PART VI

SYSTEMATIC SURVEY OF PLANT COMMUNITIES

This systematic review is a more detailed and elaborated version of the classification of the vegetation of Cuba, published by Borhidi, Muñiz and Del Risco (1979). It is based mainly on the original phytosociological relevés made by Borhidi, Borhidi and Muñiz, Borhidi and Del-Risco, Borhidi and R. Capote between 1969 and 1979, with a consideration of the vegetation studies and results of Knapp (1964, 1965), Cuatrecasas, Chapman, Ciferri, Gómez-Pompa, Hadač, Dansereau, Moncada, G. Mueller, Balátová, Berazain, Gutte, Samek, Schubert and collaborators, Stehlé, Stoffers, Smith, van Donselaar, etc. The review contains the first description and original type relevés of many Cuban and Antillean plant communities.

1. Class: **SALVINIO–EICHHORNIETEA** Borhidi and Del-Risco in Borhidi et al. (1979) 1983

(Syn.: *Cabombo–Eichhornietea* Knapp 1964)

The free-floating phanerogamic vegetation of the Neotropical freshwaters, especially in the Caribbean area.

Characteristic species: *Salvinia auriculata, S. rotundifolia, Azolla caroliniana, Lemna minima, L. perpusilla, Eichhornia crassipes, E. azurea, E. heterosperma, E. diversifolia, Pistia stratiotes, Aldrovanda vesiculosa, Utricularia* spp.

1.1 Order: SALVINIO–EICHHORNIETALIA Borhidi in Borhidi et al. (1979) 1983

Free-floating phanerogamic plant communities of the Neotropical areas, formed by unrooted plants floating on the surface of mainly eutrophic freshwater tables.

Characteristic species: *Salvinia auriculata, S. rotundifolia, Azolla caroliniana, Lemna* spp., *Eichhornia* spp., *Pistia stratiotes*.

1.1.1 Alliance: ***Azollaeo–Salvinion***
Borhidi and Muñiz in Borhidi et al. (1979) 1983

Free-floating freshwater vegetation formed by small water-pteridophytes and Lemnaceae, covering the surface of lakes, ponds, and slow streams.

Associations studied in Cuba:

Lemno–Azolletum carolinianae Borhidi and Muñiz in Borhidi et al. 1983

Association composed of *Lemna perpusilla* and *Azolla caroliniana,* represented in 10 relevés (Table 43) made by Borhidi and Muñiz, in the ponds and streams of the Batabano Swamp, S. of Havanna (Dec. 1969) and in the Lake Ariguanabo, SE of Guanajay, La Habana Province (Jan. 1970). Type: Relevé no. 2. E. of Batabanó.

Table 43 Lemno-Azolletum carolinianae Borhidi and Muñiz 1983

	1	2	3	4	5	6	7	8	9	10
Cover (%)	60	75	40	50	45	65	60	70	60	55
Lemna perpusilla Torr.	3	3—4	3	2—3	2	2	2—3	4	3	2
Lemna trinervis (Austin) Small	—	+	—	1	+	—	—	1	—	—
Azolla caroliniana Willd.	2	2	1	2	2	3	3	1—2	2	3
Spirodela polyrrhiza (L.) Schleid.	+	—	—	—	—	+ —1	—	—	+	—

Table 44 Spirodelo-Salvinietum auriculatae Borhidi and Muñiz in Borhidi et al. 1983

	1	2	3	4	5	6	7	8	9	10
Cover (%)	70	75	65	80	70	55	70	75	65	60
Salvinia auriculata Aubl.	4.4	4.4	3.4	4.4	4.4	3.3	4.5	4.5	4.4	4.5
Spirodela polyrrhiza (L.) Schleid.	1.2	2.2	2.2	2.3	2.2	2.2	1.1	—	+.1	—
Salvinia rotundifolia	—	—	—	—	—	—	—	—	—	+.1
Lemna perpusilla Torr.	—	+	—	+.1	—	—	+.1	+.1	—	—
Pistia stratiotes L.	+	—	—	—	—	—	—	+	—	—

Spirodelo–Salvinietum auriculatae Borhidi and Muñiz in Borhidi et al. 1983

Community composed of *Salvinia* and *Lemnaceae* species, represented in 10 relevés (Table 44) made by A. Borhidi and O. Muñiz in the ponds and streams of the Batabanó Swamp, in the Lake Ariguanabo and in the Zapata Swamp (Matanzas Province), 1969—1970. Type: Relevé no. 7. Zapata Swamp.

1.1.2 Alliance: ***Eichhornion azureae***
Borhidi and Muñiz in Borhidi et al. (1979) 1983

Free-floating freshwater vegetation formed by large unrooted, usually emergent aquatic plants on the surface of eutrophic and oligotrophic lakes and ponds and on that of the slow streaming rivers and creeks.

Association studied in Cuba:

Eichhornietum crassipedis Samek and Moncada 1971

Water-hyacinth mat community usually monodominant and nearly monotypic plant community of extreme by rush growth and population dynamics. It is represented in eight relevés; three of them made by Samek and Moncada in the white sand area of Cortés (Pinar del Rio Province) one by Borhidi in the Rio Hondo (Pinar del Rio Province), and four by Borhidi and Muñiz in Laguna de Ariguanabo. Type relevé no. 1 (Table 45).

Pistietum stratiotidis (Ciferri 1936) Borhidi in Borhidi et al. 1983

The name of the *Pistia stratiotes* association was used by Ciferri (1936:146) for a special aquatic plant zone in the zonation of a lake with muddy bottom. In his interpretation, *Pistia stratiotes* forms a slightly rooted population, but the water-lettuce association is usually a free-floating aquatic community, characterized by the species listed in the Table 46. The association is represented in 10 phytosociological relevés made by Borhidi, Borhidi and Muñiz in the swamp area of Batabanó, Lake Ariguanabo, 1969—1970. Type relevés no. 7. Lake Ariguanabo.

