BIOLOGICAL CONSERVATION IN SRI LANKA

(A national status report)

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PREFACE

The conservation and rational management and utilization of the Earth's resources is one of the issues being addressed by the Commonwealth Science Council in its expanded programme of science cooperation. Recognizing the importance of this programme, the Natural Resources, Energy and Science Authority of Sri Lanka (NARESA) established a Technical Committee on the Conservation of Genetic Resources and initiated several activities on the subject, one of which is the preparation of this Status Report.

This Report is not meant to give a complete coverage of the biological resources in Sri Lanka. It only seeks to give a general picture of the biological and habitat diversity in the country, the situation as regards the conservation of the biota and their natural ecosystems, and the measures that are recommended to be taken to develop a rational scheme of biological conservation. The broad survey of biological resources includes also the non-indigenous species that contribute to the economy of the country.

I am grateful to my co-authors (all of whom are members of NARESA's Technical Committee on the Conservation of Genetic Resources) for providing drafts of sections assigned to them. These drafts and other material were used in compiling the Status Report.

I am thankful to Prof. B.A. Abeywickrama and to Prof. M.D. Dassanayake for their assistance. I should also like to acknowledge my thanks to the Directors of the Tea, Rubber and Coconut Research Institutes, the Director of the Department of Animal Production and Health, and the Director of the Department of Minor Export Crops for providing the information relating to their respective subject areas, to Miss J.S. Dela, Scientific Officer, NARESA, for assisting in the compilation of the list of threatened animal species (Appendix II), and to Mrs Chandra Fernandez for word processing the entire document.

Finally I owe thanks to the Commonwealth Science Council, and to Dr Promila Kapoor in particular, for providing the financial resources that made it possible for NARESA to bring out this publication, and to Dr R.P. Jayewardene, Director General, NARESA, for his encouragement and support.

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1. THE ENVIRONMENTAL BACKGROUND

Sri Lanka is an island, 65,610 km^2 in area, situated close to the southeast corner of the peninsula of India. Sri Lanka and India have shared the same tectonic plate, known as the South-Asian Plate, since the breakup of Gondwanaland in the Cretaceous period. The two countries are separated by the shallow Palk Strait and the Gulf of Mannar. Sri Lanka lies between longitudes 79° 39' and 81°53' East and latitudes 5° 54' and 9°52' North.

The geological formations occuring in about 90 per cent of the area of Sri Lanka consist of Precambrian crystalline rocks. The other main rock types are Miocene limestone in the Jaffna peninsula and offshore islands and extending down the northwest coast as far as Puttalam and down the northeast coast to Mullaitivu, and a few square kilometers of Jurassic deposits at Tabbowa and Andigama, near Puttalam. In the overlying soils many different types have been recognized, but there are two main ones, red-yellow podsolic soils (lateritic red loams) in the wet region and reddish brown earths in the dry zone.

Considering the topography of the country, about 75 per cent of the land is seen to consist of a flat lowland peneplain (average elevation 75 m above sea level), which includes the northern half of the country and, in the southern half, forms a broad strip along the east coast and a narrow strip along the southern and western seaboard. In this peneplain, described as the first peneplain, in the northern and eastern areas, there occur isolated hills, rising up to 600 m or more, which are the remnants of erosion over long geologic periods. Within this area also occur the ruins of many hundreds of man-made irrigation reservoirs which were used for impounding water for agriculture several centuries ago.

The first peneplain rises steeply on all sides towards the south-central part of the island, and at an elevation of about 500 m a second peneplain could be recognized. Further inland, the land rises again very steeply to form a south-central mountain massif which goes up to an elevation of 2500 m. This mountainous region contains plateau-like areas which comprise a third peneplain.

The chief determinants of climate in Sri Lanka are rainfall and temperature. The rainfall shows seasonal fluctuations and is dependent on the southwest and northeast monsoons and on convectional and cyclonic effects. The mean temperature in the lowland areas is 27°C in the wet region and 30°C in the dry zone. It decreases with increase in altitude and in the montane region the mean monthly temperature varies from 13°C to 16°C, with the night temperature occasionally dropping to around zero.

The country has been divided into climatic regions in many different ways. A simplified and commonly accepted bioclimatic classification, which broadly conforms to the other classifications, recognizes the following six zones: low and mid country wet zone, montane wet zone, dry zone, arid zone, low and mid country intermediate zone, and montane intermediate zone (Fig 1).

The low and mid country wet zone covers the southwest part of the country and extends from the coast to the western and southern slopes of the central massif. There is a very high annual rainfall (from 2500 mm to over 5000 mm), and, although there are two heavy rainfall periods during the year, rainfall also occurs in the intervening months. The mean annual temperature is 27°C in the coast and, with increase in altitude, it progressively comes down to around 20°C at mid elevations.

The rainfall regime in the montane wet zone is broadly similar to that in the low and mid country wet zone, but the temperature is lower. At high elevations, on a few days in the year, the temperature drops to below zero at night, and ground frost occurs.

The term "dry zone" may be regarded as a misnomer when one considers that this region receives an annual rainfall of 1250 - 1900 mm. However, it receives its name because of the prevalence of a prolonged dry period, from May to September; and in three months, June to August, when drought conditions prevail, the rainfall is generally less than 50 mm per month. During the dry period the prevalence of strong desiccating winds accentuates the harsh conditions. The mean annual temperature in the dry zone is 30°C.

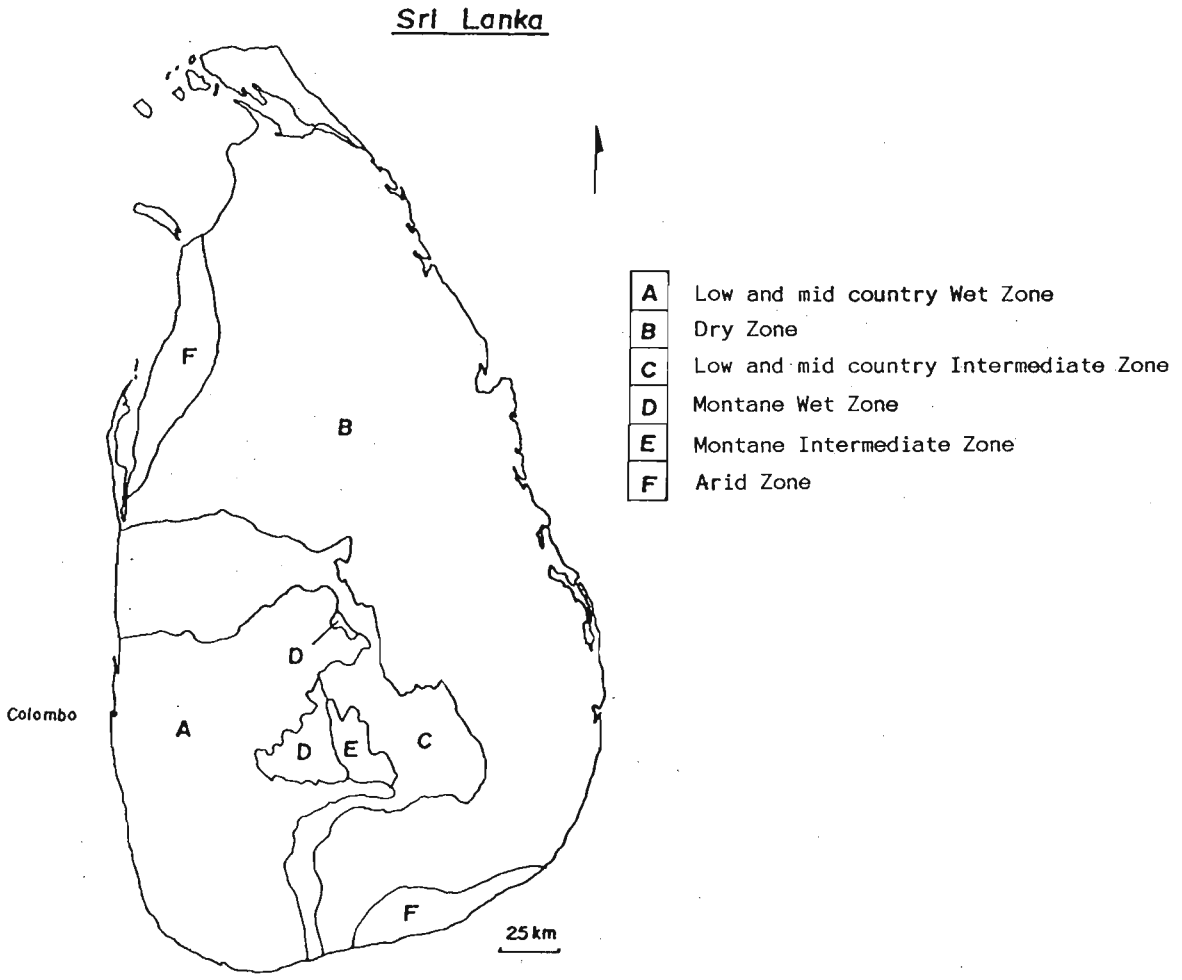

Fig. 1 Bioclimatic Zones of Sri Lanka

(Reproduced from Climate and Natural Vegetation of Sri Lanka by Yvonne Wijesinghe (Sinhala publication); Marga Institute, Colombo; 1984)

The arid zone consists of two areas in the northwest and southeast of the island. Here the mean annual rainfall is less than 1250 mm and the drought is more prolonged and more intense than in the dry zone.

The low and mid country intermediate zone, as the name implies, has a rainfall regime and temperature intermediate between those of the adjoining zones, and so is it with the montane intermediate zone.

2. NATURAL FOREST COVER - HISTORICAL DEVELOPMENTS

Sri Lanka's indigenous gene pool resides in its natural ecosystems, mainly the natural forests. The human impact on the forest ecosystems, which is largely one of deforestation, is therefore of direct relevance to a consideration of the conservation of biological resources.

Beginning in the mid eighteen hundreds forests in the southwest and south-central parts of the island, which include the montane region, began to be cleared for planting tea and rubber. Prior to planting tea, coffee was grown but had to be abandoned following a devastating spread of leaf blight.

At the beginning of the present century, 70 per cent of the land area is said to have been covered by natural forests.[1] In the mid 1940s, with the control of malaria, land settlement and population expansion took place in the dry zone, and with these developments, the rate of forest clearing increased. A comprehensive aerial photographic survey carried out, commencing in 1956, showed that the forest cover had by then dropped to 44 per cent of the land area (Fig 2).[2] A good part of the deforestation that had taken place in the intervening period was clearing for shifting cultivation. The evidence for this is seen in the same survey which showed that 15 percent of the land area was covered

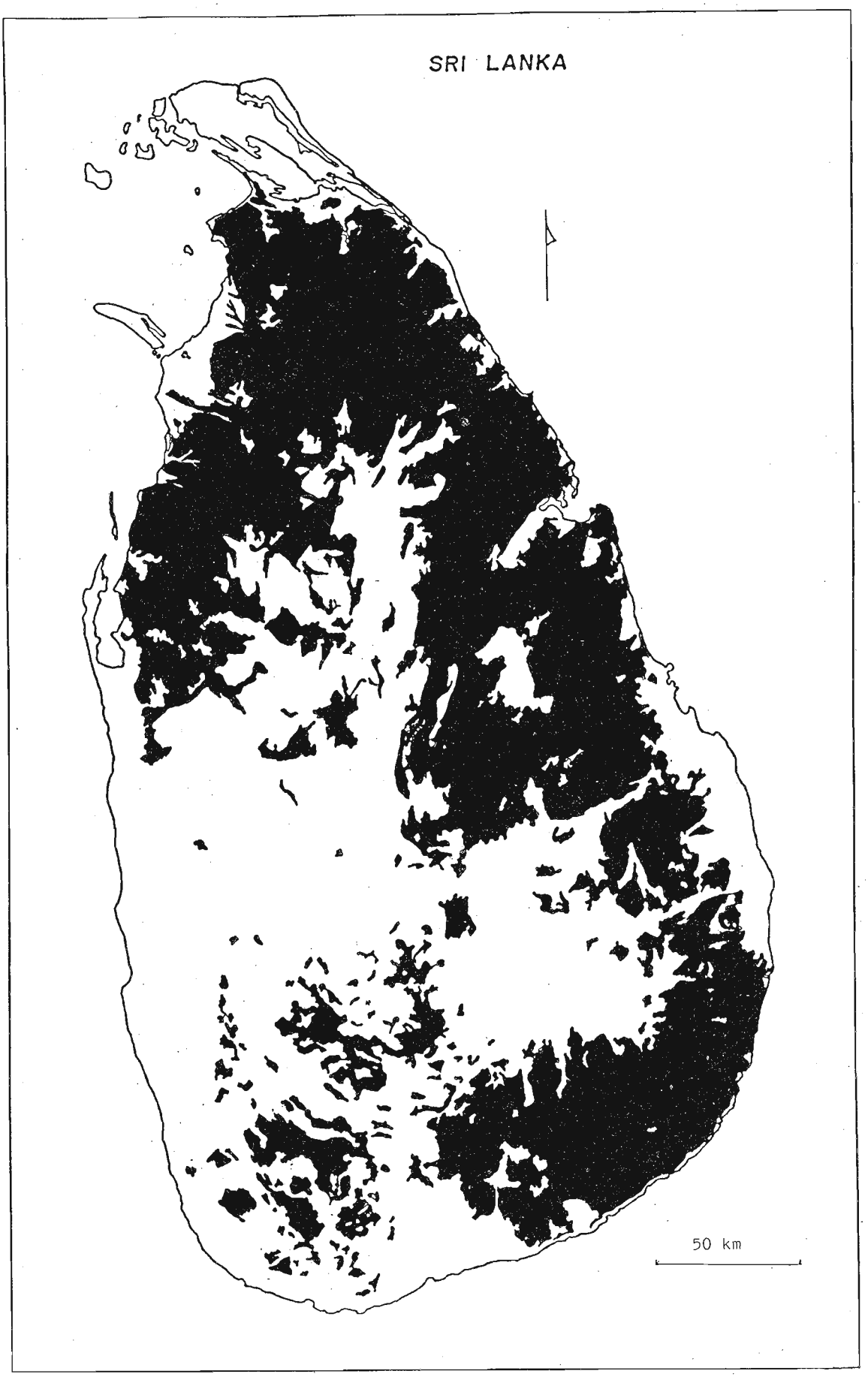

Fig.2 Forest Cover in Sri Lanka (1956 - 1961)

(Adapted from A Forest Inventory of Ceylon by J.R.T. Andrew; Forest Department, Colombo; 1961)

by shifting cultivation and land that had recently been abandoned after shifting cultivation and had not regained a tree cover (Fig 3).

From 1956 the rate of deforestation continued to increase. The estimates of forest cover made in the 1980s cannot claim the same level of precision as the 1956 computation. In 1981 a survey based on satellite imagery supplemented by ground sampling showed that the forest cover had shrunk to 24.9 per cent of the land area (Fig. 4).[3] However, an inventory carried out by the FAO two years later, in 1983, gave the area of natural high forest cover as 27 per cent of the land area.[4] Between 1981 and 1983 there was deforestation and not an increase of forest cover; hence one, if not both, estimates must contain some elements of error. Whereas the 1981 survey is supported by a forest cover map, there is no such document in the 1983 inventory.

The National Atlas published in 1988 appears to prefer the 1981 estimate of 24.9 per cent and it goes on to state that the latest figures available indicate that the natural forest cover is around 22 per cent of the land area.[1] Depending on which estimate is taken, the average rate of deforestation lies between 40,000 and 50,000 hectares per year from 1956, a rate which is very high for a country the size of Sri Lanka.

