

Natural and Cultural History of the Golfo Dulce Region, Costa Rica

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Impressum

- Katalog / Publication: Stapfia **88**, zugleich Kataloge der Oberösterreichischen Landesmuseen N.S. **80**
ISSN: 0252-192X
ISBN: 978-3-85474-195-4
- Erscheinungsdatum / Date of delivery: 9. Oktober 2008
- Medieninhaber und Herausgeber / Copyright: Land Oberösterreich, Oberösterreichische Landesmuseen, Museumstr.14, A-4020 Linz
Direktion: Mag. Dr. Peter Assmann
Leitung Biologiezentrum: Dr. Gerhard Aubrecht
Url: <http://www.biologiezentrum.at>
E-Mail: bio-linz@landesmuseum.at
In Kooperation mit dem Verein zur Förderung der Tropenstation La Gamba (www.lagamba.at).
- Wissenschaftliche Redaktion / Scientific editors: Anton Weissenhofer, Werner Huber, Veronika Mayer, Susanne Pamperl, Anton Weber, Gerhard Aubrecht
Redaktionsassistent / Assistant editor: Fritz Gusenleitner
Layout, Druckorganisation /
Layout, printing organisation: Eva Rührnößl
Druck / Printing: Plöchl-Druck, Werndlstraße 2, 4240 Freistadt, Austria
Bestellung / Ordering: <http://www.biologiezentrum.at/biophp/de/stapfia.php> oder / or bio.buch@landesmuseum.at
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- Umschlagfoto / Cover: Blattschneiderameisen. Photo: Alexander Schneider. Layout: E. Rührnößl.
- Zitiervorschlag für das Buch / The complete book may be referenced as follows: Weissenhofer, A., Huber W., Mayer V., Pamperl S., Weber A. & G. Aubrecht (Hrsg.; 2008): Natural and cultural history of the Golfo Dulce region, Costa Rica. — Stapfia 88: 768 pp.
- Zitiervorschlag für Einzelarbeiten / Single contributions may be referenced as follows: Weissenhofer A., Huber W. & M. Klingler (2008): Geography of the Golfo Dulce region. — Stapfia 88: #-#.
- Ausstellung / Exhibition: Der Pfad des Jaguars. Tropenstation La Gamba, Costa Rica
Ort / Address: Biologiezentrum der Oberösterreichischen Landesmuseen, J.-W.-Klein-Straße 73, 4040 Linz, Austria
Zeitraum / Period: 10. Oktober 2008 bis 22. März 2009
- Konzept, Organisation und Gestaltung /
Concept, organization, design: Mag. Stephan Weigl, Mag. Dr. Werner Huber, Mag. Dr. Anton Weissenhofer, Daniel Schaber
Ausstellungstechnik, Mitarbeit /
Exhibition techniques, collaboration: Jürgen Plass, Roland Rupp, Bruno Tumfart, Erwin Kapl, Josef Schmidt, Roland Zarre, Michaela Minich, Charlotte Füreder, Georg Proske, Franz Rammerstorfer
- Museumspädagogik / Museum education: Mag. Claudia Kiesenhofer
Leihgeber / Lenders: Naturhistorisches Museum Wien, Mag. Dr. Werner Huber, Mag. Dr. Anton Weissenhofer, Universität Wien; Mag. Felix Holzmann, Bischofshofen

Due to the orographic formation of its interior and its humid climate, the Golfo Dulce Region is rich with biodiversity, containing very dense flora and fauna. After HOLDRIDGE (1971), the region was subdivided into different zones, including the tropical rainforest, the tropical wetland forest, and tropical premontane rainforest. The biogeographical situation in this area shows many similarities to the flora and fauna in the Amazon and the Colombian Chocó Region and serves as a land bridge with a valuable genetic base between North and South America. After unregulated seizure of land by agricultural settlers, lumberjacks, and large landowners in the 1940s and 1950s, regulated, state-subsidised settlement reform intended to support agricultural exports in the 1960s, and intensification of the livestock industry in the 1970s, primary and secondary forest reserves have shrunk to a minimum. The constant expansion of monocultures on new land has far-reaching consequences for the local ecosystem.

The conservation and sustainable use of tropical forests is established in the Forest Declaration, Convention on Climate Protection, and Convention on the Protection of Species, which demonstrate worldwide concern for these issues. As a regional example, in the 4,304.80 km² drainage basin, the ACOSA (Área de Conservación OSA), which covers an area spanning the Cantons Osa, Golfito und Corredores, aims to protect species diversity within the 17 game preserves, which are 44.7% covered by forest, through integration and an alliance with the Parques Nacionales, Vida Silvestres y Forestales (Fig. 2). The main sector of the Corcovado National Park on the Osa Peninsula covers 424 km² and the Piedras Blancas National Park covers 148 km². The altitude ranges from sea level to 745 m on the Osa Peninsula (Cerro Rincón and Cerro Mueller in the Fila Matajambre) and to 579 m in the Esquinas forest (Cerro Nicuesa). The Golfo Dulce Forest Reserve (592 km²) was established between the two parks, thereby forming a natural forest corridor.

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The lichens of the Golfo Dulce region

Líquenes de la región de Golfo Dulce

Othmar BREUSS

Abstract: A short historical survey of the study of lichens in Costa Rica and the Golfo Dulce region is provided, followed by an overview of the lichenological investigations currently undertaken in the region. A general characterisation of the lichen flora of the Golfo Dulce region with remarks on the occurrence of species within particular habitat types is presented, and the biogeographical relationships of the lichen flora is shortly discussed. Special attention is given to foliicolous lichens which account for the greatest proportion of the species. A list of all lichen species so far known to occur in the region, based on the literature as well as on own collections, is presented.

Key words: biodiversity, lichens, mycoflora of Costa Rica, Central America.

Resumen: Se entrega una breve revisión histórica del estudio de los líquenes en Costa Rica y la región de Golfo Dulce, seguida de una descripción de las investigaciones liquenológicas que actualmente se llevan a cabo en la región. Se presenta una caracterización general de la flora de líquenes de la región de Golfo Dulce con énfasis en la presencia de especies dentro de habitat particulares y se discute brevemente las relaciones biogeográficas de la flora de líquenes. Se otorga especial atención a los líquenes folícolos que representan el mayor número de especies. Se incluye una lista de todas las especies de líquenes hasta ahora conocidas para la región, basada en la literatura como también en nuestras colecciones.

Palabras clave: biodiversidad, líquenes, micoflora de Costa Rica, América Central.

History of lichen exploration in Costa Rica

The first lichen reported from Costa Rica was *Cora pavonia* in FRIES (1851), followed by a short list by NYLANDER (1877) of a few species collected by H. Polakowsky. The first comprehensive publications dealing with Costa Rican lichens are those by MÜLLER (1891, 1893) with treatments of c. 300 lichen species collected by H. Pittier and A. Tonduz with many of them described as new. Other extensive collections made by A. S. Ørsted in 1846-1848 have never been published as a unit. After MÜLLER's (loc.cit.) papers, interest in Costa Rican lichenology declined for many years until DODGE (1933) published a study on foliose and fruticose lichens. The next papers were those by DODGE (1936) and HEDRICK (1942) which report several species that have been collected during the 1934 Allan Hancock Expedition to the west coast of Costa Rica. SANTESSON (1952) in his pioneering work on foliicolous lichens included many collections from Costa Rica. Additional lichen records from Costa Rica have been found in publications by MÜLLER (1881, 1895), VAINIO (1894), HOWE (1914), DODGE (1929), HILLMANN (1930), MOTYKA (1936-38), DES ABBAYES (1939), and IMSHAUG

(1955). A summary of all previous lichen records from Costa Rica was provided by IMSHAUG (1956).

The first native Costa Rican to publish on lichens was GÓMEZ (1972) who treated Costa Rican basidiolichens. TIBELL (1982) revised the order Caliciales in Costa Rica, and KAPPELLE & SIPMAN (1992) reported foliose and fruticose lichens from oak forests in the Talamanca Mountain Range. Within the last two decades, interest in Costa Rican lichens has increased considerably. Much fieldwork has been carried out by various collectors resulting in the production of too many papers to be cited individually. Of particular importance is the extensive work of LÜCKING (1992, 1995, 1997, 1998, 1999 and others) and LÜCKING & VEZDA (1998) on foliicolous lichens. Many Costa Rican lichen samples are cited in modern monographs and revisions of certain genera (BRAKO 1991, TIBELL 1996, AHTI 2000, STAIGER 2002). In a recent series, BREUSS (2000, 2001, 2004, 2006) published lists of lichen collections mainly from south-western Costa Rica. A field guide with descriptions and colour photographs of selected lichens from Costa Rica was provided by UMAÑA & SIPMAN (2002). Recently, in the course of the TICOLICHEN project, several genus accounts (LÜCKING et al. 2006,



Plate 1: Lichen habitats: tropical rainforest (Esquinas forest), (a) interior of primary rainforest, (b) understory along a creek near Esquinas Rainforest Lodge, (c) interior of rainforest on ridge top, (d) canopy layer of rainforest, (e) interior of primary rainforest in a ravine, (f) margin of primary forest near field station "Tropenstation La Gamba". Photos: O. Breuss.

2007, NELSEN et al. 2006, among others) and a treatment of pyrenocarpous lichens (APTROOT et al. 2008) have been published.

Lichenological research in the Golfo Dulce area

Until recently, the Golfo Dulce region received little attention, lichenologically. DODGE (1933) reported a few species from the Osa peninsula. LÜCKING (1992, 1995, 1997a,b, 1999a,b,c) examined extensive collections from the Osa peninsula and Golfito. BREUSS (2000, 2006) and BREUSS & NEUWIRTH (2007) focused on lichens from the Bosque Esquinas and its surroundings. BALOCH & GRUBE (2006) included collections from the Bosque Esquinas in their molecular studies on the Porinaceae. Several new taxa have been described from the Golfo Dulce region, namely *Calenia solorioides*, *Enterographa byssoidea*, *Ocellularia auratipruinosa*, *Anisomeridium flavovulcanus*, *Arthonia isidiata*, and, most recently, *Porina pilifera* and *Byssolecania pluriseptata*.

Lichen sampling in the Golfo Dulce region has been rather fragmentary and local. Epiphyllous lichens have been collected at several sites in the Golfo Dulce area and are rather well represented, whereas non-foliicolous lichens were mainly collected in the Bosque Esquinas region except for several macrolichen samples from the Osa peninsula and mentioned by DODGE (1933). LÜCKING's (loc. cit.) collections of foliicolous lichens are from a few sites on the Osa peninsula, from the Golfito Wildlife Refuge and from the vicinity of the Golfito airfield. The recent collecting work of BREUSS (2000, 2006) and BREUSS & NEUWIRTH (2007), which covers foliicolous as well as corticolous and lignicolous lichens, was undertaken during three one-week stays in 1999, 2002 and 2004 in the hillside forests of the Bosque Esquinas, including a riverine forest (Quebrada Chorro) and gallery woodland (Valle Bonito). Collecting work in a coastal forest has been done at one site only (San Josecito). Mangroves in tidal estuaries of the larger rivers have not yet been investigated for their lichen flora.

A part of the author's collection is still undetermined. There are a number of specimens which require critical study, and further results will be published in forthcoming papers. Continuation of the lichenological investigations in the study area is planned for the near future. In recent years, lichenologists from Graz University have carried out several lichenological expeditions to the Bosque Esquinas and their work focuses on the following fields: the colonisation of artificial leaves by foliicolous lichens in different rainforest plots (Martin Grube), phylogenetic relationships of tropical lichens

(Elisabeth Baloch), and the taxonomy of sterile crustose lichens (Barbara Emmerer, Josef Hafellner).

There is a need for further research; since the lichen flora in the Golfo Dulce area has only been explored in any depth in a few places, it is too early to attempt a detailed analysis of the local lichen flora. Only a rough and fragmental overview can therefore be given in the present contribution.