Eichhornietum azureae Borhidi in Borhidi et al. 1983

This water-hyacinth association differs from *Eichhornietum crassipedis* in preferring more oligotrophic and/or dystrophic shallow freshwaters, swamp-lakes, etc. The community is represented in 5 relevés made by Borhidi in the Zapata Swamp near Santo Tomas and Laguna del Tesoro, May, 1970. Type: Relevé no. 3. (Table 47).

Table 45 Eichhornietum crassipedis Samek and Moncada 1971

	1	2	3	4	5	6	7	8
Cover %:	100	100	95	95	100	100	100	100
Eichhornia crassipes (Mart.) Solms.	5.5	3.4	5.5	5.5	5.5	5.5	5.5	5.5
Paspalidium geminatum (L.) Stapf.	+.1	2.2	+.1	+	+	—	+	—
Vigna sp.	+.1	+.1	—	—	—	—	—	—
Ludwigia repens Forst. var. *repens*	+.1	—	—	+.1	+.1	+	+	—
Pistia stratiotes L.	—	—	—	—	+	—	—	—
Spirodela polyrrhiza (L.) Schleid.	—	—	—	+.1	+	1.1	+.1	+.1
Azolla caroliniana Willd.	—	—	2.2	—	—	.+	—	—
Salvinia auriculata Aubl.	—	—	—	+.1	—	—	—	+.1

1.1.3 Alliance: ***Ceratophyllo–Cabombion*** piauhyensis Samek and Moncada 1971

Neotropical aquatic vegetation formed by submerged and partly emerged plants of palmate- and pinnatifid leaves in eutrophic or moderately oligotrophic lakes.

Associations studied in Cuba:

Cabombetum piauhyensis Borhidi and Muñiz in Borhidi et al. 1983

The monodominant submerged plant community of the *Cabomba piauhyensis* only with some accident companions. It is represented with 5 relevés made by A. Borhidi and O. Muñiz in the Laguna Ariguanabo near Guanajay (Habana Province) in January, 1970. Type relevé: no. 1. (Table 48).

Nymphaeo–Cabombetum piauhyensis Samek and Moncada 1971

This community is formed by two layers: the submerged layer of Cabomba and the emergent layer of the water-lilies with large, entire floating leaves. It is represented with 5 relevés, all made in the white sand wetlands of West Cuba, two

Table 46 Pistietum stratiotidis (Ciferri 1936) Borhidi in Borhidi et al. 1983

	1	2	3	4	5	6	7	8	9	10
Cover %:	100	90	95	80	75	95	70	75	80	95
Pistia stratiotes L.	5.5	5.5	5.5	5.5	4.4	5.5	4.5	4.5	5.5	5.5
Salvinia auriculata Aubl.	1.1	+.1	+.1	—	—	1.1	1.1	—	+.1	—
Spirodela polyrrhiza (L.) Schleid.	+.1	—	—	+.1	—	+.1	—	—	+	—
Azolla caroliniana Willd.	+	—	—	—	1.1	—	+.1	+.1	—	+.1
Proserpinaca palustris L.	—	—	—	+.1	—	—	—	+.1	—	—
Ludwigia peduncularis (Wr. ex Griseb.) Maza	—	—	—	—	—	—	+	—	+	—

Table 47 Eichhornietum azureae Borhidi in Borhidi et al. 1983

	1	2	3	4	5
Cover %:	100	100	95	90	95
Eichhornia azurea (Sw.) Kunth	5.5	5.5	5.5	5.5	5.5
Pistia stratiotes L.	+.1	1.1	—	+.1	1.1
Salvinia auriculata Aubl.	—	—	+.1	—	1.1
Panicum aquaticum Poir.	1.1	+.1	+	+.1	—
Polygonum hispidum HBK.	+.1	+	+	+	+.1
Polygonum hydropiperoides Michx.	—	+.1	+.1	—	—
Azolla caroliniana Willd.	+	—	—	+	—

Table 48 Cabombetum piauhyensis Borhidi and Muñiz in Borhidi et al. 1983

	1	2	3	4	5
Cover %:	70	75	80	70	65
Cabomba piauhyensis Aubl.	4.4	4.4	4.5	4.5	4.4
Proserpinaca palustris L.	1.1	—	+.1	—	—
Potamogeton nodosus Poir.	—	—	+.1	+.1	—
Myriophyllum sparsiflorum C. Wr. ex Sauv.	+.1	—	—	—	—
Ludwigia inclinata (L.f.) H. Hara	—	+.1	—	—	+.1
Ludwigia erecta (L.) H. Hara	+.1	—	+.1	—	—
Utricularia mixta Barnh.	—	+ 1	+.1	—	—

Table 49 Nymphaeo-Cabombetum piauhyensis Samek and Moncada 1971

	1	2	3	4	5
Cover %:	90	75	80	75	85
Cabomba piauhyensis Aubl.	3.3	3.3	3.3	4.4	4.5
Nymphaea odorata Dryand	4.5	3.2	2.3	1.3	2.2
Nymphoides aureum (Britt.) Britt. et Millsp.	—	+.1	+.1	1.1	1.1
Ludwigia inclinata (L.f.) H. Hara	—	—	+.1	+.1	—
Salvinia auriculata Aubl.	—	—	—	+.1	+.1
Hymenachne amplexicaulis (Rudge) Nees.	—	—	+.1	—	—

by Samek and Moncada in Santa Lucia, the other three by A. Borhidi and Ramona Oviedo in the Laguna Alcatraz Mayor (3—4—5). The type relevé is no. 1. (Table 49).

1.2 Order: ALDROVANDO–UTRICULARIETALIA Borhidi in Borhidi et al. (1979) 1983

Aquatic plant communities formed by free-float submerged, mainly carnivorous hydatophytes. Some of the plant species live only slightly submerged under the surface of the water table, whereas the reproductive organs are usually emergent. They occur preferably in the eutrophic, or more frequently, in the dystrophic water of the swamp-lakes, bogs and swamp-currents.