Taking the bioclimatic zones separately, the proportion of forest cover to land area has been estimated at one per cent in the low and mid country intermediate zone and nine per cent in the low and mid country wet zone.[5] The position is better in the dry zone where 30 per cent of the land is under forest, but here the forecast of deforestation is disturbing. According to the Forestry Master Plan, deforestation in the dry zone may occur at the rate of 30,000 ha per year, and even if stringent action is taken to curtail forest clearing, it will still exceed 10,000 ha per year.[6]

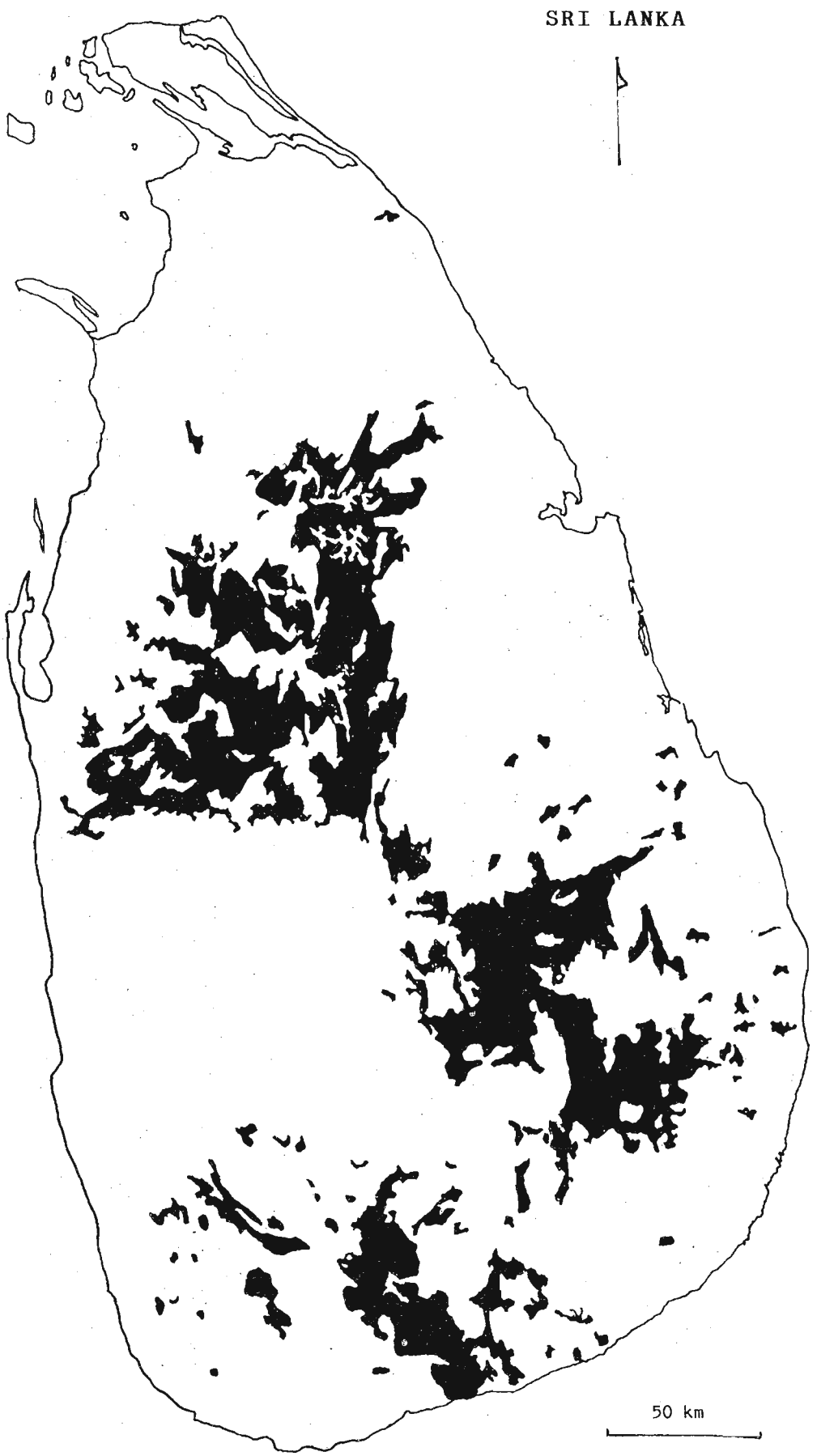

Fig. 3 Shifting Cultivation Areas (1956 - 1961)

(Adapted from A Forest Inventory of Ceylon by J.R.T. Andrew; Forest Department, Colombo; 1961)

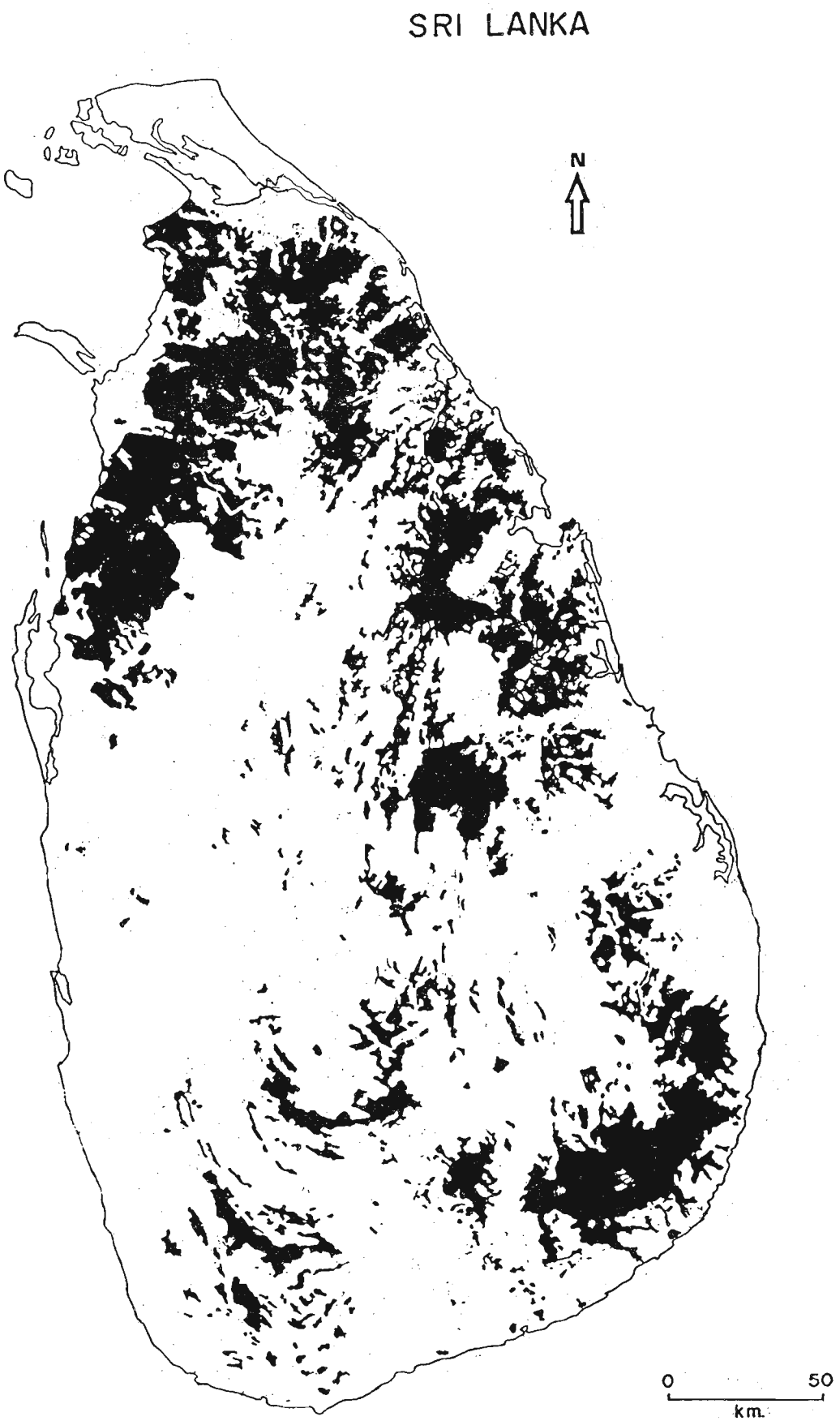

Fig. 4 Forest Cover in Sri Lanka (1981)

(From a map published by the Survey Department, Colombo)

3. THE EXISTING NATURAL FORESTS

Forest and Wild Life Reserves

Nearly all the forests in the country are state-owned. They fall mainly within the jurisdiction of two institutions, the Forest Department and the Department of Wild Life Conservation, both of which are at present under a single ministry, the Ministry of Land, Irrigation and Mahaweli Development. Most of the natural forests that fall under the jurisdiction of the Forest Department are designated Reserve Forests or Proposed Reserve Forests. The former were, several decades ago, land-marked, proclaimed reserves by gazette notification, and set apart as areas to be dedicated permanently to forestry. The supply of timber from these forests is carried out by the State Timber Corporation according to regulations prescribed by the Forest Department. Unauthorized felling and clearing (by the public) are illegal acts punishable under the Forest Ordinance.

The "proposed reserve forests" were meant to be declared as reserves. However, the tide of events over the past several decades, when forest land was diverted to uses outside the forestry sector at an increasingly rapid rate, would have rendered futile any attempt at precisely defining boundaries and land-marking the proposed reserves as a prelude to declaring them reserves. What actually took place was an erosion of many reserves and proposed reserves through encroachment, illicit clearing, and authorised clearing for agriculture and settlement, and natural forest land had perforce to be diverted to other uses on a large scale.

Besides the reserve forests and proposed reserve forests, there is another category called "other state forests". Some of these (the larger blocks) are under the Forest Department and the others under the district Government Agents. Over the years these forests were used for providing the local inhabitants with timber and other forest produce on permits, and some areas were also released for shifting cultivation. Apart from these activities covered by permits, encroachments, illicit clearings and theft of timber was widespread in these "other state forests", and there was little that the Forest Department or Government Agents could do to contain, let alone remedy, the problem.

The present position regarding "other state forests" is that (a) in the wet zone (lowland, mid country and montane), the records indicate that there are about 60,000 ha, but it is doubtful that any of this could now be recognized as forest because protection of forests outside of the reserves and proposed reserves has been virtually impossible in this region where pressure on land is severe; (b) in the intermediate and dry zones the records indicate that there are 466,000 ha of "other state forests" in the charge of the Forest Department. Here too over-exploitation, illicit felling and illicit clearing have been widespread, and large tracts would almost certainly have by now been alienated from forestry or converted into scrubland, and much of this goes unrecorded. The "other state forests" under the charge of the Government Agents are probably non-existent as forests now.

The areas falling within the jurisdiction of the Department of Wildlife Conservation are of two broad types: National Reserves and Sanctuaries. There are five types of national reserves: Strict Natural Reserves, National Parks, Nature Reserves, Jungle Corridors, and Intermediate Zones (the last-mentioned not to be confused with the bioclimatic zones of the same name). The Fauna and Flora Protection Ordinance specifies the acts that are prohibited in the different categories of national reserves and the sanctuaries, and it sets out the conditions governing entry into these areas. While all national reserves are within state land, the santuaries may include privately owned land.

The total area of national reserves declared under the Fauna and Flora Protection Ordinance is 415,000 ha, and nearly 75 per cent of this area comprises national parks, of which there are two main ones, Yala (Ruhuna) and Wilpattu, both falling partly into the dry zone and partly into the arid zone. The former is in the northwest of the country and the latter in the southeast. The total area of sanctuaries is 205,000 ha.

The total area, according to available records, of reserve forests proposed reserves, other state forests, national reserves and sanctuaries coming under the jurisdiction of the Forest Department and the Department of Wild Life Conservation is 2.3 million

hectares. In contrast, the current estimate of closed forest is 1.5 to 1.8 million hectares. One reason for the difference is that parts of the national reserves and sanctuaries are in grass and scrub and hence do not get included in a forest survey. Another, and a much more important reason is that large areas of "other state forests" and also of reserves and proposed reserves have been lost to forestry, and the records of the areas of individual forests have not been adjusted to take account of this.

In many Forest Department reports reference is made to the "forest land area", and a figure that may sometimes go as high as 39 per cent of the area of the country is given.[6] This actually refers to the land area under the charge of the Departments of Forestry and Wild Life Conservation to which is also added the area of "other state forests" under the charge of Government Agents. No claim is made that all of it is in forest, and in fact it is admitted that a substantial part of it is in scrub or is otherwise devoid of forest.[7]

Biosphere Reserves

In 1969, UNESCO launched the International Biological Programme (IBP) aimed at the rational use and conservation of the natural environment and its resources. Under this programme sectional committees to deal with different subject areas were established in each participating country. The Sri Lanka IBP sectional committee on the Conservation and Production of Terrestrial Communities (chaired by the head of the Forest Department) decided to demarcate 50-acre areas of forest in the major bioclimatic zones and to exclude such areas from any form of forest management. Out of the nine areas that were demarcated, eight were in natural forests and one in a forest plantation. The objective, in so far as the natural forest blocks were concerned, was that they would for all time remain as representative samples showing the biodiversity of the different natural forest ecosystems in the country.

In 1970, the IBP was renamed the Man and Biosphere (MAB) Programme, and the Sri Lanka MAB National Committee recommended extending the chain of biosphere reserves to cover more forests and larger areas.

The biosphere reserves invariably fell within the Forest Department's reserve forests or proposed reserve forests. The biosphere reserves have no special legal status, but the formation of "reserves within reserves" was seen as a means of strengthening the hand of the Forest Department in protecting the forest areas so identified. By 1971 a total of 36 biosphere reserves, ranging in size from 10 ha to 55,000 ha, had been named. The proliferation of biosphere reserves, both in number and size, meant a dilution in the effort at protecting them and a waning in the quality of exclusiveness that had earlier been attached to biosphere reserves. The total area of the 36 biosphere reserves, some including forest plantations, was given as 127,000 ha.[8] However, many of these reserves have not been demarcated on the ground and, when areas that have been deforested are excluded, the actual area of forest is now probably substantially less than the aggregate area given above. In fact a recent assessment carried out by the Forest Department based on inquiries made from the local forest officers indicated that the areas maintained as MAB reserves total 72,800 ha, or only a little over half what the records show.[9]

Further erosion of these reserves is bound to take place unless effective measures are taken to make their boundaries readily identifiable and to protect them from illicit felling and clearing. One of the biosphere reserves, Sinharaja (in the wet zone), has been raised to the status of an international biosphere reserve.

National Heritage Sites

In 1988 Parliament passed the National Heritage Wilderness Act, "to preserve in their natural state unique ecosystems and genetic resources and habitats of threatned species of animals and plants and for enhancing the natural beauty of the wilderness of Sri Lanka". The Sinharaja biosphere reserve, a primeval rainforest of 8900 ha, has been declared a national heritage under this Act.

4. NATURAL VEGETATION TYPES

Natural Forests

The natural forest vegetation types of Sri Lanka have been described in various ways by foresters, plant geographers and ecologists. The following table gives a widely accepted classification of the natural forest types in the different bioclimatic zones

Bioclimatic Zone	Forest Formation
Low and mid country wet zone	Tropical rainforest/Wet evergreen forest
Montane wet zone	Tropical montane forest
Low and mid elevation intermediate zone	Intermediate evergreen forest
Montane intermediate zone	---
Dry zone	Dry mixed evergreen forest
Arid zone	Semi-evergreen, thorn forest

The classification into bioclimatic zones and forest types as given in the table should not be taken to imply uniformity in the general composition of the forest within each zone. This is far from the case. It is common to find sharp changes in habitat conditions within short distances in a climatic zone. In the southwest region, in particular, as one moves from place to place , there are changes in elevation (and hence temperature), rainfall, soils, drainage, and topography. These are reflected in habitat differences which in turn result in the occurence of different associations of species in the natural forest.