Lichen flora of Costa Rica

Fungi form a species-rich group of organisms. The estimated number of known ascomycetes is 30.000-40.000, half of which are lichenised. Contrary to the ascomycetes, lichen-forming basidiomycetes are very few. At present, nearly 1400 lichen species are known from Costa Rica, according to the preliminary Internet checklist (UMAÑA TENORIO et al. 2002). As the knowledge of tropical lichens in general is very incomplete, the number of taxa will undoubtedly rise considerably with ongoing efforts of investigation, and the total number of Costa Rican lichen species may be estimated as twice that number. A critical catalogue of all lichen species so far reported from Costa Rica is in preparation and will probably be published in 2009 (BREUSS & NEUWIRTH, in prep.).

Lichen flora of the Golfo Dulce area

General characterisation

Lowland rainforest is the major habitat type in the Golfo Dulce area and the lichens, therefore, are predominantly crustose. The largest proportion of the known lichen flora is represented by foliicolous lichens, whereas corticolous crustose lichens are known to a lesser extent.

Macrolichens are scarce in the lowland rainforest with species richness rising significantly in more open secondary habitats. There, members of the Parmeliaceae constitute most of the foliose lichen flora, followed by species of the genera *Dirinaria*, *Leptogium*, *Parmeliella*, *Physcia* and *Pyxine*. Fruticose lichens such as *Cladonia* and *Usnea* species account for only a very small proportion of the lichen flora. A rich macrolichen flora is developed in anthropogenic vegetation: on fence posts and trees along roads and brooks, in pastureland and around villages, in riparian shrub vegetation and gardens.

The soil lichen flora is poorly developed in the wet tropics and usually confined to compacted soil in strongly disturbed secondary vegetation types. A luxuriant terricolous lichen growth in the investigated area was a large cover of *Baeomyces rufus* on compacted earth



Plate 2: Lichen habitats, (a) valley of Río Bonito, river banks and gallery woodland, (b) cultivated land and secondary forest near Río Bonito, (c) pasture and hillside forest near La Gamba, (d) roadside vegetation at field station "Tropenstation La Gamba". Photos: O. Breuss.

on a vertical road cutting at Fila Gamba. A small growth of *Cladonia subradiata* was found in the garden of the Esquinas Rainforest Lodge.

No lichens have yet been found growing on stone due to the scarcity of rocky areas. Coastal cliffs and riverine rocks may bear a sparse and inconspicuous lichen growth but have not yet been investigated.

Biogeographical relationships

Nearly all lichen species occurring in the Golfo Dulce area are not confined to this region but have wider distributions. Most species are pantropical to pantropical-temperate or intercontinentally distributed, whereas about one third are wide neotropical or American. A few species have narrower geographical ranges. Only 23 species are potentially endemic to Costa Rica or Central America. Endemism is generally rare in the lichen flora of the neotropics.

Of the foliicolous lichens (see below), 112 are pantropical, some of which extend their range into subtropical or temperate regions (including *Byssoloma leucoblepharum*, *B. subdiscordans*, *Gyalectidium filicinum*, *Opegrapha filicina*, *Strigula nitidula*, and *S. smaragdula*).

There are 84 neotropical species (32%); of these, four (*Coccocarpia tenuissima*, *Malcolmiella amazonica*, *Mazosia praemorsa*, *M. tumidula*) are centred on the Amazon Basin, one species (*Porina pocsii*) is Central American, and eleven species (*Byssolecania pluriseptata*, *Calenia subdepressa*, *Dimerella minima*, *D. squirrensii*, *Enterographa byssoidea*, *Fellhanera muhleii*, *Gyalideopsis actinoplacoides*, *Opegrapha alba*, *Paratracharia paradoxa*, *Porina pilifera*, and *Trichothelium longisporum*) are putatively endemic to Costa Rica. Some 26 epiphyllous species show a neotropical-African distribution pattern, and 22 species are amphi-Pacific (Neotropics and Eastern paleotropics), two of which have range extensions into the Valdivian (*Porina rubrosphaera*) or Hawaiian (*Tapellaria nana*) regions. Several species occur in all tropical regions and one extratropical region: *Arthonia cyanea* is pantropical-Valdivian, *Porina rubentior* is pantropical-Tethyan, and *Tapellaria phyllophila* is pantropical-Neozelandic-Tasmanian (LÜCKING 2003).

The non-foliicolous lichens have similar distribution patterns. About 91 species are pantropical (partly without Australia), 13 of which extend their distribution range into subtropical or temperate regions. Common pantropical species include *Bulbothrix goebelii*, *Coc-*

cocarpia erythroxyli, *C. pellita*, *Dirinaria picta*, *Glyphis citricosa*, *Leptogium azureum*, *L. phyllocarpum*, *Malcolmiella granifera*, *Megalospora tuberculosa*, *Ocellularia cavata*, *Parmotrema cristiferum*, *Porina mastoidea*, *Pyrenula anomala* and *Pyrrhospora russula*. One species is cosmopolitan in oceanic places (*Normandina pulchella*), and a further two (*Baeomyces rufus* and *Peltigera collina*) are widespread temperate to boreal. *Pertusaria tetrathalamia* is American. About 71 species are widespread throughout the neotropics, seven species (*Mycomicrothelia oleosa*, *Myriotrema barroense*, *Ocellularia landronii*, *O. submersa*, *Polymeridium flavothecium*, *Pyrenula falsaria*, and *Thelotrema neei*) are Central American, and four species (*Anisomeridium flavovulcanus*, *Arthonia isidiata*, *Gyrotrema wirthii* and *Ocellularia auratipruinosa*) are supposedly endemic to Costa Rica. *Coccocarpia domingensis*, *Leiorreuma sericeum*, and *Stegobolus auberianus* are neotropical-Pacific. Eleven species have a neotropical-African distribution pattern. Amphi-Pacific ranges (Neotropics and Eastern paleotropics) are shown in 28 species, a few of them with occurrences within the Pacific region.

Foliicolous lichens

As pointed out above, the knowledge of tropical lichens is very incomplete. Among those groups which are being more intensely studied are the foliicolous lichens, i.e. those growing on living leaves of vascular plants. Because of the short-lived substrate this life form involves short life cycles – which implies rapid reproduction – in combination with small thalli. These adhere to the leaf surface by a thin layer of mucilage except for the species of *Strigula* that grow below the leaf cuticle. Dozens of species may occur on a single leaf. A survey of general aspects of the biology of foliicolous lichens is given by SANTESSON (1952) and LÜCKING (2001).

At present, about 800 species of foliicolous lichens are known world-wide (LÜCKING 2003). The great majority of them are confined to the tropics and most of them are obligately epiphyllous. SANTESSON's (1952) monograph laid the basis for the study of foliicolous lichens which has expanded steadily in recent years. Thus, the number of 482 species world-wide known in 1993 (FARKAS & SIPMAN 1993) has been enlarged by over 300 since then. Most research concentrates on regional diversity and taxonomy, and only a few authors take up ecological studies such as to host-substrate preferences, species associations, successional colonisation and interspecific competition in epiphyllous communities (see CONRAN 1997). Studies of the distribution ecology of foliicolous lichens in Costa Rica were undertaken by LÜCKING (1992b, 1998, 1999), and LÜCKING (1997d) pointed out the possible role of epiphyllous lichens as bioindicators.

Species diversity of foliicolous lichens is highest in undisturbed rainforests. Their optimal habitat appears to be the foliage of small woody plants, young trees and ferns in the transitional position from the shady understory to natural light gaps where light level is dim and humidity is high. There are fewer species higher up in the trees, and the outer canopy exhibits low species diversity (LÜCKING 1997c). Little is known about possible host preferences, but phorophyte specificity seems to be rare in foliicolous lichens. Colonisation of leaves by lichens is greatly influenced by surface features as smoothness or hairiness and surface relief.

Due to the fragmentary study of the phyllosphere at a world-wide scale, the distribution of many species is poorly known. The increasing knowledge of epiphyllous lichens also provides a better understanding of their distribution. Many species were found to have a wider range than indicated by former literature data; in fact, the vast majority seem to be pantropical. Types of distributions in foliicolous lichens in comparison with floristic regions based on vascular plants are outlined by LÜCKING (2003).

The foliicolous lichen flora of Costa Rica is well studied. With more than 400 species currently known, which corresponds to about half of the world's species number and three quarters of all species known from the neotropics, Costa Rica's foliicolous lichen flora is the best known in the world (LÜCKING 1997c). The highest species diversity of epiphyllous lichens in Costa Rica is found in the wet undisturbed primary lowland forests where single sites can support up to 280 species (LÜCKING 1997a).

The Golfo Dulce area has a rich epiphyllous lichen flora. The 245 presently known species comprise 58% of the species number known from Costa Rica. They belong to 18 families and 50 genera. Dominant families are the Gomphillaceae, Porinaceae, and Pilocarpaceae with 51, 49, and 46 species, respectively. The most well represented genera are *Porina* (33 species), *Strigula* (15 species), and *Trichothelium* (14 species).

Rainforests

Large areas of the Golfo Dulce region are still covered by rainforest. The Golfo Dulce rainforests belong to the most luxuriant and species-rich forests in Central America, which is also true with respect to lichens. The main forest type in the region is the Tropical Wet Forest according to HOLDRIDGE (1967) which covers the lowlands of the Golfo Dulce area. It is a multi-layered forest with abundant stilt-rooted palms, dwarf palms and broad-leaved herbs dominating the shrub layer (WEISSENHOFER et al. 2001) which clothes the plains and hillsides. Due to forest clearing for planta-

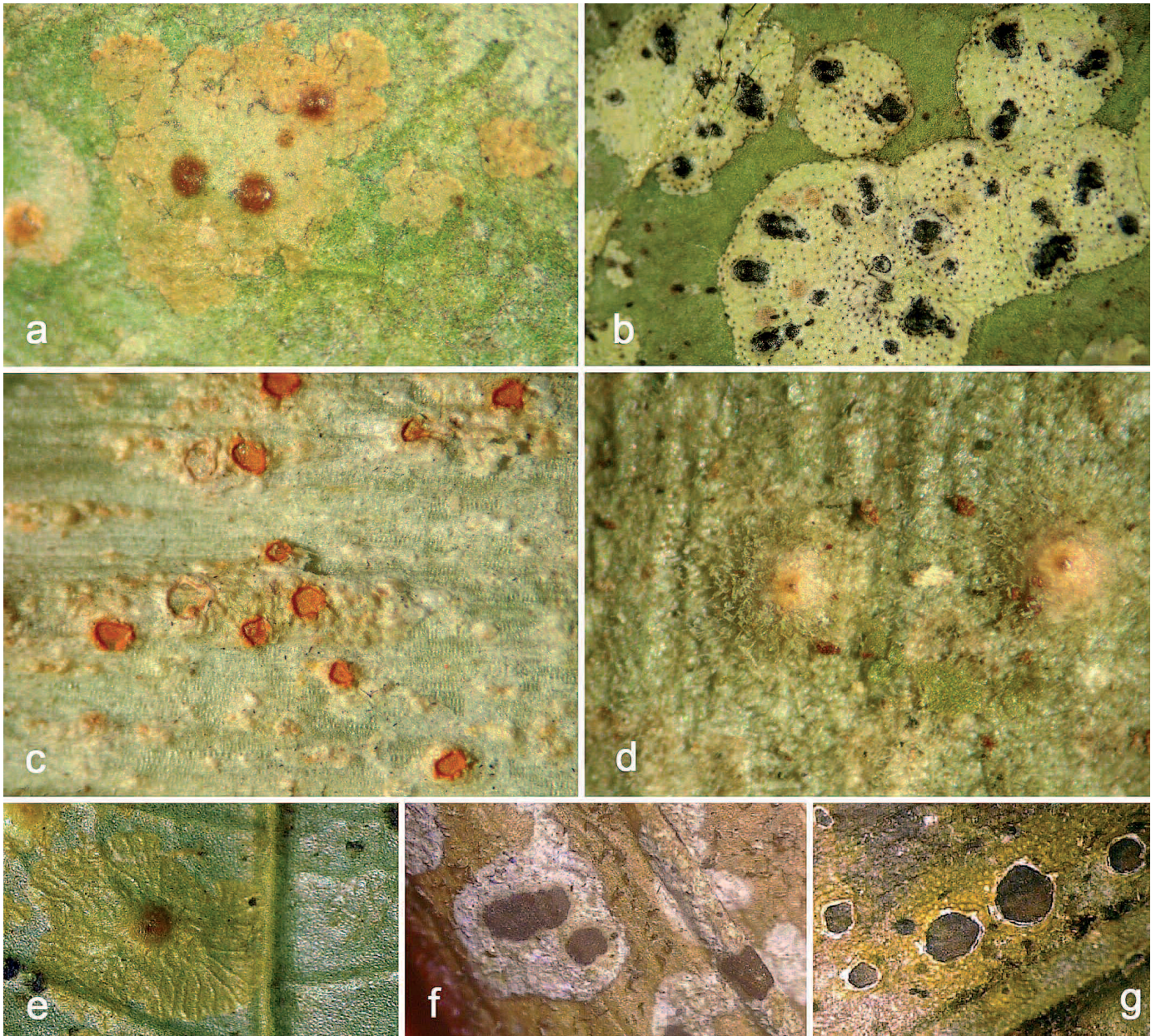


Plate 3: Epiphyllous lichens, (a) *Porina limbulata*, (b) *Strigula schizospora*, (c) *Chroodiscus coccineus*, (d) *Porina pilifera*, (e) *Porina radiata*, (f) *Echinoplaca wilsoniorum*, (g) *Mazosia melanophthalma*. Photos: G. Neuwirth.