Characteristic species: *Aldrovanda vesiculosa, Utricularia foliosa, U. juncea, U. brevifolia, U. sclerocarpa, U. stellaris, U. cornuta, U. resupinata, U. olivacea, U. incisa, U. purpurea, U. virgatula,* etc.

1.2.1 Alliance: ***Aldrovando–Utricularion***
Borhidi in Borhidi et al. (1979) 1983

Characteristics are those of the order. Communities studied in Cuba:

Utricularietum foliosae Borhidi in Borhidi et al. 1983

Free-floating submerged water plant community formed by large carnivorous plants living mostly in deeper dystrophic or eutrophic swamp-lakes of neutral or basic freshwater. The association is represented in 5 relevés made by A. Borhidi in the Lake Ariguanabo and in the Zapata Swamp area. Type: Relevé no. 2. Lake Ariguanabo, 1970. (Table 50).

Utricularietum junceae Borhidi in Borhidi et al. 1983

Free-floating submerged water plant community formed by carnivorous plants of medium or small size living mostly in shallow dystrophic or oligotrophic freshwaters of neutral or slightly acidic chemical reaction. The association is represented in 5 relevés made by A. Borhidi in the West Cuban white sand lake area. Type: relevé no. 2. Laguna Santa Maria (Pinar del Rio Province) March, 1976. (Table 51).

Utricularietum resupinatae Borhidi in Borhidi et al. 1983

Free-floating or partly rooted aquatic weed community formed by small carnivorous plants living in the shallow sublittoral sandy shore of the lakes of

Table 50 Utricularietum foliosae Borhidi in Borhidi et al. 1983

	1	2	3	4	5
Cover %:	45	50	60	40	55
Utricularia foliosa L.	3.4	3.3	4.5	2.3	3.4
Utricularia mixta Barnh.	+.1	2.2	—	1.1	1.2
Ludwigia erecta (L.) H. Hara	—	—	+1.1	1.1	—
Spirodela polyrrhiza (L.) Schleid.	—	+.1	1.1	—	—
Salvinia auriculata Aubl.	—	+.1	—	—	1.1

Table 51 Utricularietum junceae Borhidi in Borhidi et al. 1983

	1	2	3	4	5
Cover %:	50	55	45	60	50
Utricularia juncea Vahl.	3.2	3.3	3.3	3.3	3.3
Utricularia virgulata Barnh.	+.1	—	—	—	—
Utricularia pusilla Vahl.	—	—	1.1	+.1	—
Utricularia pumila Walt.	—	+.1	—	—	—
Bulbostylis tenuifolia McBr.	1.2	+.1	—	1.2	1.1
Bulbostylis capillaris (L.) C. B. Clarke	+.1	—	1.1	—	—

Table 52 Utricularietum resupinatae Borhidi in Borhidi et al. 1983

	1	2	3	4	5
Cover %	45	55	60	40	55
Utricularia resupinata B. D. Greene	3.2	3.3	4.3	3.2	3.3
Utricularia pumila Walt.	+.1	1.1	1.1		+.1
Utricularia sclerocarpa Wr. in Sauv.	+.1	+.1			
Bulbostylis tenuifolia McBr.	1.2	1.1	2.2	1.2	1.1
Bulbostylis arenaria Lindm.	–	–	+.1	.1	–
Caperonia cubana Pax. et Hoffm.	–	1.1	–	–	–

oligotrophic and usually acidic freshwater. The association is distributed all over the West Cuban wetland of the Isthmus of Guanahacabibes, and it is represented with 5 relevés made by A. Borhidi and Ramona Oviedo, March. 1976. The association is characterized by a community of minor *Utricularia* and *Bulbostylis* species. Type: relevé no. 2., Laguna del Jovero, cerca de Sandino (Pinar del Rió Province, Table 52).

1.3 Order: MAYACETALIA FLUVIATILIS Borhidi in Borhidi et al. (1979) 1983

Aquatic submerged, occasionally amphibious plant communities formed by the dense sward of moss-shaped rooted phanerophytes living in the transitional littoral zone of montane, rapid creeks and oligotrophic lowland lakes. The communities are distributed throughout the Neotropical region.

Characteristic species: *Mayaca fluviatilis, M. fluviatilis* ssp. *wrightii, Utricularia sclerocarpa, U. cornuta, U. cleistogama,* etc.

1.3.1 Alliance: ***Mayacion fluviatilis*** Borhidi in Borhidi et al. (1979) 1983

Characteristics are those of the order. Associations studied in Cuba:

Mayacetum fluviatilis Borhidi in Borhidi et al. 1983

Submerged rock pavement vegetation along the montane creek-sides and river-sides in the mountains of Oriente, especially on serpentine rocks. *Mayaca fluviatilis* is monodominant, among the accompanying species several endemics are found. The association is represented in 5 relevés made by A. Borhidi in the Sierra de Nipe (Rio Piloto, Rio del Medio, Rio Guaro); type relevé is no. 1. (Table 53) from the Rio Piloto, 19. July, 1970.

Mayacetum wrightii Borhidi in Borhidi et al. 1983

Dense, permanently or seasonally submerged littoral sward on the shore of the oligotrophic lakes in the wetlands of the white sand areas of West Cuba and Isle of

Table 53 Mayacetum fluviatilis Borhidi in Borhidi et al. 1983

	1	2	3	4	5
Cover %:	90	100	90	95	100
Mayaca fluviatilis Aubl.	5.5	5.5	5.5	5.5	5.5
Fimbristylis annua (All.) R. et S.	+.2	1.1	+.1	+.1	—
Eleocharis elegans (HBK.) R. et S.	+.1	—	+.1	—	+.1
Anemia nipensis Benedict.	+.1	—	+.1	—	—
Utricularia pusilla Vahl.	+.1	+.1	—	+.1	—
Heptanthus lobatus Britt.	—	+.1	—	—	+.1
Koehneola repens (Griseb. ex Urb.) Urb.	—	—	+.1	+.1	—