Using data obtained in sample enumerations carried out for management purposes, de Rosayro recognized four high forest communities based on the dominant species in the wet evergreen forests of Sri Lanka.[10] They are: (1) The *Dipterocarpus* community dominated by *Dipterocarpus zeylanicus* or rarely by *D. hispidus*. Other associated tree species are *Vitex pinnata*, *Chaetocarpus castanocarpus*, *Dillenia retusa*, *Wormia triquetra*, *Myristica dactyloides*, *Semecarpus gardneri* and *Shorea trapezifolia*. This community is confined to low and mid

elevations. (2) Mesua - Shorea community found at mid elevations. Both Mesua and Shorea as well as Dipterocarpus which also occurs frequently in this community belong to the Dipterocarpaceae. Common associates in this community are Palaquium petiolare, Chaetocarpus castanocarpus, Mangifera zeylanica, Calophyllum tomentosum, Vitex pinnata and Myristica dactyloides. (3) Campnosperma zeylanica and other species community. This is found in the forests of the Adam's Peak range, at mid elevations. The species associated with Campnosperma are Myristica dactyloides, Chaetocarpus castanocarpus, Syzygium neesianum, Wormia triquetra and Palaquium petiolare. (4) Vitex - Wormia - Chaetocarpus - Anisophyllea community. This occurs at low elevations. Other associates are Cryptocarya wightiana, Calophyllum spp., Syzygium neesianum, Kurrimia ceylanica, Shorea trapezifolia, Urandra apicalis, Shorea congestiflora and Syzygium makul.

The fact that many species are common to more than one of the four communities would lead one to believe that there is in fact no rigid line of demarcation between one community and another. This is also the view expressed by Gunatilleke and Ashton who carried out field investigations in six sites in the wet evergreen forest.[11] They conclude that there is a continuum of floristic variation, and individual stands cannot, with any precision, be classified into one type of community or another.

In the montane wet zone, the Syzygium - Calophyllum - Gordonia Michelia association is perhaps the best known.[12] The montane forests particularly at elevations of over 2000 m have a characteristic appearance where the trees are of much smaller stature than in the wet evergreen forest, the number of strata in the forest is less, and the trees have a gnarled and twisted form, particularly the branches.

In the Adam's peak range, Greller and Balasubramaniam have recently discovered a montane forest dominated by several species of the endemic genus Stemonoporus belonging to the Dipterocarpacae.[13]

The dry mixed evergreen forest, which is the forest type found in the dry zone, is the most extensively developed formation in Sri Lanka. As expected, there is variation in species composition.

The Manilkara - Drypetes - Chloroxylon community is the most common association. Under conditions that are more humid than the average for the zone, the Alseodaphne - Berrya - Diospyros association can be recognized.[12]

In the low and mid country intermediate zone, now containing very little natural forest, the climax formation is, in physiognomy and species composition, somewhere between the wet evergreen forest and the dry mixed evergreen forest. It has been termed the intermediate evergreen forest. Some species found in each of the adjacent formations are found here too, but others like Melia dubia, Filicium decipiens, Bombax ceiba and Lagerstroemia speciosa are commoner in this zone than elsewhere.[14]

In the arid zone the formation consists of a low, open, thorny scrub with isolated trees or patches of forest containing Manilkara hexandra, Salvadora persica, Dichrostachys cinerea, Acacia spp. and shrubs of Carissa spinarum and Zizyphus spp.[14]

Grasslands

Grasslands are found in all the climatic regions, but probably nowhere forming a true climax. The best known of the grasslands are the dry montane grasslands or dry patanas, which is the dominant vegetation of the montane intermediate zone, in the region called the Uva Basin. These grasslands are dominated by the grass Cymbobogon nardus. In sheltered valleys small pockets of forest are found. At lower elevations, on the eastern slopes of the central hills, the vegetation gradually changes to a savannah type with scattered fire-resistant trees of Careya arborea, Terminalia bellirica, Terminalia chebula, Phyllanthus emblica and Pterocarpus marsupium, and the grass Imperata cylindrica.[15]

The wet patanas, or wet montane grasslands, which are very much smaller in extent than the dry patanas, occur most prominently in Horton Plains at an elevation of about 2200 m. Over most of its area the wet patanas are dominated by tussock grasses of the genera Chrysopogon, Pollinia, Garnotia, etc., while in the permanently wet sections a bamboo, Chimonobambusa densifolia, is dominant.

Dicotyledonous herbs (e.g. Anaphalis, Ranunculus, Exacum, Centella) are present among the grasses, and there are scattered trees of Rhododendron arboreum subsp. zeylanicum. Fifteen to twenty years ago seed potato farms were set up in this area. Later, when the uniqueness of this area as a natural habitat and a watershed became widely appreciated, the potato farms were moved out and the area allowed to revert to nature. Now the grasslands of Horton Plains and the adjacent montane forests have been declared a nature reserve under the Department of Wild Life Conservation.

In the lowlands, the grasslands referred to as the talawa and damana grasslands, occuring in the wet and dry zones respectively, are the result of soil impoverishment following forest clearing, shifting cultivation, and the regular firing that often occurs in the scrub which comes up when shifting cultivation is abandoned.

The wet villu grasslands, in the dry zone, occur in wetlands in the beds of abandonded reservoirs (which abound in this region), large water holes and the flood plains of rivers, notably the Mahaweli ganga.

Inland Aquatic Vegetation

In inland ponds and reservoirs aquatic and semi aquatic vegetation types occur. Common floating plants are the naturalised exotics Salvinia molesta and Eichhornia crassipes, and a common submerged plant is Hydrilla verticillata. In shallower water, rooted plants with floating or aerial leaves are found e.g. Nymphaea, Nymphoides and Nelumbo (lotus). Marsh plants are found at the water's edge.

Coastal and Marine Vegetation

The coastal vegetation consists of sea shore vegetation covering a good part of the coastline, mangroves near river mouths and on the shores of lagoons, and salt marsh vegetation in the few areas where mud flats which are periodically inundated by sea water are found. For a short distance inland from the coast there is littoral woodland. From the point of view of conservation, the mangroves, though not extensively developed in Sri Lanka, may nevertheless be considered as the most important of these ecosystems.

The total area of mangroves has generally been taken to be about 4000 ha, but recently an FAO/UNDP inventory has estimated the area at 8000 ha.[4] The tidal variation in Sri Lanka rarely exceeds one metre and the mangroves, even where they do occur, extend only a short distance inland. The dominants in any locality generally consist of one or more of the following species. Rhizophora spp, Lumnitzera racemosa, Avicennia marina, Ceriops tagal, Bruguiera gymnorhiza, Excoecaria agallocha, Sonneratia caseolaris, Acanthus ilicifolius, Acrostichum aureum and Dolichandrone spathacea.

The marine plants in the coastal waters of Sri Lanka include many species of algae, growing wherever there is sandstone or coral reef formation. Besides the algal flora there are "marine grasses" belonging to the two families Hydrocharitaceae and Potamogetonaceae.

A National Mangrove Committee was established under the aegis of the Natural Resources Energy and Science Authority. Its function is to promote research and scientific conservation/management of the mangrove ecosystem in collaboration with scientists and institutions whose activities and interest cover mangrove areas. A small national mangrove park has been established to be developed as a site for further research and study of the mangrove ecosystem.

5. FLORISTIC DIVERSITY

Sri Lanka, despite its small size, has a flora of great richness and diversity. Over 3650 species of flowering plants and over 300 species of pteridophytes have been described. Another interesting feature is the high degree of endemism; as much as 23 percent of the species of flowering plants are endemic.[16] This might at first seem surprising in view of the close proximity of Sri Lanka to the Indian subcontinent, but the reason becomes clear when one looks at the distribution of the endemics within the country. Only about six percent of the endemics are found in the broad dry zone plains of the north and east where the flora distribution would

have been influenced by the proximity to India.[5] The other 94 per cent are found in the wet evergreen and wet montane forests of the southwest and south-central part of the island, the nearest climatic analogues of which are in distant western Malesia, Seychelles and Madagascar.[11]

The indigenous flora, other than the flowering plants, comprise ferns and fern allies - 314 species, mosses - 575 species, liverworts - 190 species, algae - 896 species, and fungi - 1920 species.[17] Of the 314 species of fern and allied species, 57 are endemic. The total number of lichen species have not been established, but 110 species have been identified in the family Thelotremataceae, and of these 39 are said to be endemic.[18]

Unfortunately, the wet southwest and south-central region (with a total land area of only a fourth of the country), which is the last refugium of the vast majority of Sri Lanka's endemic flora, is also the very area that has suffered the highest level of deforestation. In the low and mid country wet zone, for example, no more than nine per cent of the land area is now under natural forest. However, despite the heavy deforestation that has occured, there can still be recognized special areas of forest whose floristic composition is of considerable interest. One of them is the Sinharaja rainforest (area: 8900 ha), perhaps the only sizable primeval forest now remaining in Sri Lanka. A phytosociological study of Sinharaja carried out by Gunàtilleke and Gunatilleke has shown that in five 5-hectare plots there were as many as 211 species, 119 genera and 43 families represented among the trees with a girth at breast hight of 30 cm and over. The endemic species accounted for 86 per cent of the individuals enumerated.[19]

Another interesting area is the Knuckles ridge, to the northwest of Kandy. Abeywickrema has pointed out that in the Knuckles, within a small area of 150 km^2 there is a sequence of vegetation types from the dry mixed evergreen forest to the wet evergreen montane forest including patches of a unique pygmy forest with small, much-branched trees, seldom exceeding one metre in height. In the Knuckles ridge, although the area is as yet incompletely botanized, over 100 fern and allied species have been recorded as against 314 for Sri Lanka as a whole and 600 for India.[20]

Recent studies in the Peak Wilderness montane forests have revealed forest formations dominated by several species of the endemic genus Stemonoporus, of the family Dipterocarpaceae, including a newly rediscovered species, S. rigidus.[13] With regard to the occurence of species of Stemonoporus in the canopy layer of the Peak Wilderness montane forest, it has been remarked that perhaps no other dipterocarps in the world exceed them in the elevation at which they occur.[21]

There are two factors that have posed a serious threat to the preservation of floristic diversity in Sri Lanka. One is the heavy rate of deforestation which has taken place in the past and will continue in the future as various development projects, village expansion schemes and new settlement projects are launched. The second factor is the selective felling of trees which cause changes in the floristic composition of the forest and a steady depletion of the trees selectively removed.

The dry zone of Sri Lanka was, several centuries ago, cleared for cultivation. At various times between the 8th and 14th centuries cultivation in the different parts of the dry zone were abandoned and forest gradually reclaimed the land. The dry mixed evergreen forest of today is therefore of secondary origin. However, because of the long period that was available for its development, it must no doubt represent the climax vegetation of this zone.Although the yield of timber per unit area from the dry mixed evergreen forest is low and the rate of growth of most of the dry zone timber species extremly slow, some of Sri Lanka's prized timbers come from this forest. Satinwood (Chloroxylon swietenia) and Trincomalee wood (Berrya cordifolia), both dry zone species, were exported to Western countries from the latter part of last century. Domestic consumption of these timbers also grew sharply and there was profligacy in their use, as, for example, when satinwood was once sawn up for producing railway sleepers. Likewise, Vitex pinnata and ebony (Diospyros ebenum) were heavily exploited. All these timbers are now scarce. A species which is now almost extinct as a result of exploitation is the variegated ebony Diospyros quaesita. In the wet evergreen forest, the species Pericopsis mooniana which produces a timber that was much in demand is now very rare.

Everywhere in Sri Lanka timber exploitation has been so heavy that today there is only a total of 47,500 ha in the low and mid country wet zone and none at all in the dry zone where the natural forests have an adequate stocking of species and size classes to permit selective forest management on a sustained yield basis.[6]

Despite deforestation and selective exploitation, the vast majority of recorded plant species are still available in the country. However, many species, once plentiful, are now considered to be threatened, and unless action is now taken to conserve selected sites for in situ conservation of species many could soon become extinct. Appendix 1 to this report gives a list of threatened species of plants.

The selection of representative areas of different ecosystems and their absolute protection is urgently necessary if the trend towards the extinction of many species is to be arrested. The question then is : what is the minimal area that should be selected at each site? In the wet evergreen forests, the large number of species present and their intimate admixture within a stand means that the number of individuals of a species found in a unit area is generally few. This in turn means that a large area has to be selected to ensure that all the species are represented and that they are found in adequate numbers. Ashton has recommended the minimum size to be 2000 ha for the mixed dipterocarp forests of Borneo to ensure that at least 200 reproductively mature individuals of all tree species would be present.[22] For want of guidelines for Sri Lanka, the same size may be adopted wherever possible in the wet low and mid country and the wet montane zone of Sri Lanka. For the dry zone, where the floristic diversity is at a much lower level, and where endemic species are few, the minimum size of a protection area can be much lower.

There are areas at present where the protective measures are reasonably effective. These include the national parks and nature reserves and just a few forest reserves such as the Sinharaja MAB reserve. What has to be done now is to make an assessment of what other ecosystem variants have to be preserved and to demarcate suitable areas for absolute protection.

The Fauna and Flora Protection Ordinance mentions seven species of orchids, sphagnum moss, and the tree Adansonia digitata as protected species of plants. Doubts have been expressed as to whether extending the list of potected species to cover other rare and endangered species would help in their conservation. It is felt that such a move may result in these species becoming "collector's items" and being removed from their natural habitats by enthusiastic plant collectors and by unscrupulous traders. Preservation of habitats is seen as a better approach to conservation than attempting to protect named plant species.

Ex situ conservation in botanical gardens, arboreta, medicinal gardens, etc. offers some scope for preserving selected indigenous species. However, it is only the botanical gardens that are well organized and maintained on scientific lines, and here the total area is very small. There are only three botanical gardens (Peradeniya, Hakgala, Heneratgoda) and their total area is less than 100 ha. There are no botanical gardens in the dry zone. The opening of more botanical gardens and of arboreta is strongly recommended.

6. FAUNISTIC DIVERSITY

Sri Lanka's fauna which has been influenced by the climatic, topographic and zoogeographic history of the country shows a high degree of diversity and several other features of interest. Almost all the general phyla are represented. The available information varies among the phyla. In general, taxonomic information on aquatic invertebrates and the vertebrate classes is fairly comprehensive, but, in respect of all groups, ecological and biological information is scanty.

Some of the general features of interest are (1) The fauna indicates the geographic history of the island in relation to the major continents in the region. The affinities of the fauna have been indicated by Crusz,[23] Mc Kay,[24] and several other authors. (2) The majority of the endemic species are found in the wet southwest region, particularly at middle and high elevations.

(3) The fauna of the dry zone is similar to the South Indian fauna. (4) The fauna shows considerable regional variation within the country. (5) There are several examples where speciation has occured as a result of long isolation in special habitats within a narrow geographic range.

Invertebrate Fauna

Invertebrates of the Inland Waters: The freshwater zooplankton is a well documented group and it is believed that almost all the species have been recorded except, perhaps, in the Rotifera. Over 40 species of protozoans, about 140 species of Rotifera, 68 species of Cladocera, 27 species of Copepoda, and numerous larval stages have been recorded. Most of the species are cosmopolitan or tropicopoliton, while none are endemic.

In the Monogenea 23 species have been reported, and it is likely that 31 other species recorded in India and Pakistan are also present in Sri Lanka. In the Hirudinea, 13 species have been recorded so far, and one of them, Placobdella undulata, a parasitic leech recorded from the Beira Lake in Colombo, is endemic.

In the Crustacea, the Ostracoda, which consists mainly of benthic and a few limnetic species, is represented by 31 species belonging to 19 genera. Eleven species are endemic and most of them are rare. In the Anostraca three species have been recorded, all in the dry zone and with very restricted distribution. Five species of Conchostraca have been recorded. The group Decapoda is represented by 10 species of shrimp, 11 species of freshwater prawns and lobsters, 7 species of freshwater crabs, and 13 species of penaeid prawns (in lagoons and estuaries). Ten of the species of decapods are endemic. Members of this group are of economic importance, especially the penaeid prawns. In the Amphipoda only two species have been recorded.

The mayflies of Sri Lanka have been very incompletely documented, but the available literature indicates the presence of 18 endemic species. Among the black flies (Simulidae), studies done so far have indicated the presence of 13 species. In the Mollusca, 31 species have been described so far, and of these 12 are endemic and found mainly in the montane and submontane region. The species Paludomus loricatus, P. neritoides and P. solidus have probably

evolved owing to long isolation of their respective mountain stream habitats.

