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SUMMARY

This paper reports on the April-May 1983 Projeto Flora expedition to Serra do Cachimbo in northcentral Brazil, a phytogeographically poorly known area near the transition between the Amazon forest and the central Brazilian planalto. The objective of this expedition was to collect botanical specimens with special emphasis on lichens. Rock outcrops are common in this area and several soil types combined with varied topography give rise to a diversity of vegetation types including Amazon caatinga, campo rupestre, gallery forest and Amazon forest. A preliminary checklist of 91 macrolichens is provided with a discussion of ecological distribution of lichens in each habitat.

INTRODUCTION

The April-May 1983 Projeto Flora expedition to the Serra do Cachimbo, Brazil, explored an area along the Cuiabá-Santarém highway (BR-163) at about 55°W longitude and approximately 9°35'S to 5°55'S latitude (Fig. 1). The objective of the expedition was to collect botanical specimens from this phytogeographically poorly known area, much of which is rapidly being deforested for ranching and farming. One of the main emphases was the collection of lichens which had been noted by previous botanical explorers of the area to be locally very abundant at Cachimbo and in the surrounding area. This paper reports ecological observations of the lichen flora and includes a preliminary checklist of the macrolichens.

Serra do Cachimbo, an extensive mesa with elevations up to 600 m, trends NW to SE across the southwestern portion of Pará and south just across the border to Mato Grosso. The serra lies on the southern rim of the Amazon basin, near the transition between the Amazon forest and the central Brazilian planalto (Lleras & Kirkbride, 1978) and drains over cataracts to the north, by way of the Rio Tapajós to the west, and the Rio Xingu

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to the east. The plateau lies on the Precambrian Brazilian Shield and consists primarily of quartzite with minor expressions of granite, sandstone, and calcareous rock. The terrain is dissected into ridges with valleys forming extensive plains between the ridges. Soils on the plateau are quartzite sands and are believed to be formed by in situ weathering of parental material (Projeto Radambrasil, 1980). Surrounding the Cachimbo plateau are metamorphic and sedimentary rocks and soils with a higher clay content. Rock outcrops are common in this area and the variety of soils combined with the topography gives rise to different vegetation types. Among these vegetation types are upland white-sand savannas which exhibit a high degree of endemism in flowering plants, making the *serra* particularly interesting botanically.

The climate of this area is typical of Amazonia, with high humidity, hot days and cool nights. Precipitation, as gathered from 9 years of records at Air Base Cachimbo, averages 2,285 mm/year, with a pronounced dry period beginning in May and ending in August.

Completion of the Cuiabá-Santarém highway (BR-163), in Oct 1976, opened up a vast area of the Amazon Basin for deforestation. It also provided an opportunity for biological exploration in a region which was previously difficult to visit. Until the construction of an airstrip by the Brazilian Air Force at Serra do Cachimbo, entry to the area was only possible by rivers. Soares (1953) visited this air base in 1952 to examine the vegetation, as part of his study of the limits of the Amazonian forest. There were several expeditions to this area during the 1950's and 1960's, but most were limited by logistic difficulties. Lleras and Kirkbride (1978) collected at Serra do Cachimbo as well as along the Cuiabá-Santarém highway and reported on aspects of the vegetation. They describe several different vegetational elements in the vascular plant flora as well as the abundance and variety of cryptogams. The diversity of cryptogams was also noticed by the 1977 Projeto Flora expedition which visited the Cachimbo area. The collections and observations of these explorations prompted the 1983 Projeto Flora expedition to return to Serra do Cachimbo at what was anticipated as the peak flowering time to continue to survey the vegetation with special emphasis on the collection of cryptogams.

The 1983 Projeto Flora expedition spent essentially 6 weeks in the area, collecting some 1900 specimens of lichens and fungi, 1000 specimens of vascular plants and 860 bryophytes. This expedition traveled over 1000 km north along BR-163 from km 740 to Santarém. Five field camps were set up at the locations indicated in Fig. 1. Roughly one and a half weeks were spent collecting in the general area of each camp.