Table 54 Mayacetum wrightii Borhidi in Borhidi et al. 1983

	1	2	3	4	5
Cover %:	100	100	90	100	100
Mayaca fluviatilis ssp. wrightii (Griseb.) Borhidi	5.5	5.5	5.5	5.5	5.5
Eleocharis interstincta (Vahl) R. et S.	1.1	+.1	—	1.1	1.2
Eleocharis capillacea Kük.	—	+.1	1.1	+.1	—
Eleocharis minima Kunth	+.1	+.1	—	—	—
Eriocaulon lacustre Ruhl.	—	+.1	+.1	—	—
Pinguicula filifolia Wr. ex Griseb.	—	+.2	—	+.2	—
Rhynchospora cyperoides (Sw.) Mart.	+.2	+.1	1.1	+.2	+.1
Scirpus confervoides Poir.	+.2	+.2	+.1	1.2	—
Rhynchospora tracei Britt.	—	—	—	+.2	+.1
Utricularia juncea Vahl.	+.2	+.2	+.1	1.2	—
Andropogon sp.	—	—	—	+.2	—

Pine. *Mayaca fluviatilis* ssp. *wrightii* is a characteristic morphologically distinct ecotype of the white sand areas. The type relevé is no. 2. (Table 54) from the Laguna de la Máquina Pinar del Rio Province, made by A. Borhidi and Ramona Oviedo, March, 1976.

2 Class: **CABOMBO–NYMPHAEETEA**
Borhidi and Del-Risco in Borhidi et al. (1979) 1983

(Syn.: *Cabombo-Eichhornietea* Knapp 1964 p.p.)

Aquatic vegetation of the Neotropical freshwaters, formed by rooted hydatophytes submerged or emerged, in the different ecological types (eutrophical, oligotrophical and dystrophical) of freshwaters.

Characteristic species: *Brasenia peltata, B. schreberi, Cabomba aquatica, C. piauhyensis, Hydrocotyle umbellata, nymphaea* spp., *Potamogeton* spp., *Myriophyllum sparsiflorum, M. verticillatum, Nymphoides* spp., etc.

2.1 Order: CABOMBO-NAJADETALIA
Borhidi and Del-Risco in Borhidi et al. (1979) 1983

(Syn: *Utriculario-Najadetalia* Knapp 1964 p.p.)

Neotropical aquatic vegetation formed by submerged and rooted plants in the standing or slowly streaming freshwaters, sometimes also in slightly saline brackish waters.

Characteristic species: *Cabomba* spp., *Ceratophyllum demersum, Myriophyllum pinnatum, M. sparsiflorum, Najas marina, N. microdon, Vallisneria americana, V. neotropicalis.*

2.1.1 Alliance: ***Vallisnerion americanae***
Borhidi and Del-Risco in Borhidi et al. (1979) 1983

Subaquatic freshwater swards formed by rooted submerged aquatic weeds with ribbon-like leaves mostly in eutrophic or slightly dystrophic lakes, rarely also in slightly saline waters.

Associations studied in Cuba:

Vallisnerietum americanae Borhidi and Muñiz in Borhidi et al. 1983

Submerged aquatic, monodominant dense sward of *Vallisneria americana* with very few accompanying species. The association is also known from Florida and the SE. United States. It is represented in 5 relevés made by A. Borhidi and O. Muñiz in the Rio Zaza (Sancti Spiritus province), July 1970. Type relevé: No. 3. (Table 55).

Vallisnerietum neotropicalis Borhidi and Del-Risco in Borhidi et al. 1983

Subaquatic dense sward formed almost exclusively by *Vallisneria neotropicalis.* This community is widely distributed and common in the Laguna del Tesoro (Zapata Peninsule, Matanzas Province). It is represented with 5 relevés made by A. Borhidi and E. Del-Risco, October, 1974. Type relevé: no. 2. (Table 56).

Table 55 Vallisnerietum americanae Borhidi and Muñiz in Borhidi et al. 1983

	1	2	3	4	5
Cover %:	100	100	100	100	100
Vallisneria americana Michx.	5.5	5.5	5.5	5.5	5.5
Hydrocotyle umbellata L.	+.1	+.1	+.1	–	+.1
Potamogeton nodosus Poir.	–	–	+.1	+.1	–

Table 56 Vallisnerietum neotropicalis Borhidi and Del-Risco in Borhidi et al. 1983

	1	2	3	4	5
Cover %:	100	100	100	100	100
Vallisneria neotropicalis M. Vict.	5.5	5.5	5.5	5.5	5.5
Utricularia foliosa L.	+.1	+.1	+.1	1.1	—
Hydrocotyle umbellata L.	—	1.1	·	-	+.1
Panicum geminatum Forsk.	—	—	—	—	+.1
Potamogeton nodosus Poir.	—	—	+.1	+.1	

2.2 Order: NYMPHAEETALIA AMPLAE Knapp 1964 ex Borhidi et al. (1979) 1983

Aquatic vegetation formed mostly by rooted large emergent hydatophytes with floating leaves. The communities belonging to this phytosociological unit live in shallow eutrophic, oligotrophic and dystrophic freshwaters.

Characteristic species: *Brasenia schreberi, Nymphaea ampla, N. blanda, Nuphar luteum* ssp. *macrophyllum, Hydrocotyle umbellata, Nelumbo lutea, Nymphoides humboldtiana, N. grayana, Potamogeton* spp.

2.2.1 Alliance: ***Potamion illinoensis*** Borhidi in Borhidi et al. (1979) 1983

Slightly emergent, densely closed aquatic swards mostly in eutrophic, slowly streaming freshwaters.

Associations studied in Cuba:

Potametum illinoensi-nodosi Borhidi and Muñiz in Borhidi et al (1979) 1983

A fairly dense aquatic plant community formed by two mostly co-dominant Potamogeton species. It is found mainly in the sublittoral zone of the slowly flowing lowland rivers and drainage ditches of wetlands and swamp areas. The 5 representative relevés (Table 57) were made by A. Borhidi and O. Muñiz in the Zapata Swamp, May, 1970. Type relevés: no. 2. Laguna del Tesoro.

