deserts
Tillandsia werdermanni-dominated deserts of extreme southern Peru and northern Chile, in the Tacna-Arica region, where this endemic bromeliad forms mats or long strands at altitudes between 700 metres and 1000 metres.
(Rauh, 1985: 247-248; Walter and Breckle, 1991b: 257).

74.126 *Tillandsia landbeckii* garua deserts
Tillandsia landbeckii-dominated deserts of northern Chile.
(Rauh, 1985: 248).

74.13 Cactus garua deserts
Garua deserts of the coastal lowlands and coastal cordillera hills of Peru and northern Chile colonized by communities of succulent perennials, mostly dominated by prostrate-creeping, spherical, short-stemmed or columnar cacti, with either a very sparse or nonexistent accompanying flora, generally limited to cryptogams and ground bromeliads of genus *Tillandsia* or, particularly on the lomas of southern Peru and in the fog oases of northern Chile, by loma annuals and geophytes and by succulent shrubs.
(Koepcke, 1961: 227-229; Hernandez, 1973: 36-43; Ducoing, 1973: 39-40; Rauh, 1985: 248-251, 255; Schnell, 1987b: 52; Walter and Breckle, 1991b: 259; Gajardo, 1994: unit 1C131).

74.131 *Haageocereus* garua deserts
Garua deserts of sandy coastal flats and coastal lomas of north-central and southern Peru dominated by stands of creeping or erect cacti of genus *Haageocereus*. *Asthenes cactorum* is a characteristic bird of this community.
(Koepcke, 1961: 228; Rauh, 1985: 248-251; Walter and Breckle, 1991b: 259).

74.1311 Northern creeping *Haageocereus* garua deserts
Garua deserts dominated by stands of creeping *Haageocereus repens* of sandy deserts of the Trujillo area in north-central Peru.
(Rauh, 1985: 248-251; Walter and Breckle, 1991b: 259).

74.1312 Southern creeping *Haageocereus* garua deserts
Garua deserts of southern Peru dominated by stands of creeping cacti of genus *Haageocereus*, located, in particular, on the lomas of the coast of Arequipa between Chala and Mollendo, in the hills of Nazca, and in the coastal dunes of the Tacna area. Several species are involved. On the Arequipa lomas, colonies of *Haageocereus decumbens* are scattered along the entire coastal stretch, *Haageocereus ambiguus* and *Haageocereus litoralis* are limited to the Atico area, *Haageocereus mamillatus* to the Camana area. In Tacna, *Haageocereus australis* is the constituting species.
(Koepcke, 1961: 228; Rauh, 1985: 249; Cullmann *et al.*, 1986: 184).

74.1313 Central Peruvian *Haageocereus* garua deserts
Garua deserts of coastal lowlands and coastal hills of central Peru harbouring colonies of erect or semidecumbent cacti of genus *Haageocereus*, in particular, *Haageocereus limensis*, sometimes associated with *Tillandsia spp.*
(Koepcke, 1961: 228; Cullmann *et al.*, 1986: 184).

74.132 *Islaya* garua deserts
Garua deserts with gypsiferous soils, colonized by beds of spherical cacti of genus *Islaya* (*Neoporteria p.*), in coastal areas near Chala, southern Peru, accompanied only by blue-green algae (cyanobacteria).

(Koepcke, 1961: 227-228; Rauh, 1985: 249; Walter and Breckle, 1991b: 259).

74.133 *Copiapoa* garua deserts
Garua deserts of northern Chile, mostly within the coastal Tal-Tal desert, dominated by short, thick, cylindrical or cushion-forming, often glaucous or chalky, cacti of genus *Copiapoa*, in particular, *Copiapoa cinerea* (*Copiapoa cinerea* var. *cinerea*, *Copiapoa cinerea* var. *columna-alba*, *Copiapoa cinerea* var. *haseltoniana*), *Copiapoa lembeckei*, *Copiapoa humilis*, *Copiapoa desertorum*, *Copiapoa solaris*, *Copiapoa dealbata*, *Copiapoa cinerascens*, accompanied by rolling lichens *Rocella cervicornis*, *Parmelia vagans*, *Tornabenia ephebaea*, by annuals, shrubs and bunchgrasses, notably annual Nolnaceae (*Nolana crassifolia*, *Nolana sedifolia*, *Nolana leptophylla*), *Mathewsia incana*, *Cassia brogniartii*, *Dinemandra ericoides*, *Euphorbia lactiflua*, the bunchgrass *Stipa tortuosa*.
(Rauh, 1985: 250; Hoffmann, 1989: 40-41, 102-103, 106-107, 114-115, 128-129, 112-113; Walter and Breckle, 1991b: 259; Quintanilla, 1988: 10-11; Gajardo, 1994: units 1C141, 1C142, 1C144, *p.*).

74.1331 Tal-Tal *Copiapoa* garua deserts
Stretches of the northern Chilean Tal-Tal garua desert dominated by cylindrical or cushion-forming cacti of genus *Copiapoa*, in particular, *Copiapoa cinerea* (*Copiapoa cinerea* var. *cinerea*, *Copiapoa cinerea* var. *columna-alba*, *Copiapoa cinerea* var. *haseltoniana*), *Copiapoa lembeckei*, *Copiapoa humilis*, *Copiapoa desertorum*, *Copiapoa solaris*.
(Hoffmann, 1989: 40-41, 102-103, 106-107, 114-115, 128-129).

74.13311 *Copiapoa cinerea* garua deserts
Stretches of the northern Chilean Tal-Tal garua desert dominated by the cylindrical *Copiapoa cinerea sensu lato*, in particular, by *Copiapoa cinerea* var. *cinerea*, *Copiapoa cinerea* var. *columna-alba*, *Copiapoa cinerea* var. *haseltoniana*.
(Hoffmann, 1989: 40-41, 102-103, 106-107).

74.13312 Tal-Tal cushion *Copiapoa* garua deserts
Stretches of the northern Chilean Tal-Tal garua desert dominated by cushion-forming cacti of genus *Copiapoa*, in particular, *Copiapoa desertorum*, *Copiapoa solaris*.
(Hoffmann, 1989: 40-41, 114-115, 128-129).

74.133121 *Copiapoa desertorum* garua deserts
Stretches of the northern Chilean Tal-Tal garua desert dominated by cushion-forming cacti of species *Copiapoa desertorum*, with four varieties, all vulnerable or rare, and of very restricted range.
(Hoffmann, 1989: 40-41, 128-129).

74.133122 *Copiapoa solaris* garua deserts
Stretches of the northern Chilean Tal-Tal garua desert dominated by the cushion-forming, vulnerable, cactus *Copiapoa solaris*, of very restricted range.
(Hoffmann, 1989: 40-41, 114-115, 128-129).

74.1332 Huasco *Copiapoa* garua deserts
Stretches of the northern Chilean Huasco garua desert dominated by cylindrical or cushion-forming cacti of genus *Copiapoa*, in particular, *Copiapoa dealbata* var. *carrizalensis*, *Copiapoa cinerascens*.
(Hoffmann, 1989: 41, 44, 100-101, 112-113).

74.13321 *Copiapoa dealbata* garua deserts
Stretches of the northern Chilean Huasco garua desert dominated by *Copiapoa dealbata* var. *carrizalensis*, *Copiapoa cinerascens*, characteristic, in particular, of the coastal hills between Totoral Bajo and Huasco.
(Hoffmann, 1989: 41, 112-113).

74.13322 *Copiapoa cinerascens* garua deserts
Stretches of the northern Chilean Huasco garua desert dominated by *Copiapoa cinerascens*, characteristic, in particular, of Pan de Azucar National Park.
(Hoffmann, 1989: 44, 100-101).

74.134 Columnar cactus garua deserts
Garua deserts of Peru and Chile dominated by formations of tall columnar cacti, in particular of genera *Eulychnia* and *Neoraimondia*.
(Rauh, 1985: 250-251).

74.1341 *Neoraimondia* garua deserts
Garua deserts of the rocky coastal slopes and coastal lomas of southern Peru, dominated by stands of the tall, up to 8 metres high, columnar *Neoraimondia arequipensis*, often associated with prostrate *Haageocereus* and globular *Islaya* species, and with herbaceous loma plants. The furnariids *Leptasthenura aegithaloides* and *Asthenes cactorum* are characteristic.
(Koepcke, 1961: 228-229; Rauh, 1985: 250).

74.1342 *Eulychnia* garua deserts
Garua deserts of northern Chile dominated by arborescent columnar cacti of genus *Eulychnia*.
(Britton and Rose, 1937b: 137-140; Rauh, 1985: 250-251; Cullmann *et al.*, 1986: 307; Quintanilla, 1988: 9-11; Hoffmann, 1989: 38-41; Gajardo, 1994: units 1C131, 1C141, 1C142, 1C144, *p.*).

74.13421 *Eulychnia iquiquensis* garua deserts
Garua deserts of tops and slopes of coastal hills of the Tocopilla coastal desert of northern Chile between 19° 30' S and 24° S, dominated by the endangered tall, arborescent columnar cactus *Eulychnia iquiquensis*, accompanied by the arbuscular succulent euphorb *Euphorbia lactiflua* and by *Frankenia chilensis*. *Eulychnia iquiquensis* may form fairly dense woods.
(Rauh, 1985: 250-251; Quintanilla, 1988: 9; Gajardo, 1994: unit 1C13-1C131; Hoffmann, 1989: 40, 136-137).

74.13422 *Eulychnia aricensis* garua deserts
Garua deserts of coastal slopes of extreme northern Chile, between Camaraca and the basin of Camarones, dominated by the tall, arborescent columnar cactus *Eulychnia aricensis*, accompanied by *Haggeocereus australis*, *Opuntia ovata*, *Neoporteria aricensis*, *Trichocereus glaucus*, *Opuntia tunicata*.
(Rauh, 1985: 250-251; Quintanilla, 1988: 9; Gajardo, 1994: unit 1C13-1C131; Hoffmann, 1989: 38, 136).

74.13423 *Eulychnia breviflora* garua deserts
Garua deserts of northern Chile dominated by the fairly tall, arborescent, multi-stemmed cactus *Eulychnia breviflora*, at times forming relatively dense woods.
(Hoffmann, 1989: 40, 138-139).

74.13424 *Eulychnia saintpieana* garua deserts
Garua deserts of northern Chile, mostly within the coastal Tal-Tal desert, extending to the Tocopilla desert and the southern transition zone, dominated by medium-tall columnar cacti, in particular, *Eulychnia saintpieana*, *Trichocereus coquimbanus*, *Trichocereus deserticolus*, *Trichocereus fulvilanus*.

(Britton and Rose, 1937b: 137-140; Rauh, 1985: 250-251; Cullmann *et al.*, 1986: 307; Quintanilla, 1988: 10-11; Hoffmann, 1989: 41, 142-143; Gajardo, 1994: units 1C141, 1C142, 1C144, *p.*).