tions and pastures or timber exploitation on flat land, the flat forest types are preserved only in the Corcovado National Park and have vanished from other regions where rainforests are restricted to the hillsides, e.g. in Piedras Blancas National Park. The hills and ridges (filas) often have very steep slopes and deep ravines which are difficult to access. The fila ridges are the “driest” parts, the ravines the wettest. The rainforest on the highest hill-tops and ridges shows premontane affinities with dense groundlayer mainly of ferns and a rich epiphyte cover.

Down in the dense forest with a closed canopy layer, where light levels are low, crustose lichens over-

whelmingly dominate; few species are macrolichens (foliose and fruticose growth forms). Squamulose, leprose, and filamentous lichens are also rare. The dominant role of crustose lichens in lowland rainforests has been pointed out by several investigators (see KOMPOSCH & HAFELLNER 2002). One reason for the absence of macrolichens under these conditions may be physiological (ZOTZ 1999). Most macrolichens that occur near ground level within the forest are species with blue-green photobionts such as *Leptogium* and *Coccocarpia* species. The macrolichen flora becomes increasingly richer in situations where light intensities are higher than within the forest – on stream-side trees, in larger light gaps, on forest edges and in the canopy. It can part-

ly be observed on fallen canopy branches and is represented by common and widespread species especially of the family Parmeliaceae but is not characteristic for lowland rainforests.

Typical lichen crusts in shade on tree bases and lower trunks include several *Porina* species (*Porina dolichophora*, *P. epimelaena*, *P. exasperatula*, *P. mastoidea*, *P. rudiusscula*, *P. tijucana*), *Anisomeridium flavovulcanus*, *Pyrenula* spp., *Malcolmiella granifera*, *Myeloconis* spp. and members of the large family Thelotremaaceae. There is a high proportion of sterile, sorediate, isidiate or otherwise vegetatively reproducing species which are difficult to identify. The squamulose growth form is represented by *Eschatogonia prolifera* and *Phyllopsora* species. Filamentous lichens are *Dictyonema* and *Coenogonium* species. Besides unknown sterile crusts, several *Porina* species seem to be among the most shade-tolerant lichens that form extensive species-poor mosaics on buttresses, stilt-roots and woody lianas above the forest floor.

Characteristic foliicolous species on shady understorey leaves are *Arthonia accolens*, *A. leptosperma*, *Dimerella siquirrensis*, *Fellhanera fuscata*, *Gyalidea epiphylla*, *Phylloblastenia amazonica*, *Porina epiphylla*, *P. limbulata*, *P. mirabilis*, *P. rufula*, *Strigula phyllogena*, *Strigula platypoda*, and *Trichothelium epiphyllum*, whereas *Arthonia palmulacea*, *Badimia dimidiata*, *Chroodiscus coccineus*, *Eremothecella calamicola*, *Mazosia* species, *Opegrapha filicina*, *Phyllobathelium firmum*, *Porina fulvella*, *Porina subepiphylla*, *Strigula maculata*, *S. subtilissima*, and *Paratracharia paradoxa* prefer less damp and lighter spots in the forest. Epiphyllous associations in light gaps include *Actinoplaca strigulacea*, *Aspidothelium fugiens*, *Calenia depressa*, *Calopadia foliicola*, *C. fusca*, *Echinoplaca* species, *Gyalectidium filicinum*, *Gyalideopsis vulgaris*, *Strigula smaragdula*, *Tricharia urceolata*, and *T. vainioi*.

Much of the Golfo Dulce rainforest is pristine forest and supports special lichen communities. *Amazonomyces farkasiae*, *Arthonia orbygniae*, *Aulaxina microphana*, *Badimia galbinea*, *Byssoloma minutissimum*, *Caleniopsis laevigata*, *Fellhanera verrucifera*, *Gyalidea epiphylla*, *Mazosia longispora*, *M. rubropunctata*, *M. tenuissima*, *Paratracharia paradoxa*, *Porina radiata*, *P. guianensis*, *P. pseudo-fulvella*, and *Strigula macrocarpa* are examples of species which seem to be restricted to primary forests, whereas occurrences of *Asterothyrium* species, *Bullatina aspidota*, *Porina vezdae*, and *Strigula antillarum* indicate secondary forests. Most species found in the study area have a wide altitudinal distribution, but *Badimia galbinea*, *Bapalmuia palmularis*, *Byssolecania* species, *Cryptothecia filicina*, *Mazosia tumidula* and *Porina radiata* are largely confined to lowland forests.

Secondary vegetation

Although the Golfo Dulce region is largely uninhabited, parts of the landscape have been affected by human activities. Land outside the national parks became fragmented, fenced, grazed and cultivated and locally shows different stages of recolonisation and successions. Disturbed forests and secondary vegetation shelter lichen communities which are very different from those in virgin forests. There is a decline in foliicolous lichens, a predominance of corticolous species, and a richer macrolichen flora in the more open vegetation. The close proximity of (nearly) undisturbed primary forest and secondary habits created by man affects biodiversity levels considerably. It is the interlinking of primary and secondary vegetation with transition features between forested and open areas and their contrasting plant communities that provides high numbers of lichen species within comparatively small areas.

The synanthropic lichen flora has been investigated in the surroundings of the village of La Gamba. Solitary trees along roads or in pastures have a rich growth of lichens. *Arthothelium galbineum*, *Glyphis cicatricosa*, *Leptogium phyllocarpum*, *Normandina pulchella*, *Parmeliella stylophora*, *Physcia atrostriata*, *P. krogiae*, and *P. lobulata* are among those lichens that have been found only in cultivated areas. Large thalli of *Parmotrema cristiferum*, *P. dilatatum* and *P. endosulphureum* colonise well-lit stems and branches. Fence posts support a rich cover of lignicolous lichen communities that are dominated by Graphidaceae. Lichens present on dead wood include *Carbacanthographis chionophora*, *Graphis chrysocarpa*, *G. disserpens*, *G. proserpens*, *G. rimulosa*, *G. striatula*, *G. vestitoides* and *Thalloloma anguinaeforme*. Most of these species are absent or rare in natural habitats.

Species inventory

At present, 471 lichen taxa are known from the Golfo Dulce region. They are listed below with foliicolous and non-foliicolous lichens enumerated separately (species found on both leaves and bark or lignum are shown in both sections). The list is based on literature records and on (unpublished) collections by the author. Taxonomy of foliicolous lichens mostly follows LÜCKING et al. (2000). *Dimerella* is retained as a genus distinct from *Coenogonium*. To facilitate comparison of literature data, the most recent changes in generic delimitations, e.g. within the Gomphillaceae (LÜCKING et al. 2005), have not been considered. Taxonomy of Graphidaceae follows STAIGER (2002). Every species name is followed by abbreviations referring to the subregions of the area (BE, Go, Osa, Caño) and the literature references.

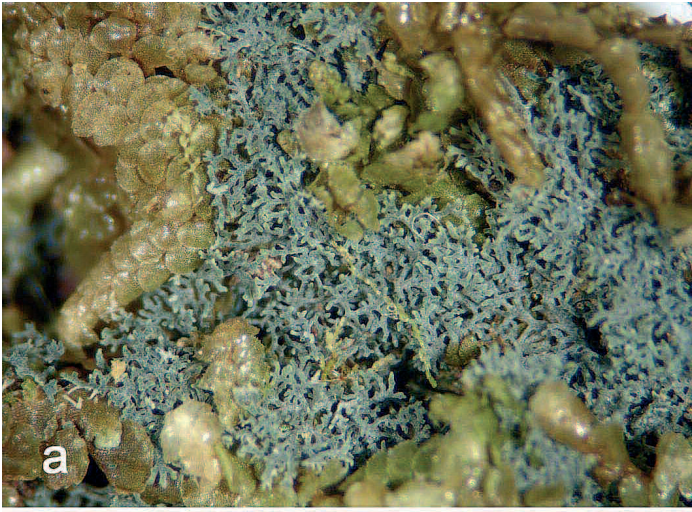


Plate 4: Corticolous lichens, (a) *Coccocarpia filiformis*, (b) *Sarcographa ramificans*, (c) *Graphis chrysocarpa*, (d) *Graphis vestitoides*, (e) *Platythecium allosporellum*, (f) *Sarcographa labyrinthica*. Photos: G. Neuwirth.

Abbreviations:

BE = Bosque Esquinas and La Gamba, Go = Golfo to, Osa = Peninsula de Osa, Caño = Isla del Caño; Ap&al08 = APTROOT et al. 2008, BaGr06 = BALOCH & GRUBE 2006, Br00 = BREUSS 2000, Br06 = BREUSS 2006, BrNe07 = BREUSS & NEUWIRTH 2007, HaKa95 = HAFELLNER & KALB 1995, Lü95 = LÜCKING 1995, Lü97 = LÜCKING 1997, Lü99 = LÜCKING 1999, LüMa96 = LÜCKING & MATZER 1996, LüSér.97 = LÜCKING & SÉRUSIAUX 1997