Nymphaeo-Potametum nodosi Borhidi in Borhidi et al. 1983

An aquatic plant community, similar to the former one. It occurs frequently in contact with *Potametum illinoensi-nodosi* in shallower freshwater, on muddier bottom, replacing the former mostly toward the shore in the hydrosere. The representative 5 relevés were made by A. Borhidi and O. Muñiz at the same localities and date. Type relevé: no. 1. Zapata Swamp near Buenaventura. (Table 58).

Hydrocotyletum umbellati Del-Risco in Borhidi et al. 1983

A very common plant community of *Hydrocotyle umbellata,* formed usually in the transitional zone between water-lily mat and littoral sedge marsh or reed-grass marsh communities. It is usually composed of two layers, a submerged and an emergent one. The submerged dominant are *Vallisneria, Najas, Potamogeton, Ceratophyllum* and others. Five representative relevés (Table 59). were made by E. Del Risco and A. Borhidi in the Laguna del Tesoro, near Guama (Zapata Swamp), in October and ovember. 1974. Type relevé: no. 4.

Table 57 Potametum illinoensi-nodosi Borhidi and Muñiz in Borhidi et al. 1983
(*Potametum nodosi-malaini* Borhidi and Muñiz 1979 nom. nud.)

	1	2	3	4	5
Cover %.	70	75	80	60	70
Potamogeton illinoisensis Morong	3.3	3.4	5.5	3.3	3.4
Potamogeton nodosus Poir.	3.4	3.2	—	1.3	2.3
Utricularia foliosa L.	—	+.1	1.1	—	—
Hydrocotyle umbellata L.	+.1	+.1	—	—	—
Vallisneria neotropicalis M. Vict.	—	—	1.1	2.2	—
Paspalidium paludivagum (L.) Stapf.	+.1	—	—	—	—

Table 58 Nymphaeo-Potametum nodosi Borhidi in Borhidi et al. 1983

	1	2	3	4	5
Cover %:	100	90	95	80	100
Potamogeton nodosus Poir.	5.5	5.5	5.5	5.5	5.5
Nymphaea ampla (Salisb.) DC.	2.2	2.2	1.3	2.2	—
Sagittaria lancifolia L.	1.2	—	+.1	—	+.1
Utricularia foliosa L.	1.2	+.1	—	1.1	—
Utricularia mixta Barnh.	—	—	—	—	+.1
Proserpinacea palustris L.	—	—	—	+	—

Table 59 Hydrocotyletum umbellati Del-Risco in Borhidi et al. 1983

	1	2	3	4	5
Cover %:	60	70	75	80	70
Hydrocotyle umbellata L.	3.3	3.4	4.4	4.5	3.3
Utricularia foliosa L.	+.1	+.r	—	—	—
Vallisneria neotropicalis M. Vict.	1.1	2.2	2.2	4.4	+.1
Scirpus validus (Vahl) T. Koyama	—	+.1	—	1.1	1.1
Paspalidium paludivagum (L.) Stapf	—	—	+.1	+.r	—
Polygonum punctatum Ell.	1.1	—	—	—	—

Myriophylletum sparsiflori Borhidi in Borhidi et al. 1983

This association is a very characteristic plant community of the little, shallow white sand lakes, forming the inner belt of the rooted aquatic vegetation. In can be found in slightly oligotrophic, shallow freshwaters on sandy bottom. The representative relevés (Table 60) were made by A. Borhidi and Ramona Oviedo in the white sand wetland of West Cuba, March, 1976. Type relevé: no. 4. Laguna Alcatraz Chiquito, near Cortés (Pinar del Rio Province).

2.2.2 Alliance: ***Nelumbio-Nymphaeion amplae***
Samek and Moncada 1971

Emergent freshwater vegetation formed by water-lily mats and by other large, rooted aquatic plants with large-floating or emergent leaves and showy flowers. The communities belonging to this alliance grow in all types of freshwaters, but more frequently in dystrophic and oligotrophic ones.

Associations studied in Cuba:

Brasenietum schreberi Borhidi in Borhidi et al. 1983

Emergent, rooted freshwater plant community living mostly in the inner side of the water-lily mats, in somewhat deeper water and on muddy substrate. Brasenia is monodominant, the companions are the dominant species of the neighbouring communities of the zonation. Five representative relevés were made by A. Borhidi in the Ariguanabo Lake, January, 1975. Type relevé: no. 3. (Table 61).

Nymphaeetum amplae Borhidi and Muñiz in Borhidi et al. 1983

This is the association of the very common water-lily mats of the Antilles and tropical America, mentioned but not analyzed by Ciferri (1936) and Dansereau (1966). This community is widely distributed in eutrophical and dystrophical lakes, ponds, dead arms of rivers, etc. Five representative relevés were made by Borhidi and Muñiz in the Lake Ariguanabo near Guanajay, January, 1970. Type relevé: no. 3. (Table 62).