74.135 Soil cactus garua deserts
Garua deserts of northern Chile colonized by beds of brownish soil cacti of genus *Neochilenia* (*Neoporteria p.*), partly buried in the soil, in particular *Neochilenia dimorpha*, *Neochilenia esmeraldana*, *Neochilenia napina*, *Neochilenia occulta*, *Neochilenia odieri*, *Neochilenia taltalensis*.
(Weisser, 1967; Rauh, 1985: 251; Hoffmann, 1989: 206-207, 216-217, 222-223, 224-228, 230-231; Walter and Breckle, 1991b).

74.14 Herbaceous and suffrutescent lomas
Garua deserts of the coastal lowlands and coastal cordillera hills of Peru and northern Chile colonized by communities of hygrophyte annuals, geophytes or half-shrubs and shrubs.
(Koepcke, 1961: 225-227; Walter, 1962: 389-392; Walter, 1968: 181; Hernandez, 1973: 36-37; Ducoing, 1973: 39-40; Rauh, 1985: 254-255; Schnell, 1987b: 52-53; Walter and Breckle, 1991b: 260-261).

74.141 Herbaceous lomas
Garua deserts of the coastal lowlands and coastal cordillera hills of Peru colonized by communities of hygrophyte annuals and geophytes.
(Koepcke, 1961: 225-227; Walter, 1962: 389-392; Walter, 1968: 181; Rauh, 1985: 254-255; Schnell, 1987b: 52-53; Walter and Breckle, 1991b: 260-261).

74.1411 Peruvian herbaceous sand lomas
Open formations of hygrophyte annuals and bulb or corm geophytes occupying seasonally fogbound coastal hill stations ("lomas") of Peru, in particular, sand and loam plateaux and sea-facing slopes of the coastal cordillera, and, very locally, coastal clifftops, in areas of maximum fog condensation, mostly in the 300-500 metre altitudinal belt. The dense, green carpets of vegetation, which form during the garua season, include annuals such as *Cenchrus tribuloides*, *Chenopodium paniculatum*, *Drymaria molluginea*, *Eragrostis peruviana*, *Lupinus mollendoensis*, *Portulaca pillosissima*, *Viola weberbaueri*, *Monnina weberbaueri*, semisucculent *Calandrinia spp.*, and the endemics *Bowlesia palmata*, *Drymaria weberbaueri*, *Nama dichotoma*, *Nolana humifusa*, *Palaua malvifolia*, *Plantago limensis*, *Spergularia collina*. Geophytes comprise *Stenomesson coccinium* and *Zephyranthes albicans*, *Oxalis bulbigera*, *Oxalis solarensis*, *Solanum spp.*, *Geranium limae*.
(Walter, 1962: 389-392; Rauh, 1985: 254-255; Schnell, 1987b: 50-53; Walter and Breckle, 1991b: 260-261).

74.1412 Peruvian herbaceous stone lomas
Varied open formations of hygrophyte annuals and bulb or corm geophytes occupying seasonally fogbound stony stations of the coastal regions of Peru, in particular, *Hymenocallis amancaes*-dominated communities of central Peru.
(Koepcke, 1961: 227).

74.142 Suffrutescent lomas
Garua deserts of the coastal lowlands and coastal cordillera hills of Peru and northern Chile colonized by communities of half-shrubs and shrubs.
(Koepcke, 1961: 225; Hernandez, 1973: 36-37; Ducoing, 1973: 39-40; Rauh, 1985: 255).

74.1421 Northern Chilean suffrutescent lomas
Open formations of half-shrubs and succulent shrubs, accompanied by annuals and bulb or corm geophytes, of fog oases of northern Chile. The shrubs include *Euphorbia lactiflua*, *Bahia ambrosioides*, *Calceolaria paposana*, *Heliotropium floridum*, *Nicotiana solanifolia*.
(Hernandez, 1973: 36-37; Ducoing, 1973: 39-40; Rauh, 1985: 255).

74.1422 Peruvian evergreen suffrutescent lomas
Communities of the garua deserts of the coastal lowlands and coastal cordillera hills of Peru dominated by evergreen shrubs, characteristic of areas with permanent moisture below the surface.
(Koepcke, 1961: 225).

74.1423 Peruvian deciduous suffrutescent lomas
Communities of the garua deserts of the coastal lowlands and coastal cordillera hills of Peru dominated by shrubs that are green during the garua season and may reach a height of two metres. They are characteristic of sites with intense moistening during the garua season, but with no permanent ground moisture. The half-succulent shrub *Carica candicans* is a common component.
(Koepcke, 1961: 225).

74.143 *Calandrinia* succulent lomas
Communities of the garua deserts of the coastal lowlands and coastal cordillera hills of Peru dominated by succulent species of the Portulacaceae genus *Calandrinia*, mostly occupying limited surfaces and often forming a belt in the lower part of the herbaceous hygrophyte lomas. Succulent *Oxalis* are the most conspicuous accompaniers of the *Calandrinia*.
(Koepcke, 1961: 227).

74.144 Rooted bromeliad lomas
Communities of the coastal garua deserts of Peru, characteristic of rock escarpments, dominated by rooted bromeliads of genera *Pitcairnia* and *Tillandsia*.
(Koepcke, 1961: 229).

74.15 Cryptogam garua deserts
Deserts of the garua zone of coastal Peru and northern Chile, occupied by communities of lichens or blue-green algae (cyanobacteria).
(Koepcke, 1961: 229-232; Walter, 1962: 389; Rauh, 1985: 255-256; Schnell, 1987b: 52; Walter and Breckle, 1991b: 259).

74.151 Blue-green algae garua deserts
Deserts of the garua zone of coastal Peru and northern Chile colonized by communities of blue-green algae (cyanobacteria), in particular gelatinous layers of *Nostoc commune*.
(Koepcke, 1961: 229, 232; Walter, 1962: 389; Rauh, 1985: 255-256; Schnell, 1987b: 52; Walter and Breckle, 1991b: 259).

74.1511 Hard substrate algae lomas
Clay or clayey sand deserts of the garua zone of coastal Peru and northern Chile darkened by colonies of blue-green algae (cyanobacteria).
(Koepcke, 1961: 229; Walter, 1962: 389; Rauh, 1985: 255-256; Schnell, 1987b: 52; Walter and Breckle, 1991b: 259).

74.1512 *Nostoc* sand lomas
Sand deserts of the immediate vicinity of the coast in the garua zone of Peru and northern Chile occupied by unrooted gelatinous layers of the blue-green alga (cyanobacteria) *Nostoc commune*, capable of covering vast surfaces.
(Koepcke, 1961: 232; Walter, 1962: 389; Rauh, 1985: 255-256; Schnell, 1987b: 52; Walter and Breckle, 1991b: 259).

74.152 Lichen garua deserts
Garua deserts of Peru and northern Chile occupied by colonies of attached or free lichens.
(Koepcke, 1961: 231; Walter, 1962: 389; Rauh, 1985: 255-256; Schnell, 1987b: 52; Walter and Breckle, 1991b: 259).

74.1521 Coastal lichen garua deserts
Coastal sands and oases of the garua zone of Peru and northern Chile, colonized by grey-green communities of lichens (*Cladonia spp.*, *Teloschistes spp.*, *Anaptychia leucomelaena*, *Ramalina cerruchis*) and algae (*Trentepohlia polycarpa*), at altitudes comprised between sea level and 300 metres.
(Koepcke, 1961: 231; Walter, 1962: 389; Rauh, 1985: 255-256; Schnell, 1987b: 52; Walter and Breckle, 1991b: 259).

74.1522 Upland lichen garua deserts
Formations of the highest reaches of the garua zone of Peru and northern Chile, between 800 metres and 1000 metres altitude, constituted by multicoloured crustaceous lichen mosaics on rock debris.
(Koepcke, 1961: 229; Rauh, 1985: 255; Walter and Breckle, 1991b: 259).

74.153 Moss garua deserts
Moss-dominated formations of the garua deserts of Peru, for the most part of very limited extent.
(Koepcke, 1961: 229).

74.2 Northern Chilean fog-free coastal deserts

Deserts of northern Chile, south to about 28° S, situated outside of the reach of annually recurring garua fogs, constituting the Atacama desert in the strict sense, devoid of vegetation, colonized by lichens or supporting ephemeral vegetation dependent on the nonannual occurrence of rainfall.
(Johnson, 1965: 19; Walter, 1968: 178; Hueck and Seibert, 1972: unit 69; Ducoing, 1973: 23-39; Hernandez, 1973: 43-51; Schnell, 1987b: 42-45; Walter, 1979: 116; Rauh, 1985: 257-260; Walter and Breckle, 1991b: 261-264; Gajardo, 1994: subregion 1A).

74.21 Unvegetated fog-free coastal deserts
Large unvegetated expanses, regs, ergs, hamadas and rocky slopes, constituting, together with the thallophyte-colonized areas of 74.22, 90% of the area of the Atacama deserts of northern Chile, outside of the reach of annually recurring garua fogs.
(Rauh, 1985: 257; Walter and Breckle, 1991b: 261-264).

74.22 Cryptogam fog-free coastal deserts
Areas of the Atacama desert of northern Chile, between 22° S and 27° S, colonized by largely subterranean communities of crustaceous "window lichens", belonging to the Buelliaceae, Dermatocarpaceae, Lecideaceae and Ascosporaceae, and of cyanobacteria.

(Rauh, 1985: 257; Walter and Breckle, 1991b: 261-264).

74.23 Ephemeral therophyte fog-free coastal deserts
Areas of the fog-free Atacama deserts of northern Chile, subject to the occasional phenomenon of "flowering desert", the appearence in rare years with sufficient rainfall of an ephemeral therophyte vegetation at places which are otherwise for many years devoid of any visible plant life, an occurrence very rare in the central parts of the desert, more frequent in its southern fringes where it may involve large surfaces. The annual communities are formed by *Nolana baccata*, *Adesmia tenella*, *Cryptantha parviflora*, *Lupinus microcarpus*, *Plantago hispidula*, *Tetragonia copiapina*, *Tetragonia macrocarpa*, *Viola polypoda*, *Calandrinia acuminata*, *Calandrinia barneoudi*, *Cristaria spp.*; one geophyte, *Euphorbia copiapina* participates in their composition.
(Ducoing, 1973: 36; Rauh, 1985: 257-258, 259-260; Walter and Breckle, 1991b: 261-264).

74.24 Ephemeral geophyte fog-free coastal deserts
Depressions of the fog-free Atacama deserts of northern Chile in which appear, in rare years with sufficient rainfall, an ephemeral geophyte vegetation, a phenomenon similar to and parallel with the bloom of the therophyte communities of 74.23 on higher ground. The main representative species of the communities are *Hippeastrum ananuca*, *Leucocoryne purpurea*, *Argylia radiata*, *Euphorbia copiapina*.
(Rauh, 1985: 257-258; Walter and Breckle, 1991b: 261-264).