VEGETATION TYPES

In the following discussion, an attempt is made to describe the major vegetation types encountered at Serra do Cachimbo and along BR-163, particularly as they relate to habitats for lichens.

AMAZON CAATINGA

The most interesting habitat for lichens was the vegetation on white sand which has been named "Amazon caatinga" by Anderson (1981) and referred to by others as "campina". Upland areas of white sand are scattered throughout Amazonia. They occur mostly as islands and "associated with these soils is a highly distinctive vegetation which ranges from savanna to forest and is characterized by pronounced sclerophylly, low density and high endemism." (Anderson, 1981). Extreme edaphic conditions and insularity of these sites provide a unique biotic character. Anderson (1981) recognizes various intergrading structural phases of this vegetation type including Amazon caatinga savanna, scrub, woodland and forest.

Open areas of white sand occur on the plateau at Cachimbo. The nutrient poor soils limit the vegetation cover to shrubs, grasses, sedges and Eriocaulaceae which form islands of vegetation with patches of pure white sand between them. Lichens are abundant in this habitat with extensive mats of Cladoniaceae in open areas and at the base of vegetation where the soils are more stabilized. Common mat forming species include *Cladina sprucei*, *Cladonia peltastica* and *Cladonia signata*. Other pioneering species such as *Cladonia corallifera* and *C. subradiata* are especially abundant at the base of the vegetation tussocks and on exposed roots.

Savanna and Scrub

Pires (1974) estimates that 266,000 km² of Amazonia is covered by savanna or scrub. In areas primarily covered by grasses and lichens and with less than 10% woody plant cover, the term "caatinga savanna" has been recommended by Anderson (1981). At Cachimbo there are extensive semi-arid savannas dominated by grasses and sedges with scattered trees, primarily Leguminosae. Cryptogams are more abundant where the grasses and sedges are sparse. One common lichen in this habitat is *Cladonia pityrophylla*, found on the soil around the bases of grasses.

Caatinga scrub (sensu Anderson, 1981), open areas intermixed with shrubs and small trees, provide an excellent habitat for lichens. Especially common are woody plant epiphytes, notably Parmeliaceae, Physciaceae, *Usnea* spp., *Dictyonema sericeum*, and various crustose lichens. Of the parmeliaceous lichens, the not commonly collected genera, *Bulbothrix* and *Relicina*, are particularly conspicuous. Species of *Pyxine*, *Dirinaria* and *Heterodermia* often thickly cover the branches of the shrubs.

Forest and Woodland

Where more clay is present in the soil the savanna and scrub grade into wooded vegetation "caatinga woodland" and "caatinga forest" (sensu Anderson, 1981). These forests are still quite dry like the savanna lands but as light intensity is reduced by the woody vegetation cover, macrolichens become less abundant and are replaced by crustose species.

CAMPO RUPESTRE

Vegetation with large amounts of exposed rock has been termed "campo rupestre" by Eiten (1978). The large exposures of quartzite at Cachimbo are covered with lichens. The macrolichens include *Parmotrema eborinum*, *Pseudoparmelia chapadensis*, *Xanthoparmelia* spp. and many species of Physciaceae such as *Heterodermia flabellata*, *H. casarettiana*, *Pyxine coralligera*, and *Pyxine* sp. 1. The large thalli indicate old age and suggest that the area has been stable for a long time. The sandstone outcrops sustain a thick cover of crustose lichens.

GALLERY FOREST

Thick shrubs and tall palms, particularly the Buriti palm (*Mauritia vinifera*), along the rivers and streams at Cachimbo form the moist gallery forest. *Coccocarpia* spp. are especially common throughout the gallery forests. Species of *Sticta*, *Leptogium*, *Collema* and Pannariaceae were found on trees near the water and are apparently restricted to this habitat at Cachimbo. *Lobaria ravenelii*, collected only once, seems to be restricted to this habitat also.