Table 60 Myriophylletum sparsiflori Borhidi in Borhidi et al. 1983

	1	2	3	4	5
Cover %:	70	80	90	85	95
Myriophyllum sparsiflorum Wr. ex Sauv.	3.4	4.4	4.5	4.4	4.5
Proserpinaca palustris L.	1.2	2.2	+.1	1.1	–
Cabomba piauhyensis Aubl.	1.1		–	–	1.2
Utricularia foliosa L.	2.2	–	1.1	–	·
Utricularia mixta Barnh.	–	1.1	–	–	–
Mayaca fluviatilis ssp. wrightii (Griseb.) Borhidi		–	–	1.1	–

Table 61 Brasenietum schreberi Borhidi in Borhidi et al. 1983

	1	2	3	4	5
Cover %:	80	75	90	85	70
Brasenia schreberi Gmel.	4.5	4.5	5.5	4.5	3.3
Nymphaea ampla (Salisb.) DC.	–	+.1	—	—	1.2
Nuphar luteum (L.) Sibth. and Sm. ssp. Macrophyllum (Small) Beal.	+.1	+.1	—	+.1	—
Potamogeton nodosum, Poir.	+.1	—	—	—	—
Utricularia foliosa L.	—	—	2.2	—	1.2
Scirpus confervoides Poir.	—	—	—	—	1.2
Eleocharis interstincta (Vahl.) R. and S.	—	—	—	—	1.1

Table 62 Nymphaeetum amplae Borhidi and Muñiz 1983

	1	2	3	4	5
Cover %:	80	90	85	90	80
Nymphaea ampla (Salisb.) DC.	4.4	5.5	5.5	5.5	5.5
Brasenia schreberi Gmel.	2.2	—	—	—	—
Nuphar luteum ssp. *macrophyllum* (Small) Beal.	—	1.1	—	+.1	—
Potamogeton nodosus Poir.	—	+.1	2.2	—	2.2
Utricularia foliosa L.	2.2	—	1.1	1.1	+.2
Eleocharis interstincta (Vahl.) R. and S.	+.1	+.1	—	—	+.1
Ludwigia erecta (L.) H. Hara	—	+.1	—	—	—

Nupharetum macrophylli Borhidi and Del-Risco in Borhidi et al. 1983

This is a vicarious community of the water-lily mat in shallower, more dystrophic freshwater and muddier sites. Somewhere it is in contact shoreward with water-lily mats. Five representative relevés were made by Borhidi and Del Risco in the Zapata Swamp, E. of Buenaventura, Zanja de Jiqui, and by Borhidi in the Laguna del Tesoro, October, November 1974 and March, 1975, respectively. Type relevé: no. 1. (Table 63).

Nelumbonetum luteae Samek and Moncada 1971

This is the American lotus mat community formed by large-leaved, highly emergent, rooted water plants is rather common in the littoral zones of both eutrophic and oligotrophic freshwater lakes. It is mostly a 2- or 3-layered community, with a high emergent layer of *Nelumbo lutea,* a less emergent layer with floating leaves of *Nymphaea, Nuphar* and *Potamogeton* species and a submerged layer formed mostly by *Utricularia* species. The representative relevés can be

Table 63 Nupharetum macrophylli Borhidi and Del-Risco in Borhidi et al. 1983

	1	2	3	4	5
Cover %:	80	70	85	65	75
Nuphar luteum ssp. *macrophyllum* (Small) Beal.	4.4	3.3	5.5	4.4	4.5
Nymphaea ampla (Salisb.) DC.	2.2	2.3	1.3	2.2	1.2
Potamogeton nodosus Poir.	2.2	—	1.2	—	—
Utricularia foliosa L.	2.2	—	—	+.2	+.2
Eleocharis interstincta (Vahl.) R. and S.	—	1.1	—	1.1	—
Sagittaria lancifolia L.	—	—	+.1	—	—
Polygonum punctatum Ell.	—	—	+.1	—	—

Table 64 Nelumbonetum luteae Samek et Moncada 1971

	1	2	3	4	5	6	7	8	9	10
Cover (%):	80	50	85	70	85	80	90	85	100	95
Nelumbo lutea (Willd.) Pers.	4.4	3.3	1.3	1.2	4.4	3.4	4.5	4.4	4.4	3.3
Eleocharis interstincta (Vahl.) R. and S.	—	2.3	2.3	2.3	1.2	1.2	—	—	—	—
Nymphoides aureum (Britt.) Britt. and Millsp.	—	2.2	1.2	3.2	—	—	—	—	—	—
Nymphaea ampla (Salisb.) DC.	—	—	—	—	1.1	3.3	3.3	2.3	4.4	4.4
Utricularia foliosa L.	2.2	2.2	—	—	—	2.2	1.3	2.3	1.2	+.2
Panicum geminatum Forsk.	—	—	3.3	1.2	—	+.2	1.2	—	—	—
Panicum parvifolium Lam.	—	—	—	1.2	—	—	—	—	—	—
Rhynchospora cyperoides (Sw.) Mart.	—	—	—	1.1	—	—	—	—	—	—
Scholnoplectus validus (Vahl.) T. Koyama	—	—	—	—	—	1.1	2.2	1.2	1.1	1.2
Utricularia mixta Barnh.	—	—	—	—	—	—	+.2	—	+.2	—

divided into two subassociations; relevés nos 1—5 represent the subass. *eleocharetosum interstinctae* (relevés made by Samek and Moncada at Sabanalamar, in oligotrophic lakes); type relevé: nos 1. the relevés nos 6—10, made by Borhidi and Muñiz in the Laguna Ariguanabo, January, 1970, represent the subass. *nymphaeetosum amplae* of the more eutrophic waters (Table 64). Type relevé of the subassociation: no. 9.

Eichhornio heterospermae-Nymphoidetum aureae Samek and Moncada 1971

This is an aquatic community of the slightly oligotrophic to eutrophic shallow lakes of West Cuba, composed of rooted, floating leaved aquatic weeds *(Nymphoides, Marsilia, Nymphaea)* and of free-floating ones *(Eichhornia, Salvinia)*. Ten representative relevés were made by Samek and Moncada in the Laguna Santa Lucia, near Mantua, at the edge of the white sand area of West Cuba. The relevés 1—5 represent the subass. *marsilietosum polycarpae,* those of nos 6—7 represent

the subass, *typicum*, and 8—10 the subass. *cabombetosum*. The characteristic species of the subassociation *marsilietosum* is correctly: *Marsilia polycarpa* Hook, and Grev. rather than *M. quadrifolia* L. as suggested by the mentioned authors. Type relevé: no. 6. (Table 65).