Lagoon Habitat: The fauna of the lagoons and estuaries do not show a high degree of diversity, but they are economically important. The recorded species include five annelids, 28 molluscs, and 24 arthropods. None of these species are endemic. Among the vertebrates, the most important are the commercial fin fishes. Ecologically, lagoons and estuaries serve an important function in that they are the nursery grounds for many species of marine fish - about 136 species have been recorded.

Marine Invertebrates: A total of 201 species of crabs have been recorded. Only a few are of direct economic importance, but as a group they play an important role in nutrient cycling. In the Cephalapoda, so far 11 species belonging to four families have been recorded from the seas surrounding Sri Lanka. Sepia pharaonis and S. aculeata contribute most to the cuttlefish catches.

Coral reefs fringe a major part of the coastline of Sri Lanka, and of these the best known are those on the western and southern coasts and off Trincomalee in the east. One hundred and seventy one species in 65 genera have so far been identified.[25]

Terrestrial Invertebrates: A little over 400 species of spiders (Arachnida) belonging to 236 genera have been recorded, but it suspected that the actual number of species in Sri Lanka may be close to a thousand. Eighteen of the species are mygalomorphs (a group which includes the tarantula) and the rest are araneomorphs.

The mosquito fauna has been studied in some detail. One hundred and thirty nine species have so far been recorded, and among them are the genera Culex, Aedes, and Anopheles which are human disease vectors.

In the Coleoptera, the ground beetles (Carabidae) are represented by 140 genera and 525 species so far recorded. They are found in all the different ecological regions. Ten of the genera and 127 of the species are endemic. In the group Meloidae (blister beetles) 15 species in seven genera have been recorded; three of the species are endemic.

A total of 265 species of land snails have been recorded. The highest concentration of species occurs in the montane region (montane wet zone and montane intermediate zone). There is also a fair number of species in the low and mid country wet zone, but there are only ten species whose distribution is confined to the dry zone.

Vertebrate Fauna

Fresh and Brackish Water Fishes: The ichthyological diversity in Sri Lanka is said to be lower than expected for a tropical country close to a mainland[26]. Fifty one species of teleost fishes indigenous to Sri Lanka have been recorded.[27] Of these, 42 are believed to be typically riverine and the rest marsh-dwelling. Of the 51 species, about a third are endemic - there is no general agreement as to the exact number of endemic species.

The inland fish fauna of Sri Lanka shows some interesting features. The majority of the endemic species are found in the wet region and have a preference for clear perennial streams. Eleven species possess accessory respiratory organs indicating a capacity to live in water with a low oxygen content. True lacustrine or lake dwelling fishes are absent, and this is to be expected as there are no natural large inland water bodies.

Twenty two species of fishes have been introduced to Sri Lanka. Most of these species, inhabiting the large number of man-made reservoirs in the country, are a supplementary source of protein for the people.

The numerous land activities which have been taking place in Sri Lanka at an increasing pace in recent years have had adverse effects on the habitats of indigenous fishes. Forest clearing, intensive logging, land cultivation without proper soil conservation measures, and the heavy use of agrochemicals have both despoiled the available habitats and reduced their range. Other factors which threaten indigenous fish species are the large scale capture of ornamental fishes for trade, reclamation of marshes, dynamiting of fish in river pools, and damming of rivers resulting in reduced outflow into the floodplains downstream.

Amphibians: The amphibian fauna in Sri Lanka are represented by 39 species in ten genera. One genus, Nannophrys, and its three

species, N. ceylonensis, N. marmorata and N. guentheri, and 16 other species are endemic. Many of the endemic frogs occupy very special habitats and have a relatively small geographic range. For example, the three species of Nannophrys referred to above are found separately in the central massif, the Knuckles range, and the southern hill-range, respectively, and their preferred habitats are steep hillsides with trickling water; Philautus schmardanus, a rare bush frog, is confined to the montane wet zone; and Ramenella palmata is found in cavities formed through decay in the trunks of trees in the wet evergreen forest. The endemic species also include three of the genus Ichthyophis (limbless amphibians).

Reptiles: The Sri Lankan reptilian fauna comprise two species of crocodiles, five turtles, three tortoises, 92 snakes, 21 geckos, 16 lizards, two monitors and 21 skinks.

The two crocodile species occupy different habitats, Crocodylus porosus in estuary systems and occasionally in the main rivers, and C. palustris in the major reservoirs.

The five species of turtles that come ashore for nesting in the Sri Lanka beaches make up over half the number of turtle species found world-wide. All the Sri Lankan species are considered threatened. Of the three species of tortoises, one is a land species and two are found in freshwater. The freshwater tortoises have been captured for slaughter and their numbers have been reduced considerably.

Of the 21 species of geckos, six are endemic and rare and are generally restricted to special habitats within narrow geographic ranges. For example, Calodactylodes illingworthi has been recorded so far only from a rock cave in Maha Oya in the dry zone. Ten of the 14 agamids are endemic. As with the geckos, the endemic species are rare, and they have a restricted geographic distribution. Ceratophora, an endemic genus, has three species and they are confined to different geographic areas: C. stoddarti in the Knuckles mountain range, C. tennenti in the central massif, and C. aspera in the mid elevation wet evergreen forests in the south. Of the 21 species of skinks, as many as 17 are endemic and all of these are rare. The two species of monitor found in Sri Lanka are Varanus cepedianus and V. monitor (the water monitor); the latter is a protected animal under the Fauna and Flora Protection Ordinance.

Thirty-nine of the 92 species of snakes are endemic. Among the non-endemic species are 13 sea snakes. The venomous species are two species of krait, the cobra, and two vipers. The majority of endemic species are small, non poisonous and live in litter and humus, and with the expansion of modern agricultural practices involving the use of high levels of agrochemicals, these species are at risk.

Birds: Three hundred and ninety species of birds have been recorded in Sri Lanka up to now. Among these there are 169 migrant species and 20 endemic species. The majority of the endemic species are found in the wet southwest region of the country, and today they are mostly confined to the natural forest areas.

The migrant species arrive in Sri Lanka towards the end of August and leave the following year during April and May. Waders, ducks and wagtails are the main migrant groups, and they are generally associated with wetland habitats.

Out of the total number of species found in Sri Lanka, as many 57 have appeared in various international lists as vulnerable or threatened. Recent observations have shown that 11 of these species are seriously threatened in Sri Lanka. Among them are Ephippiorhychus asiaticus with only 13 birds so far recorded, all in the Yala National Park; Centropus chlororhynchus, confined to the undisturbed lowland wet evergreen forests; Myiophoneus blighi, probably not found outside Horton Plains; and Alcedo meninting phillipsi, confined to the eastern foothills of the central massif and with only around ten sightings in the past century.

Mammals: The terrestrial mammalian fauna of Sri Lanka may be said to be large when compared to other islands of similar size. A total of 86 indigenous and ten introduced species have been recorded. The indigenous species comprise 30 bats, 23 rodents (including a species of hare), 14 carnivores, 7 artiodactyls, 6 shrews, 4 primates, and one each of the elephant and pangolin. Twelve of the species are endemic; they are four shrews, five rodents, one carnivore, and two primates. Four endemic species belong to monotypic genera: Feroculus and Solisorex (shrews), and Coelomys and Srilankamys (rodents).

A noticeable feature of the mammalian fauna is the prominent subspecies manifestation through colour variation e.g. Presbytis senex (purple-faced leaf monkey) with five subspecies; Ratufa macroura (giant squirrel), with three subspecies; and Funambulus palmarum (palm squirrel), with five subspecies.

The distribution of indigenous mammalian fauna follows very closely the distribution of the natural vegetation types. Also, as with the flora, the highest diversity is seen in the low and midcountry wet zone, and no doubt the low percentage of forest cover in this region threatens the survival in Sri Lanka of many of the mammalian species.

Among the large mammals in Sri Lanka, perhaps the best known is the elephant, Elephas maximus. Today they are found only in the dry zone. Even within this zone the clearing of forests for agriculture and settlement in recent years had inevitably led to a dimunition in their numbers, and crude estimates have put the present population at 2500 to 3000. Action is being taken by the Department of Wild Life Conservation to preserve adequate areas of natural forest, strategically located, for protecting this species.

Other mammalian macrofauna indigenous to Sri Lanka include several species of deer (Muntiacus sp., Cervus spp.), the bear (Melursus ursinus), and the leopard (Panthera pardus) and other species of the cat family (Felis spp.).

In the ocean surrounding Sri Lanka 37 species of Cetacea have been recorded, and these include the sperm and blue whales which are found in large numbers close to the coast off Trincomalee. There is one very rare species of Dugong off the Kalpitiya coast in the northwest.

Conservation

Despite its relatively small size, Sri Lanka possesses a fauna (and a flora) of great diversity. In the early part of this century natural ecosystems covered a good part of the country, and conservation of the indigenous fauna and flora was not a matter for concern. In recent decades, however, deforestation and the despoiling of the natural environment have taken place at an alarmingly rapid rate and there is now a pressing need to take

positive action to safeguard the indigenous fauna and flora of the country.

Within the natural forests are found the habitats of the vast majority of Sri Lanka's indigenous species. Many species of endemic fauna show special adaptations to survive in their particular ecological niches, and the large scale clearing of natural forests has resulted in a rapid decrease in their populations which threatens their survival. Coral reefs have suffered as badly. Mining for the production of lime, the collection of corals and coral fishes, and pollution caused by the soaking of coconut husks in coastal waters have resulted in a serious destruction of the coral reefs off the southwest coast.

Used wisely, Sri lanka's natural resources are adequate to sustain its population while still leaving sufficiently large areas of natural ecosystems for conserving the fauna in their natural habitats. On the positive side, Sri Lanka has relatively large areas set apart as National Parks, but unfortunately, these areas are mostly in the arid zone and the adjacent areas of the dry zone where animal diversity is not of a high order.

According to the International Red Databook of IUCN there are only 43 threatened animal species (distributed among the different categories endangered, vulnerable and rare) in Sri Lanka. The list is small only because of the lack of recorded information about other species, and there is no doubt that the number of threatened species is far larger. Appendix II gives a provisional list of threatened species of fauna in Sri Lanka.

The legal and administrative measures taken by the Government for conserving the fauna and flora make an impressive list; these have been documented up to the year 1973 by Crusz.[28] More recently, Erdelen has discussed various issues affecting the conservation of fauna and flora in Sri Lanka.[29] Although many legal enactments and regulations for protecting the indigenous fauna and flora exist, their implementation has left much to be desired. What is now required is purposeful action to identify, demarcate and conserve adequate areas of natural ecosystems for preserving Sri Lanka's rich heritage of indigenous fauna and flora.

7. CROP GENETIC RESOURCES

Sri Lanka is an agricultural country where a variety of field crops have been cultivated for centuries and where traditional farming practices abound. The traditional farmlands in the diverse agro-ecological regions have harboured a wide range of "land race" populations. However, with the advent of modern agriculture and the implementation of efficient agricultural extension programmes, many of these traditional land races of crop plants, notably those of rice, have been systematically replaced by newer breeds of high yielding cultivated varieties or cultivars.

Crop genetic resources also include spices, for which Sri Lanka is well known, plantation crops - tea, rubber and coconut, a variety of horticultural species, and numerous forest plantation species.

Rice

Rice, *Oryza sativa*, is Sri Lanka's staple food and is the backbone of its agriculture as well as its culture. The long agricultural history based on rice culture and the wide range of eco-edaphic conditions present in the country have endowed Sri Lanka with wide varietal diversity in this species. The Director of the International Rice Research Institute in the Philippines once stated that "Sri Lanka is a gold-mine for rice genes. While there are 120,000 cultivars of rice in the whole world, this small island has 2800 varieties recorded so far". In addition, a number of wild relatives of rice are widely distributed throughout the island. These include *O. rufipogon*, *O. eichingeri*, *O. nivara* and *O. granulata*, whose live collections are maintained by the Plant Genetic Resources Centre of the Department of Agriculture.

Indigenous rice varieties have shown wide adaptability to adverse conditions of soil alkalinity, acidity and salinity. Traditional varieties grown in uplands are well known for their drought tolerance, while varieties grown in the coastal areas and in the flood plains of rivers possess tolerance to submergence and flash floods. At higher elevations (over 1000 m) the few rice varieties cultivated show tolerance to low temperature.

This wide range of rice germplasm has generated outstanding gene sources for a variety of useful traits. Most outstanding are the varieties with broad-based resistance to serious pests like the brown plant hopper, leaf roller and thrip, and those with tolerance to iron toxicity and other adverse soil conditions. In the screening of rice germplasm at present emphasis is generally given to the identification of source material with resistance to pests and with adaptibility to the different agro-ecological conditions prevailing in the country. However, there are many other attributes for which a number of traditional rice varieties are renowned among the farmers. Among these, medicinal properties are claimed for varieties like kaluheenati and dhanahal. El wee and heenati are used as a weaning food and during convalescence after illness. Among fragrant varieties are suwandal, and among varieties with superior eating quality are suduru samba, muthu samba, kuruluthuda, etc. Wild rice varieties tolerant to high salinity are known from the peaty marshes of Muthurajawela.

Systematic collections of rice germplasm have been maintained since 1967 in Rice Breeding Stations at Batalagoda, Maha Illuppallama, Gannoruwa and Bombuwela, and also in several other regional agricultural research stations. In addition to ex situ conservation of live collections of rice cultivars in these research stations spread over different climatic regions of the country, a large collection of diaspores is preserved in a modern Plant Genetic Resources Centre recently established at Gannoruwa, Peradeniya. The status report of the Plant Genetic Resources Centre (PGRC) prepared in October 1988, records 2164 collections of traditional and improved cultivars of rice and 89 collections of wild relatives and weedy races of O. sativa.

Coarse Grains

Millets, sorghum and maize are the other cereals grown in Sri Lanka. Among the millets commonly cultivated by traditional shifting cultivators are Eleusine coracana (finger millet; S:* kurakkan), Setaria italica (foxtail millet or Italian millet; S: tanahal), Panicum miliaceum (common millet; S: meneri) and Paspalum scrobiculatum (kodo millet). Up to January 1988, 104 collections of Eleusine coracana, 11 collections of Panicum miliare (Little millet),

* "S" denotes Sinhala names

44 collections of Setaria italica and 9 collections of Paspalum scrobiculatum have been stored at PGRC. Three finger millet cultivars (CO-10, JNR 3B-1008 and HPB 83-4) suitable for use in cropping patterns in rain-fed farming in the dry zone have been evaluated for release.

Millets have a great potential on account of their high nutritional value, high degree of drought tolerance, and resistance to spoilage. However, this crop has received inadequate attention over the years and this has resulted in a reduction in the genetic variability. Millet germplasms need to be collected on a much larger scale than at present and they should be assessed for their utility and breeding value. This is extremely important in the context of agricultural development in the Mahaweli development area and in other large irrigation schemes in the dry zone.

Sorghum is grown to a very limited extent and only in the drier parts of the country. A variety with red and white compact panicles and another with loose panicles known as 'rice sorghum' have been encountered. Rice sorghum has loose panicles with rice-shaped grains without glumes, and it can be cooked like rice. This variety may have potential for future exploitation and needs further investigation. Maize is widely cultivated in the dry zone for human consumption and for animal feed. Up to January 1988, 71 collections of Zea mays (maize) and 31 collections of Sorghum bicolor (sorghum) have been stored at the PGRC. Six promising cultivars of maize (Comp. 6, Across 7843, Across 7929, Across 8140, Poza Rica 8140, and Poza Rica 7931) obtained through varietal improvement programmes have been released for cultivation. Of these, Poza Rica 8140 is known to have a high lysine and typtophan content while Poza Rica 7931 is an early maturing variety.

Coix lacryma-jobi (S: kirindi) and Echinochloa frumentacea (S: rajamarata), both of which have yet unexploited potential as grain cereals, are reported as growing in the wild.

Grain Legumes

Grain legumes which constitute an important source of protein, particularly for rural communities of Sri Lanka, are being systematically incorporated into crop diversification programmes.