74.25 Dwarf-shrub fog-free coastal deserts
Depressions and rocky terrain of the fog-free Atacama deserts of northern Chile colonized by sparse communities of dwarf shrubs, in particular, *Skytanthus arcutus*, sometimes accompanied by cacti.
(Ducoing, 1973: 36-37; Rauh, 1985: 257-258; Walter and Breckle, 1991b: 261-264).

74.26 Succulent fog-free coastal deserts
Depressions and rocky terrain of the fog-free Atacama deserts of northern Chile colonized by sparse colonies of globular cacti of genera *Copiapoa* and *Neochilenia* (*Neoporteria*), in particular, the rare and endangered *Neoporteria krainziana* of sand deserts of the Arica interior.
(Ducoing, 1973: 36-37; Rauh, 1985: 257-258; Hoffmann, 1989: 38-40, 232-233; Walter and Breckle, 1991b: 261-264).

74.3 Sechura coastal deserts and semideserts

Deserts and semideserts extending from southern Ecuador, where they include the Santa Elena peninsula and El Muerto Island, south to the region of Trujillo, at about 8° S, in northern Peru, a more or less narrow coastal area situated out of reach of the main garua fogs and subject to irregular abundant rainfall occurring at a less than annual rate; characterizd by a mosaic of unvegetated zones, steppes, shrublands, tall cactus scrublands, halophile communities and woodland formations, the latter listed under 4B.
(Murphy, 1936: 308; Koepcke, 1961: 195-217, 232-234; Hueck and Seibert, 1972: unit 69 *p.*; Parker *et al.*, 1982: 12-13, 23; Rauh, 1985: 242-246; Schnell, 1987b: 48; Walter and Breckle, 1991b: 265-266).

74.31 Sechura coastal unvegetated deserts
Unvegetated sand, salt or gypsum expanses of the Sechura coastal deserts.
(Koepcke, 1961: 232-234; Rauh, 1985: 242-246).

74.311 Sechura coastal sand deserts
Unvegetated sand dunes with barkans ("medanos") of the Sechura coastal deserts.
(Koepcke, 1961: 234; Rauh, 1985: 242-246).

74.312 Sechura coastal salt deserts
Unvegetated salt and gypsum expanses of the Sechura coastal deserts.
(Koepcke, 1961: 233).

74.32 *Neoraimondia gigantea* deserts
Cactus parks of the stony hills of the western flank of the coastal cordilleras of northern Peru dominated by the very tall *Neoraimondia gigantea*.
(Koepcke, 1961: 209-213; Rauh, 1985: 244-24; Schnell, 1987b: 48).

74.33 Sechura desert shrublands
Shrub formations of the Sechura deserts and semideserts, either evergreen and dependant on access to the water table, or drought-deciduous, green only after the rains, which may occur at irregular, pluri-annual, intervals.
(Koepcke, 1961: 145-147, 195-196, 201-202; Rauh, 1985: 244, 245-246).

74.331 Sechura desert rain-green shrublands
Rain-green shrub formations of the Sechura deserts and semideserts, in particular, *Cercidium praecox* formations.
(Koepcke, 1961: 201-202).

74.332 Sechura desert evergreen shrublands
Evergreen shrublands of the deserts of northern Peru and the Santa Elena peninsula of southern Ecuador, in particular dune-bushlands formed by the almost sand-buried *Cryptocarpus pyriformis* and *Capparis angulata*.
(Koepcke, 1961: 120, 145-147; Rauh, 1985: 244, 245-246).

74.34 Sechura desert rain-green grasslands and forblands
Deserts and semideserts of northern Peru capable of supporting, after rains that may occur at several-year intervals, fairly dense grasslands or communities of nongraminoid herbs, otherwise devoid or nearly devoid of apparent vegetation.
(Koepcke, 1961: 196-202; Rauh, 1985: 246).

74.341 Sechura desert rain-green grasslands
Desert grasslands of the southern Sechura desert of Peru, dominated by the grasses *Aristida adscensionis*, *Anthephora hermaphroditica*, *Bouteloua disticha*, *Chloris virgata*, *Eragrostis spp.*, green only after rains that may occur at several-year intervals.
(Koepcke, 1961: 196-198; Rauh, 1985: 246).

74.342 Sechura desert rain-green forblands
Desert communities of the northern Sechura desert, green only after rains that may occur at several year intervals, dominated by the forbs *Amaranthus haughtii*, *Eroelichia interrupta*, *Boerhaavia verbenacea*, *Boerhaavia erecta*, *Tephrosia purpurea*, *Stylosanthes psammophila*, *Oxalis ramulosa*, *Sida weberbaueri*, *Turnera pumilea*, *Merremia pentaphylla*, *Coldenia paronychioides*, *Cacabus multiflorus*, with a small admixture of grasses that include the *Aristida adscensionis*, *Bouteloua aristidoides*, *Eragrostis cilianensis*, *Eriochloa peruviana*.
(Koepcke, 1961: 198-199, 201-202; Rauh, 1985: 246).

74.35 Sechura desert psammo-halophile communities
Grasslands of sandy-saline soils of the northern Peruvian Sechura desert, dominated by the grass *Distichlis spicata*.
(Rauh, 1985: 246).

74.36 Sechura tall cactus scrub-savannah semideserts
Semidesert xerophyte and succulent parks of Ecuador and extreme northern Peru, occupied by an open scrub often dominated by *Ipomoea carnea*, with emergent tall cacti such as *Armatocereus cartwrightianus*, *Pilocereus tweedyanus*, *Monvillea diffusa*, *Monvillea maritima*.
(Koepcke, 1961: 205-208; Rauh, 1985: 244; Schnell, 1987b: 48).

74.4 Chilean southern transition semideserts

Semideserts of the southern fringe of the Peruvian-Chilean Desert, forming the transition to the mediterraneo-steppic zones to the south, developed in subcoastal regions between 27° S and 30° S, in coastal regions between 28° S and 29° 30' S, occupied by communities of small shrubs, succulents and rain-dependent annuals, with, in particular, the shrubs *Heliotropium curassavicum*, *Chuquiraga ulicina*, cacti of genera *Copeapoa*, *Eriosyce*, *Neochilenia*, *Opuntia*, annuals of genera *Calandrinia*, *Adesmia*, *Cristaria*.
(Hueck and Seibert, 1972: unit 68 *p.*; Ducoing, 1973: 36, 38; Rauh, 1985: 258; Schnell, 1987b: 47; Walter and Breckle, 1991c: 146; Gajardo, 1994: subregions 1D, 1C15).

74.41 Huascan coastal transition semideserts

Semideserts of the southern fringe of the Peruvian-Chilean Desert, in the zone of transition to mediterraneo-steppic Chile, developed in coastal and near-coastal regions between 28° S and 30° S, occupied by complex communities of small shrubs, succulents and rain-dependant annuals, with, in particular, the shrubs *Heliotropium stenophyllum* and *Oxalis gigantea*, accompanied by the composites *Pleocarphus revolutus*, *Ophryosporus triangularis*, *Encelia tomentosa*, by *Ephreda andina*, by the cacti *Opuntia miquelii*, *Opuntia ovata*, *Trichocereus coquimbana*, *Eulychnia acida*, and by annuals of genera *Calandrinia*, *Adesmia*, *Cristaria*.
(Gajardo, 1994: unit 1C15-1C151).

74.411 Huascan coastal shrubby semideserts
Semideserts of the southern fringe of the Peruvian-Chilean Desert, in the zone of transition to mediterraneo-steppic Chile, developed in coastal and near-coastal regions between 28° S and 30° S, occupied by communities dominated by small shrubs.
(Gajardo, 1994: unit 1C15-1C151).

74.412 Huascan coastal succulent semideserts
Semideserts of the southern fringe of the Peruvian-Chilean Desert, in the zone of transition to mediterraneo-steppic Chile, developed in coastal and near-coastal regions between 28° S and 30° S, occupied by communities dominated by succulents.
(Gajardo, 1994: unit 1C15-1C151).

74.413 *Eulychnia acida* transition deserts
Transition deserts of Chile dominated by tall, arborescent forms of the strongly branched cactus *Eulychnia acida*.
(Hoffmann, 1989: 134-135).

74.42 Chilean interior lowland transition semideserts
Semideserts of the southern fringe of the Peruvian-Chilean Desert, in the zone of transition to mediterraneo-steppic Chile, developed in subcoastal lowlands between 27° S and 29° S.
(Gajardo, 1994: subregion 1D16).

74.421 Chilean *Skytanthus* dwarf-shrub transition semideserts
Semideserts of the southern fringe of the Peruvian-Chilean Desert, in the zone of transition to mediterraneo-steppic Chile dominated by the dwarf Apocynaceae shrub *Skytanthus acutus*, developed in subcoastal lowlands between 27° S and 29° S, locally extending into the Tal-Tal coastal regions.
(Gajardo, 1994: units 1D16-1D161, 1D16-1D162, 1C14-1D162).

74.422 Chilean *Encelia* shrub transition semideserts
Semideserts of the southern fringe of the Peruvian-Chilean Desert, in the zone of transition to mediterraneo-steppic Chile, dominated by the composite shrub *Encelia tomentosa*, accompanied by the annuals *Nolana paradoxa*, *Nolana rostrata*, *Cristaria glaucophylla*, developed in subcoastal regions between 27° S and 29° S, extending locally into the Tal-Tal and Huasco coastal regions.
(Gajardo, 1994: units 1D16-1D163, 1C14-1D163, 1C15-1D163).

74.423 Chilean *Nolana-Cryptantha* annual transition semideserts
Semideserts of the southern fringe of the Peruvian-Chilean Desert, in the zone of transition to mediterraneo-steppic Chile, widespread in subcoastal lowlands between 27° S and 29° S, occupied by communities of annuals, in particular, *Nolana baccata*, *Cryptantha parviflora*, *Tetragonia copiapina*, *Tetragonia macrocarpa*, *Adesmia tenella*, *Nolana rostrata*, *Calandrinia calycina*, *Viola polypoda*.
(Gajardo, 1994: units 1D16-1D161, 1D16-1D162, 1C14-1D162).

74.424 Chilean *Opuntia* transition semideserts
Semideserts of the southern fringe of the Peruvian-Chilean Desert, in the zone of transition to mediterraneo-steppic Chile, dominated by colonies of cacti of genus *Opuntia*, in particular, the arbustive, low thicket-forming, cylindrical-stemmed *Opuntia miquelii* and the cushion-forming *Opuntia berteri*, developed in subcoastal lowlands between 27° S and 29° S.
(Hoffmann, 1989: 42, 240-241, 244-245).