Nymphoidetum aureae Borhidi in Borhidi et al. 1983

Monodominant formed by *Nymphoides aurea* in shallow slightly oligotrophic lakes of the white sand area. Type relevé is no. 1. (Table 66) made by Samek and Moncada in the Laguna Santa Lucia, other relevés (nos 2—5) made by Borhidi and Oviedo in Laguna La Maquina, March, 1976.

Nymphoidetum grayanae Borhidi in Borhidi et al. 1983

Freshwater plant association formed by rooted floating leaved aquatics, in shallow, eutrophic waters of limestone karstic pits in South Isle of Pine and

Table 65 Eichhornio heterospermae-Nymphoidetum aureae Samek and Moncada 1971

	marsilietosum					*cabombetosum*				
	1	2	3	4	5	6	7	8	9	10
Cover %:	95	45	75	80	90	80	40	100	60	80
Nymphoides aurea (Britt.) Britta and Millsp.	4.4	2.2	3.3	3.4	4.4	4.4	2.3	1.2	1.1	2.3
Eichhornia heterosperma Alexander	+.1	1.2	2.3	+.1	1.2	1.1	1.2	5.5	2.2	+.1
Salvinia auriculata Aubl.	+.1	+ 1	+.1	+.1	1.3	+.1	+.1	—	+.1	—
Marsilea polycarpa Hook. and Grev.	3.2	2.2	1.2	3.3	3.3	—	—	—	—	—
Polygonum punctatum Ell.	+.1	+.1	+.2	+.1	—	—	—	—	—	—
Cabomba piauhyensis Aubl.	—	—	—	+.1	+.1	—	—	2.3	3.3	2.3
Nymphaea odorata Dryand.	—	—	—	—	—	—	—	—	2.2	3.3
Ludwigia inclinata (L.f.) H. Hara	1.2	—	—	—	—	+.1	—	—	+ 1	—
Hymenachne amplexicaulis (Rudge) Nees.	—	+ 1	+ 1	—	—	—	—	—	—	—

Table 66 Nymphoidetum aureae Borhidi in Borhidi et al. 1983

	1	2	3	4	5
Cover %:	100	80	65	70	90
Nymphoides aurea (Britt.) Britt. and Millsp.	5.5	4.5	3.4	4.4	4.5
Nymphaea odorata Dryand.	—	+.1	2.2	+.2	1.2
Ludwigia inclinata (L.f.) H. Hara	1.2	—	1.2	—	+.2
Ludwigia erecta (L.) H. Hara	—	+.1	—	+.1	+.1
Hymenachne amplexicaulis (Rudge) Nees.	1.2	—	—	—	+.1
Cabomba piauhyensis Aubl.	—	—	—	+.1	1.2
Caperonia palustris (L.) St. Hill.	—	—	+.1	—	—

peninsula of Guanahacabibes. The five representative relevés were made by Borhidi, 26. December, 1969, between Cayo Piedra and Punta del Este, Isla de Pinos. Type relevé: no. 3. (Table 67).

Polygonetum densiflori Borhidi in Borhidi et al. 1983

Seasonally flooded freshwater plant community formed by aquatic and amphibious plants in the littoral zone of the shallow, muddy swamp lakes. It is a transitional community to the grass and sedge marshes. Five representative relevés were made by Borhidi in the Swamp area of Bataban, type relevé: no. 3. (Table 68).

2.2.3. Alliance: ***Crino-Limnocharion flavae***
Borhidi in Borhidi et al. (1979) 1983

Emergent aquatic vegetation of the slowly streaming shallow, slightly eutrophic freshwaters, forming dense swards along creeks and rivers.

Characteristic species: *Crinum americanum, C. oliganthum, Limnocharis flava, Fuirena umbellata, Rhynchospora* ssp.

Table 67 Nymphoidetum grayanae Borhidi in Borhidi et al. 1983

	1	2	3	4	5
Cover %:	80	70	90	75	80
Nymphoides grayana (Griseb.) Arthur	4.5	4.4	5.5	4.4	4.5
Cabomba piauhyensis Aubl.	+.1	—	1.1	—	+.2
Nymphaea ampla (Salisb.) DC.	+.2	+.1	—	—	—
Hydrocotyle umbellata L.	—	—	+.1	—	1.1
Marsilia polycarpa Hook. et Grev.	1.2	+.1	—	—	+.1
Salvinia natans L.	—	+.1	—	+.1	—

Table 68 Polygonetum densiflori Borhidi in Borhidi et al. 1983

	1	2	3	4	5
Cover %:	80	95	100	100	90
Polygonum densiflorum Meisn.	3.3	4.5	5.5	4.4	4.4
Eleocharis interstincta (Vahl.) R. et S.	+.1	—	1.2	1.1	
Sagittaria lancifolia L.	1.1	—	—	—	—
Hydrocotyle umbellata L.	+.1	1.2	2.2	2.2	—
Nymphaea ampla (Salisb.) DC.	—	+.1	—	—	2.2
Panicum geminatum Forsk.	—	+.1	—	—	1.1
Ludwigia erecta (L.) H. Hara	+.1	—	+.1	—	—
Hymenachne amplexicaulis (Rudge) Nees.	—	—	—	1.1	—

Table 69 Limnocharietum flavae Borhidi in Borhidi et al. 1983

	1	2	3	4	5
Cover %:	100	100	100	100	100
Limnocharis flava (L.) Buchan.	5.5	5.5	5.5	5.5	5.5
Rhynchosporacyperoides (Sw.) Mart.	1.1	+.1	—	—	—
Rhynchospora stellata (Lam.) Griseb.	+.1	—	1.2	1.1	1.2
Fimbristylis ovata (Burm.f.) Kern.	—	1.1	—	1.2	—
Fuirena umbellata Rottb.	+.1	+.1	1.1	1.1	+.1
Eleocharis cellulosa Torrey	—	1.1	—	—	—
Crinum americanum L.	—	—	—	—	+.2

Associations studied in Cuba:

Limnocharietum flavae Borhidi in Borhidi et al. 1983

This is the community of swamp-lily formed in shallow beds of slowly flowing freshwater streams, especially in river bends. Five representative relevés were made by Borhidi in Rio Cristal, La Habana and Rancho Boyeros, in October, 1969. Type relevé: no. 3. (Table 69).