The collection of local and introduced germplasm material for yield characteristics as well as for site specificity is being done by the PGRC. Up to January 1988, 143 collections of Vigna unguiculata (cow pea), 29 collections of Vigna radiata (green gram), 19 collections of Vigna mungo (black gram), 13 collections of Macrotyloma uniflorum (horse gram), 30 collections of Psophocarpus tetragonolobus (winged bean), 16 collections of Canavalia ensiformis (sword bean), 15 collections of Phaseolus lunatus (Lima bean), 18 collections of Vigna umbellata (S: boo ma), 8 collections of Lablab niger (lablab), 8 collections of Pisum sativum (pea), 4 collections of Glycine max (soya bean), 3 collections of Mucuna pruriens (velvet bean) and 1 collection of Pachyrrhizus sp. (yam bean) have been stored by PGRC at Gannoruwa.

Cajanus cajan (pigeon pea), grown mostly as a backyard crop in isolated areas, was decimated by acute pest problems. Wild relatives of pigeon pea such as Atylosia (S: wal-kollu), Rhynchosia and Dunbaria, and wild species of Glycine and Mucuna, some of which are already facing extinction in their natural habitats, need to be conserved in both in situ and ex situ germplam conservation centres.

Vegetables

Of the cucurbitaceous vegetables, 49 collections of Momordica charantia (bitter gourd), 5 collections of Momordica dioica (wild bitter gourd; S: thumbakarawila), 11 collections of Trichosanthes anguina (snake gourd), 2 collections of Trichosanthes cucumerina (wild snake gourd; S: dummella) 38 collections of Luffa acutangula (S: wetakolu), 8 collections of Luffa aegyptica (wild luffa; S: niyan wattakolu), 89 collections of Cucurbita spp. (pumpkin), 11 collections of Benincasa hispida (ash pumpkin) and 86 collections of Cucumis spp. have been made by PGRC up to January 1988.

Among the solanaceous vegetables, 63 collections of Solanum melongena (S: wambotu), 39 collections of elabatu and 26 collections of Lycopersicon esculentum (tomato) have been made by PGRC up to January 1988.

Among the other vegetables, 98 collections of Phaseolus vulgaris (bean), 148 collections of yard-long bean, 119 collections of Hibiscus esculentus (okra), 23 collections of Amaranthus spp.

(amaranth) and 208 collections of wild and cultivated varieties of Capsicum have been made.

Root and Tuber Crops

Under a collaborative programme with the International Development Research Centre of Canada, systematic efforts are currently being made to assemble and evaluate local and introduced root and tuber crop germplasms. Sweet potato (Ipomoea batatas), of tropical American origin, has been in cultivation in Sri Lanka for such a long period of time that it is now naturalised. The current annual extent of sweet potato cultivation is 6300 ha, mainly as a rain-fed small-holder crop. The national average yield is 8-10 tonnes per hectare, and the total productive capacity, 65,000 tonnes per year.[30] Two promising hybrids (CARI-9 and CARI-242) with excellent culinary qualities and higher yields than the traditional varieties like Wariyapola have been developed. Over 71 accessions of sweet potato are maintained at the Central Agricultural Research Institute (CARI), Gannoruwa.

Cassava has been in cultivation for nearly 200 years since it was introduced by the Dutch in 1796. Cassava is cultivated in almost every district, except perhaps in extremely dry areas, as a rain-fed crop. During the period 1978-1982, a total of 53,646 ha was cultivated with cassava and the average yield was reported to be 9.7 tonnes per hectare by the Department of Census and Statistics. Most of the "varieties" found in Sri Lanka are considered to be derivatives of orginal stocks selected by farmers from open pollinated seedlings. In 1948, Chandraratne and Nanayakkara identified 75 races,[31] and, through hybridisation, improved higher-yielding genotypes with low HCN content were obtained.

A nationwide germplasm collection and evaluation of cassava and their hybridisation resulted in the selection of two promising cassava varieties, namely CARI-555 and CARI-526. The local cassava germplasm shows much variation in tuber yield, shape and size, and the quality is rather poor except in a popular variety known as Mu-51. For genetic upgrading of cassava in Sri Lanka, a stock of hybrid seeds of 30 crosses were received from CIAT, Colombia, in 1985. The selected exotic hybrids showed extensive morphological

variation and a wide range of apparently desirable characters such as high tuber yield; good harvest index; high tuber number; low rind thickness; erect, non-branching and vigorous growth habit; long leaf life; and ease of harvesting. Six more clones of cassava varieties with desirable characters such as high yield and dry matter content, low HCN content, resistance to CMD and mealy bug, and tolerance to moisture stress were received in 1986 from IITA, Nigeria. At the CARI, Gannoruwa, 128 native collections and 80 exotic accessions of cassava germplasm are maintained and being evaluated for improvement and propagation.

A total of 29 accessions of Dioscorea yams belonging to the species D. alata, D. esculenta, D. rotundata, D. bulbifera and D. pentaphylla are maintained at CARI.[32] In the course of a research project on tuber crops Harischandra et al have characterised and evaluated 342 accessions of Dioscorea species from nine administrative districts of Sri Lanka, 13 accessions of D. alata from Puerto Rico, and one accession of D. rotundata from Nigeria.[33]

Among the aroids, 21 accessions belonging to species of Xanthosoma, Colocasia and Alocasia have been collected. Nineteen accessions of the popularly grown root crop Solenostemon rotundifolius (S: innala) are being evaluated at present at CARI. Germplasm of Maranta arundinacea (arrow root), Amorphophallus spp. and Helianthus tuberosus (artichoke) are also available.

Spices and Other Economically Useful Plants

Sri Lanka has been world-renowned for its spices since early historical times. There are at least seven or eight species of Cinnamomum in Sri Lanka including a recent discovery named C. sinharajanse Kosterm. from the Sinharaja forest. The highly aromatic bark of the cinnamon of commerce has been collected from wild trees of C. zeylanicum (C. verum) from the earliest times. Ibn Batuta in the fourteenth century, and Nicolo Conti in the fifteenth, both refer to it. However, cultivation which is now widespread in the southwestern coastal areas appears to date back only as far as the Dutch period (1650-1796 AD). The wild species are restricted to the natural forests of the wet zone. A germplasm collection of wild species and cultivated variations is maintained by the Department of Minor Export Crops (DMEC) at Matale and Matara.

Elettaria cardamomum (L.) Maton is represented in Sri Lanka by the variety cardamomum which is widely cultivated in the cool mountain slopes of the Nuwara-Eliya, Ratnapura, Kandy and Matale districts, under the shade of the natural forest canopy, and a wild variety, major, commonly found in lowland rain forests. Over 120 accessions of germplasm of the cultivated variety have been collected. Many intraspecific hybrids of the variety cardamomum are available at the Gammaduwa substation of DMEC. Foreign germplasm material has also been introduced recently.

Piper nigrum (pepper) and Piper betle (betel) are both widely cultivated in the lowland wet and intermediate zones of Sri Lanka. Considerable genetic diversity is shown by the cultivated as well as the wild species of the genus Piper. In a study of the genus Piper, seven wild species, P. argyrophyllum, P. attenuatum, P. chuvya, P. sylvestre, P. thwaitesii, P. trineuron and P. zeylanicum, and three cultivated species, P. longum (S: tippili), P. betle and P. nigrum were identified. About 500 local selections of Piper nigrum are currently being maintained, out of which ten have been found promising. Varieties introduced from India (Panniyur 1) and from Malaysia (Kuching), along with local selections, are recommended for cultivation.

Syzygium aromaticum (clove) is widely cultivated in home gardens of the Kandy and Matale districts, and a representative collection of germplasm is maintained at DMEC. Field collections of Areca catechu (arecanut or betel nut) are also maintained at DMEC, but their wild relatives such as A. concinna are considered endangered in the wild.

Three species of nutmeg are present in Sri Lanka. Over 30 high yielding mother plants of the cultivated species, Myristica fragrans, have been identified in the Kandy district. Two accessions of vanilla (Vanilla fragrans) are available at DMEC. The citronella germplasm collection at DMEC consists of 250 accessions and these include the Sri Lanka type or Heen pengiri (Cymbopogon nardus), the Java type or Maha pengiri (C. winterianus) and the wild type or Mana (C. nardus var. confertiflorus). There are ten accessions of the lemon grass, (C. flexosus).

Two species of chilli in cultivation are Capsicum annuum (S: miris) and C. frutescens (S: kochimiris). Both local and introduced selections made at the Regional Agricultural Research Stations have been released for cultivation. There are two accessions each of Zingiber officinale (ginger) and Curcuma longa (turmeric) at CARI.

Limited progress has been made in the collection of germplasm of oil crops such as Sesamum indicum (sesame), Ricinus communis (castor) and Helianthus annuus (sun flower) and fibre crops such as Gossypium herbaceum (cotton) and Hibiscus cannabinus (kenaf).

Horticultural Crops

Many varieties of banana locally known as anamalu, bim-kehel (dwarf plantain), embul (sour plantain), hondarawalu, kolikuttu, poovalu, suvendel and rath kehel are grown throughout the country, primarily as a home garden crop. Another popular variety 'seeni kehel' (sweet plantain) is a robust one which not only survives under adverse ecological conditions but is also resistant to many pests and diseases affecting other varieties. A small live collection of the different varieties is maintained at CARI. Two wild relatives of banana, Musa balbisiana and M. acuminata, are present in Sri Lanka.

Two important fruit crops that are under threat are Citrus aurantifolia (lime) and C. sinensis (sweet orange). A serious genetic erosion due to virus and fungal diseases and drought depleted the diversity and genetic variability of these species several decades ago. There is an urgent need to collect the existing germplasm for conservation. Some promising introductions from abroad have also been made recently. Feronia limonia (wood apple) is another popular native fruit tree with much potential for improvement but still collected mostly from the wild and now almost restricted to the wildlife reserves of the dry zone. This species should receive high priority in in situ conservation and plant improvement.

The other fruit crops such as mango (Mangifera sp.), jak (Artocarpus heterophyllus), avocado (Persea americana), mangosteen (Garcinia mangostana), durian (Durio zibethinus), rambutan (Nephelium lappaceum), guava (Psidium guajava), papaw (Carica papaya) and pomegranate (Punica granatum) have been in cultivation for a long

time, and through introductions and selections they exhibit wide variability. However, germplasm collections of these important fruit crops have not been made either from the wild or from cultivations, and their systematic collection before it becomes too late is strongly advocated.

A number of other fruit crops found mostly in home gardens are Aegle marmelos (S: beli), Annona spp. (S: anona); Cynometra cauliflora (S: nan-nan) and Averrhoa carambola (S: kamaranga). Among the wild fruit species not yet brought into cultivation but having promise for improvement and popularisation are Phyllanthus emblica (S: nelli), Tamarindus indica (tamarind), Euphoria longana (S: mora), Dialium ovoideum (S: gal siyambala) and Garcinia quaesita. These are exploited from the wild at present and no serious efforts have been made for their cultivation. Rapid deforestation, particularly in the dry zone, have seriously affected the wild populations of these species and a systematic collection of their germplasm is urgently needed.

Major Plantation Crops

Tea: The Assam species of tea, Camellia assamica Masters (C. sinensis var. assamica), was introduced into Sri lanka in 1839 but was commercially grown only in 1867 after the collapse of the coffee plantations which were decimated by the blight fungus Hemileia vastatrix. Tea is now grown on 201,000 hectares, from almost sea level up to c. 2000 m, yielding about 225 million kg of tea each year. Tea exports account for 30 per cent of the foreign exchange earnings of the country.

The original germplasm introduced from Assam has been subject to breeding and selection for over a century and the selected germplasm is being closely conserved in various breeding stations and tea estates in Sri Lanka. The commercially culivated tea in Sri Lanka today consists of natural hybrids of three main 'types'. They are the China type (C. sinensis L.), the Assam type (C. assamica Masters) and the Cambod or Southern type regarded as a subspecies of the Assam plant and named C. assamica subsp. lasiocalyx Planch.

Until the 1950s tea plantations were raised from seeds selected on the basis of leaf type rather than yield. At present, over 70 per cent of the total tea area is under seed tea of highly mixed types

and a high proportion of these bushes are low-yielding China or China hybrid plants. The vegetative propagation techniques developed in the 1930s and introduced into plantations in the early 1950s have made it possible to propagate efficiently the outstanding hybrids selected from breeding programmes of the Tea Research Institute (TRI). The yield of made tea from seed tea was around 600 kg. Intense selection procedures and subsequent vegetative propagation have produced a series of clones of tea with high yields; resistance to pests, disease and drought; a high rate of fermentation; etc. The yield potential of clonal tea in the higher elevations is 2500-3000 kg per hectare per year while in the lower elevations it is 4000-5000 kg and may even go up to 8000 kg. Although high yields have been realised in the low country, the overall mean yield of clonal tea in these areas at present has been found to be only 1840 kg per hectare per year due to the widespread incidence of pests (the situation being aggravated by large scale planting of one or two clones), and the occurence of periodic droughts.[34] A series of improved selections have been recommended for planting in Sri Lanka from time to time. At present, 30 clones have been recommended for the high elevation zone, 24 for mid-elevations, and 24 for the low elevation zone. Germplasm conservation through the establishment of germplasm banks is being carried out by the TRI, and experimental work in tissue culture has been started.

Rubber: Almost all the rubber plantations in Sri Lanka and other South and Southeast Asian countries, have, for nearly a century, been cultivated with a highly inbred selection of lines derived from 1919 seedlings introduced into Sri Lanka from South America via Kew Gardens, U.K., by Henry Wickam in 1876. The narrowing of the genetic base continued with the introduction of clonal propagation, and the directional selection for higher yield and disease resistance further eroded this limited genetic variability.

In 1981, Hevea breeders of member countries of the International Rubber Research and Development Board (IRRDB) ventured on an expedition to collect wild Hevea germplasm mainly from three western states of Brazil, namely, Acre, Rodonia and Mato-Grosso. A total of 64,736 seeds were collected and, in accordance with the Intenational Code of Plant Collection, 50 per cent of these seeds were retained

in Manaus, Brazil, and the balance was sent to Malaysia (75 per cent) and Ivory Coast (25 per cent) which acted as distribution centres for Asia and Africa respectively. Besides seeds, the collection included budwood from 194 potentially high yielding seedling trees. Sri Lanka has already received about 6000 accessions from Malaysia from this germplasm collection and another 4000 are expected in 1989 and 1990. A germplasm garden and a multiplication centre have been established at the Neuchatel State Plantation in the Kalutara District, and another, in the Hantana hills of the University of Peradeniya, is being planned.

Coconut: The total area under coconut cultivation was estimated at 405,000 ha in 1985. Serious attempts to assemble coconut germplasm were begun in 1960 when seven forms of the variety Nana, three of the variety Typica, and two each of the varieties Aurantica, San Ramon and West African Tall were established as representative collections. A programme for the purification of local germplasm through self-pollination was carried out at Bandirippuwa Estate, Lunuwila, and this led to the establishment of field gene banks for San Ramon and the dwarf palm. In the mid 1980s a programme was launched where estates likely to have had a single source, and where palms which showed desirable characteristics were present, were identified and collections made. These collections were planted, each accession at two of three selected locations at Bandirippuwa, Poththukulama and Minneriya.

Collections of germplasm of different forms of coconut, both local tall forms and other introduced varieties which have now been naturalised, such as dwarf types and San Ramon, have been made.

Recently, collections were made from palms which survived a prolonged drought with a view to developing drought tolerant cultivars.

Miscellaneous Economic Crops

Tobacco: In Sri Lanka, about 22,000 ha of land are utilised for tobacco cultivation, primarily in the hills of the Kandy, Nuwara Eliya and Matale districts, and also on the banks and flood plains of rivers. Very little information is available on the germplasm of tobacco, most of which is imported from overseas.

Sugarcane: After several unsuccessful attempts during the past 150 years, sugarcane plantations were established about 30 years ago. In the eastern low and mid country intermediate zone, in Wellawaya and Moneragala, 10,000 ha of land have been allocated to two multinational companies for sugarcane cultivation, and the State Sugar Corporation will develop 14,000 ha of plantations under the Sevenagala project. The newly established Sugar Cane Research Institute is collecting germplasm for breeding purposes.