AMAZON FOREST

Surrounding the Cachimbo upland, in areas below 350 m elevation, the major form of vegetation is "mata alta" or Amazon forest. Where igarapés or small rivers dissect these forests, such as at Cachoeira da Luz (km 877), the vegetation is extremely wet and lush with many palms and ferns. Macrolichens were collected from the canopy where possible. Most species found in this habitat are common pantropical taxa such as *Parmotrema gardneri*, *P. tinctorum*, *P. zollingeri*, *Pseudoparmelia amazonica*, *P. salacinifera* and *P. sphaerospora*. Although a few macrolichen species, including *Coccocarpia* and *Leptogium* spp., are found in the understory on tree trunks, branches, and lianas, foliicolous lichens and crustose species are more abundant.

SECONDARY VEGETATION

In burned areas, extensive growth of *Pteridium aquilinum* limited the available lichen habitats. Where the forest was disturbed along the road, a monotonous secondary growth is encountered, mostly *Cecropia* spp. and Solanaceae. The *Cecropia* bark often sustains crustose lichens, mostly Graphidaceae and sterile forms. Macrolichens found on the shrubs along the roadside include *Bulbothrix isidiza*, *B. goebelii*, *B. ventricosa*, *Parmotrema dilatatum*, *P. praesorediosum*, *P. sulphuratum* and *Pseudoparmelia amazonica*. Common on the soil and on wood were *Cladonia signata*, *C. corallifera* and *C. subradiata*.

MACROLICHEN CHECKLIST

Of the approximately 1900 lichen collections made during this expedition about

25% are macrolichens. All have been identified to genus and some 85% have been tentatively identified to species. It is estimated that even in the relatively well known macrolichens 10% of these collections may be undescribed species. Following is an annotated checklist of the macrolichens collected with notes on habitat preference:

BULBOTHRIX (PARMELIACEAE)

Bulbothrix apophysata (Hale & Kurok.) Hale

B. bicornuta (Müll. Arg.) Hale

A rare species, previously reported only from the type collection from Rio de Janeiro.

B. coronata (Fée) Hale

B. fungicola (Lyngé) Hale

B. goebelii (Zenker) Hale

B. isidiza (Nyl.) Hale

B. schiffneri (Zahlbr.) Hale

A rare species, previously known from the type collection from São Paulo and collected by Projeto Flora in the Federal Territory of Roraima. Collected on the Cachimbo plateau.

B. subcoronata (Müll. Arg.) Hale

B. suffixa (Stirton) Hale

Collections of this species included the strain containing atranorin and gyrophoric acid as well as the acid free strain.

B. ventricosa (Hale & Kurok.) Hale

B. viridescens (Lyngé) Hale

A rare lichen limited in range to Brazil and Uruguay (Hale, 1976a).

Bulbothrix sp. 1

Possibly a new species with a sorediate thallus and containing atranorin and gyrophoric acid.

Monographed by Hale (1976a), *Bulbothrix* is not commonly collected because it is small and inconspicuous. It was abundant in the Cachimbo area represented by 10 of the 14 species reported from Brazil. Of special interest are the two species with bicornute spores, previously only known from the type collections.

Habitat: All species of *Bulbothrix* occurred on bark in the semi-arid Amazon caatinga and secondary vegetation.

CLADINA (CLADONIACEAE)

Cladina sprucei (Ahti) Ahti

Habitat: This Amazonian species was very abundant on the white sand of the Amazon caatinga vegetation at Cachimbo.

CLADONIA (CLADONIACEAE)

***Cladonia corallifera* (Kunze) Nyl.**

Habitat: Common on a variety of substrates including bark, wood, and soil; especially common on soil of termite mounds in the Amazon caatinga and secondary vegetation.

C. didyma* (Fée) Vain. var. *didyma

Habitat: On soil in gallery forest.

***C. didyma* (Fée) Vain. var. *vulcanica* (Zoll.) Vain.**

Habitat: On wood in small swamp with secondary vegetation.