74.43 Chilean montane transition semideserts
Shrubby semideserts of high floristic diversity of the southern fringe of the Peruvian-Chilean Desert, in the zone of transition to mediterraneo-steppic Chile, developed in near-coastal low mountains, between

27° 30' S and 30° S, occupied by communities characterized by the presence of the caesalpinid *Balsamocarpon brevifolium* and of numerous other endemic shrubs. *Caesalpinia angulata*, *Enselia tomentosa*, *Bulnesia chilensis* are notable constituents.
(Gajardo, 1994: unit 1D17-1D171).

8 . AGRICULTURAL LAND AND ARTIFICIAL LANDSCAPES

Cultivated or built-up areas under the overwhelming influence of human activity; the natural vegetation cover has been totally replaced as a result of agricultural practices, urbanization or industrialization. A natural flora and fauna subsists mainly in areas of extensive and traditional cultivation and dwelling. Wild plants may grow among crops, in hedges, along roads, on walls and in fallow fields. Many animals have, during the course of the past few thousand years, adapted to these man-created habitats.

81. IMPROVED AND INTRODUCED GRASSLANDS

Heavily fertilized or reseeded permanent grasslands, sometimes even treated by selective herbicides, with very impoverished flora and fauna.

81.1 Temperate improved and introduced grasslands

Dry or mesophile, sometimes humid, heavily fertilized or reseeded, intensive permanent pastures of temperate regions of Chile, Argentina and Uruguay, abundant, in particular, in the Valdivian region of Chile where most grasslands are dominated by foreign grasses, including *Trifolium pratense*, *Holcus lanatus*, *Dactylus glomerata*, *Lolium perenne*, more localized and recent in the Pampa region of Argentina where seeded pastures or hay meadows are increasingly used for cattle fattening and dairy farming.
(Oberdorfer, 1960; Quintanilla, 1973, 1974, 1984, 1987; Gajardo, 1994; Bertoncello and Garcia, 1995).

81.2 Tropical improved and introduced grasslands

Heavily fertilized or reseeded permanent grasslands of the tropical regions of South America.
(Koechlin *et al.*, 1981).

81.21 Tropical dry zone intensive pastures
Heavily fertilized or reseeded permanent pastures established in dry woodland and savanna areas of tropical South America, in particular, of the cerrados and campos limpos of Brazil, with *Hyparrhenia rufa*, *Digitaria decumbens*, *Brachiaria spp.*.
(Koechlin *et al.*, 1981: 30).

81.22 Tropical moist forest-cut intensive pastures
Heavily fertilized or reseeded permanent pastures established on deforested areas of the moist forest regions of South America, in particular, in Amazonia, the Parana basin and the Mato Grosso, in Brazil, with *Panicum maximum*.
(Koechlin *et al.*, 1981: 30).

82. CROPLAND

Arable fields planted for annually or regularly harvested crops other than those that carry phanerophytic trees or shrubs. They include fields of cereals, cane, and other graminaceous plants, or of oil seed plants, legumes, fodder, potatoes and other forbs. If a tree layer is present, it can be indicated by simultaneous use of a code of 83 or 84 with the present one. Croplands comprise intensively cultivated fields, planted with native South American or exotic species or cultivars, involving moderate to high chemical or organic fertilization and/or systematic use of pesticides, with complete ground occupation, as well as traditionally and extensively cultivated crops of native plants, with little or no chemical or organic fertilization, generally without the use of pesticides, involving a more limited ground occupation over comparatively small surfaces. Faunal and floral quality and diversity depend on the intensity of agricultural use and on the presence of borders of natural vegetation between fields.
(Wiggins and Porter, 1971; Schnell, 1987b: 271-285; Clark, 1990; Collier *et al.*, 1992: 52-59).

82.1 Sugar cane fields

Fields of sugar cane (*Saccharum officinarum*) of tropical regions of South America; sugar cane, long-introduced and extremely widespread, forms usually tall, dense beds with a very low associated floral or faunal diversity.
(Wiggins and Porter, 1971; Schnell, 1987b: 277; Huber and Alarcon, 1988: unit 102; Sick, 1993: 24; Bertoncello and Garcia, 1995: 147, 220-229; Brown, 1995: 112-113).

82.2 Cereal fields

Fields of gramineous, mostly annual, plants cultivated primarily for the production of seeds.
(Quintanilla, 1973, 1974, 1984, 1987; Schnell, 1987b: 271-285; Huber and Alarcon, 1988; Sarrailh *et al.*, 1994: 184-186; Bertoncello and Garcia, 1995: 220-229).

82.21 Maize fields
Fields of maize, *Zea mais*, indigenous to the Americas, cultivated in South America since pre-Inca times, widespread in warm, mesothermic and cold regions, up to 3000-3200 metres, sometimes 3500 metres in the central Andes.
(Cabrera, 1958: 370; Wiggins and Porter, 1971; Schnell, 1987b: 271-272; Huber and Alarcon, 1988: units 20, 23; Bertoncello and Garcia, 1995: 220-225).

82.22 Exotic cereal fields
Fields of introduced gramineous cereals, notably, wheat, sorghum, oats, barley, rye. They are most widespread in temperate regions of South America, mostly of the Argentinian and Uruguayan pampas and Valdivian and mediterranean Chile, and in the mountains, up to 4000 metres in the Andes; sorghum, in particular, is important also in lowland tropical areas.
(Schnell, 1987b: 276-277; Huber and Alarcon, 1988: units 20, 23, 92; Sarrailh *et al.*, 1994: 184-186; Bertoncello and Garcia, 1995: 220-229).

82.3 Forb cropland

Fields of oil-seed plants, legumes, fodder, potatoes and other annually harvested non-gramineous herbs, native or exotic, cultivated as monocultures in temperate or tropical regions of South America.
(Wiggins and Porter, 1971; Schnell, 1987b: 271-285; Huber and Alarcon, 1988: units 20, 23, 37, 63, 79, 92; Sarrailh *et al.*, 1994: 184-186; Bertoncello and Garcia, 1995: 223).

82.31 Cotton fields
Fields of cotton (*Gossypium spp.*) of tropical regions of South America. All cotton fields are included irrespective of whether the stems of the plants are woody or not.

(Schnell, 1987b: 277; Huber and Alarcon, 1988: units 20, 23, 37, 63; Bertoncello and Garcia, 1995: 220-229).

82.32 Tobacco fields
Fields of tobacco (*Nicotiana tabacum*) of tropical regions of South America.
(Schnell, 1987b: 276; Huber and Alarcon, 1988: unit 23; Bertoncello and Garcia, 1995: 220-229).

82.33 Native food-crop fields
Fields of native legumes, oil-seed plants, tubers and other annually harvested non-gramineous herbs cultivated as monocultures in temperate or tropical regions of South America.
(Schnell, 1987b: 271-276; Huber and Alarcon, 1988; Bertoncello and Garcia, 1995).

82.331 Bean fields
Fields of native beans of genus *Phaseolus* (*Phaseolus vulgaris*), cultivated in South America since 8000 b.p., widespread in tropical, temperate and mountain zones.
(Wiggins and Porter, 1971; Schnell, 1987b: 272-273).

82.332 Highland pseudocereal fields
Fields of Chenopodiaceae (*Chenopodium quinoa*, *Chenopodium pallidicaule*) and Amaranthaceae (*Amaranthus mantegazzianus*, *Amaranthus caudatus*) of the high altitudes of the Andes. These traditional crops, harvested for seeds, are very ancient, characteristic, in particular, of the Altiplano, at about 3700-4000 metres and of somewhat lower altitudes, about 1200-3600 metres in southern Argentina.
(Dorst, 1957: 47; Cabrera, 1958: 370; Dorst, 1967: 200; Schnell, 1987b: 273-274).

82.333 Underground crop fields
Fields of tropical or temperate South America planted with native forbs cultivated for the production of tubers, bulbs, corms, underground fruits.
(Wiggins and Porter, 1971; Schnell, 1987b: 273-275).
82.3331 Highland tuber fields
Fields of tropical or temperate South America planted with native forbs of Andean origin cultivated for the production of tubers, in particular, potato (*Solanum tuberosum*, *Solanum andigenum*), oka (*Oxalis tuberosa*), ishanio (*Tropaeolum tuberosum*) and yacou or yacon (*Polymnia edulis*).
(Dorst, 1957: 47; Cabrera, 1958: 370; Schnell, 1987b: 273; Huber and Alarcon, 1988: unit 92; Mabberley, 1993; Bertoncello and Garcia, 1995: 220-229; Brown, 1995: 113).

82.3332 Tropical lowland tuber and corm fields
Fields of tropical South America planted with native forbs cultivated for the production of tubers, bulbs or corms, in particular, sweet potato (*Ipomoea batatas*), yautia (*Xanthosoma spp.*).
(Schnell, 1987b: 274).

82.3333 Arachide fields
Fields of tropical South America planted with the native fruit-burying Fabaceae *Arachis hypogaea*.
(Wiggins and Porter, 1971; Schnell, 1987b: 274-275; Brown, 1995: 113).

82.334 Tomato and cucurbit fields
Fields of South America planted with the Solonaceae *Solanum lycopersicum* or Cucurbitaceae (*Cucurbita maxima*, *Cucurbita moschata*, *Cucurbita pepo*, *Cyclantera spp.*) of old domestication on the continent.
(Wiggins and Porter, 1971; Schnell, 1987b: 275; Brown, 1995: 113).

82.34 Exotic forb fields
Fields of oil-seed plants, in particular sesame, sunflower, soya, tung, legumes, fodder (alfalfa), sugarbeets and other annually harvested forbs of extra-South American origin, cultivated as monocultures in tropical or temperate regions of South America.
(Cabrera, 1958; Quintanilla, 1974, 1988; Schnell, 1987b: 276-278; Huber and Alarcon, 1988: units 20, 37; Sarrailh *et al.*, 1994: 184-186; Laclau, 1994: 57; Bertoncello and Garcia, 1995: 220-229).

82.4 Market gardens

Fields of seasonal vegetables, herbaceous fruit plants and flowers of temperate regions of South America, grown under generally very intensive conditions in rotational mosaics, particularly around cities.
(Quintanilla, 1973, 1974, 1984, 1987; Sarrailh *et al.*, 1994: 184-186; Bertoncello and Garcia, 1995: 163, 220-229).

82.5 Flooded crops

Inundated or inundatable fields for the cultivation of crops requiring free water, in particular, rice (*Oryza sativa*).
(Schnell, 1987b: 277; Huber and Alarcon, 1988: units 27, 37).

82.51 Rice fields
Inundated or inundatable fields for the cultivation of rice (*Oryza sativa*). When not too heavily treated, they may provide substitution habitats for some wetland faunal elements, in particular, birds, including ducks, rails, herons and icterids.
(Schnell, 1987b: 277; Huber and Alarcon, 1988: units 27, 37; Sick, 1993: 24; Gajardo, 1994: unit 1A4-1A42).