Cashew: Anacardium occidentale (cashew) is cultivated on a commercial scale in the northwestern coastal districts. This tropical American tree, introduced to Sri Lanka by the Portuguese, is cultivated in home gardens as well. Although there appears to be wide variability in the species, no systematic germplasm collection has been made.

Palmyrah: There is an estimated total of 11 million palmyrah palm (Borassus flabellifer) trees in the country, distributed over 24,500 ha, mainly in the districts of Jaffna, Killinocchi, Mannar and Mullaitivu. The Palmyrah Development Board established in 1978 has taken charge of the development of the palmyrah industry through improved production, processing and marketing.

Forest Plantations

That the exploitation of natural forests, as a means of sustained production of timber, had serious limitations was perceived by the government even as far back as a century ago. This prompted the forest officers at the time to raise forest plantations, although on a very small scale at first. Teak (Tectona grandis), an exotic species to Sri Lanka, was perhaps the first species to be raised as a forest plantation. This was done at different sites, mainly in the dry zone. Another exotic species, Swietenia macrophylla, the broad-leaf mahogany, was also planted towards the end of last century, in the intermediate zone lowlands, around Kurunegala.

In the early part of the present century, and up to the 1950s, plantation trials were carried out with numerous exotic species, and when some of them showed promise, they were planted on a management scale. Most of the trials were carried out in the montane zone where there was a demand for fuelwood for domestic use, for the tea

industry and for the railway. Eucalyptus is the plant that received the greatest attention in these forestation activities. In 1947, a study of eucalyptus planting in Sri Lanka revealed that there were no less than 20 species among the plantations and individual trees in the country.[35] Eucalyptus microcorys, E. grandis and E. robusta were the species that had been raised as plantations on a large scale. E. citriodora, E. pilularis and E. globulus had been planted on a smaller scale. In the 1950s Eucalyptus was introduced to the lowlands, E. deglupta to the wet zone and E. camaldulensis to the dry zone. Recently, two other species, E. torelliana and E. tereticornis have been found to give promising results in the wet and dry zones respectively, and the latter is now being planted on a management scale.

In the early forestation activities in the montane zone, besides the species of eucalyptus referred to above, other exotic hardwood species like Cedrela spp., Tristania conferta, Acacia melanoxylon and Acacia mollissima were planted. Several softwood species were also tried out and, of these, three, namely, Pinus patula, P.caribaea and Cupressus macrocarpa were extended to management scale planting. In the 1960s Pinus trials were extended to the lowlands, and Pinus caribaea var. hondurensis was found to be suitable for planting in degraded lowland sites in the wet zone. From the 1970s, using appropriate varieties, P. caribaea began to be planted extensively in the low and mid country wet zone and the montane intermediate zone.

Meanwhile, from the late 1950s onwards, in the dry zone, extensive planting with teak was carried out year after year. Eucalyptus camaldulensis, Eucalyptus tereticornis, and a species of bamboo, Dendrocalamus strictus, were also planted, but on a very limited scale. At various times in the past, Casuarina equisetifolia (in sandy tracts in the dry zone), Prosopis juliflora (in the arid zone), and Gmelina arborea (in the lowland intermediate zone) were planted.

In the wet zone lowlands, besides Pinus caribaea, Albizzia moluccana, Alstonia macrophylla, Araucaria cunninghami and, more recently, Leucaena leucocephala were planted, but on a limited scale and infrequently. Swietenia macrophylla, though it has not been raised as a plantation in recent decades, was for several years

used for line-planting over large areas of over-exploited natural forests in the low and mid country wet zone. However, because of poor after-care only very little of the planting has survived.

In recent years planting trials with several hitherto untested species were carried out and so far two species of Acacia, A. mangium (for the wet low country) and A. auriculiformis (for the dry zone), have yielded good results and are now included in the forestation programme.

The 1987 Administration Report of the Conservator of Forests gives the area of forest plantations in Sri Lanka as 163,000 ha (not counting the natural forests line-planted with mahogany). Teak, Eucalyptus and Pinus together, adding up to 140,000 ha, account for the bulk of the area. The total area of new plantations raised in 1987, which is included in the above figure, is given as 5031 ha.[36]

8. ANIMAL HUSBANDRY AND FISHERIES

The livestock animals commonly reared in Sri Lanka are cattle, buffalo, goat, pig, sheep and poultry. The livestock populations recorded in 1985 are given below.

Neat Cattle	1,782,300
Buffaloes	966,600
Goats	539,600
Sheep	26,600
Pigs	83,600
Poultry	7,097,600

The indigenous cattle are said to belong to the Sinhala breed. They have a very low genetic potential for milk yield, but possess several adaptive traits such as resistance to disease, ability to feed on coarse grasses, tolerance of high levels of internal parasitism, low requirement of water, etc. Cross breeding with imported breeds is being carried out to increase the milk yield while retaining the useful, adaptive traits.

The buffalo (Bos bubalus bubalus) is not indigenous to Sri Lanka. The so called "wild buffaloes" which inhabit natural forests are feral animals i.e. domestic animals which have escaped to the wild. More than 95 per cent of the buffaloes in Sri Lanka belong to the group known as the swamp buffalo. The other five per cent belong to the imported riverine breeds Murrah and Surti and their crosses. The indigenous buffalo has a poor genetic potential for milk yield and its main use is for draught power. Breeding programmes have been designed to upgrade the local buffalo using males of the Murrah and Surti breeds.

Only preliminary work has been done so far on goats and pigs with respect to germplasm selection and improvement. The wild pig (popularly referred to as wild boar), Sus scrofa cristatus, has increased sharply in population in recent years and is today considered by the agriculturist as a pest. Eggs and chicken meat are important sources of proteins for human nutrition in Sri Lanka. High egg and high protein meat yielders are at present obtained by the importation of selected breeds from abroad and hybridising them for the local market. The local breeds of poultry (fowl) are fast disappearing due to the popularisation of imported varieties. The local breeds which are resistant to tropical diseases and adapted to local conditions have to be conserved for interbreeding programmes with imported varieties.

Although the fisheries industry contributes only two per cent to the GDP, over 70 per cent of animal proteins consumed by the population is derived from fish. Coastal fisheries (up to 30 nautical miles) yield 90 per cent of the country's total marine catch, and the balance is from the deep sea. Inland fisheries contribute 20 per cent of the total local catch. Tilapia and carps are the widely reared fish in inland waters. Crustaceans, molluscs and ornamental fish are popular export commodities and therefore conservation of their genetic resources has to be considered .

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APPENDIX I

Threatened Species of Vascular Plants in Sri Lanka *

PTERIDOPHYTES

Equisetaceae
Equisetum debile Roxb.

Isoetaceae
Isoetes coromandelina L.f.

Lycopodiaceae
Lycopodium carolinianum L.
L. ceylanicum Spring
L. clavatum L.
L. hamiltonii Spreng.
L. phlegmaria L.
L. phyllanthum Hook. & Arn
L. pinifolium Bl.
L. pulcherrimum Wall.ex H. & G.
L. serratum Thunb.
L. squarrosum Forst.
L. wightianum

Psilotaceae
Psilotum nudum (L.) Beauv.

Selaginellaceae
Selaginella calostachya (Hook. & Grev.) Alston
S. cochleata (Hook. & Grev.) Spring
S. praetermissa Alston
S. wightii Hieron.

Adiantaceae
Actiniopteris radiata (Sw.) Link
Cheilanthes thwaitesii Mett. ex Kuhn
Idiopteris hookeriana (Ag.) T.G. Walker
Pellaea boivini Hook.
P. falcata (R. Br.) Fee
Pteris argyrea T. Moore
P. confusa T.G. Walker
P. gongalensis T.G. Walker
P. praetermissa T.G. Walker
P. reptans T.G. Walker

Aspleniaceae
Asplenium disjunctum Sledge
A. longipes Fee
A. nitidum Sw.
A. obscurum Bl.
A. pellucidum Lam.

Cyatheaceae
Cyathea hookeri Thw.
C. sinuata Hook. & Grev.

Dennstaedtiaceae
Microlepia majuscula (Lowe) T. Moore
Lindsaea repens
var. pectinata (Bl.) Mett. ex Kuhn

Dryopteridaceae
Deparia polyrhizon (Baker) Sledge
Diplazium cognatum (Hieron) Sledge
D. paradoxum Fee
D. zeylanicum (Hook.) T. Moore
Polystichum anomalum (Hook. & Arn.) J. Sm.
Pteridrys syrmatica (Willd.) C. Chr. & Ching
P. zeylanica Ching
Tectaria thwaitesii (Bedd.) Ching

Grammitidaceae
Ctenopteris glandulosa J. Sm.
C. repandula (Mett.) C. Chr. & Tard.
C. thwaitesii (Bedd.) Sledge
Grammitis wallii (Bedd.) Copel.
Scleroglossum sulcatum (Kuhn) V.A.V.R.
Xiphopteris cornigera (Baker) Copel.

Hymenophyllaceae
Trichomanes exiguum (Bedd.) Baker
T. intramarginale Hook. & Grev.
T. motleyi van den Bosch
T. nitidulum van den Bosch
T. pallidum Bl.
T. saxifragoides C. Presl
T. wallii Thw. ex Trim.

Lomariopsidaceae
Bolbitis appendiculata
var. asplenifolia (Bory) Sledge
Teratophyllum aculeatum (Bl.) Mett.

Marattiaceae
Marattia fraxinea Sm.

Ophioglossaceae
Botrychium daucifolium Wall. ex Hook. & Grev.
B. lanuginosum Wall. ex Hook. & Grev.
Helminthostachys zeylanica (L.) Hook.
Ophioglossum costatum R. Br.
O. gramineum Willd.
O. nudicaule L.f.
O. pendulum L.
O. petiolatum Hook.
O. reticulatum L.

* Reproduced from The Threatened Plants of Sri Lanka by B.A. Abeywickrema. The Natural Resources, Energy and Science Authority, Colombo 7. pp 56

(The names of endemic plants are underlined)

Osmundaceae
Osmunda collina Sledge

Polypodiaceae
Belvisia mucronata (Fee) Copel.
Leptochilus wallii (Baker) C. Chr.
Microsorium dilatatum (Bedd.) Sledge
Pleopltis macrocarpa (Bory ex Willd.) Kaulf

Schizaeaceae
Schizaea digitata (L.) Sw.

Thelypteridaceae
Amauroplta hakgalensis Holttum
Ampelopteris prolifera (Retz.) Copel.
Christella meeboldii (Rosenst.) Holttum
C. subpubescens (Bl.) Holttum
C. zeylanica (Fee) Holttum
Pronephrium gardneri Holttum
Sphaerostephanos subtruncatus (Bory) Holttum
Thelypteris confluens (Thunb.) Morton
Trigonospora angustifrons Sledge
T. calcarata (Bl.) Holttum
T. ciliata (Benth.) Holttum
T. glandulosa Sledge
T. obtusiloba Sledge
T. zeylanica (Ching) Sledge

GYMNOSPERMS

Cycadaceae
Cycas circinalis L.

ANGIOSPERMS

Acanthaceae
Andrographis macrobotrys Nees
Barleria nitida Nees
Gymnostachyum thwaitesii T. Anders.
Strobilanthes caudata T. Anders.
S. gardnerana (Nees) T. Anders.
S. nigrescens T. Anders.
S. nockii Trim.
S. punctata Nees
S. rhytisperma C.B. Clarke
S. Stenodon C.B. Clarke
S. thwaitesii T. Anders.
S. zeylanica T. Anders.
Synnema uliginosum (L.F.) Kuntze

Amaranthaceae
Achyranthes bidentata Bl.
A. diandra Roxb.
Centrostachys aquatica (R. Br.) Wall. ex Moq.
Cyathula ceylanica Hook.f.

Anacardiaceae
Semecarpus moonii Thw.
S. obovata Thw.
S. parvifolia Thw.

Annonaceae
Alphonsea hortensis H. Huber
A zeylanica Hook.f. & Thoms.
Anaxagorea luzonensis A. Gray
Artabotrys hexapetalus (L.f.) Bhandhari
Goniothalamus thomsonii Thw.
Miliusa zeylanica Gardn. ex Hook.f & Thoms.
Orophea polycarpa A. DC.
Phoenicanthus coriacea (Thw.) H. Huber
P. obliqua (Hook.f. & Thoms.) Alston
Polyalthia moonii Thw.
P. persicaefolia (Hook.f. & Thoms.) Thw.
Uvaria cordata (Dunal) Alston
U. semecarpifolia Hook.f. & Thoms.
Xylopia nigricans Hook. f. & Thoms.

Apocynaceae
Anodendron rhinosporum Thw.
Hunteria zeylanica (Retz.) Gardn. ex. Thw.
Petchia ceylanica (Wight) Livera
Rauvolfia serpentina (L.) Benth. ex Kurz.
Vallaris solanacea (Roth) Kuntze
Willughbeia cirrhifera Abeywick.
Wrightia flavido-rosea Trim.

Apostasiaceae
Apostasia wallichii R. Br.

Araceae
Arisaema A. constrictum Barnes
Cryptocoryne spiralis (Retz.) Fischer
C. thwaitesii Schott.
Rhaphidophora decursiva (Roxb.) Schott.
R. pertusa (Roxb.) Schott.
Typhonium flagelliforme (Lodd.) Bl.

Araliaceae
Polyscias acuminata (Wight) Seem.

Asclepiadaceae
Bidaria cuspidata (Thunb.) Huber
Brachystelma lankana Dassanayake & Jayasuriya
Caralluma adscendens (Roxb.) Haworth
C. umbellata Haworth
Ceropegia candelabrum L.
C. elegans Wall.
var. gardneri (Thw.) Huber
C. parviflora Trim.
C. taprobanica Huber
C. thwaitesii Hook.
Cosmostigma racemosum(Roxb.) Wight
Cynanchum alatum Wight & Arn.
Dischidia nummularia R. Br.
Gymnema rotundatum Thw.
Heterostemma tanjorense Wight & Arn
Hoya pauciflora Wight
Marsdenia tenacissima (Roxb.) Moon
Oxystelma esculentum (L.f.) R. Br. ex Schult.
Taxocarpus kleinii Wight & Arn.
Tylophora fasciculata Buch. - Ham. ex Wight & Arn.
T. multiflora (Wight & Arn.) Alston
T. pauciflora Wight & Arn.
T. zeylanica Decne.

Balanophoraceae
Balanophora fungosa J.R. & G. Forst.

Balsaminaceae
Impatiens janthina Thw.
I. leucantha Thw.
I. repens Moon
I. subcordata Arn.
I. taprobanica Hiern.
I. walkeri Hook

Begoniaceae
Begonia dipetala R. Grah.
B. subpeltata Wight

Bombacaceae
Cullenia rosayroana Kosterm.
(Adansonia digitata L. introduced to Sri Lanka and not indigenous, but needs protection for historical reasons)

Boraginaceae
Cordia subcordata Lam.
Heliotropium supinum L.
Rotula aquatica Lour.

Burmanniaceae
Burmannia championii Thw.
Thismia gardnerana Hook. f.

Campanulaceae
Campanula canescens Wall. ex DC.
C. fulgens Wall.

Capparidaceae
Cadaba fruticosa (L.) Druce
Capparis divaricata Lam.
C. floribunda Wight
C. tenera Dalz.
Cleome chelidonii L.f.

Caryophyllaceae
Stellaria pauciflora Zoll. & Mor.

Celastraceae
Euonymus thwaitesii Laws.
Maytenus fructicosa (Thw.) Loes.

Combretaceae
Lumnitzera littorea (Jack.) J.O. Voigt

Commelinaceae
Cyanotis obtusa (Trim.) Trim.