***C. hypoxanthoides* Vain.**

Habitat: On soil in Amazon caatinga vegetation.

***C. nana* Vain.**

Habitat: On soil in Amazon caatinga vegetation.

***C. peltastica* (Nyl.) Müll. Arg.**

Habitat: Common on bark and wood in Amazon caatinga vegetation. Four chemical strains were collected at Cachimbo including: usnic acid and squamatic acid; usnic acid, unknown and thamnolic acid; usnic acid and thamnolic acid; and usnic acid, squamatic acid and boninic acid aggregate.

***C. pityrophylla* Nyl.**

Habitat: On soil at the base of grasses in savanna areas.

***C. ramulosa* (With.) Laundon**

Habitat: A common species on various substrates in the Amazon caatinga and secondary vegetation.

***C. signata* (Eschw.) Vain.**

Habitat: On soil in Amazon caatinga vegetation forming large mats.

***C. subradiata* (Vain.) Sandst.**

Habitat: On a variety of substrates in Amazon caatinga and secondary vegetation.

***Cladonia* sp. 1**

Habitat: On soil in Amazon caatinga vegetation. This species will be described elsewhere by T. Ahti who has selected a collection from Serra do Cachimbo as the holotype. Four chemical strains are recognized: usnic acid and squamatic acid; usnic acid and barbatic acid; usnic acid and thamnolic acid; and usnic acid, barbatic acid and thamnolic acid.

***Cladonia* sp. 2**

Habitat: On soil in secondary vegetation and gallery forest. This species contains usnic acid, didymic acid and thamnolic acid and will be described elsewhere by T. Ahti.

***Cladonia* sp. 3**

Habitat: On soil in Amazon caatinga vegetation. This species will be

described elsewhere by T. Ahti.

Cladonia spp.

Included here are several taxa which have not yet been identified to species.

Cladoniaceae are especially abundant in the area of Cachimbo. Several species, including *Cladina sprucei*, *Cladonia peltastica* and *Cladonia signata*, formed extensive mats on the open sand and at the bases of grasses, sedges, and shrubs. The identification of many collections, particularly of red fruiting *Cladonia* species, still awaits confirmation by T. Ahti who is currently monographing this family for the neotropics.

COCCOCARPIA (COCCOCARPIACEAE)

Coccocarpia domingensis Vain.

Habitat: On bark and living leaves in gallery forest.

C. epiphylla (Fée) Krempelh.

Habitat: On living leaves in Amazon forest.

C. erythroxyli (Spreng.) Swinsc. & Krog

Habitat: On bark and wood, common and widespread in all vegetation types.

C. filiformis L. Arvidss.

Habitat: On bark in gallery forest.

C. imbricascens Nyl.

Habitat: On bark in gallery forest. Previously reported only from the type collections which are without locality, date and collector (Arvidsson, 1982).

C. palmicola (Spreng.) L. Arvidss. & D. Gall.

Habitat: On bark and wood, common and widespread in all vegetation types.

C. pellita (Ach.) Müll. Arg.

Habitat: On bark in gallery forest.

C. stellata Tuck.

Habitat: Follicolous and on bark in Amazon caatinga scrub and woodland.

COLLEMA (COLLEMATACEAE)

Collema cf. **pulcellum** Ach. var. **leucopeplum** (Tuck.) Degel.

Habitat: On bark in gallery forest.

DICTYONEMA (DICTYONEMATACEAE)

Dictyonema pavonia (Sw.) Parmasto

Habitat: On bark in Amazon forest.

D. sericeum (Sw.) Berk.

Habitat: On bark in Amazon caatinga scrub, woodland and forest and gallery forest.

DIRINARIA (PHYSICACEAE)

Dirinaria aegialita (Afz. in Ach.) Moore

D. applanata (Fée) Awasthi

D. melanocarpa (Müll. Arg.) Dodge

Habitat: All species of *Dirinaria* were found on bark in secondary vegetation.

HETERODERMIA (PHYSICACEAE)

Heterodermia casarettiana (Massal.) Trevis.