82.52 Flooded dicot crops
Inundated or inundatable fields for the cultivation of forbs, in particular, watercress, *Nasturtium officinale* (*Rorippa nasturtium-aquaticum*).
(Cabrera, 1964: 50-51; Cabrera and Zardini, 1978: 303).

83. ORCHARDS, SHRUB CROPLANDS AND TREE PLANTATIONS

Fields planted with trees, shrubs or large tree-like or stiffly shrubby nongramineous herbs for the exploitation of fruit, flowers, leaves, sap or wood. Extensive orchards and old plantations may support a rich flora and fauna.
(Quintanilla, 1973, 1974, 1984, 1987; Schnell, 1987b: 271-285).

83.1 High-stem orchards and sap groves

Land planted with tree standards or large tree-like nongramineous herbs cultivated for the production of fruit, flowers, leaves or sap.
(Schnell, 1987b: 271-285).

83.11 Palm plantations and artificial oases
Formations dominated by planted or introduced palms, in particular, date-palm (*Phoenix dactylifera*), groves of high water-table sites in Peruvian and northern Chilean salt deserts, oil palm (*Elaeis guineensis*) and coconut (*Cocos nucifera*), plantations of tropical coastal areas.
(Koepcke, 1961: 149; Schnell, 1987b: 278; Quintanilla, 1988: 14; Huber and Alarcon, 1988: unit 5).

83.12 Evergreen broad-leaved tree orchards
Land planted in broad-leaved evergreen trees cultivated for fruit, leaves or flowers, native to South America or introduced.
(Schnell, 1987b: 275, 277, 279-280).

83.121 Native evergreen broad-leaved orchards
Land planted in native South American broad-leaved evergreen trees cultivated for fruit, leaves, bark or flowers, in particular, cashew (*Anacardium occidentale*), Brazil nut (*Bertholletia excelsa*), cocoa (*Theobroma cacao*), avocado (*Persea americana*), guava (*Psidium guajava*), papaya (*Carica papaya*), cherimoya (*Annona cherimola*), graviola (*Annona muricata*), custard apple (*Annona squamosa*), bullock's heart (*Annona reticulata*), quinquina (*Cinchona spp.*), kapok (*Ceiba pentandra*).
(Wiggins and Porter, 1971; Hueck, 1978: 91; Schnell, 1987b: 275, 279-280).

83.122 Exotic broad-leaved evergreen orchards
Land planted in non-South American broad-leaved evergreen trees cultivated for fruit, leaves or flowers, in particular, citrus, olive, mango (*Mangifera indica*).
(Wiggins and Porter, 1971; Quintanilla, 1973, 1974; Schnell, 1987b: 277; Brown and Grau, 1993).

83.13 Deciduous tree orchards
Land planted in broad-leaved winter- or drought-deciduous trees cultivated for fruit, leaves or flowers, in particular, Rosaceae, Prunaceae, walnuts (*Juglans*) or chestnuts (*Castanea*) of temperate or montane affinities.
(Quintanilla, 1973, 1974, 1984, 1987; Bertoncello and Garcia, 1995: 223).

83.14 Sap groves
Land planted in native South American broad-leaved evergreen trees cultivated for sap, in particular, the rubber trees *Hevea spp.*.
(Singer, 1984: 613; Carvalho, 1984; Sioli, 1984b; Schnell; 1987b: 280).

83.15 Banana plantations
Land planted in giant tree-like soft herbs of the family Musaceae for the production of bananas (*Musa spp.*).
(Wiggins and Porter, 1971; Schnell, 1987b: 276).

83.2 Shrub orchards

Plantations of small native or non-native ligneous species or stiffly shrubby nongramineous herbs.

83.21 Native shrub and rosette monocot orchards
Plantations of small ligneous species or stiffly shrubby nongramineous herbs native to South America.

83.211 Native shrub orchards
Plantations of small ligneous species native to South America, including dwarf trees, shrubs, espaliers and climbers, including, in particular, mate (*Ilex paraguariensis*), manioc (*Manihot esculenta*) and coca (*Erythroxylum coca*) plantations.
(Schnell, 1987b: 274, 279-280; Laclau, 1994: 49; Bertoncello and Garcia, 1995: 220-225).

83.212 Rosette monocot plantations
Plantations of ligneous species, including dwarf trees, shrubs, espaliers and climbers or of stiffly shrubby nongramineous herbs. Fields of stiff-leaved, rosette-forming plants, in particular bromeliads (pineapple) and agaves (sisal).
(Schnell, 1987b: 280; Huber and Alarcon, 1988: unit 63; Collier *et al.*, 1992; Bertoncello and Garcia, 1995: 220-229).

83.22 Exotic shrub orchards
Plantations of non-South American ligneous species, including dwarf trees, shrubs, espaliers and climbers.

83.221 Coffee plantations
Plantations of *Coffea arabica* or *Coffea liberica* mostly located at middle altitudes and sometimes under tall trees, which should be indicated by combination of this code with unit 84.5.
(Wiggins and Porter, 1971; Schnell, 1987b: 277).

83.222 Tea plantations
Plantations of *Camellia sinensis*.
(Laclau, 1994: 49; Bertoncello and Garcia, 1995: 220-230).

83.223 Vineyards
Plantations of vine, *Vitis vinifera*, relatively widespread, particularly on low outer Andean slopes of Argentina, Chile and Peru, in some interior Andean valleys and in southern Brazil.
(Quintanilla, 1973, 1974, 1984, 1987; Schnell, 1987b: 278; Sarrailh *et al.*, 1994: 94-96; Bertoncello and Garcia, 1995: 220-225).

83.224 Low-stem orchards
Land planted in small trees cultivated for fruit, in particular, espaliers of various Rosaceae.

83.3 Tree plantations

Cultivated ligneous formations planted for the production of wood, composed of exotic species or of native species out of their natural range and habitat.

83.31 Conifer plantations
Cultivated conifer formations planted for the production of wood, composed of exotic species, of native species out of their natural range, or of South American conifers within their natural area of occurrence, but in conditions of high artificiality.

83.311 Indigenous conifer plantations
Plantations of South American conifers within their natural area of occurrence, but in conditions of high artificiality, including very dense or out-of-station plantation and impoverished undergrowth.

83.3111 Andean conifer plantations
Plantations of Andean conifers of genera *Araucaria*, *Austrocedrus* or *Fitzroya* within their natural area of occurrence but in conditions of high artificiality, including very dense or out-of-station plantation and impoverished undergrowth.
(Santos Biloni, 1990).

83.3112 Subtropical araucaria plantations
Plantations of *Araucaria angustifolia* within its southern Brazilian and northern Argentinian natural area of occurrence but in conditions of high artificiality, including very dense or out-of-station plantation and impoverished undergrowth.
(Laclau, 1994: 57).

83.312 Exogenous conifer plantations
Plantations of Old World or North American species of conifers, in particular, of genus *Pinus* (*Pinus radiata*, *Pinus leiophylla*, *Pinus ponderosa*, *Pinus contorta*, *Pinus patula*, *Pinus montezumae*, *Pinus merkusii*, *Pinus khasya*, *Pinus elliottii*), *Pseudotsuga* (*Pseudotsuga menziesii*), *Abies* (*Abies nordmanniana*), *Picea* (*Picea abies*), *Cupressus* (*Cupressus macrocarpa*, *Cupressus sempervirens*, *Cupressus arizonica*, *Cupressus torulosa*). These plantations offer little support for indigenous biological diversity and constitute biological deserts as far as the fauna is concerned. Plantations of South American conifers outside of their natural area of occurrence are included, but are not of significant occurrence.
(Ragonese, 1959; Dimitri, 1972: 97-100; Quintanilla, 1973, 1974, 1984, 1987; Schnell, 1987b: 282; Huber and Alarcon, 1988: unit 40; Cerda *et al.*, 1992: 28; Sick, 1993: 24, 50-51; Goic *et al.*, 1994: 136-137; Laclau, 1994: 57; Bertoncello and Garcia, 1995: 219).

83.32 Broad-leaved tree plantations
Cultivated evergreen or deciduous tree formations planted for the production of wood, composed of exotic species, of native species out of their natural range, or of native species planted in artificial conditions with a considerably modified accompanying cortège.
(Quintanilla, 1973, 1974, 1984, 1987; Goic *et al.*, 1994: 133-136; Bertoncello and Garcia, 1995: 219).

83.321 Austral broad-leaved tree plantations
Plantations of trees of southern temperate or southern subtropical affinities, belonging in particular to species of Australian origin of genera *Eucalyptus* and *Acacia*.
(Ragonese, 1959; Parker *et al.*, 1982; Goic *et al.*, 1994: 133-136; Bertoncello and Garcia, 1995: 219).

83.3211 Eucalyptus plantations
Plantations of trees of the Australian genus *Eucalyptus*, in particular, *Eucalyptus globulus*, particularly widespread in the Andes, *Eucalyptus camaldulensis*, *Eucalyptus cladocalyx*, *Eucalyptus delegatensis*, *Eucalyptus nitens*, *Eucalyptus radiata*, *Eucalyptus astringens*, *Eucalyptus bicostata*, *Eucalyptus brockwayi*, *Eucalyptus regnans*, *Eucalyptus gomphocephala*, *Eucalyptus grandis*, *Eucalyptus maidenii*, *Eucalyptus cornuta*, *Eucalyptus fastigata*, *Eucalyptus pauciflora*, *Eucalyptus viminalis*. These plantations offer little support for indigenous biological diversity and constitute biological deserts as far as the fauna is concerned. *Eucalyptus* nectar, however, attracts hummingbirds.
(Ragonese, 1959; Budowski, 1968: 159-161; Dimitri, 1972: 101-102; Quintanilla, 1973, 1974, 1984, 1987; Schnell, 1987b: 282; Sick, 1993: 24; Goic *et al.*, 1994: 134-136; Laclau, 1994: 57; Bertoncello and Garcia, 1995: 219).

83.3212 Acacia plantations
Plantations of Australian species of genus *Acacia*, in particular *Acacia melanoxylon*, *Acacia saligna*, *Acacia cyanophylla*.
(Quintanilla, 1973, 1974, 1984, 1987; Goic *et al.*, 1994: 133-134).

83.322 Tropical broad-leaved tree plantations
Plantations of trees of tropical affinities.

83.3221 Indigenous tropical broad-leaved tree plantations
Plantations of South American trees of tropical affinities cultivated in or near their natural range and habitat, but in artificial conditions leading to a considerably modified species cortège, and often to monodominance. Such plantations may constitute favourable habitats for native fauna.
(Sick, 1993: 51).

83.3222 Exogenous tropical broad-leaved tree plantations

Plantations of tropical non-South American trees, such as the Asiatic *Gmelina arborea*, or of tropical South American trees cultivated out of their natural range and habitat. They usually do not provide suitable resources for native fauna.
(Sick, 1993: 51).