Compositae
Adenostemma angustifolium Arn.
Anaphalis fruticosa Hook. f.
A. pelliculata Trim.
A. thwaitesii C.B. Clarke
Blepharispermum petiolare DC.
Blumea angustifolia Thw.
B. aurita (L.f.) DC.
B. barbata DC.
B. crinita Arn.
B. lanceolaria (Roxb.) Druce
Glossogyne bidens (Retz.) Alston
Gynura hispida Thw.
G. zeylanica Trim.
Notonia grandiflora DC.
N. walkeri (Wight) C.B. Clarke
Senecio gardneri (Thw.) C.B. Clarke
Sphaeranthus amaranthoides Burm. f.
Vernonia anceps C.B. Clarke ex Hook. f.
V. pectiniformis DC.
V. thwaitesii C.B. Clarke
Xanthium indicum Konig

Connaraceae
Ellipanthus unifoliatus (Thw.) Thw.

Convolvulaceae
Argyreia choisyana Wight ex C.B. Clarke
A. hancorniifolia Gardn. ex Thw.
A. pomacea Choisy
A. splendens (Roxb.) Sweet
Bonamia semidigyna (Roxb.) Hallier f.
Ipomoea coptica (L.) Roem. & Schultes
I. jucunda Thw.
I. staphylina Roem. & Schult.
I. wightii (Wall.) Choisy

Crassulaceae
Kalanchoe laciniata (L.) Pers.

Cucurbitaceae
Kedrostis rostrata (Rottl.) Cogn.
Melothria leiosperma (Wight & Arn.) Cogn.

Cyperaceae
Baeothryon subcapitatum (Thw.) T. Koyama
Carex breviscapa C.B. Clarke
C. taprobanensis T. Koyama
Cyperus articulatus L.
C. cephalotes Vahl
Eleocharis confervoides
confervoides (Poir.) T. Koyama
E. lankana T. Koyama
Fimbristylis zeylanica T. Koyama
F. monticola Hochst. ex Steud.
Hypolytrum longirostre Thw.
Mapania immersa (Thw.) Benth. ex C.B. Clarke
Mariscus compactus (Retz.) Boldingh
Pycreus stramineus (Nees) Clarke
Rhynchospora
gracillima Thw.
Scirpodendron ghaeri (Gaertn.) Merr.
Scleria pilosa Boeck.
Tricostularia undulata (Thw.) Kern.

Dilleniaceae
Acrotrema dissectum Thw. ex Hook. f.
A. lyratum Thw. ex Hook. f.
A. thwaitesii Hook. f. & Thoms.

Dioscoreaceae
Dioscorea spicata Roth

Dipterocarpaceae

Cotylelobium scabriusculum (Thw.) Brandis
Hopea cordifolia (Thw.) Trim.
Shorea disticha (Thw.) Ashton
S. lissophylla Thw.
S. ovalifolia (Thw.) Ashton
Stemonoporus
affinis Thw.
S. lanceolatus Thw.
S. moonii Thw.
S. nitidus Thw.
S. oblongifolius Thw.
S. petiolaris Thw.
S. reticulatus Thw.
S. rigidus Thw.
Vatica obscura Trim.

Ebenaceae

Diospyros acuta Thw.
D. albiflora Alston
D. atrata (Thw.) Alston
D. attenuata Thw.
D. chaetocarpa Kosterm.
D. ebenoides Kosterm.
D. koenigii Kosterm.
D. moonii Thw.
D. opaca Clarke
D. oppositifolia Thw.
D. quaesita Thw.

Elaeocarpaceae

Elaeocarpus ceylanicus (Arn.) Mast.
E. montanus Thw.

Eriocaulaceae

Eriocaulon fluviatile Trim.
E. longicuspis Hook. f.
E. luzulifolium Mart.
E. philippo-coburgi Szy.
E. walkeri Hook. f.

Euphorbiaceae

Agrostistachys hookeri (Thw.) Hook. f.
Antidesma thwaitesianum Muell. Arg.
Bridelia stipularis (L.) Bl.
(=B. scandens Willd.)
Chaetocarpus pubescens (Thw.) Hook.f.
Chrozophora rottleri (Geisel.) A. Juss. ex Spreng.
Cleistanthus collinus (Roxb.) Hook.f.
Croton moonii Thw.
Dalechampia indica Wight
Drypetes lanceolata (Thw.) Pax & Hoffm.

Euphorbia cristata Heyne ex Roth
Glochidion nemorale Thw.
Mallotus distans Muell. Arg.
Phyllanthus affinis Muell. Arg.
P. anabaptizatus Muell. Arg.
P. hakgalensis Thw. ex Trim.
P. longiflorus Heyne
P. rotundifolius Klein ex Willd.
Podadenia sapida Thw.
Putranjiva zeylanica (Thw.) Muell. Arg.
Sauropus assimilis Thw.
S. retroversus Wight
Trigonostemon diplopetalus Thw.

Flacourtiaceae

Hydnocarpus octandra Thw.

Gentianaceae

Exacum sessile L.
Crawfurdia championii (Gardn.) Trim.

Geraniaceae

Geranium nepalense Sweet

Gesneriaceae

Aeschynanthus ceylanica Gardn.
Chirita moonii Gardn.
C. walkeri Gardn.
Didymocarpus floccosus Thw.
D. zeylanicus R. Br.
Epithema carnosum (G. Don) Benth.

Goodeniaceae

Scaevola plumieri (L.) Vahl

Guttiferae (= Clusiaceae)

Calophyllum cordato-oblongum Thw.
C. cuneifolium Thw.
G. trapezifolium Thw.
Garcinia terpnophylla (Thw.) Thw.
Mesua stylosa (Thw.) Kosterm.

Haloragidaceae

Laurembergia indica (Thw.) Schindl.
L. zeylanica (Arn. ex C.B. Clarke) Schindl.

Hippocrateaceae

Hippocratea arnottiana Wight
H. macrantha Korth.

Hydrocharitaceae

Nechamandra alternifolia (Roxb.) Thw.

Icacinaceae

Pyrenacantha volubilis Wight

Labiatae (= Lamiaceae)

Anisochilus paniculatus Benth.
Coleus elongatus Trim.
Leucas longifolia Benth.
Plectranthus
capillipes Benth.
P. glabratus (Benth.) Alston
P. subincisus Benth.

Scutellaria robusta Benth.

Lauraceae

Actinodaphne albifrons Kosterm.
Cassytha capillaris Meisn.
Cinnamomum capparu-coronde Bl.
C. citriodorum Thw.
C. litseifolium Thw.
Cryptocarya membrancea Thw.

Litsea nemoralis (Thw.) Hook.f.
L. undulata Hook. f.

Leguminosae
Acacia ferruginea DC.
Adenanthera bicolor Moon
Albizia amara (Roxb.) Boivin
Alyssicarpus longifolius (Rottl. ex Spreng.) Wight & Arn.
Bauhinia scandens L.
Cassia italica (Mill.) F.W. Andr.
C. senna L.
Caesalpinia crista L.
C. digyna Rottl. ex Willd.
C. hymenocarpa (Prain) Hattink
C. major (Medic.) Dandy & Exell
Crotolaria berteroana DC.
C. linifolia L.f.
C. montana Roth
C. mysorensis Roth
C. triquetra Dalzell
C. wightiana Graham
C. willdenowiana DC.
Crudia zeylanica (Thw.) Benth.
Cynometra ripa Kostel.
Desmodium gangeticum (L.) DC.
D. jucundum Thw.
D. zonatum Miq.
Dioclea javanica Benth.
Dunbaria ferruginea Wight & Arn.
Eleiotis monophylla (Burm.f.) DC.
Eriosema chinense Vogel
Galactia striata (Jacq.) Urban
Indigofera constricta (Thw.) Trim.
I. glabra L.
I. parviflora Heyne
I. trifoliata L.
I. wightii Grah. ex Wight & Arn.
Mucuna gigantea (Willd.) DC.
M. monosperma (Roxb.) DC.
Pericopsis mooniana (Thw.) Thw.
Rhynchosia acutissima Thw.
R. densiflora (Roth) DC.
R. nummularia (L.) DC.
R. suaveolens (L.f.)DC.
Sesbania sericea (Willd.) Link
Smithia conferta J.E. Sm.
Sophora violacea Thw.
S. zeylanica Trim.
Strongylodon siderospermus Cordemoy
Tephrosia hookerana Wight & Arn.
T. senticosa (L.) Pers.
T. spinosa (L.) Pers.

Lemnaceae
Lemna gibba L.

Lentibulariaceae
Utricularia scandens Benj.
(= U. capillacea Wall.)

Liliaceae
Chlorophytum heyneanum Wall.
Dipcadi Montanum (Dalz.) Bak.
Urginea rupicola (Trim.) Trim.ex Hook.f.

Loranthaceae (See also Viscaceae)
Barathranthus mabaeoides (Trim.) Danser
Dendrophthoe lonchiphyllus (Thw.) Danser
Helixanthera ensifolia (Thw.) Danser
Macrosolen barlowii Wiens
Tolypanthus gardneri (Thw.) v. Tiegh.

Malvaceae
Abutilon pannosum (Forst.f.) Schlecht.
(=A. muticum G. Don.)
Dicellostyles axillaris (Thw.) Thw.
Julostylis angustifolia (Arn.) Thw.
Pavonia patens (Andr.) Chiov.
(= P. glechomifolia Garcke)
Thespesia lampas (L.) Soland. ex Correa

Melastomaceae
Medinilla maculata Gardn.
Memecylon ellipticum Thw.
M. gracillimum Alston
M. grande Retz.
M. leucanthum Thw.
M. macrocarpum Thw.
M. orbiculare Thw.
M. ovoideum Thw.
M. phyllanthifolium Thw. ex C.B. Clarke
M. revolutum Thw.
M. rotundatum (Thw.) Cogn. Bremer,

Sonerila brunonis Wight & Arn.
S. cordifolia Cogn.
S. firma (Thw.) Lundin
S. gardneri Thw.
S. lanceolata Thw.
S. pilosula Thw.
S. robusta Arn.
S. tomentella Thw.
S. wightiana Arn.

Menispermaceae
Coscinium fenestratum (Gaertn.) Colebr.

Menyanthaceae
Nymphoides aurantiaca (Dalz.) Kuntze

Moraceae
Broussonetia zeylanica (Thw.) Corner
Dorstenia indica Wight
Ficus costata Ait.
F. trimenii King
Maclura cochinchinensis (Lour.) Corner

Myrtaceae
Eugenia amoena Thw.
E. cotinifolia ssp. phyllyraeoides (Trim.) Ashton
E. fulva Thw.
E. glabra Alston

E. mabaeoides ssp. pedunculata (Trim.) Ashton
E. rivulorum Thw.
E. rufofulva Thw.
E. terpnophylla Thw.
Syzygium lewisii Alston

Ochnaceae
Ochna rufescens Thw.

Olacaceae
Ximenia americana L,

Oleaceae
Jasminum angustifolium (L.) Willd.
J. bignoniaceum Wall. subsp. zeylanicum P.S. Green
Olea paniculata R. Br.

Orchidaceae
Agrostophyllum zeylanicum Hook. f.
Bulbophyllum crassifolium Thw. ex Trim.
B. purpureum Thw.
B. tricarinatum Petch
Coelogyne zeylanica Hook. f.
Corymborchis veratrifolia (Reinw.) Bl.
Dendrobium maccarthiae Thw.
Diplocentrum recurvum Lindl.
Eria tricolor Thw.
Galeola javanica (Bl.) Benth. & Hook. f.
Gastrodia zeylanica Schlecht.
Goodyera fumata Thw.
Habenaria virens (Lindl.) Abeywick.

Liparis barbata Lindl.
L. brachyglottis Reichb. f. ex Trim.
Malaxis densiflora (A. Rich.) Kuntze
M. lancifolia (Thw.) Kuntze
M. purpurea (Lindl.) Kuntze
Oberonia claviloba Jayaweera
O. dolabrata Jayaweera
O. fornicata Jayaweera
O. quadrilatera Jayaweera
O. recurva Lindl.
O. scyllae Lindl.
O. wallie-silvae Jayaweera
O. weragamensis Jayaweera
Peristylus plantagineus (Lindl.) Lindl.
Phreatia elegans Lindl.
Pteroceras
viridiflorum (Thw.) Holttum
Rhynchostylis retusa Bl.
Robiquetia gracilis (Lindl.) Garay
Sirhookera latifolia (Wight) Kuntze
Taeniophyllum gilimalense Jayaweera
Vanda thwaitesii Hook.f.

Orobanchaceae
Aeginetia pendunculata Wall.
Cambellia aurantiaca Wight
Christisonia thwaitesii Trim.

Palmae

Areca concinna Thw.
Nypa fruticans Wurmb.

Piperaceae
Peperomia wightiana Miq.

Podostemaceae
Dicraea stylosa Wight

Polygalaceae
Polygala leptalea DC.

Portulacaceae
Portulaca wightiana Wall. ex Wight & Arn.

Proteaceae
Helicia ceylanica Gardn.

Rhizophoraceae
Bruguiera cylindrica (L.) Bl.
Ceriops decandra (Griff.) Ding Hou

Rosaceae
Alchemilla indica var. sibthorpioides Hook. f.
Rubus glomeratus Blume
Sanguisorba indicum (Gardn.) Thiruvengadum

Roxburghiaceae
Stemona minor (Thw.) Hook. f.

Rubiaceae
Byrsophyllum ellipticum (Thw.) Bedd.
Canthium macrocarpum Thw.
Dichilanthe zeylanica Thw.
Gardenia turgida Roxb.
Hedyotis cyanescens Thw.
H. cymosa Thw.
H. evenia Thw.
H. gardneri Thw.
H. inamoena Thw.
H. quinquenervia Thw.
H. rhinophylla Thw. ex Trim.
Lasianthus rhinophyllus (Thw.) Thw.
L. thwaitesii Hook. f.
Nargedia macrocarpa (Thw.) Bedd.
Neurocalyx gardneri Thw.
Oldenlandia trinervia Retz.
Ophiorrhiza pallida Thw.
Psychotria glandulifera Thw. ex Hook. f.
P. longipetiolata Thw.
P. moonii (Thw.) Hook. f.
P. plurivenia Thw.
P. stenophylla (Thw.) Hook. f.
Saprosma indicum Dalz.
S. scabridum (Thw.) Bedd.
Scyphiphora hydrophyllacea Gaertn. f.
Scyphostachys pedunculatus Thw.
Tricalysia erythrospora (Thw.) Alston.

Rutaceae
Atalantia racemosa Wight
Glycosmis cyanocarpa (Bl.) Spreng.
var. simplicifolia Kurz

Naringi crenulata (Roxb.) Nicolson
Zanthophyllum caudatum Alston

Sapindaceae
Cardiospermum corindum L.
Euphoria gardneri (Thw.) Thw.
Thraulococcus simplicifolius (Thw.) Radlk.

Sapotaceae
Madhuca moonii (Thw.) H.J. Lam
Palaquium canaliculatum (Thw.) Engl.
P. thwaitesii Trim.

Scrophulariaceae
Adenosma subrepens (Thw.) Benth. ex Hook. f.
Lindernia viscosa (Hornem.) Boldingh
Verbascum chinense (L.) Santapau

Simaroubaceae
Suriana maritima L.

Sonneratiaceae
Sonneratia apetala Buch. - Ham.

Sterculiaceae
Pentapetes phoenicea L.
Pterygota thwaitesii (Mast.) Alston
Sterculia guttata Roxb.

Stylidiaceae
Stylidium uliginosum Sw.

Symplocaceae
Symplocos diversifolia Brand.
S. elegans Thw.
S. kurgensis Clarke

Symphoremaceae
Symphorema involucratum Roxb.

Taccaceae
Tacca leontopetaloides (L.) Kuntze

Theaceae
Gordonia speciosa (Gardn.) Choisy

Thymelaeaceae
Phaleria capitata Jack.

Tiliaceae
Corchorus tridens L.
Grewia asiatica L.
G. hirsuta Vahl
Triumfetta glabra Rottl. ex Spreng.

Triuridaceae
Hyalisma janthina Champ.
Sciaphila erubescens (Champ.) Miers
S. inornata Petch ex Alston
S. secundiflora Trim. ex Benth.