Foliicolous lichens

- Actinoplaca strigulacea* MÜLL. ARG.: BE, Br06
Amazonomyces farkasiae (LÜCKING) LÜCKING, SERUS. & THOR: BE, Osa, Lü95, BrNe07
Arthonia accolens STIRT.: BE, Osa, Br06, Lü95
Arthonia aciniformis STIRT.: BE, Br00, BrNe07, Lü95
Arthonia cinnabarinula MÜLL. ARG.: BE, BrNe07
Arthonia cyanea MÜLL. ARG.: BE, Go, Br06, Lü92, Lü95
Arthonia epidendri (REHM) R. SANT.: BE, BrNe07
Arthonia intermedia MATZER: Osa, MATZER 1996
Arthonia leptosperma (MÜLL. ARG.) R. SANT.: BE, Osa, Br00, Br06, BrNe07, Lü95
Arthonia mira R. SANT.: Go, Lü92
Arthonia orbignyae (UPADHYAY) MATZER: BE, Osa, Br00, Lü95
Arthonia palmulacea (MÜLL. ARG.) R. SANT.: BE, Go, Osa, Br06, BrNe07, Lü95,
Arthonia trilocularis MÜLL. ARG.: BE, Go, Osa, BrNe07, Lü92, Lü95
Aspidothelium fugiens (MÜLL. ARG.) R. SANT.: BE, Br06, BrNe07
Aspidothelium geminiparum (MALME) R. SANT.: BE, BrNe07
Aspidothelium ornatum LÜCKING: BE, Br06
Aspidothelium papillicarpum LÜCKING: BE, Br06
Aspidothelium scutellarpum LÜCKING: BE, BrNe07
Aspidothelium trichothelioides SÉRUS. & VÉZDA: BE, Br06
Asterothyrium microsporum R. SANT.: BE, BrNe07
Asterothyrium pittieri MÜLL. ARG.: Go, Lü92
Asterothyrium rotuliforme (MÜLL. ARG.) SÉRUS.: BE, BrNe07
Aulaxina intermedia LÜCKING: BE, BrNe07
Aulaxina microphana (VAIN.) R. SANT.: BE, BrNe07
Aulaxina minuta R. SANT.: BE, Osa, Br06, BrNe07, Lü97
Aulaxina multiseptata R. SANT.: BE, Br06
Aulaxina opegraphina FÉE: BE, Go, Br06, Lü92
Aulaxina quadrangula (STIRT.) R. SANT.: BE, Osa, Br06, BrNe07, Lü97
Aulaxina submuralis KALB & VÉZDA: BE, BrNe07
Bacidina apiatica (MÜLL. ARG.) VÉZDA: BE, BrNe07
Bacidina pallidocarpa (MÜLL. ARG.) VÉZDA: BE, Br06
Badimia dimidiata (BAB. ex LEIGHTON) VÉZDA: BE, Br00, Br06, BrNe07
Badimia galbinea (KREMP.) VÉZDA: BE, Br00, Br06, BrNe07
Badimia pallidula (KREMP.) VÉZDA: BE, Br00, Br06
Badimia tuckermanii (R. SANT.) LÜCKING, LUMBSCH & ELIX: BE, BrNe07
Bapalmua costaricensis LÜCKING & KALB: BE, BrNe07
Bapalmua palmularis (MÜLL. ARG.) SÉRUS.: BE, Br06
Bullatina aspidota (VAINIO) VÉZDA & POELT: BE, Go, Br06, Lü92
Bysssolecania deplanata (MÜLL. ARG.) R. SANT.: BE, Br06, BrNe07
Bysssolecania fumosonigricans (MÜLL. ARG.) R. SANT.: BE, Br06, BrNe07
Bysssolecania hymenocarpa (VAIN.) KALB et al.: BE, BrNe07
Bysssolecania pluriseptata BREUSS: BE, BrNe07
Bysssolecania variabilis VÉZDA, KALB & LÜCKING: BE, BrNe07
Bysssolecania vezdae KALB & LÜCKING: BE, BrNe07
Byssoloma aeruginascens VÉZDA: Osa, ELIX & al. 1995
Byssoloma leucoblepharum (NYL.) VAINIO: BE, Br00, Br06, BrNe07
Byssoloma lueckingii SÉRUS.: Go, SÉRUSIAUX 1995
Byssoloma minutissimum KALB & VÉZDA: BE, Br06, BrNe07
Byssoloma subdiscordans (NYL.) P. JAMES: BE, Br06, BrNe07
Byssoloma tricholomum (MONT.) ZAHLBR.: BE, BrNe07
Byssoloma vanderystii SÉRUS.: BE, BrNe07
Calenia bullatinoides LÜCKING: Go, LÜCKING et al. 2001
Calenia depressa MÜLL. ARG.: BE, Br06, BrNe07
Calenia graphidea VAIN.: BE, Osa, BrNe07, Lü97
Calenia lueckingii HARTMANN: BE, BrNe07
Calenia phyllogena (MÜLL. ARG.) R. SANT.: BE, Osa, Br06, BrNe07, Lü97
Calenia solorinoides LÜCKING: Go, Lü91, Lü92
Calenia subdepressa LÜCKING: BE, Osa, Br06, BrNe07, Lü97
Calenia thelotremella VAIN.: Osa, Lü97
Calenia triseptata ZAHLBR.: BE, Osa, BrNe07, Lü97
Caleniopsis laevigata (MÜLL. ARG.) VÉZDA & POELT: BE, BrNe07
Calopadia foliicola (FÉE) VÉZDA: BE, Osa, Br06, Lü99
Calopadia fusca (MÜLL. ARG.) VÉZDA: BE, Caño, Go, Osa, Br06, BrNe07, Lü92, Lü99
Calopadia perpallida (NYL.) VÉZDA: BE, Br00, BrNe07
Calopadia phyllogena (MÜLL. ARG.) VÉZDA: BE, Osa, Br06, BrNe07, Lü99
Calopadia puiggarii (MÜLL. ARG.) VÉZDA: BE, Caño, Br06, BrNe07, Lü99
Calopadia subcoerulescens (ZAHLBR.) VÉZDA: BE, Br06, BrNe07
Caprettia neotropica LÜCKING & SÉRUS.: Osa, SÉRUSIAUX & LÜCKING 2003
Chroodiscus australiensis LUMBSCH & VÉZDA: BE, Br06
Chroodiscus coccineus (LEIGHT.) MÜLL. ARG.: BE, Go, Osa, Br00, Br06, BrNe07, Lü92, Lü99b
Coccocarpia domingensis VAIN.: BE, BrNe07
Coccocarpia epiphylla (FÉE) KREMP.: BE, Br06
Coccocarpia stellata TUCK.: BE, Br00, Br06
Coccocarpia tenuissima MÜLL. ARG.: BE, BrNe07
Coenogonium ciliatum KALB & LÜCKING: BE, BrNe07
Coenogonium implexum NYL.: BE, Br00
Coenogonium moniliforme TUCK.: Osa, Lü99c
Cryptothecia filicina (ELLIS & EVERH.) LÜCKING et al.: BE, Osa, BrNe07, Lü95
Dictyonema phyllogenum (MÜLL. ARG.) ZAHLBR. f. *phyllogenum*: BE, Br06, BrNe07
Dictyonema sericeum (SW.) BERK. f. *phyllophilum* PARM.: BE, BrNe07
Dimerella dilucida (Kremp.) R. SANT.: BE, Br06, BrNe07, Osa, Lü99c

- Dimerella epiphylla* (MÜLL. ARG.) MALME: BE, Go, Osa, Br06, BrNe07, Lü92, Lü99c
- Dimerella fallaciosa* (MÜLL. ARG.) VĚZDA: BE, Br06, BrNe07
- Dimerella flavicans* VĚZDA & FARKAS: BE, Br00
- Dimerella hypophylla* VĚZDA: BE, Osa, Br06, BrNe07, Lü99c
- Dimerella isidiifera* LÜCKING: Osa, Lü99c
- Dimerella lisowskii* VĚZDA: BE, BrNe07
- Dimerella minima* (MÜLL. ARG.) R. SANT.: BE, Br06, BrNe07, Osa, Lü99c
- Dimerella siquirrensis* LÜCKING: BE, Go, Osa, Br06, BrNe07, Lü99c
- Dimerella subzonata* LÜCKING: BE, Osa, Br06, Lü99c
- Dimerella usambarensis* VĚZDA & FARKAS: BrNe07
- Echinoplaca bispora* KALB & VĚZDA: BE, Br06, BrNe07
- Echinoplaca diffluens* (MÜLL. ARG.) R. SANT.: BE, Br06, BrNe07
- Echinoplaca epiphylla* FÉE: BE, Go, Osa, Br06, BrNe07, Lü92, Lü97
- Echinoplaca furcata* SÉRUS.: Osa, Lü97
- Echinoplaca fusconitida* LÜCKING: BE, Br06, BrNe07
- Echinoplaca handelii* (Zahlbr.) LÜCKING: BE, Br06
- Echinoplaca hymenocarpoides* (VAIN.) LÜCKING: BE, BrNe07
- Echinoplaca leucotrichoides* (VAIN.) R. SANT.: BE, Osa, Br06, BrNe07, Lü97
- Echinoplaca marginata* LÜCKING: BE, Osa, BrNe07, Lü97
- Echinoplaca pellicula* (MÜLL. ARG.) R. SANT.: BE, Go, Osa, Br06, BrNe07, Lü97
- Echinoplaca tricharioides* KALB & VĚZDA: BE, BrNe07
- Echinoplaca verrucifera* LÜCKING: BE, Caño, Osa, Br06, Lü97
- Echinoplaca wilsoniorum* LÜCKING: vicinity of field station La Gamba
- Enterographa angustissima* (VAIN.) R. SANT.: Go, Lü92
- Enterographa byssoidea* LÜCKING: BE, Go, Lü92, BrNe07
- Eremothecella calamicola* SYD.: BE, Osa, BrNe07, Lü95
- Fellhanera angustispora* LÜCKING: Osa, Lü97b
- Fellhanera fuscata* (MÜLL. ARG.) VĚZDA: Osa, Lü97b
- Fellhanera muhleii* LÜCKING: Osa, Lü97b
- Fellhanera rhabdophylli* (REHM) VĚZDA: BE, BrNe07
- Fellhanera rubida* (MÜLL. ARG.) LÜCKING: Osa, Lü97b
- Fellhanera stanhopeae* (MÜLL. ARG.) LÜCKING, LUMBSCH & ELIX: Osa, Lü97b
- Fellhanera subfuscata* LÜCKING: Osa, Lü97b
- Fellhanera subternella* (NYL.) VĚZDA: BE, Br06, BrNe07
- Fellhanera verrucifera* LÜCKING: Osa, Lü97b
- Gyalectidium ciliatum* LÜCKING, THOR & MATSUMOTO: BE, BrNe07
- Gyalectidium filicinum* MÜLL. ARG.: BE, Osa, BrNe07, Lü97
- Gyalidea epiphylla* VĚZDA: BE, Osa, Br06, Lü99b
- Gyalideopsis actinoplacoides* LÜCKING: BE, BrNe07
- Gyalideopsis rubescens* VĚZDA: BE, Go, BrNe07, Lü92
- Gyalideopsis verruculosa* VĚZDA & HAF.: BE, Br06
- Gyalideopsis vulgaris* (MÜLL. ARG.) LÜCKING: BE, Osa, Br06, BrNe07, Lü97
- Lasioloma arachnoideum* (KREMP.) R. SANT.: BE, Go, Osa, Br06, BrNe07, Lü92, Lü99
- Lichenopeltella setifera* MATZER: BE, BrNe07
- Loflammia epiphylla* (FÉE) LÜCKING & VĚZDA: BE, Br06
- Loflammia gabrielis* (MÜLL. ARG.) VĚZDA: Go, Osa, Lü99
- Lyromma nectandrae* BAT. & H. MAIA: Go, Lü92
- Macentina perminuta* VĚZDA: BE, BrNe07
- Malcolmiella amazonica* (REDINGER) KALB & LÜCKING: BE, BrNe07
- Mazosia bambusae* (VAINIO) R. SANT.: BE, Osa, Br06, BrNe07, LüMa96
- Mazosia dispersa* (HEDRICK) R. SANT.: BE, Go, Osa, Br06, BrNe07, Lü92, LüMa96
- Mazosia longispora* LÜCKING & MATZER: BE, BrNe07
- Mazosia melanophthalma* (MÜLL. ARG.) R. SANT.: BE, Go, Br06, BrNe07, LüMa96
- Mazosia paupercula* (MÜLL. ARG.) R. SANT.: BE, Br00
- Mazosia phyllosema* (NYL.) ZAHLBR.: BE, Go, Br00, Br06, BrNe07, Lü92
- Mazosia pilosa* KALB & VĚZDA: BE, Go, Osa, Br00, Br06, BrNe07, LüMa96
- Mazosia praemorsa* (STIRT.) R. SANT.: BE, Br06, BrNe07
- Mazosia pseudobambusae* KALB & VĚZDA: BE, Osa, BrNe07, LüMa96
- Mazosia rotula* (MONT.) A. MASSAL.: BE, Caño, Osa, Br00, Br06, BrNe07, LüMa96
- Mazosia rubropunctata* R. SANT.: Caño, LüMa96
- Mazosia tenuissima* LÜCKING & MATZER: BE, Osa, Br00, Br06, BrNe07, LüMa96
- Mazosia tumidula* (STIRT.) MÜLL. ARG.: BE, Osa, Br00, Br06, BrNe07, LüMa96
- Microtheliopsis uleana* MÜLL. ARG.: BE, BrNe07
- Musaespora kalbii* LÜCKING & SÉRUS.: Osa, LüSér97
- Opeggrapha alba* LÜCKING: Go, Lü91, Lü92
- Opeggrapha filicina* MONT.: BE, Caño, Go, Br06, BrNe07, Lü92, LüMa96
- Opeggrapha lambinonii* SÉRUS.: Osa, LüMa96
- Opeggrapha phylloporinae* MÜLL. ARG.: BE, BrNe07
- Opeggrapha puiggarii* MÜLL. ARG.: Go, Lü92
- Opeggrapha sipmanii* MATZER: Osa, MATZER 1996
- Opeggrapha strigulae* R. SANT.: BE, BrNe07
- Paratracharia paradoxa* (LÜCKING) LÜCKING: BE, Br00, Br06, BrNe07
- Phyllobathelium firmum* (STIRT.) VĚZDA: BE, Br06, BrNe07
- Phyllobathelium leguminosae* (CAVALC. & A.A. SILVA) LÜCKING & SÉRUS.: BE, BrNe07
- Phylloblastia amazonica* KALB & VĚZDA: BE, Br06, BrNe07
- Porina alba* (R. SANT.) LÜCKING: BE, Osa, BALOCH & GRUBE 2006, Br06, BrNe07, LüVe98
- Porina andreana* LÜCKING & VĚZDA: BE, Br06
- Porina atriceps* (VAIN.) VAIN.: BE, BrNe07
- Porina barvica* LÜCKING: BE, BrNe07
- Porina conspersa* MALME: BE, Br06
- Porina distans* VĚZDA & VIVANT: BE, Br06
- Porina epiphylla* (FÉE) FÉE: BE, Osa, BaGr06, Br06, BrNe07
- Porina fulvella* MÜLL. ARG.: BE, Go, Lü92, Br00, BE, BrNe07
- Porina fusca* LÜCKING: BE, BrNe07
- Porina andreana* LÜCKING & VĚZDA: BE, Br06
- Porina guianensis* LÜCKING & VĚZDA f. *guianensis*: BE, Br06
- Porina imitatrix* MÜLL. ARG.: BE, Br06
- Porina karnatakensis* MAKH., ADAW. & PATW.: BE, Osa, LüVe98, Br06, BrNe07
- Porina leptosperma* MÜLL. ARG.: BE, Br00, BrNe07
- Porina leptospermoides* MÜLL. ARG.: BE, Br06, BrNe07
- Porina limbulata* (KREMP.) VAINIO: BE, BaGr06, Br00, Br06, BrNe07