Habitat: On bark and rock in Amazon caatinga scrub, woodland and forest and gallery forest.

H. diademata (Tayl.) Awasthi

Habitat: On bark and rock in Amazon caatinga woodland and forest, gallery forest and Amazon forest.

H. flabellata (Fée) Awasthi

Habitat: On rock in campo rupestre. This is the most common species of *Heterodermia* in the Cachimbo area. This species formed large thalli covering rocks.

H. galactophylla (Tuck.) W. Culb.

Habitat: On bark in secondary vegetation.

H. obscurata (Nyl.) Trevis.

Habitat: On bark in gallery forest.

H. podocarpa (Bél.) Awasthi

Habitat: On bark in gallery forest.

H. speciosa (Wulf.) Trevis.

Habitat: On rock in gallery forest.

HYPOTRACHYNA (PARMELIACEAE)

Hypotrachyna costaricensis (Nyl.) Hale

Habitat: On bark in gallery forest.

H. formosana (Zahlbr.) Hale

Habitat: On bark in Amazon caatinga woodland and forest.

H. palmarum (Lynge) Hale

Habitat: On bark in Amazon caatinga scrub. This is a rare species known previously only from southern Brazil (Hale, 1975).

H. silvatica (Lynge) Hale

Habitat: On bark in Amazon forest. This is a rare species known previ

ously only from southern Brazil (Hale, 1975).

Hypotrachyna sp. 1

Habitat: On bark in Amazon caatinga woodland and forest. This species will be described elsewhere by M. E. Hale.

LEPTOGIUM (COLLEMATACEAE)

Leptogium austroamericanum (Malme) Dodge

L. azureum Mont. s. lat.

L. cf. isidiosellum (Riddle) Sierk

L. marginellum (Sw.) S. Gray

Leptogium spp.

Habitat: **Leptogium** spp. were abundant in the gallery forests and Amazon forest. Identification of additional species awaits further monographic work on the neotropical species.

LOBARIA (LOBARACEAE)

Lobaria ravenelii (Tuck.) Yoshim.

Habitat: Encountered on twigs in gallery forest.

PARMELIELLA (PANNARIACEAE)

Parmeliella nigrocincta (Mont.) Müll. Arg.- complex

Habitat: On bark in Amazon forest. Jørgensen (1978) states that **P. nigrocincta** is variable and may prove to be heterogeneous.

PARMOTREMA (PARMELIACEAE)

Parmotrema abnuens (Nyl.) Hale

P. affluens (Hale) Hale

P. crassescens (Stirton) Hale

This is a rare South American species containing norstictic acid, not a common acid in **Parmotrema**.

P. dilatatum (Vain.) Hale

One collection lacked usnic acid.

P. disparile (Nyl.) Hale

Several collections of this species contained usnic acid, not previously reported for this species.

P. eborinum (Hale) Hale

Several collections of this species contained usnic acid, not previously reported for this species. Certain sterile collections growing on rock were assigned to this species based on substrate.

P. endosulphureum (Hillm.) Hale

P. fasciculata (Vain.) Hale

P. flavotinctum (Hale) Hale

P. gardneri Dodge

Several collections of this species contained usnic acid, not previously reported for this species.

P. latissimum (Fée) Hale

P. neotropicum Kurok.

P. praesorediosum (Nyl.) Hale

P. progenes Hale

P. cf. subrugata (Kremp.) Hale

All collections here assigned to this species are sterile.

P. sulphuratum (Nees & Flot.) Hale

P. tinctorum (Nyl.) Hale

P. zollingeri (Hepp) Hale

Three elements have been included in this species; one corresponding to the original description, one with usnic acid and one with slightly larger spores and smaller lobes.

***Parmotrema* spp.**

Preliminary studies by M. E. Hale indicate that there may be as many as 6 undescribed species which will be published elsewhere.

Habitat: Most *Parmotrema* spp. were abundant on bark and rock throughout the Cachimbo area. Samples of the canopy vegetation indicate the abundance of this genus in that habitat, but logistic difficulties prevented extensive collection from the high canopy.