Umbelliferae
Peucedanum ceylanicum Gardn.
Sanicula elata Buch.-Ham. ex D. Don

Urticaceae
Elatostema acuminatum (Poir.) Brongn.
E. walkerae Hook. f.
Lecanthus peduncularis (Royle) Wedd.

Vahliaceae
Vahlia dichotoma (Murr.) Kuntze

Verbenaceae
Premna divaricata Wall.
P. purpurascens Thw.
P. thwaitesii C.B. Clarke
Priva cordifolia (L.f.) Druce
Svensonia hyderabadensis (Walp.) Moldenke

Violaceae
Hybanthus ramosissimus (Thw.) Melch.

Viscaceae
Ginalloa spathulifolia (Thw.) Oliv. ex Hook.f.
Korthalsella japonica (Thunb.) Engl.
Notothixos floccosus (Thw.) Oliver
Viscum ramosissimum Roxb. ex DC.

Zingiberaceae
Alpinia fax Burtt & Smith
A. rufescens (Thw.) Schum.
Amomum acuminatum Thw.
A. benthamianum Trim.
A. graminifolium Thw.
A. hypoleucum Thw.
A. trichostachyum Alston
Curcuma albiflora Thw.

APPENDIX II

Threatened Animal Species in Sri Lanka*

INSECTS

Lepidoptera		
Atrophaneura jophon*	-	The Sri Lanka rose
Troides helena darsius	-	The common bird wing
Papilio polymnestor parinda	-	The blue mormon
P. helenus mooreanus	-	The red helen
Hasora badra lanka	-	The Ceylon awl
Bibasia sena sena	-	The orange tail awl
Tagiades japetus obscurus	-	The Ceylon snow flat
Tapena thwaitesi thwaitesi	-	The black angel
Gomalia elma albofasciata	-	The African marbled skipper
Caprona alida lanka	-	The Ceylon golden angel
Pratapa deva deva		
Tajuria jehana	-	The plains blue royal
Horaga albimacula	-	The brown onyx
Catapaecilma major myositina	-	The common tinsel
Rapala iarbus	-	The Indian red flash
Jamides coruscans	-	The Ceylon cerulean
Celastrina singalensis	-	The Sinhalese hedge blue
C. lanka	-	The Ceylon hedge blue
Prioneris sita	-	The painted saw tooth
Suastus minuta minuta	-	The Ceylon palm bob
Udaspes folus	-	The grass demon
Halpe decorata	-	The decorated ace
H. homolea egena	-	The rare ace
Baoris farri penicillata	-	The paint brush swift
Potanthus pseudomaesa pseudomaesa	-	The common dart
Euthalia lubentina psittacus	-	The gaudy baron
Parthenos sylvia cyaneus	-	The clipper
Limenitis procris calidasa	-	The commander
Vindula erota asela	-	The cruiser
Phalanta alcippe ceylonica	-	The small leopard
Byblia ilithyia	-	The joker
Cethosia nietneri nietneri	-	The tamil lace wing
Doleschallia bisaltide ceylonica	-	The autumn leaf
Discophora lepida ceylonica	-	The southern duffer
Idea lynceus jasonia*	-	The Ceylon tree nymph
Graphium antiphates ceylonicus*	-	The five bar swordtail
Parantica taprobana*		
Kallima philarchus philarchus	-	The blue oak leaf

* Compiled by Miss J.D.S. Dela in consultation with Dr S.W. Kotagama

(The names of endemic animals are underlined. The species denoted by * are those which are included in the 1988 IUCN Red List of Threatened Animals)

Hymenoptera
Aneuretus simoni* - Sri Lanka relict ant

CRUSTACEANS

Cladocera
Ghardaqlaia ambigua
Stenocypris fernandoi
Chrissa ceylonica
C. halyi
Centrocypris viridis
Darwinuka lundi

Decapoda
Caridina singalensis
C. pristis
C. fernandoi
C. zeylanica
C. costai
Macrobrachium srilankanse
Ceylonthelphusa rugosa
C. soror
C. inflatissima
Oziothelphusa minneriyensis

MOLLUSCS

Bulimus inconspicua
Paludomus chilinoides
P. tanschauricus nasutus
P. bicinctus
P. decussatus
P. nigricans
P. regalis
P. sulcatus
P. loricatus
P. neritoides
P. solidus
P. palustris
Charonia tritonis* - Triton´s trumpet

FISHES

Cypriniformes

Barbus titteya*	- Cherry barb
B. cumingii*	- Cuming's two-banded barb
B. nigrofasciatus*	- Three banded crimson barb
B. srilankensis*	
B. pleurotaenia*	- Side striped barb
Rasbora vaterifloris*	- Vateria flower rasbora
Horadandiya atukorali	- Green carplet
Puntius melanampyx	- Black banded barb
P. bimaculatus	- Two spot barb
Labeo fisheri*	- Green labeo
Garra ceylonensis	- Stone sucker
Noemacheilus notostigma	- Spotted loach
Lepidocephalus jonklaasi*	- Spotted loach

Ophiocephaliformes

Channa orientalis	- Smooth breasted snake-head

Perciformes

Malpulutta kretseri*	- de Kretser's fish
Belontia signata*	- leaf lates

AMPHIBIANS

Anura

Bufo kelaartii	- Torrent toad
B. microtympanum	- Small eared toad
B. atukoralei	- Atukorale's dwarf toad
Rana corrugata	- Wrinkled frog
R. greenii	- Sri Lanka reed frog
R. (Hylarana) gracilis	- Slender wood frog
R. (Hylarana) aurantiaca	- Lesser wood frog
Nannophrys guentheri	- Guenther's cliff frog
N. ceylonensis	- Sri Lanka cliff frog
N. marmorata	- Marbled cliff frog
Rhacophorus cruciger	- Greater hourglass tree frog
R. eques	- Montane hourglass tree frog
R. microtympanum	- Small eared tree frog
R. nasutus	- Sharp nosed tree frog
Philautus schmardanus	- Wrinkled tree frog
P. nasutus	- Lesser sharp nosed tree frog
Ramanella palmata	- Montane ramanella
R. obscura	- Red ramanella
Microhyla zeylanica	- Montane narrow mouthed frog

Apoda

Ichthyophis glutinosus	-	Lesser yellow banded caecilian
I. pseudangularis	-	Yellow banded caecilian
I. orthoplicatus	-	Brown caecilian

REPTILES

Testudinata

Dermochelys coriacea*	-	Leathery turtle
Lepidochelys olivacea*	-	Olive-backed ridly turtle
Caretta caretta*	-	Loggerhead turtle
Eretmochelys imbricata*	-	Hawksbill turtle
Chelonia mydas*	-	Green turtle
Melanochelys trijuga	-	Hard-shelled terrapin
Lissemys punctata	-	Soft-shelled terrapin

Crocodylia

Crocodylus porosus*	-	Estuarine crocodile

Squamata

Cnemaspis podihuna	-	Lesser diurnal gecko
Gymnodactylus frenatus	-	Jungle gecko
Geckoella triedrus	-	Devil gecko
G. yakhuna	-	Devil gecko
Hemidactylus depressus	-	Jungle gecko
Calodactylodes illingworthi	-	Great rock gecko
Calotes liocephalus		
C. ceylonensis	-	Sri Lanka lizard
C. liolepis		
C. nigrilabris	-	Black-lipped lizard
C. calotes	-	Green garden lizard
Otocryptis wiegmanni	-	Earless lizard
Cophotis ceylanica	-	Pigmy tree lizard
Ceratophora stoddarti	-	Rhino-horned lizard
C. tennenti*	-	Tennent´s horn nosed lizard
C. aspera	-	Rough-nose horned lizard
Lyriocephalus scutatus	-	Hump-nosed lizard
Chamaeleo zeylanicus	-	Chamaeleon
Mabuya macularia	-	Spotted skink
Dasia haliana	-	Haly´s skink
Sphenomorphus megalops		
S. striatopunctatus		
S. taprobanensis	-	Smooth skink
S. deignani		
S. dorsicatenatus		
S. fallax	-	Brown skink
Riopa singha		
Chalcidoceps thwaitesi	-	Four-toed snake skink
Nessia burtoni	-	Three-toed snake skink

N. didactyla	-	Two-toed snake skink
N. monodactyla	-	Toeless snake skink
N. sarasinorum	-	Sarasin's snake skink
N. smithi	-	Smith's snake skink
N. deraniyagalai	-	Deraniyagala's snake skink
N. layardi	-	Layard's snake skink
N. hikanala	-	Shark-headed snake skink
Typhlops mirus		
T. ceylonicus		
T. malcolmi		
T. violaceus	-	All the Typhlops species
T. lankaensis		and Typhlina bramina
T. veddae		are referred to as
T. tenebrarum		blind snakes
T. porrectus		
T. leucomelas	-	Pied typhlops
Typhlina bramina		
Uropeltis melanogaster		
U. phillipsi		
U. ruhunae		
Pseudotyphlops philippinus	-	Large shield-tail snake
Rhinophis blythi		
R. drummondhayi	-	All Uropeltis,
R. porrectus		Rhinophis,
R. punctatus		Pseudotyphlops and
R. philippinus		Platyplectrurus species
R. oxyrhynchus		are referred to as
R. trevelyanus		rough-tails or shield-tails
R. dorsimaculatus		
R. tricolorata		
Platyplectrurus madurensis		
Cylindrophis maculatus	-	Sri Lankan pipe snake
Oligodon sublineatus	-	Dumeril's kukri snake
O. calamarius	-	Kukri snake
Lycodon osmanhilli	-	Taylor's wolf snake
Dendrelaphis oliveri	-	Oliver's bronze back
Cercaspis carinatus	-	Sri Lanka wolf snake
Balanophis ceylonensis	-	Blossom krait
Aspidura copei	-	Cope's roughside
A. trachyprocta	-	The common roughside
A. drummondhayi	-	Drummond-Hay's roughside
A. brachyorrhus	-	Boie's roughside
A. guentheri	-	Guenther's roughside
A. deraniyagalae		
Haplocerus ceylonensis	-	The black spined snake
Chrysopelea taprobanica		
C. ornata	-	Gold and black tree snake
Dryophis pulverulentus	-	Brown speckled whip snake
Boiga barnesi	-	Barne's cat snake
Cerberus rhynchops	-	Dog-faced water snake
Xenochrophis asperrimus	-	The common pond snake
Bungarus ceylonicus	-	Sri Lanka krait

Hypnale hypnale	-	Merrem's hump-nosed viper
H. nepa	-	Montane hump-nosed viper
H. walli	-	Gloyd's hump-nosed viper
Trimeresurus trigonocephalus	-	Green pit viper
Python molurus*	-	Rock python

BIRDS

Pelecaniformes

Pelicanus philippensis philippensis	-	Spotted-billed pelican
Phalacrocorax carbo sinensis	-	Indian comorant

Ciconiiformes

Egretta gularis schistacea	-	Indian reef heron
Ephippiorhynchus asiaticus asiaticus	-	Black-necked stork
Plegadis falcinellus falcinellus	-	Glossy ibis

Anseriformes

Sarkidiornis melanotos melanotos	-	Comb duck

Falconiformes

Aviceda jerdoni ceylonensis	-	Legge's bazza
Spizaetus nipalensis kelaarti	-	Mountain hawk eagle
Hieraaetus kienerii kienerii	-	Rufous-bellied hawk eagle
Ictinaetus malayensis perniger	-	Black eagle
Ichthyophaga ichthyaetus plumbeiceps	-	Grey-headed fishing eagle
Falco peregrinus peregrinator	-	Peregrine falcon
F. tinnunculus objurgatus	-	Indian kestral

Galliformes

Francolinus pictus watsoni	-	Painted partridge
Galloperdix bicalcarata	-	Sri Lanka spurfowl
Gallus lafayettii	-	Jungle fowl

Gruiformes

Rallus striatus albiventer	-	Blue-breasted banded rail
Porzana fusca zeylonica	-	Ruddy crake

Charadriiformes

Dromas ardeola	-	Crab plover
Cursorius coromandelicus	-	Indian courser
Vanellus gregarius*	-	Sociable lapwing
Sterna hirundo tibetana	-	Common tern
S. dougallii korustes	-	Roseate tern

Columbiformes

Treron phoenicoptera phillipsi	-	Yellow-legged green pigeon
Columba torringtoni*	-	Sri Lanka wood pigeon

Psittaciformes

Loriculus beryllinus	- Sri Lanka lorikeet
Psittacula calthorpae	- Layard's parakeet

Cuculiformes

Cuculus micropterus micropterus	- Indian cuckoo
Phaenicophaeus pyrrhocephalus*	- Red-faced malkoha
Centropus chlororhynchus*	- Green-billed coucal

Strigiformes

Tyto alba stertens	- Barn owl
Phodilus badius assimilis	- Bay owl
Otus scops leggei	- Little scops owl
Bubo nipalensis blighi	- Forest eagle owl

Caprimulgiformes

Batrachostomus moniliger	- Frogmouth

Coraciiformes

Alcedo meninting phillipsi	- Blue-eared kingfisher
Ceyx erithacus erithacus	- Three-toed kingfisher
Halcyon pileata	- Black-capped purple kingfisher
Eurystomus orientalis	- Broad-billed roller

Piciformes

Megalaima flavifrons	- Yellow-fronted barbet
Chrysocolaptes festivus	- Black-backed woodpecker

Passeriformes

Sturnus senex*	- Sri Lanka white-headed starling
Gracula ptilogenys	- Sri Lanka hill mynah
Cissa oranata*	- Sri Lanka blue magpie
Irena puella puella	- Fairy blue bird
Pycnonotus penicillatus	- Yellow-eared bulbul
Turdoides rufescens	- Sri Lanka rufous babbler
Garrulax cinereifrons*	- Ashy-headed laughing thrush
Muscicapa sordida	- Dusky-blue fly catcher
Bradypterus palliseri*	- Sri Lanka warbler
Myiophoneus blighi*	- Arrenga
Zoothera wardii	- Pied ground thrush
Z. spiloptera*	- Spotted-winged ground thrush
Z. dauma imbricata	- Sri Lanka scaly thrush
Dicaeum vincens*	- Legge's flower pecker
Zosterops ceylonensis	- Sri Lanka white-eye
Lonchura kelaarti kelaarti	- Hill munia

MAMMALS

Insectivora

Feroculus feroculus	- Kelaart's long-clawed shrew
Suncus zeylanicus	- Ceylon jungle shrew
Crocidura miya	- Ceylon long-tailed shrew
Solisorex pearsoni	- Pearson's long-clawed shrew

Chiroptera

Kerivoula picta	- Painted bat

Primata

Loris tardigradus	- Slender loris
Presbytis senex	- Purple-faced langur

Rodentia

Petaurista petaurista	- Large flying squirrel
Petinomys fuscocapillus	- Small flying squirrel
F. layardi	- Flame-striped jungle squirrel
F. sublineatus	- Ceylon dusky-striped jungle squirrel
Mus fernandoni	- The Ceylon spiny-mouse
Rattus montanus	- Nillu rat
Coelomys mayori	- Bicoloured spiny-rat
Srilankamys ohiensis	- Ceylon bicoloured spiny-rat
Vandeleuria nolthenii	- Ceylon highland long-tailed tree mouse

Cetacea

Balaenoptera musculus*	- Great blue whale
B. physalus*	- Fin whale
Megaptera novaeangliae*	- Hump-backed whle
Eubalaena australis*	- Southern right whale

Carnivora

Lutra lutra nair	- Ceylon otter
Melursus ursinus*	- Sloth bear
Paradoxurus zeylonensis	- Golden palm-civet
Herpestes vitticollis	- Striped-necked mongoose
Felis rubiginosa*	- Rusty spotted cat
F. chaus	- Jungle cat
F. viverrina	- Fishing cat
Panthera pardus*	- Leopard

Proboscidea

Elephas maximus*	- Elephant

Sirenia

Dugong dugon*	- Dugong

Artiodactyla

Tragulus meminna	- Mouse-deer