- Porina lucida* R. SANT.: BE, Osa, LüVe98, Br00, Br06, BaGr06, BrNe07
- Porina nitidula* MÜLL. ARG.: BE, BaGr06, BrNe07
- Porina octomera* (MÜLL. ARG.) F. SCHILL.: BE, BrNe07
- Porina ornata* VÉZDA: BE, BrNe07
- Porina papillifera* (STIRT.) F. SCHILL.: BE, BrNe07
- Porina pilifera* NEUWIRTH: BE, NEUWIRTH & PFALLER 2006, BrNe07
- Porina pocsii* VÉZDA: BE, Br06
- Porina pseudofulvella* SÉRUS.: BE, Br00, BrNe07
- Porina radiata* KALB, LÜCKING & VÉZDA: BE, Osa, LüVe98, BaGr06, Br00, Br06, BrNe07
- Porina repanda* (STIRT.) LÜCKING & R. SANT.: BE, Osa, HaKa95, BaGr06, Br00, BrNe07
- Porina rubentior* (STIRT.) MÜLL. ARG.: BE, BaGr06, Br00, Br06, BrNe07
- Porina rubescens* (LÜCKING) HAF. & KALB: Osa, HaKa95
- Porina rubrosphaera* R. SANT.: BE, BrNe07
- Porina rufula* (KREMP.) VAINIO: BE, Br00, Br06, BaGr06, BrNe07
- Porina subepiphylla* LÜCKING & VÉZDA: BE, Go, Osa, LüVe98, BaGr06, Br06, BrNe07
- Porina tetracerae* (AFZ.) MÜLL. ARG.: BE, Br06
- Porina tetramera* (MALME) R. SANT.: BE, Br06, BrNe07
- Porina vezdae* LÜCKING: BE, BrNe07
- Pseudocalopadia mira* LÜCKING: Osa, Lü99
- Sporopodium antonianum* ELIX, LUMBSCH & LÜCKING: Osa, ELIX et al. 1995, Lü99
- Sporopodium citrinum* (ZAHLEBR.) ELIX et al.: BE, Osa, Br00, Lü99
- Sporopodium leprieurii* MONT.: BE, Go, Osa, Br06, BrNe07, ELIX et al. 1995, Lü99
- Sporopodium phyllocaris* (MONT.) A. MASSAL.: Caño, Lü99
- Sporopodium xantholeucum* (MÜLL. ARG.) ZAHLEBR.: BE, Br00
- Strigula antillarum* (FÉE) MÜLL. ARG.: Go, Lü91, Lü92
- Strigula complanata* (FÉE) MONT.: BE, Br06, BrNe07
- Strigula concreta* (FÉE) R. SANT.: BE, Go, Lü92, BrNe07
- Strigula macrocarpa* VAINIO: BE, Br06, BrNe07
- Strigula maculata* (COOKE & MASSEE) R. SANT.: BE, Br06, BrNe07
- Strigula nemathora* MONT. var. *nemathora*: BE, Br06, BrNe07
- Strigula nemathora* MONT. var. *pulchella* (MÜLL. ARG.) R. SANT.: BE, BrNe07
- Strigula nitidula* MONT.: BE, Br00
- Strigula obducta* (MÜLL. ARG.) R.C. HARRIS: BE, BrNe07
- Strigula phaea* (TUCK.) R.C. HARRIS: Osa, Ap&al08
- Strigula phyllogena* (MÜLL. ARG.) R.C. HARRIS: BE, Br00, Br06, BrNe07
- Strigula platypoda* (MÜLL. ARG.) R.C. HARRIS: BE, Br06, BrNe07
- Strigula schizospora* R. SANT.: BE, BrNe07
- Strigula smaragdula* FR.: BE, Go, Lü92, Br06, BrNe07
- Strigula subelegans* VAINIO: BE, Br06, BrNe07
- Strigula subtilissima* (FÉE) MÜLL. ARG.: BE, Br06, BrNe07
- Strigula viridis* (LÜCKING) R.C. HARRIS: BE, BrNe07
- Tapellaria bilimbioides* R. SANT.: BE, BrNe07
- Tapellaria epiphylla* (MÜLL. ARG.) R. SANT.: BE, Osa, Lü99, Br00, Br06, BE, BrNe07
- Tapellaria malmei* R. SANT.: BE, Osa, Lü99, BrNe07
- Tapellaria nana* (FÉE) R. SANT.: BE, Br06
- Tapellaria nigrata* (MÜLL. ARG.) R. SANT.: BE, BrNe07
- Tapellaria phyllophila* (STIRT.) R. SANT.: BE, Br06, BE, BrNe07
- Tapellaria puiggarii* (MÜLL. ARG.) R. SANT.: BE, BrNe07
- Tapellariopsis octomera* LÜCKING: Osa, Lü99
- Tricharia albostrigosa* R. SANT.: BE, Br00, Br06, BrNe07
- Tricharia amazonum* VAIN.: Osa, Lü97
- Tricharia carnea* (MÜLL. ARG.) R. SANT.: Osa, Lü97
- Tricharia couepiae* (BAT.) LÜCKING & SÉRUS.: Osa, Lü97
- Tricharia helminthospora* R. SANT.: BE, Osa, Lü97, BrNe07
- Tricharia heterella* (STIRT.) LÜCKING: BE, Osa, Lü97, Br06, BrNe07
- Tricharia hyalina* KALB & VÉZDA: BE, Osa, Lü97, BrNe07
- Tricharia planicarpa* LÜCKING: BE, BrNe07
- Tricharia santessoniana* KALB & VEZDA: BE, BrNe07
- Tricharia urceolata* (MÜLL. ARG.) R. SANT.: BE, Osa, Lü97, Br00, Br06, BrNe07
- Tricharia vainioi* R. SANT.: BE, Osa, Lü97, Br06, BrNe07
- Trichothelium alboatrum* VAIN.: BE, BrNe07
- Trichothelium annulatum* (KARST.) R. SANT.: Osa, Lü98
- Trichothelium bipindense* F. SCHILL.: BE, Osa, Lü98, Br00, Br06, BrNe07
- Trichothelium epiphyllum* MÜLL. ARG.: BE, Osa, Lü98, Br00, Br06, BaGr06, BrNe07
- Trichothelium juruense* (P. HENN.) F. SCHILL.: BE, Osa, Lü98, BrNe07
- Trichothelium longisporum* LÜCKING: BE, Osa, Lü98, Br06, BrNe07
- Trichothelium minus* VAIN.: BE, Go, Osa, Lü98, Br06, BrNe07
- Trichothelium minutum* (LÜCKING) LÜCKING: BE, Osa, Lü98, BrNe07
- Trichothelium mirum* LÜCKING: Osa, Lü98
- Trichothelium montanum* LÜCKING: BE, Osa, Lü98, BrNe07
- Trichothelium pallescens* (MÜLL. ARG.) F. SCHILL.: BE, Osa, Lü98, Br06, BrNe07
- Trichothelium pallidesetum* LÜCKING: BE, Br06
- Trichothelium sipmanii* R. LÜCKING s.str.: BE, Osa, Lü98, Br06
- Trichothelium sipmanii* R. LÜCKING f. *multiseptatum* LÜCKING: BE, Osa, Lü98, BrNe07
- Trichothelium ulei* (P. HENN.) HÖHNEL: Osa, Lü98
- Non-follicolous lichens**
- Anisomeridium ambiguum* (ZAHLEBR.) R.C. HARRIS: Osa, Ap&al08
- Anisomeridium americanum* (A. MASSAL.) R.C. HARRIS: Caño, Ap&al08
- Anisomeridium flavovulcanus* KOMPOSCH: BE, Osa, KOMPOSCH 2005, BrNe07
- Anisomeridium infernale* (MONT.) R.C. HARRIS: BE, BrNe07
- Anthracothecium prasinum* (ESCHW.) R.C. HARRIS: Osa, Ap&al08
- Arthonia complanata* FÉE: BE, Br00, BrNe07
- Arthonia isidiata* GRUBE, LÜCKING & UMANA-TENORIO: Osa, Grube & al. 2004
- Astrothelium crassum* (FÉE) APTROOT: Osa, Ap&al08
- Astrothelium eustomum* (MONT.) MÜLL. ARG.: BE, Br06
- Astrothelium galbineum* BE, Osa, Br06, BrNe07, Ap&al08
- Astrothelium eustomum* (MONT.) MÜLL. ARG.: BE, Br06
- Astrothelium interjectum* R.C. HARRIS: BE, Br06