PHYSICIDIA (LECANORACEAE)

Physcidia squamulosa Tuck.

Habitat: On bark in Amazon caatinga woodland and gallery forest.

PSEUDOPARMELIA (PARMELIACEAE)

Pseudoparmelia amazonica (Nyl.) Hale

Habitat: On bark, very common in all habitats.

P. chapadensis (Lynge) Hale

Habitat: On rock in campo rupestre, gallery forest and Amazon forest. Hale (1976b) tentatively places this Brazilian species in *Pseudoparmelia*. It appears to be similar to *P. sphaerospora* except for the ovoid spores and rock substrate.

P. salacinifera (Hale) Hale

Habitat: On bark and rock, common in all habitats.

P. sphaerospora (Nyl.) Hale

Habitat: On bark in all habitats. One collection contained stictic and constrictic acid in addition to the unidentified pigment reported for this species (Hale, 1976b).

Pseudoparmelia sp. 1

Habitat: On bark in Amazon forest. This species may possibly be the undescribed fertile morph of *P. amazonica*.

Pseudoparmelia sp. 2

Habitat: On bark in Amazon caatinga woodland and forest. This species is characterized by a chemical compound which is not yet identified.

PYXINE (PHYSICIACEAE)

Pyxine berteriana var. **subobscurascens** (Halme) Imsh.

P. coralligera Malme

Pyxine sp. 1

This species is like *C. cocoes* (Sw.) Nyl. but differs in chemistry as it lacks lichexanthone.

Habitat: All three species of **Pyxine** were found on rock in campo rupestre and other areas with rock outcrops.

RELICINA (PARMELIACEAE)

Relicina abstrusa (Vain.) Hale

Habitat: On rock in Amazon forest.

R. relicinella (Nyl.) Hale

Habitat: On bark in Amazon caatinga woodland and forest and Amazon forest.

R. subabstrusa (Gyelnik) Hale

Habitat: On bark in gallery forest.

STICTA (LOBARIACEAE)

Sticta lherminieri Vainio

Habitat: On bark in gallery forest.

S. weigelii (Ach.) Vain.

Habitat: On bark in gallery forest.

USNEA (USNEACEAE)

Usnea spp.

Habitat: On twigs in caatinga vegetation. Included here are several taxa not yet determined to species.

XANTHOPARMELIA (PARMELIACEAE)

Xanthoparmelia spp.

Habitat: On rock in campo rupestre. Included here are several taxa not yet determined to species.

RESUMO

Nos meses de abril e maio de 1983 o Projeto Flora Amazônica fez uma expedição científica de botânica, especialmente para coleta de criptógamas, à Serra do Cachimbo e ao longo da estrada Cuiabá-Santarém (BR-163). No percurso da BR-163 para Serra do Cachimbo existem vários tipos de vegetações como caatinga amazônica, mata ciliar, mata alta e capoeira. Nesta expedição foram coletadas cerca de 1900 exsicatas de líquens. Dentre os macrolíquens encontrados aproximadamente 10% podem ser espécies ainda não descritas. Neste trabalho estão sendo apresentados uma lista preliminar de 91 macrolíquens e a discussão da distribuição ecológica dos líquens em cada ambiente.

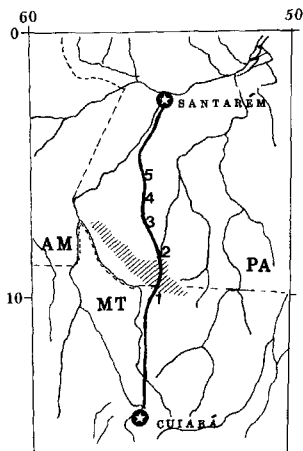


Fig. 1. Geographic location of Serra do Cachimbo and field camps along BR 163: 1. Km-763; 2. Km-877; 3. Km-1011; 4. Km-1115; 5. Km-1226.

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