83.323 Northern temperate broad-leaved tree plantations
Plantations of deciduous trees of northern temperate affinities, in particular, of genera *Populus* (*Populus nigra*, *Populus alba*), *Salix* (*Salix fragilis*, *Salix alba*, *Salix viminalis*, *Salix babylonica*).
(Ragonese, 1959; Dimitri, 1972: 100-101; Quintanilla, 1973, 1974, 1984, 1987; Bertoncello and Garcia, 1995: 219).

84. TREE LINES, HEDGES, RURAL MOSAICS

Ligneous formations of small size, arranged in a linear, reticulated or insular manner, closely interwoven with grassy or cultivated habitats. Also, combinations of such elements and mixed agricultural formations, containing both ligneous and herbaceous layers. Very artificial, disturbed or heterogeneous systems, containing many planted or exogenous elements can be listed here while more natural ensembles utilising many natural elements and covering substantial surfaces are better classified under section 9. As for unit 94, landscapes in which pastures, crops and plantation elements are intimately mixed can be described by use of the first three codes below (if useful, specified by codes from 3, 4 and 83) in conjunction with other codes from section 8 and other open habitat sections. Surfaces characterized by mixed agricultural formations, and in particular, those that combine ligneous and herbaceous elements on the same surfaces can be designated by one of the codes 84.4 or 84.5 and their elements specified by use of other codes from section 8 or any other.

84.1 Tree lines

Ligneous formations arranged in a linear manner, mostly for shelter or shading.
(Budowski, 1968: 160).

84.2 Hedgerows

Ligneous formations of small size arranged in a linear or reticulated manner, closely interwoven with grassy or cultivated habitats, usually serving functions of partition and shelter, characteristically formed of trees and shrubs in temperate oceanic regions of the western seaboard of continents, notably in southern Chile, of *Cereus* or *Opuntia* cacti in arid and semiarid regions, in particular, in the Andes.
(de Planhol, 1976: 81).

84.3 Small woodlots

Ligneous formations of small size, arranged in an insular manner within cultivated environments.
(Quintanilla, 1973, 1974, 1984, 1987).

84.4 Rural mosaics

Reticulated landscapes of tree-lines, hedgerows, plantations, woodlots, pastures and crops.

84.41 Temperate rural mosaics
Reticulated landscapes of tree-lines, hedgerows, plantations, woodlots, pastures and crops of temperate regions, characteristic, in particular, of southern mediterranean and Valdivian Chile, of Chiloe Island, of the northern Pampas.
(Quintanilla, 1973, 1974, 1984, 1987).

84.42 Lowland tropical rural mosaics
Reticulated landscapes of tree-lines, hedgerows, plantations, woodlots, pastures and crops of hot humid or subhumid lowland tropical regions, characteristic, in particular, of Caribbean and peri-Orinocan northern South America.
(Huber and Alarcon, 1988: units 13, 63 i.a.; Iremonger, 1996).

84.43 Highland tropical rural mosaics
Reticulated landscapes of tree-lines, hedgerows, plantations, woodlots, pastures and crops of high tropical humid or subhumid mountains.
(Huber and Alarcon, 1988: units 84, 92; Brown and Grau, 1993; Brown, 1995; Young and Leon, 1995: 363-376).

84.44 Desert oasis rural mosaics

Reticulated landscapes of tree-lines, hedgerows, plantations, woodlots, pastures and crops of valleys and oases within warm tropical, subtropical or temperate deserts and of oases of the dry Andes.
(Cabrera, 1958: 369-370; Gajardo, 1994: subregion 1A4, units 1A4-1A41, 1A4-1A42, 1A4-1A43, 1B7-1A42).

84.5 Shaded crops and pastures

Crops or pastures developed under orchards or other cultivated ligneous formations. Tropical middle altitude plantations of *Coffea arabica* or *Coffea liberica* (unit 83.221), in particular, are sometimes established under tall native trees, in which case part of the original faunal and floral forest cortège may survive.
(Brown and Grau, 1993; Brown, 1995).

84.6 Anthropogenic riverine woods

Formations of watercourses, such as those with *Prosopis alba* and *Geoffroea decorticans*, of anthropic origin, occupying canyons and oases of the northern Chilean desert and the Desierto del Salar de Atacama.
(Gajardo, 1994: 1A4-1A43, 1B12-1A43).

85. URBAN PARKS AND LARGE GARDENS

Usually varied formations, created for recreational use. The vegetation, usually composed mainly of introduced species or cultivars, can nevertheless include many native plants and supports a varied fauna when not intensively managed. The heterogeneity of the habitat engenders a high faunal diversity with, however, a preponderance of common species. The frequent presence of old trees favours the installation of rarer specialists.

85.1 Large parks

Large, varied urban green spaces. Their fauna may include a substantial representation of the regional rural or woodland fauna. Their constituting elements can be specified by use of the codes below. (ffrench, 1976: 16; Sick, 1993: 24-25).

85.11 Park woodlots

Copses, groves or woods of native or introduced trees, with or without accompanying shrubbery and herbaceous undergrowth, constituting elements of urban parks.

85.12 Park lawns

Grasslands, usually mowed, and, in South America, composed of exotic grasses, constituting elements of urban parks.

85.13 Park basins

Bodies of water, including basins or more natural ponds or lakes, constituting elements of urban parks. Seminatural communities that might colonize them can be indicated by use of codes of 15, 22, 23 or 24.

85.14 Park flower beds, arbors and shrubbery

Plantations of ornamental forbs or shrubs constituting elements of urban parks.

85.15 Park sub-natural communities

Elements of sub-natural communities enclaved in parks or colonizing their elements; codes from sections other than 8 are to be used to precise their nature.

85.2 Small parks and city squares

Small public urban green spaces usually with a simplified structure and suitable for only a very impoverished representation of rural faunas.

85.3 Gardens

Areas of land planted with ornamental or food-crop vegetation, and adjoining a dwelling.

85.31 Ornamental gardens

Areas of land adjoining a house, planted with ornamental grass, shrubs, trees, flower beds.

85.32 Subsistance gardens

Areas of land used for the cultivation of fruit, vegetables, fruit trees or other domestic crops in the immediate vicinity of a dwelling.

85.4 City block inner spaces

Complexes of gardens or other green spaces, often partitioned by walls, located inside city blocks and completely or almost completely surrounded by continuous architectural structures.

86. TOWNS, VILLAGES, INDUSTRIAL SITES

Areas used for human occupation and industrial activities. A considerable fauna has adapted to buildings. Some bird species nest nearly exclusively in them, using mostly structures with traditional architecture. Other species, of montane rocky habitats, have colonized lowlands in villages and towns. Bats roost in buildings. Rock plants colonize old walls and roofs.

86.1 Cities and towns

Densely populated urban areas integrated within a built-up ensemble of medium to large size, with limited access to surrounding rural areas.

86.2 Villages and hamlets

Small groups of houses in rural areas, susceptible to strong interconnection between usages by the fauna of the built-up and countryside habitats.

86.3 Active industrial sites

Areas built-up for the purpose of industrial activities and presently in operation.

86.4 Inactive industrial sites

Abandoned industrial sites and byproducts of industrial activities susceptible of colonisation by seminatural communities.
(Cabrera and Zardini, 1978: 7).

86.41 Quarries
Permanently or temporarily unworked sites or parts of sites of open-sky extractive activities.

86.411 Sand, clay and kaolin quarries
Permanently or temporarily unworked sites or parts of sites of open-sky soft material extraction, often significant as reproduction sites of burrowing species.

86.412 Gravel quarries
Permanently or temporarily unworked sites or parts of sites of open-sky pebble extraction.

86.413 Hard stone quarries
Permanently or temporarily unworked sites or parts of sites of open-sky hard material extraction, sometimes significant as reproduction or forraging sites of rupicolous species.

86.42 Slag heaps and other detritus heaps
Features of relief formed by byproducts of industrial activities, susceptible of colonisation by seminatural communities.

86.43 Railroad switch yards and other open spaces
Railroad tracksides, switch yards and maintenance areas providing isolated or linear patches of ground susceptible of colonisation by seminatural communities.
(Cabrera and Zardini, 1978: 7).

86.5 Greenhouses and agricultural constructions

Structures established for the purpose of agricultural activities, dispersed within the rural environment.

86.6 Archeological sites

Sites of former human activity, containing ruins of greater or lesser spatial coverage and vertical profile.

87. FALLOW LAND, WASTE PLACES

Fields abandoned or left to rest, roadsides and other interstitial spaces on disturbed ground. They are colonised by numerous pioneering, introduced or nitrophilous plants. They sometimes provide habitats that can be used by animals of open spaces.
(Oberdorfer, 1960; Cabrera and Zardini, 1978: 7).

87.1 Temperate fallow fields and ruderal communities

Communities of pioneering, introduced or nitrophilous plants colonising, in particular, waste places, fallow fields, disused farmland, disturbed natural or seminatural areas of temperate South America, including the Pampas, Patagonia, the southern Andes, Valdivian and mediterranean Chile.
(Oberdorfer, 1960; Quintanilla, 1973, 1974, 1984, 1987: 17; Cabrera and Zardini, 1978: 7; Gajardo, 1994: units 4B8-4B87, 5A1-4B87, 5A3-4B87).

87.2 Lowland tropical fallow fields and ruderal communities

Fields of tropical lowland regions of South America abandoned or left to rest, roadsides and other interstitial spaces or disturbed ground within lowland tropical regions of South America.

87.3 Highland tropical fallow fields and ruderal communities

Communities of pioneering, introduced or nitrophilous plants colonising, in particular, waste places, fallow fields, disused farmland, disturbed natural or seminatural areas of higher altitudes of tropical mountains South America; such invasive formations are comprised of, in the puna, for example, species of exotic origin (*Melilotus indicus*, *Rumex crispus*, *Convolvulus arvensis*, *Brassica campestris*) as well as extra-zonal American origin (*Bromus unioloides*, *Viguiero tucumanensis*, *Xanthium spinosum*, *Descurainia argentina*, *Bidens andicola*); invaders of Puna origin include *Tarassa antofagastana*, *Acaena canescens*, *Deyeuxia arundinacea*, *Nicotiana undulata*, *Solanum sinuatirecurvum*, *Gnaphalium melanosphaeroides*.
(Cabrera, 1958: 370-371).

88. MINES AND UNDERGROUND PASSAGES

Artificial underground spaces. They may constitute important substitute habitats for cave-dwelling animals such as bats.

89. INDUSTRIAL LAGOONS AND RESERVOIRS, CANALS
Very artificial aquatic habitats; seminatural communities that might colonize them can be indicated by use of codes of 15, 22, 23 or 24.

89.1 Saline industrial lagoons and canals

Artificial aquatic habitats carrying salt or brackish water.

89.11 Sea harbours
Seaside complexes of artificial basins and inlets constructed for the purposes of navigation.

89.12 Saltworks
Active or recently abandoned salt-extraction evaporation basins. Detailed habitats can be specified by use of the subdivisions of 15 and 23 in conjunction with 89.12.