- Astrothelium variolosum* (ACH.) MÜLL. ARG.: BE, Br06
Bacidia lutescens MALME: BE, BrNe07
Baeomyces rufus (HUDSON) REBENT.: BE, BrNe07
Bathelium degenerans (VAIN.) R.C. HARRIS: Osa, Ap&al08
Bathelium feei (MEISSN.) APTROOT: Osa, Ap&al08
Biatora furfurosa TUCK. ex NYL.: BE, BrNe07
Bulbothrix apophysata (HALE & KUROK.) HALE: BE, Br06, BrNe07
Bulbothrix goebelii (ZENKER) HALE: BE, BrNe07
Bulbothrix klementii HALE: BE, BrNe07
Bulbothrix laevigatula (NYL.) HALE: BE, BrNe07
Bulbothrix suffixa (STIRTON) HALE: BE, Br06
Calopadia cf. *chacoensis* (MALME) KALB & VĚZDA: BE, Br00
Calopadia foliicola (FÉE) VĚZDA: BE, Osa, Br06, Lü99
Calopadia isidiosa KALB & VĚZDA: BE, BrNe07
Calopadia lecanorella (NYL.) KALB & VĚZDA: BE, Br06, BrNe07
Calopadia perpallida (NYL.) VĚZDA: BE, Br00, BrNe07
Calopadia subcoerulescens (ZAHLEBR.) VĚZDA: BE, BrNe07
Carbacanthographis chionophora (REDINGER) STAIGER & KALB: BE, Br06, BrNe07
Celothelium aciculiferum (NYL.) VAIN.: BE, BrNe07
Cladonia subradiata (VAIN.) SANDST.: area of the Esquinas Rainforest Lodge
Coccocarpha dissecta SWINSC. & KROG: Osa, LÜCKING et al. 2007
Coccocarpha epiphylla (FÉE) KREMP.: BE, Br06
Coccocarpha erythroxyli (SPRENGEL) SWINSC. & KROG: BE, Osa, Br00, LÜCKING et al. 2007
Coccocarpha filiformis L. ARVIDSS.: BE, BrNe07
Coccocarpha glaucina KREMP.: Osa, LÜCKING et al. 2007
Coccocarpha palmicola (SPRENGEL) ARVIDSS. & GALLOWAY: BE, Osa, Br00, DODGE 1933, LÜCKING et al. 2007
Coccocarpha pellita (ACH.) MÜLL. ARG.: BE, Osa, Br06, DODGE 1933
Coccocarpha stellata TUCK.: BE, Br00, Br06
Coenogonium acrocephalum MÜLL. ARG.: near Esquinas Rainforest Lodge, Fila Golfito
Coenogonium implexum NYL.: BE, Br00
Coenogonium interplexum NYL.: BE, Br06
Coenogonium leprieurii (MONT.) NYL.: BE, BrNe07
Coenogonium linkii EHRENB.: BE, Br06, BrNe07
Coenogonium subvirescens (NYL.) NYL.: BE, Osa, DODGE 1933, BrNe07
Crocynia gossypina (SW.) A. MASSAL.: BE, Br06, BrNe07
Crocynia pyxinoides NYL.: BE, Br00
Dichosporidium nigrocinctum (EHRENB.: FR.) THOR: BE, Br00
Dictyonema glabratum (SPRENG.) D. HAWKSW.: BE, Br06
Dictyonema sericeum (SW.) BERK.: BE, Br00, Br06
Diorygma confluens (FÉE) KALB, STAIGER & ELIX: BE, Br00
Diorygma poitaei (FÉE) KALB, STAIGER & ELIX: BE, Br06
Diorygma pruinosum (ESCHW.) KALB, STAIGER & ELIX: BE, BrNe07
Diorygma reniforme (FÉE) KALB, STAIGER & ELIX: BE, Br06, BrNe07
Dirinaria aegialita (ACH.) MOORE: BE, BrNe07
Dirinaria picta (SW.) CLEM. & SHEAR: BE, Br00, BrNe07
Dyplolabia afzelii (ACH.) A. MASSAL.: BE, BrNe07
Echinoplaca bispora KALB & VĚZDA: BE, Br06, BrNe07
Echinoplaca similis KALB & VĚZDA: BE, BrNe07
Eschatogonia prolifera (MONT.) R. SANT.: BE, Br06, BrNe07
Fissurina cingalina (NYL.) STAIGER: BE, BrNe07
Gassicurtia coccinea FÉE: BE, Br06
Glyphis cicatricosa ACH.: BE, Br06, BrNe07
Graphis acharii FÉE: BE, Br06
Graphis analoga NYL.: BE, BrNe07
Graphis anfractuosa (ESCHW.) ESCHW.: BE, BrNe07
Graphis anguilliformis TAYLOR: BE, Br06, BrNe07
Graphis antillarum VAIN.: BE, BrNe07
Graphis cf. *furcata* FÉE: BE, BrNe07
Graphis chrysocarpha (RADDI) SPRENG.: BE, Br06, BrNe07, STAIGER 2002
Graphis dimidiata VAINIO: BE, Br00, BrNe07
Graphis disperpens NYL.: BE, BrNe07
Graphis duplicata ACH.: BE, Br06
Graphis elegans (SM.) ACH.: BE, BrNe07
Graphis elongatoradians FINK: BE, BrNe07
Graphis flexibilis KREMP.: BE, Br00, Br06
Graphis cf. *haemographa* NYL.: BE, Br00
Graphis leptocarpha FÉE: BE, BrNe07
Graphis longula KREMP.: BE, Br06, BrNe07
Graphis paraserpens LIZANO & LÜCKING: BE, BrNe07
Graphis plurispora (REDINGER): BE, Br06
Graphis proserpens VAIN.: BE, BrNe07
Graphis rimulosa (MONT.) TREVISAN: BE, Br00, Br06, BrNe07
Graphis striatula (ACH.) SPRENG.: BE, BrNe07
Graphis vestitoides (FINK) STAIGER: BE, Br00, Br06, BrNe07
Gyalideopsis confluens KALB & VĚZDA: BE, BrNe07
Gyalideopsis lambionii VĚZDA: BE, BrNe07
Gyalideopsis vainioi KALB & VĚZDA: BE, BrNe07
Gyrotrema wirthii RIVAS PLATA, LÜCKING & LUMBSCH: Osa, RIVAS PLATA et al. 2008
Haematomma leprarioides (VAINIO) VAINIO: BE, Br06
Laurera subdisjuncta (MÜLL. ARG.) R.C. HARRIS: Osa, Ap&al08
Leiorreuma exaltatum (MONT. & V. D. BOSCH) STAIGER: BE, Br00, Br06, BrNe07
Leiorreuma hypomelaenum (MÜLL. ARG.) STAIGER: BE, Br06
Leiorreuma lyellii (SM.) STAIGER: BE, BrNe07
Leiorreuma sericeum (ESCHW.) STAIGER: BE, BrNe07
Leptogium austroamericanum (MALME) DODGE: BE, Br00, BrNe07
Leptogium azureum (SW.) MONT. s.str.: BE, Osa, Br00, Br06, BrNe07, DODGE 1933
Leptogium caespitosum (TAYLOR) SWINSCOW & KROG: BE, Br06
Leptogium coralloideum (MEYEN & FLOT.) VAIN.: BE, BrNe07
Leptogium denticulatum NYL.: BE, Osa, BrNe07, DODGE 1933
Leptogium foveolatum NYL.: BE, Br06
Leptogium marginellum (SW.) S.F. GRAY: BE, Br00, Br06, BrNe07
Leptogium phyllocarpum (PERS.) MONT.: BE, Br06, BrNe07
Leptogium standleyi DODGE: BE, Br06
Leptogium stipitatum VAINIO: BE, Br06, BE, BrNe07
Leptogium tuckermanii DODGE: BE, Br00
Leptogium ulvaceum auct.: BE, Br00, Br06
Malcolmiella granifera (ACH.) KALB & LÜCKING: BE, Br00, Br06, BrNe07
Malcolmiella psychotrioides KALB & LÜCKING: BE, BrNe07
Megalospora tuberculosa (FÉE) SIPMAN: BE, BrNe07

Megalotremis biocellata APTROOT: Osa, Ap&al08
Megalotremis nemorosa (R.C. HARRIS) APTROOT: BE, Osa, Br06, Ap&al08
Megalotremis verrucosa (MAKH. & PATW.) APTROOT: BE, Osa, BrNe07, Ap&al08
Musaespora gigas (Z AHLBR.) R.C. HARRIS: Osa, Ap&al08
Mycocomrothelia hemisphaerica (MÜLL. ARG.) D. HAWKSW.: Osa, Ap&al08
Mycocomrothelia oleosa APTROOT: BE, BrNe07
Mycoporium eschweileri (MÜLL. ARG.) R.C. HARRIS: Osa, Ap&al08
Myeloconis fecunda P.M. MCCARTHY & ELIX: BE, Br06, BrNe07
Myeloconis guyanensis P.M. MCCARTHY & ELIX: BE, Br06
Myriotrema album FÉE: BE, Br00, Br06
Myriotrema barroense (HALE) HALE: BE, BrNe07
Myriotrema glaucophaenum (KREMP.) HALE: BE, Br06, BrNe07
Myriotrema myriocarpum (FÉE) HALE: BE, Br06
Myriotrema pachystomum (NYL.) HALE: BE, BrNe07
Myriotrema trypaneoides (NYL.) HALE: BE, BrNe07
Nadvornikia hawaiiensis (TUCK.) TIBELL: BE, Br06
Normandina pulchella (BORRER) NYL.: BE, BrNe07
Ocellularia alborosella (NYL.) R. SANT.: BE, Br00, Br06
Ocellularia auratipruiosa BREUSS: BE, Br00, Br06
Ocellularia cavata (ACH.) MÜLL. ARG.: BE, BrNe07
Ocellularia comparabilis (KREMP.) MÜLL. ARG.: BE, Br06
Ocellularia crocea (KREMP.) OVEREEM: BE, Br06
Ocellularia dactyliza HALE: BE, BrNe07
Ocellularia interposita (NYL.) HALE: BE, Br06
Ocellularia landronii HALE: BE, BrNe07
Ocellularia perforata (LEIGHTON) MÜLL. ARG.: BE, Br00, Br06
Ocellularia rhodostroma (MONT.) Z AHLBR.: BE, Br00, Br06, BrNe07
Ocellularia submersa MÜLL. ARG.: BE, Br06
Ocellularia xanthostroma (NYL.) Z AHLBR.: BE, Br06, BrNe07
Opegrapha curvula REDINGER: BE, Br06
Parmeliella isidiopannosa P.M. JØRG.: BE, BrNe07
Parmeliella pannosa (SW.) MÜLL. ARG.: BE, BrNe07
Parmeliella stylophora (VAIN.) P.M. JØRG.: BE, Br06, BrNe07
Parmotrema cristiferum (TAYLOR) HALE: BE, Br00, BrNe07
Parmotrema dilatatum (VAINIO) HALE: BE, Br06, BrNe07
Parmotrema endosulphureum (HILLM.) HALE: BE, Br00, Br06, BrNe07
Parmotrema flavescens (KREMP.) HALE: BE, BrNe07
Parmotrema rubifaciens (HALE) HALE: BE, Br06
Parmotrema sulphuratum (NEES & FLOTOW) HALE: BE, Br00, Br06
Peltigera collina (ACH.) SCHRAD.: BE, BrNe07
Pertusaria tetrathalamia (FÉE) NYL.: BE, Br06
Phaeographis caesiodisca STAIGER: BE, BrNe07
Phaeographis decipiens (FÉE) MÜLL. ARG.: BE, Br06
Phaeographis haematites (FÉE) MÜLL. ARG.: BE, Br00
Phaeographis intricans (NYL.) STAIGER: BE, BrNe07
Phaeographis lindigiana MÜLL. ARG.: BE, Br06
Phaeographis schizoloma Müll. ARG.: BE, Br06
Phyllopsora buettneri (MÜLL. ARG.) Z AHLBR. var. *glauca* (DE LESD.) BRAKO: BE, Br06
Phyllopsora confusa SWINSCOW & KROG: BE, BrNe07
Phyllopsora corallina (ESCHW.) MÜLL. ARG. var. *ochroxantha* (NYL.) BRAKO: BE, Br06
Phyllopsora furfuracea (PERS.) Z AHLBR.: BE, BrNe07
Physcia atrostriata MOBERG: BE, Br00, Br06, BrNe07
Physcia krogiae MOBERG: BE, Br00
Physcia lobulata MOBERG: BE, BrNe07
Physcidea wrightii TUCK.: BE, BrNe07
Physma byrsaeum (ACH.) TUCK.: BE, BrNe07
Platythecium allosporellum (NYL.) STAIGER: BE, BrNe07
Platythecium grammitis (FÉE) STAIGER: BE, Br06
Polymeridium albidum (MÜLL. ARG.) R.C. HARRIS: BE, BrNe07
Polymeridium contendens (NYL.) R.C. HARRIS: BE, BrNe07
Polymeridium flavothecium R.C. HARRIS: BE, Br06, BrNe07
Porina dolichophora (NYL.) MÜLL. ARG.: BE, Br06, BrNe07
Porina eminentior (NYL.) MCCARTHY: BE, BrNe07
Porina epimelaena VAINIO ex REDINGER: BE, Br06, BrNe07
Porina exasperatula VAINIO: BE, KOMPOSCH 2005
Porina mastoidea (ACH.) MÜLL. ARG.: BE, Br06, BrNe07
Porina rudiusscula (NYL.) MÜLL. ARG.: BE, Br06, BrNe07
Porina tujucana VAINIO: BE, Br06, BrNe07
Pseudopyrenula diluta (FÉE) MÜLL. ARG.: BE, BrNe07
Pseudopyrenula subnudata MÜLL. ARG.: BE, Br00, Br06
Psorella leucophyllina (NYL.) Z AHLBR.: BE, BrNe07
Pyrenula acutalis R.C. HARRIS: BE, Br06
Pyrenula acutispora HAF. & KALB: Osa, Ap&al08
Pyrenula anomala (ACH.) VAIN.: BE, Osa, BrNe07, Ap&al08
Pyrenula aspistea (ACH.) ACH.: BE, Osa, Br06, BrNe07, Ap&al08
Pyrenula cocoes MÜLL. ARG.: BE, Br06
Pyrenula concatervans (NYL.) R.C. HARRIS: Osa, Ap&al08
Pyrenula confinis (NYL.) R.C. HARRIS: Osa, Ap&al08
Pyrenula cryptothelia (MÜLL. ARG.) APTROOT & ETAYO: Osa, Ap&al08
Pyrenula dermatodes (BORR.) SCHAER.: Osa, Ap&al08
Pyrenula duplicans (NYL.) APTROOT: BE, Br06
Pyrenula cf. falsaria (Z AHLBR.) R.C. HARRIS: BE, BrNe07
Pyrenula laetior MÜLL. ARG.: BE, Osa, Br06, Ap&al08
Pyrenula leucostoma ACH.: Osa, Ap&al08
Pyrenula lineatostroma APTROOT: Osa, Ap&al08
Pyrenula mamillana (ACH.) TREV.: BE, Osa, Br06, Ap&al08
Pyrenula massariospora (STARB.) R.C. HARRIS: BE, Osa, BrNe07, Ap&al08
Pyrenula microcarpa MÜLL. ARG.: BE, Br06
Pyrenula pyrenuloides (MONT.) R.C. HARRIS: Caño, Ap&al08
Pyrenula quassiaecola FÉE: Osa, Ap&al08
Pyrenula septicollaris (ESCHW.) R.C. HARRIS: BE, BrNe07
Pyrenula subcongruens MÜLL. ARG.: Caño, Ap&al08
Pyrenula tenuisepta R.C. HARRIS: Osa, Ap&al08
Pyrrhospora russula (ACH.) HAF.: BE, Br06, BrNe07
Pyxine eschweileri (TUCK.) VAIN.: BE, BrNe07
Sarcographa cinchonarum FÉE: BE, BrNe07
Sarcographa heteroclita (MONT.) Z AHLBR.: BE, Br06, BrNe07
Sarcographa labyrinthica (ACH.) MÜLL. ARG.: BE, Br00, Br06, BrNe07
Sarcographa medusulina (NYL.) MÜLL. ARG.: BE, Br06
Sarcographa ramificans (KREMP.) STAIGER: BE, BrNe07
Sarcographa tricosia (ACH.) MÜLL. ARG.: BE, BrNe07
Sporopodium xantholeucum (MÜLL. ARG.) Z AHLBR.: BE, Br00
Stegobolus auberianus (MONT.) A. FRISCH & KALB: BE, Br06
Stegobolus wrightii (TUCK.) A. FRISCH: BE, Br06, FRISCH & KALB 2006, BrNe07

Tapellaria epiphylla (MÜLL.ARG.) R. SANT.: BE, Br00
Thallolema anguinaeforme (VAIN.) STAIGER: BE, Br06
Thallolema cinnabarinum (FÉE) STAIGER: BE, Br06
Thallolema hypoleptum (NYL.) STAIGER: BE, STAIGER 2002
Thelotrema glaucopallens NYL.: BE, Br06
Thelotrema neei (HALE) HALE: BE, BrNe07
Tricharia fumosa KALB & VÉZDA: BE, BrNe07
Trypethelium annulare (FÉE) MONT.: BE, Br06
Trypethelium neogalbium R.C. HARRIS: Osa, Ap&al08
Trypethelium nitidiusculum (NYL.) R.C. HARRIS: BE, Osa, Br06, Ap&al08
Trypethelium papulosum (NYL.) MAKH. & PATW.: BE, Br06
Trypethelium subcatervarium MALME: BE, Br06
Trypethelium tuberculatum (VAIN.) R.C. HARRIS: Osa, Ap&al08
Trypethelium variolosum ACH.: BE, BrNe07
Usnea brasiliensis (ZAHLEBR.) MOT.: BE, BrNe07

Discussion

A total of 469 species are known from the Golfo Dulce area, which represents 33% of the species so far accepted to occur in Costa Rica. Though very far from complete, the list demonstrates the remarkable nature of the investigated area and highlights the need for maintaining conservation efforts. The catalogue includes 110 genera and 471 infrageneric taxa, the richest genera being *Porina* (40 species), *Graphis* and *Pyrenula* (22 each), *Strigula* and *Trichothelium* (15 each), *Arthonia* and *Mazosia* (13 each). The largest proportion is held by foliicolous lichens (52%). As in other parts of the tropics, the most species-rich families are the Porinaceae with mainly epiphyllous species, the Thelotremataceae with mainly rainforest species, and the Graphidaceae with a higher diversity in open places. One reason for the high diversity is the interlinking of primary rainforest with secondary vegetation types. Given the extraordinary biodiversity of Costa Rica and the rather fragmentary collecting work in the study area, the real species number can be expected to be significantly higher. There are a great many species yet to be discovered by further field work, especially in the more remote areas of the region.

Acknowledgements

The author thanks Dr. G. Neuwirth (Tumeltsham) for providing the lichen photos, and Dr. M. Grube (Graz) and Dr. R. Lücking (Chicago) for comments and corrections.

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Contents/Indice

Prefaces and introduction — Prólogos y introducción

Dr. Pedro LEON Coordinator, President Aria's Initiative on Peace with Nature	11
O. Univ.-Prof. Dr. Georg WINKLER Rector of the University Vienna	12
Dr. Josef PÜHRINGER Governor of Upper Austria	13
Introduction Introducción	14

ABIOTIC ASPECTS — FACTORES ABIÓTICOS

Geography — Geografía

Geography of the Golfo Dulce region (survey) Geografía de la región del Golfo Dulce (sinopsis) WEISSENHOFER A., HUBER W. & KLINGLER M.	19
--	----

Geology — Geología

Outline of the geology of the Golfo Dulce Region (Costa Rica) and its surroundings in Central America (survey) Vista de conjunto de la geología de la Región del Golfo Dulce (Costa Rica) y de sus inmediaciones en América Central (sinopsis) MALZER O. & FIEBIG M.	23
Geological and mineralogical investigations of the lithologies and their weathering products in a study area south-west of the field station "La Gamba", Golfo Dulce, Costa Rica Investigación geológica y mineralógica de las rocas y sus productos de meteorización, en un área al suroeste de la estación "La Gamba", Golfo Dulce, Costa Rica SCHEUCHER L.E.A., VORTISCH W. & LAGUNA-MORALES J.	31
Anthropogenic and natural radionuclides in soil of a tropical rainforest of Southern Costa Rica Radionúclidos antropogénicos y naturales en el suelo de un bosque lluvioso tropical del sur de Costa Rica BOSSEW P., HUBMER A. & STREBL F.	47

Climate — Clima

The climate of the Esquinas rainforest (survey) El clima del bosque lluvioso Esquinas (sinopsis) WEISSENHOFER A. & HUBER W.	59
---	----

PLANT BIOLOGY — BIOLOGÍA DE PLANTAS

Ecosystems and vegetation — Ecosistemas y vegetación

Ecosystem diversity in the Piedras Blancas National Park and adjacent areas (Costa Rica), with the first vegetation map of the area

Diversidad de ecosistemas en el Parque Nacional Piedras Blancas y áreas adyacentes (Costa Rica), con la primera presentación de una mapa vegetacional

WEISSENHOFER A., HUBER W., KOUKAL T., IMMITZER M., SCHEMBERA E., SONTAG S., ZAMORA N. & WEBER A. 65

Plant diversity — Diversidad de plantas

Plant diversity and biogeography of the Golfo Dulce region, Costa Rica (survey)

Diversidad vegetal y biogeografía de la región de Golfo Dulce, Costa Rica (sinopsis)

HUBER W., WEISSENHOFER A., ZAMORA N. & WEBER A. 97

Alien plants and invasion patterns in different habitats of the Golfo Dulce area, Costa Rica

Plantas exóticas y patrones de invasión en diferentes hábitat del área de Golfo Dulce, Costa Rica

HUBER W., WEISSENHOFER A. & ESSL F. 105

Survey of Rubiaceae in the Golfo Dulce area, Costa Rica:
New species, combinations and name changes since 2001

Investigaciones en Rubiaceae en el área de Golfo Dulce, Costa Rica:
nuevas especies, combinaciones y cambios de nombre desde 2001

WILL S. & KIEHN M. 111

Medicinal plants in La Gamba and in the Esquinas rain forest

Plantas medicinales en La Gamba y de la selva tropical Esquinas

LÄNGER R. 121

Life forms — Formas de vida vegetal

Plant life forms in the Golfo Dulce region and other neotropical rainforests (survey)

Formas de vida vegetal en la región de Golfo Dulce y en otros bosques lluviosos neotropicales (sinopsis)

HIEZ P. 129

Terrestrial litter trappers in the Golfo Dulce region: diversity, architecture and ecology of a poorly known group of plant specialists

Plantas captadoras de hojarasca en la región de Golfo Dulce: diversidad, arquitectura y ecología de un grupo de plantas especialistas poco conocido

WEISSENHOFER A., HUBER W., WANEK W. & WEBER A. 143

Ecophysiology — Ecofisiología

Primary production and nutrient cycling in lowland rainforests of the Golfo Dulce region

Producción primaria y ciclo de nutrientes en bosques lluviosos de tierras bajas de la región de Golfo Dulce

WANEK W., DRAGE S., HINKO N., HOFHANSL F., PÖLZ E.-M., RATZER A. & RICHTER A. 155

Fungi and lichens — Hongos y líquenes

Diversity and ecology of fungi in the Golfo Dulce region (survey)

Diversidad y ecología de hongos en la región del Golfo Dulce (sinopsis)

PIEPENBRING M. & RUIZ-BOYER A.

179

The lichens of the Golfo Dulce region (survey)

Líquenes de la región de Golfo Dulce (sinopsis)

BREUSS O.

193

ANIMAL BIOLOGY — BIOLOGÍA DE ANIMALES

Spiders — Arañas

Cupiennius (Araneae, Ctenidae): Biology and sensory ecology of a model Spider

Cupiennius (Araneae, Ctenidae): Biología y ecología sensorica de una araña modelo

BARTH F.G.

211

Key to the genus *Cupiennius* (Araneae, Ctenidae)

Clave de determinación de genus *Cupiennius* (Araneae, Ctenidae)

BARTH F.G. & CORDES D.

225

Insects — Insectos

Diversity, biogeography and ecology of insects in the Pacific lowlands of Costa Rica, with emphasis on La Gamba (survey)

Diversidad, biogeografía y ecología de los insectos en las tierras bajas del Pacífico de Costa Rica con énfasis en La Gamba (sinopsis)

SCHULZE C.H.

229

Banderillas: Effects of deforestation on dragonflies (Insecta, Odonata) in the Pacific lowland of Costa Rica

Banderillas: Efectos de la deforestación sobre libélulas (Insecta, Odonata) en la tierra baja Pacífica en Costa Rica

HOFHANSL F.P. & SCHNEEWEIFS S.

237

Longhorn beetles (Coleoptera, Cerambycidae) of the Golfo Dulce region, Costa Rica

Cerambícidos (Coleoptera, Cerambycidae) de la región de Golfo Dulce, Costa Rica

HUBWEBER L.

249

Diversity of Euglossini (Hymenoptera, Apidae) in primary and secondary lowland rainforests in south-western Costa Rica

Diversidad de Euglossini (Hymenoptera, Apidae) en bosques lluviosos de tierras bajas primarios y secundarios en el sudoeste de Costa Rica

GRUBER M.H., MORAWETZ L. & WIEMERS M.