89.13 Inland saline industrial lagoons and canals
Inland artificial saltwater bodies.

89.2 Fresh water industrial lagoons and canals

Artificial aquatic habitats carrying fresh water.

89.21 Navigable canals
Linear artificial fresh water bodies open to navigation.

89.22 Ditches and small canals
Narrow linear artificial fresh water bodies, mostly used for irrigation or partition.

89.23 Industrial lagoons and ornemental ponds
Artificial fresh water basins used for the needs of navigation, industrial activities, recreation or ornamentation outside of city parks.

89.24 Sewage farms and sewage works
Sewage treatment plants and their basins.

9 . WOODED GRASSLANDS AND SCRUBS

Large ecosystems composed of a mosaic combination of woodland and grassland, of scattered trees growing within grass or shrub ecosystems, or of native trees shading surfaces transformed for grazing or cultivation, in which a stable equilibrium between the tree and grass or scrub formations is naturally or artificially maintained. They are characteristic of zonal ecotones, and of some regions where traditional extensive combined agro-pastoral methods are used. Their constituting elements can be precised by use of codes borrowed from sections 3 and 4, occasionally from 8. Transition pre- and post-forest phases, covered in 3, are excluded, as are very artificial rural mosaics included in 8.

91. PARKLANDS

Extensive surfaces characterized by mixed agro-pastoral formations, combining ligneous and herbaceous elements on the same surfaces.
(Walter, 1979; Soltner, 1985; Dupriez and De Leener, 1993).

92. BOCAGES

Reticulated landscapes of small linear, insular and semiinsular wooded habitats, tree-lines, hedgerows, closely interwoven with grassy or cultivated habitats. Also, combinations of such elements and mixed agricultural formations, containing both ligneous and herbaceous layers, characteristic in particular of south-central Chile.
(Quintanilla, 1973, 1974, 1984, 1987; Walter, 1979; Soltner, 1985; Dupriez and De Leener, 1993; Gajardo, 1994).

93. WOODED STEPPE

Formations of the transition zone between forests and steppes, occurring in mid-latitudes, north of and inland from the subantarctic and nemoral forest belts, in regions of reduced summer humidity, as well as in areas adjacent to, or under the influence of the mediterranean and warm-temperate humid zones, represented by a macromosaïc of steppe and connected, contiguous, disjunct or widely spaced woodland stands, the latter usually with a very developed grassy understorey, or by a scattering of trees within a steppe environment. The forest elements are often located on porous or slightly raised ground, valley sides or slopes, the grasslands occupying less well drained soils and lower places. Detailed habitats can be coded by combining subdivisions of prefixes of 4 and 3 with the relevant geographical or physiographic subdivisions of 93.
(Walter, 1979; Rieley and Page, 1990).

93.1 Patagonian wooded steppe

Formations of the ecotonal zone between Magellanic or southern Andean broad-leaved deciduous, broad-leaved evergreen or conifer forests (units 41, 45, 42) and the southern Patagonian and sub-Andean steppes (unit 34.2).
(Humphrey *et al.*, 1970: 29-30; Dimitri, 1972; Moore, 1983; Quintanilla, 1989).

93.2 Pampean wooded steppe

Formations of the transition between Pampean steppes (unit 34.1) and tropical dry woodland of the Espinal (unit 4B.6).
(Cabrera and Willink, 1980: 75-76; Burkart *et al.*, 1994: 3, 13, 20; Daniele and Natenzon, 1994: units 1 *p.*, 6, 11).

93.21 Northern Pampean wooded steppe
Formations of the northeastern, Entrerian, part of the humid warm-temperate Pampa region combining mesopotamic Pampean steppes (unit 34.1) with northern Espinal dry woodland of unit 4B.62, represented by *Prosopis algarrobilla* and *Prosopis nigra*.
(Cabrera and Willink, 1980: 75; Burkart *et al.*, 1994: 3; Daniele and Natenzon, 1994: unit 1 *p.*).

93.22 Western Pampean wooded steppe
Formations of the transition between steppes of the inland Pampas (unit 34.1) and tropical algarrobo dry woodland of the western Espinal (unit 4B.62) formed by *Prosopis alba*, *Prosopis nigra*, *Acacia caven*.
(Cabrera and Willink, 1980: 76; Burkart *et al.*, 1994: 13; Daniele and Natenzon, 1994: unit 6 *p.*).

93.23 Southern Pampean wooded steppe
Formations of the transition between steppes of the southern part of the inland Pampas and of the southern Pampas (unit 34.1) and tropical dry woodland of the southern Espinal formed by *Prosopis caldenia* (unit 4B.62).
(Cabrera and Willink, 1980: 76; Burkart *et al.*, 1994: 20; Daniele and Natenzon, 1994: unit 11).

93.3 Central Chilean wooded steppe

Mixed formations of the central valley of Chile combining mediterranean steppic grasslands (unit 34.3) with small woods or parkland formed by trees representative of the mediterranean xerophytic temperate forests (unit 45) or by *Acacia caven* (unit 4B).
(Quintanilla, 1973, 1974: 51, 53; Quintanilla, 1984, 1987: 13-18; Gajardo, 1994).

93.31 Central Chilean *Acacia caven* wooded steppe
Mixed formations of the central valley of Chile combining mediterranean steppic grasslands (unit 34.3) with *Acacia caven* dry tropical woods or parkland (unit 4B.8).
(Quintanilla, 1973, 1974: 51; Quintanilla, 1984, 1987: 13-18; Gajardo, 1994)

93.32 Central Chilean boldo-quillay wooded steppe

Mixed formations of the central valley of Chile combining mediterranean steppic grasslands (unit 34.3) with small woods or parkland formed by trees representative of the mediterranean xerophytic temperate forests (unit 45), characteristic, in particular, of the southern mediterranean zone, in the Bio-Bio basin. The dominant trees are most often *Quillaja saponaria* and *Peumus boldus* (units 45.611, 45.612).

(Quintanilla, 1973, 1974: 53; Gajardo, 1994).

95. TREELINE ECOTONES

Formations of the timberline, or combat zone (*Kampfzone, zone de combat*) of mountains, in which subalpine forests give way to alpine or subantarctic heaths and scrubs, to alpine grasslands, or to tropical alpine communities; they are characterized by a scattering of stunted, gnarled trees punctuating an alpine shrub or grassland environment, by a macromosaïc of alpine shrub and grass formations with scattered islands of forest, or by open or clear forest with an undergrowth composed of alpine elements such as ericaceous shrubs. They occupy a narrow belt, varying in altitudinal location according to latitude, exposure and other climatic or edaphic conditions. Detailed habitats can be coded by combining subdivisions of prefixes 31, 36, 37, 3C, 41, 42, 43, 45 or 49 with the relevant physiographic subdivisions of 95.

95.1 Temperate treeline ecotones

Formations of the timberline, or combat zone (*Kampfzone, zone de combat*) of temperate mountains, in which temperate deciduous or evergreen forests give way to southern Andean dwarf shrub heaths, cushion heaths or feldmark, or to temperate alti-Andean grasslands. Detailed habitats can be coded by combining subdivisions of prefixes 31, 36, 37, 41, 42, 43 or 45 with code 95.1.

95.2 Montane savannas

Savannas of the higher levels of high South American tropical mountains constituted by montane grasslands of unit 3C and montane woodlands of unit 49 or, sometimes, dry woodland of unit 4B.

95.21 Tropical Andean savannas
Suprasylvatic or extrasylvatic savanna formations of the very high altitudes of the tropical Andes, composed of tussock grasslands (unit 3C.14) and *Polylepis* woodland (unit 4B).
(Koepcke, 1961: 179-192; Troll, 1968; Cabrera, 1968; Cuatrecasas, 1968; Schnell, 1971: 788-797; Hueck and Seibert, 1972: units 82 *p.*, 83 *p.*, 84 *p.*; Rieley and Page, 1990).

95.22 Brazilian shield high mountain savannas
Savanna formations of the very high altitudes of the high mountains of the Brazilian shield, composed of montane tropical grasslands of unit 3C.2 and montane woodland of unit 49.

95.23 Venezuelo-Guianian highland savannas
Savanna communities of the isolated mountains of South America, in particular, of Mount Roraima, at 2772 metres, and Mount Duida, 2396 metres, as well as of lower tepuis and inselbergs, composed of tropical montane grasslands of unit 3C.3 and tropical montane woodland of unit 49.

95.231 Tepui montane savannas
Montane savannas of the high isolated mountains of the Guianan shield of northeastern South America, in particular, of Mount Roraima, at 2772 metres, and Mount Duida, 2396 metres, and the Pakaraima Mountains of southern Guyana.
(Schnell, 1987a).

95.232 Guianan rock savannas
Savannas of relatively low altitude granitic outcrops emerging from Guianan rain forest.
(Schnell, 1987a).

95.24 Caribbean montane savannas
Montane savannas of the high isolated mountains of the Caribbean façade of northern South America.

95.25 Sierras Pampeanas savannas
Montane savannas of the high isolated crystalline Sierras Pampeanas of Cordoba, southern Santiago del Estero and northern San Luis, constituted by montane bunchgrasslands of unit 3C.5 and dry montane woodland of unit 49.
(Moreno, 1993; Burkart *et al.*, 1994: 28-29; Daniele and Natenzon, 1994: unit 16 *p.*).

96. SAVANNAS

Formations transitional between tropical grassland and dry tropical woodland or, sometimes, tropical forests, including both homogeneous surfaces of grassland with a more or less even, more or less dense, scattering of trees or tall shrubs, and macromosaics of grasslands and isolated or connected stands of woodland. The grasslands involved may be savanna grasslands, tropical seasonally flooded grasslands, tropical permanently flooded grasslands or tropical steppes, the woodlands are usually dry tropical woodlands (dry forest, bushland, scrub forest, scrub woodland), sometimes fragments of monsoon forest, rain forest, mountain forest or tropical swamp forest.
(Koepcke, 1961: 203-205; Hueck and Seibert, 1972, 1981: units 8, 11, 12, 13, 29, 31, 34, 35, 37, 43, 46, 47, 48, 49, 50, 56, 58, 59, 60, 61; Walter, 1979; Cabrera and Willink, 1980; Koechlin and Legris, 1981; Koechlin *et al.*, 1981; Sarmiento, 1983; Huber and Alarcon, 1988; Rieley and Page, 1990; Daniele and Natenzon, 1994: regions 2, 3, 4, 5, 6, 7; Archibold 1995: 60).