257

Stingless bees of the Golfo Dulce region, Costa Rica (Hymenoptera, Apidae, Apinae, Meliponini)

Las abejas sin aguijón de la región de Golfo Dulce, Costa Rica (Hymenoptera, Apidae, Apinae, Meliponini)

JARAU S. & BARTH F.G.

267

Butterfly diversity of the Piedras Blancas National Park and its vicinity –
a preliminary assessment (Lepidoptera: Papilionidae & Hesperioidea)

Diversidad de mariposas del Parque Nacional Piedras Blancas y zonas cercanas –
una evaluación preliminar (Lepidoptera: Papilionidae & Hesperioidea)

WIEMERS M. & FIEDLER K.

277

Feeding behaviours of neotropical butterflies (Lepidoptera, Papilionoidea)

Ingestión de alimentos en mariposas neotropicales (Lepidoptera, Papilionoidea)

KRENN H.W.

295

Amphibians and reptiles — Anfibios y reptiles

The amphibians and reptiles of the Golfo Dulce region (survey)

Los anfibios y reptiles de la región del Golfo Dulce (sinopsis)

HÖBEL G.

305

Plasticity and geographic variation in the reproductive ecology of gladiator frogs,
particularly *Hypsiboas rosenbergi*

Plasticidad y variación geográfica en la ecología reproductiva de ranas gladiadoras, especialmente *Hypsiboas rosenbergi*

HÖBEL G.

329

Reproductive behaviour of the glass frog *Hyalinobatrachium valerioi*
(Anura: Centrolenidae) at the tropical stream Quebrada Negra (La Gamba, Costa Rica)

Comportamiento reproductivo de la rana de cristal *Hyalinobatrachium valerioi* (Anura: Centrolenidae)
en el arroyo tropical Quebrada Negra (La Gamba, Costa Rica)

VOCKENHUBER E.A., HÖDL W. & KARPEN U.

335

Birds — Aves

Birds of La Gamba – a call for research and scientific collaboration

Aves de La Gamba – un llamado para investigación y colaboración científica

AUBRECHT G. & SCHULZE C.H.

349

The birds of La Gamba (survey)

Los pajaros de La Gamba (sinopsis)

TEBB G.

353

Habia atrimaxillaris (Dwight & Griscom) 1924 – the black-cheeked ant-tanager.
History of an endemic bird species from SW Costa Rica, from discovery to endangered status

Habia atrimaxillaris (Dwight & Griscom) 1924 – tangara hormiguera cabecinegra.

Historia de una especie de ave endémica del Sudoeste de Costa Rica – desde su descubrimiento a su estatus de peligro

AUBRECHT G.

381

Bird assemblages of forested and human-modified countryside habitats
in the Pacific lowlands of southern Costa Rica

Grupos de aves de hábitat boscosos y rurales en las tierras bajas del Pacífico del sur de Costa Rica

SCHULZE C.H. & RIEDL I.

395

Mammals — Mamíferos

Mammals of the Piedras Blancas National Park, Costa Rica: species composition, habitat associations and efficiency of research methods – a preliminary overview (survey)

Mamíferos del Parque Nacional Piedras Blancas, Costa Rica: composición de especies, asociaciones de hábitat y eficiencia de métodos de investigación – una panorámica preliminar (sinopsis)

LANDMANN A., WALDER C., VORAUER A. & EMSER T.

409

Bats of the La Gamba region, Esquinas rain forest, Costa Rica: species diversity, guild structure and niche segregation

Murciélagos de la región de La Gamba, bosque lluvioso Esquinas, Costa Rica: diversidad específica, estructura gremial y segregación de nichos

LANDMANN A., WALDER C., VORAUER A., BOHN S. & WEINBEER M.

423

Limnology — Limnología

The river network of the Piedras Blancas National Park, Costa Rica (survey)

La red fluvial del Parque Nacional Piedras Blancas, Costa Rica (sinopsis)

TSCHELAUT J., PICHLER C., WEISSENHOFER A. & SCHIEMER F.

441

Macroinvertebrates and leaf litter decomposition in a neotropical lowland stream, Quebrada Negra, Costa Rica

Macroinvertebrados y descomposición de residuos de hojas en un curso de agua de tierras bajas neotropical, Quebrada Negra, Costa Rica

TSCHELAUT J., WEISSENHOFER A. & SCHIEMER F.

457

The role of leaf anatomy and tannins in litter decay in a tropical stream

El rol de la anatomía foliar y de los taninos en la descomposición de la hojarasca en un arroyo tropical

RIEMERTH A., GUSENLEITNER M. & SCHIEMER F.

467

Freshwater bryozoans in La Gamba (Costa Rica: Piedras Blancas National Park): a general introduction

Briozoos de agua dulce en La Gamba (Costa Rica: Parque Nacional Piedras Blancas): una introducción

WÖSS E.R.

485

Ecology of fishes of Quebrada Negra, Costa Rica, a first order neotropical lowland stream

Ecología de los peces de Quebrada Negra, Costa Rica, río neotropical de primer orden de tierras bajas

PICHLER C. & SCHIEMER F.

495

PLANT-ANIMAL INTERACTIONS — INTERACCIONES DE PLANTAS Y ANIMALES

Pollination — Polinización

Pollination in the plants of the Golfo Dulce area (survey)

Polinización en las plantas del área de Golfo Dulce (sinopsis)

WEBER A.

509

Phenology and pollination of *Ceiba pentandra* (Bombacaceae) in the wet forest of south-eastern Costa Rica

Fenología y biología de la polinización de *Ceiba pentandra* (Bombacaceae) en el bosque húmedo del sudeste de Costa Rica

ROJAS-SANDOVAL J., BUDDE K., FERNÁNDEZ M., CHACÓN E., QUESADA M. & LOBO J.A.

539

Phenology of tree species of the Osa Peninsula and Golfo Dulce region, Costa Rica

Fenología de especies de árboles de la Península de Osa y la región de Golfo Dulce, Costa Rica

LOBO J., AGUILAR R., CHACÓN E. & FUCHS E.

547

Style release experiments in four species of Marantaceae from the Golfo Dulce area, Costa Rica

Experimentos acerca de la sensibilidad del estilo en cuatro especies de marantáceas del área del Golfo Dulce, Costa Rica

CLASSEN-BOCKHOFF R. & HELLER A.

557

Notes on the pollination of the perfume flowers of *Gloxinia perennis* (Gesneriaceae) by euglossine bees

Notas sobre la polinización de las flores perfumadas de *Gloxinia perennis* (Gesneriaceae) por abejas euglossine

WITSCHNIG G., HICKL C. & WEBER A.

573

Scientific work of Austrian students in the “Austrian rainforest” (Piedras Blancas National Park, Costa Rica), with special regard to pollination studies

Trabajo científico de los estudiantes en el “Bosque lluvioso de los Austriacos”

(Parque Nacional Piedras Blancas, Costa Rica), con especial consideración en los estudios de polinización

WEBER A.

579

Ants and plants — Hormigas y plantas

A house in the tropics: full pension for ants in *Piper* plants

Una casa en el tropico: pensión completa para hormigas en plantas de *Piper*

FISCHER R. & MAYER V.

589

Does nectar production reduce herbivore pressure on *Passiflora* species (Passifloraceae) in a tropical rainforest in Costa Rica?

Puede la producción de néctar reducir la presión de herbivoría en especies de *Passiflora* (Passifloraceae) en un bosque tropical de Costa Rica?

THURNER M. & MAYER V.

599

HUMAN ASPECTS — ASPECTOS HUMANOS

History and development — Historia y desarrollo

Indigenous societies of the south east of Costa Rica, 15th century

Sociedades indígenas del sudeste de Costa Rica, siglo XVI

BARRANTES CARTÍN C.

609

The stone balls of Palmar

Las esferas de piedra de Palmar

STEPHENS C.

631

Impacts of the United Fruit Company in Southwest Costa Rica Impacto de la United Fruit Company en el Suroeste de Costa Rica STEPHENS C.	635
---	-----

Corcovado National Park – almost a banana plantation El Parque Nacional Corcovado – casi una plantación bananera STEPHENS C.	645
--	-----

Case study: economic and structural settlement changes and their consequences in the community of La Gamba, Golfo Dulce region Estudio de caso: Cambios estructurales y económicos de la población y sus consecuencias en la comunidad La Gamba, región del Golfo Dulce KLINGLER M.	649
---	-----

History of nature exploration — Historia de exploración de la naturaleza

Un ejemplo de intercambio científico entre Europa y América Latina: las investigaciones de la expedición científica Austríaca en Costa Rica (1930) An example of scientific interchange between Europe and Latin America: The investigations of the Austrian scientific expedition to Costa Rica (1930) DÍAZ BOLAÑOS R.E.	657
---	-----

Otto Porsch and the scientific goals and results of the Austrian Costa Rica expedition 1930 Otto Porsch y los objetivos y resultados científicos de la expedición Austriaco-Costarricense de 1930 WEBER A.	667
--	-----

History of nature conservation — Historia de protección de la naturaleza

Before Corcovado: Early conservation initiatives on the Osa Peninsula (survey) Antes del Corcovado: Primeras iniciativas pro-conservación en la Península de Osa (sinopsis) CHRISTEN C.A.	675
---	-----

Looking back to the foundation of the Corcovado National Park, a crown jewel of nature in Costa Rica Una mirada retrospectiva a la fundación del Parque Nacional Corcovado, una corona de joyas de la naturaleza en Costa Rica UGALDE A.	683
--	-----

In defence of local livelihoods, the forest and the Golfo Dulce: the campaign against “Ston Forestal” in the 1990s and its historical roots En defens de los medios de vida locales, el bosque y el Golfo Dulce: la campaña contra Ston Forestal en los 1990 y sus raíces históricas VAN DEN HOMBERGH H.	693
--	-----

Current conservation projects — Proyectos actuales de protección de la naturaleza

The Osa biological corridor in the context of the mesoamerican biological corridor El corredor biológico Osa en el contexto del corredor biológico mesoamericano GARCÍA R.	701
--	-----

Conectividad entre el Parque Nacional Piedras Blancas y la Fila de Cal

The link between the Piedras Blancas National Park and the Fila de Cal

MORERA C. & ROMERO M.

707

The Biological Corridor Project in the Piedras Blancas National Park, Costa Rica.

A project to preserve the biodiversity by reforestation and alternative culture, with support of the community La Gamba by new marketing strategies

El proyecto de corredor biológico en el Parque Nacional Piedras Blancas, Costa Rica.

Un proyecto para preservar la biodiversidad mediante la reforestación y cultivos alternativos, con el apoyo de la comunidad de la Gamba de nuevas estrategias de comercialización

WEISSENHOFER A., BARQUERO M., HUBER W., MAYER V. & NÁJERA UMAÑA J.

715

Reintroducción de la Lapa Roja (*Ara macao*) en Playa San Josecito, Golfito

Reintroduction of the scarlet macaw (*Ara macao*) to Playa San Josecito, Golfito

VARELA BENAVIDES I. & JANIK D.

725

The project "Rainforest of the Austrians"

El proyecto "Bosque de los Austriacos"

SCHNITZLER M.

733

The "Tropical Research Station La Gamba" – science, education and nature conservation in Costa Rica

La "Estación Tropical La Gamba" – ciencia, educación y conservación en Costa Rica

ALBERT R. & WEBER A.

739

Ecotourism and local development — Ecoturismo y desarrollo local

Ecotourism in La Gamba. An economical and ecological alternative for the residents of La Gamba?

Ecoturismo en La Gamba. Una alternativa económica y ecológica para los residentes de La Gamba?

FAHRNBERGER M.

743

Sinergias entre ecoturismo y desarrollo local en la península de Osa, Costa Rica

Synergistic effects of ecotourism and local development on the Osa Peninsula, Costa Rica

MORERA C.

755

APPENDIX — APÉNDICE

Authors' addresses

Direcciones de los autores

763

Vegetation map of the Piedras Blancas Nationalpark, Golfito Forest Reserve and adjacent areas

Mapa de vegetación del Parque Nacional Piedras Blancas, Reserva Forestal Golfito y áreas adyacentes