96.1 Northern South American savannas

Savannas of the Orinoco basin and of the lowlands and coastal basins of Caribbean South America.
(Hueck and Seibert, 1972, 1981: units 59, 60, 61; Cabrera and Willink, 1980: 63-64; Sarmiento, 1983: 253-264; Schnell, 1987a: 419-437; Huber and Alarcon, 1988: units 11, 12, 18, 19, 22, 25, 26, 28, 29, 30, 31, 32, 36, 38, 45, 46, 47, 55, 67, 68, 69, 76, 77, 101; Coupland, 1992d: 364; Huber, 1995: units 70, 71, 72, 73, 74, 75, 76).

96.11 Llanos savannas

Savannas of the sedimentary Orinoco basin, constituting a vast and varied, mostly seasonal, partly hyperseasonal, complex developed in Colombia and Venezuela, between the Andes and the Caribbean Cordilleras, in the west and north, and the Guianan shield, in the east and south, north of the Amazonian rain forest zone, under an alternatedly dry and wet tropical climate, with annual rainfall between 1000 and 2200 millimetres and one or two to five or six dry months. They combine grasslands of unit 3A.11 with a ligneous arborescent element composed of *Curatella americana*, often dominant if not the only arborescent species, *Bowdichia virilioides*, *Byrsonima crassifolia*, *Byrsonima verbascifolia*, *Roupala spp.*, and/or a frutescent element comprising *Miconia spp.*, *Mimosa pudica*, *Tibouchina spp.*, *Waltheria glomerata*.
(Hueck and Seibert, 1972, 1981: units 59, 60; Cabrera and Willink, 1980: 63-64; Sarmiento, 1983: 253-263; Schnell, 1987a: 419-437; Huber and Alarcon, 1988: units 18, 19, 22, 25, 26, 28, 29, 30, 31, 32, 36, 38, 45, 55, 67, 68, 69, 76, 77; Coupland, 1992d: 364; Huber, 1995: units 70, 71, 72, 73, 74, 75, 76; Archibold, 1995: 64).

96.12 Caribbean savannas

Isolated seasonal and hyperseasonal savanna complexes of the Caribbean coasts, coastal basins and coastal low mountain slopes of northern South America, developed in the Rio Atrato basin and the middle Magdalena valley of Colombia, in the basin of Lake Maracaibo and on the coastal chains of Venezuela, on Trinidad.
(Hueck and Seibert, 1972, 1981: units 61, 60 *p.*; Sarmiento, 1983: 263-264; Huber and Alarcon, 1988: units 11, 12, 101, 104).

96.121 Magdalena-Atrato savannas

Isolated seasonal and hyperseasonal savannas of the Rio Atrato basin and the middle Magdalena valley of Colombia.
(Hueck and Seibert, 1972, 1981: unit 61; Hueck, 1978: 143; Sarmiento, 1983: 263).

96.122 Maracaibo savannas

Isolated seasonal and hyperseasonal savannas of the basin of Lake Maracaibo, in Venezuela.
(Hueck and Seibert, 1972, 1981: unit 59 *p.*; Sarmiento, 1983: 263; Huber and Alarcon, 1988: units 11, 12).

96.123 Caribbean cordillera savannas

Savannas of the coastal chains of Venezuela, developed in the Serrania del Litoral at altitudes comprised between 800 and 1200 metres, on the southern slopes of the Avila range and between 40 and 600 metres in the valleys of Aragua, also widespread in the Serrania del Interior.
(Sarmiento, 1983: 264; Huber and Alarcon, 1988: units 101, 104).

96.124 Trinidad savannas
Hyperseasonal savannas of the Aripo Savanna, southeast of Arima, on Trinidad, with a grassland element constituted by unit 3A.124.
(ffrench, 1976: 15; Sarmiento, 1983: 263).

96.2 Guianan plateau savannas

Savannas of the South American Guianan shield plateau in Venezuela, Guyana, Surinam, French Guiana and northeastern Brazil, combining a grassland element formed by unit 3A.2 with an arborescent component formed by *Bowdichia virgilioides*, *Byrsonima verbascifolia*, *Byrsonima crassifolia*, *Byrsonima cocolobaefolia*, *Curatella americana*, *Plumeria spp.*, *Roupala spp.*, the palm *Mauritia flexuosa* and a frutescent component comprising species of genera *Byrsonima*, *Clusia* and *Hirtella*.
(Hueck and Seibert, 1972, 1981: unit 57; Hueck, 1978: 83-84, 439; Sarmiento, 1983: 264-267; Schnell, 1987a: 409, 411; Huber and Alarcon, 1988: units 118, 119, 120, 121, 125, 129, 137, 146; Coupland, 1992d: 364; Huber, 1995: units 73, 79, 80, 81, 82, 83, 84).

96.3 Guianan coastal savannas

Savannas of the coastal lowlands of northern South America in Guyana, Surinam and French Guiana.
(Hueck and Seibert, 1972, 1981: unit 50; Hueck, 1978: 83-84; Sarmiento, 1983: 267-269; Schnell, 1987a: 438-443).

96.4 Amazonian savannas

Enclave savannas of the Amazonian forest zone in the Amazonian basin and the southern, upper, Orinocan basin, with a grassland element formed by grasslands of unit 3A.4 and a ligneous component including, in particular, *Aeschynomene paniculata*, *Bowdichia virgilioides*, *Byrsomina verbascifolia*, *Byrsomina spicata*, *Curatella americana*, *Derris spruceana*, *Hancornia speciosa*, *Huminiria spp.*, *Plumeria spp.*, *Qualea grandiflora*, *Salvertia convalliodora*.
(Hueck and Seibert, 1972, 1981: units 1, 2, 3, 4, 5, 8, 11, 14; Hueck, 1978: 43-44, 47-48, 54; Medina and Sarmiento, 1981: 635; Sarmiento, 1983: 269-271; Schnell, 1987a: 233-241; Huber and Alarcon, 1988: units 55, 56, 57; Huber, 1995: units 77, 78, 87; Archibold, 1995: 64-65).

96.5 Brazilian shield savannas

Savannas of the Brazilian shield, distributed principally in the Cerrados region of Mato Grosso, Mato Grosso do Sul, Rondonia, Goias, Minas Gerais, Tocantins, southeastern Para, southern Maranhao, western Bahia, extending northeastwards into the Caatinga region and eastwards into Paranean uplands, constituting the most extensive savanna complex in South America; the grassland component is formed by unit 3A.5. The amount of tree cover, provided by dry woodland of unit 4B.22 or its associated shrub communities, is variable and traditionally used to subdivide the complex of communities grading from pure grassland to sclerophyllous woodland into five categories, campo limpo (grassland), campo sujo (tree or shrub savanna), campo cerrado (wooded savanna), cerrado (savanna woodland) and cerradao (sclerophyllous woodland). The three middle grades are savannas, individualized here as subunits.
(Hueck and Seibert, 1972: units 46, 48, 49, 55, 56; Cabrera and Willink, 1980: 56-60; Sarmiento, 1983: 247-253; Schnell, 1987a: 326-396; Schnell, 1987b: 20-21; Coupland, 1992d: 364; Archibold, 1995: 63-64).

96.51 Brazilian shield campo sujo savannas
Savannas of the Brazilian shield cerrados region characterized by an overwhelmingly grassland physiognomy with a scattered woody layer, usually formed of small trees or shrubs, with a total cover of less than 2 %.
(Sarmiento, 1983: 246-247).

96.52 Brazilian shield campo cerrado savannas
Savannas of the Brazilian shield cerrados region characterized by a predominently grassland physiognomy with an open tree cover ranging between 2% and 15%.
(Sarmiento, 1983: 246-247).

96.53 Brazilian shield cerrado savanna
Savannas or savanna woodlands of the Brazilian shield cerrados region characterized by a tree cover of more than 15 %, most often ranging from 20 % to 30 %, or 3000-4000 trees per hectare, occasionally reaching 40 %.
(Sarmiento, 1983: 246-247).

96.6 Pantanal-Mojos savannas

Savannas of the southwestern periphery of the Brazilian shield, distributed principally in the Mojos region of northeastern Bolivia and in the Pantanal area of western Mato Grosso and Mato Grosso do Sul and of extreme eastern Bolivia and northeastern Paraguay.
(Hueck and Seibert, 1972: units 47, 58; Sarmiento, 1983: 271-273; Schnell, 1987a: 397-399; Archibold, 1995: 65).

96.61 Pantanal savannas
Savannas of the Pantanal area of western Mato Grosso and Mato Grosso do Sul and of extreme eastern Bolivia and northeastern Paraguay, region of transition between the cerrado of the adjacent Brazilian shield and the Chaco.
(Hueck and Seibert, 1972: unit 58; Loureiro *et al.*, 1982: 344; Sarmiento, 1983: 271-272; Archibold, 1995: 65).

96.62 Mojos savannas
Savannas of the Mojos region of northeastern Bolivia, in a region of transition between the Amazon basin communities, the cerrado of the Brazilian shield and the Chaco, with isolated outposts enclaved in forest areas of the Madre de Dios, Beni, Mamore system, including the Pampa del Heath in the Rio Heath valley of extreme eastern Peru. The grassland component is provided by grasslands of unit 3A.62, the ligneous element is often dominated by the palm *Acrocomia totai* accompanied by *Aspidosperma spp.*, *Celtis iguanea*, *Cassia spectabilis*, *Chlorophora reticulata*, *Chrysophyllum spp.*, *Cochlospermum trilobum*, *Croton cardenasii*, *Fagara pubescens*, *Swartzia jorori*, *Terminalia fagifolia*, *Ziziphus elegans*.
(Herzog, 1923: 110-129; Hueck and Seibert, 1972: unit 47; Parker *et al.*, 1982: 16; Sarmiento, 1983: 272-273; Schnell, 1987a: 397-399; Foster *et al.*, 1994: 65-74).

96.7 Subtropical savannas

Savannas of the Chaco, the northern Espinal and the northern Campos of northeastern Argentina, southern Paraguay, southern Brazil and northern Uruguay, developed under megathermic climate conditions.
(Martinez-Crovetto, 1963; Hueck and Seibert, 1972: units 35, 37, 54, 63, *p.*; Burkart, 1975; Cabrera and Willink, 1980: 60-62, 69-70; Burkart *et al.*, 1994; Daniele and Natenzon, 1994: regions 2, 3, 4, 5, 6, 7, 12; Carnevali, 1994).

96.8 Pacific savannas

Savannas of the Pacific lowlands and pre-Andean slopes of tropical South America, developed in the transition regions between Pacific evergreen or semievergreen rain forest regions and Pacific coastal deserts. The grassland component is constituted by ephemeral annual grasslands and forblands of unit unit 74.34, the ligneous element by evergreen or drought-deciduous woodland.
(Koepcke, 1961: 203-205; Hueck and Seibert, 1972, 1981: unit 33 *p.*).

97. WOODED DESERTS AND SEMI-DESERTS

Formations of the subtropical or coastal desert zones resulting from the colonisation by dry tropical woodland trees of shrubby or grassy semidesert or desert communities. Included are desert savannas, pseudo-steppes and sand-dune open woodlands.

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