3 Class: **CLADIETEA JAMAICENSIS** Knapp (1964) ex Borhidi et al. (1979) 1983

Tall reed-grass, sedge-, wintersedge-, cattail-marshes and swamps, rivercane- and bamboo-brakes in the regularly flooded alluvial surfaces and littoral zones of the lowland rivers in Central America and the West Indies.

3.1 Order: GYNERIO-BAMBUSETALIA Borhidi in Borhidi et al (1979) 1983

Rivercane- and bamboo-brakes monodominant, formed by 3—10 m high, often lignified gramineaes, along the riversides (Fig. 337).

Characteristic species: *Gynerium sagittatum, Bambusa vulgaris* (naturalized), *Arundo donax,* etc.

3.1.1 Alliance: ***Gynerion sagittati*** Borhidi in Borhidi et al. 1979

With the same characteristics as the order.

Association studied in Cuba:

Gynerietum sagittati Borhidi (Fig. 337)

Fig. 337 Gynerium sagittatum reed vegetation in the valley of the Jaguani river at La Melba (Photo: A. Borhidi)

3.2 Order: CYPERO HETEROPHYLLI-PENNISETETALIA Borhidi in Borhidi et al. 1979

Secondary communities of reedgrass- and sedge-marshes conditioned by human influence along the gravelly submontane and montane creeks and riversides.

Characteristic species: *Cyperus heterophyllus, C. surinamensis, Pennisetum purpureum*, etc.

3.2.1 Alliance: **Cyperion heterophylli** Borhidi in Borhidi et al. 1979

Communities with the same characters as those of the order, represented by several secondary associations in Cuba and the other West Indian islands.

3.3 Order: SCIRPO-ELEOCHARIETALIA INTERSTINCTAE Borhidi and Muñiz in Borhidi et al. (1979) 1983

Communities of tall swamp and marsh vegetation formed by grasses and sedges in steady or seasonally flooded eutrophic, dystrophic or slightly saline wetland areas, without a continuous accumulation of peat in the soils.

Characteristic species: *Scirpus validus, Schoenoplectus americanus, Eleocharis interstincta, E. cellulosa, E. articulata, Cyperus articulatus, C. diffusus, C. swartzii, Sagittaria lancifolia, S. intermedia, Echinodorus* spp. *Pontederia lanceolata, Paspalidium paludivagum, Panicum aquaticum, P. lacustre, Rhynchospora corniculata, R. gigantea,* etc.

3.3.1 *Sagittario-Eleocharion interstinctae* Borhidi and Del-Risco in Borhidi et al. (1979) 1983

Tall spike-rush and sedge marshes in eutrophic or slightly saline freshwaters of low wetlands. Characteristic species are the same as those of the order.

Associations studied in Cuba:

Sagittario-Eleocharetum interstinctae Del-Risco in Borhidi et al. 1983

This association is found in the littoral zone of the muddy eutrophic and peaty dystrophic lakes, ponds and bogs of the swamp and wetland areas, formed by the dominant spike-rush species, sedges and with a layer of aquatic plants. Five representative relevés were made by A. Borhidi and O. Muñiz, in 1970 and later by E. Del Risco and A. Borhidi, (1974—1975) all in the Zapata Swamp. Type relevé: no. 3. (Table 70).

Paspalidietum paludivagi Del-Risco and Borhidi in Borhidi et al. 1983

This association is a monodominant community of tall, emergent grasses forming a lower vegetation zone at the inner side of the read-grass of cattail zone in the sublittoral belt of the eutrophic or dystrophic lakes. In typical form it is a one-layered community, but in deeper water it develops a two-layered form, with a dense second herb layer formed by submerged aquatic plants. In our five relevés, all made by E. Del-Risco and A. Borhidi in the Zapata Swamp area, nos 1—3 represent the two layered subass, *vallisnerietosum,* and nos 4—5 the subass. *typicum.* Type relevé no. 4. (Table 71).

Eleocharetum cellulosae Borhidi in Borhidi et al. 1983

Tall spike-rush marsh with two herb layers formed in the eutrophic wetlands and the dystrophic to slightly halotrophic seaside swamps and marshes. (Fig. 338) The tall herb layer is composed of the monodominant *Eleocharis cellulosa, Pontederia*

Table 70 Sagittario-Eleocharetum interstinctae Del-Risco in Borhidi et al. 1983

	1	2	3	4	5
Cover %:	100	100	90	90	100
Eleocharis interstincta (Vahl.) R. and S.	4.5	5.5	5.5	4.5	5.5
Pontederia lanceolata Nutt.	2.4	–	1.2	–	–
Sagittaria lancifolia L.	1.1	2.3	2.3	2.2	+.2
Nuphar luteum ssp. *macrophyllum* (Small) Beal.	2.2	+.r	–	–	–
Nymphaea ampla (Salisb.) DC.	–	+.r	1.2	2.3	2.2
Polygonum punctatum Ell.	+.r	–	–	1.1	–
Typha domingensis (Pers.) Kunth	–	1.1	–	–	-
Cyperus ligularis L.	–	1.1	+.1	–	–
Potamogeton nodosus Poir.	–	+.1	–	+.1	1.1
Proserpinaca palustris L.	–	+.1	+.1	–	–
Rhynchospora stellata Griseb.	–	1.2	–	+.1	–
Hymenachne amplexicaulis (Rudge) Nees	–	–	–	–	+.1
Phyla stoechadifolia (L.) Small	–	+.r	–	–	–
Mikania hastata (L.) Willd.	–	+.r	–	–	–
Scirpus cubensis Poepp. and Kunth	2.3	–	1.2	+.1	–

Table 71 Paspalidietum paludivagi Del-Risco and Borhidi in Borhidi et al. 1983

	1	2	3	4	5
Cover %:	100	100	95	100	90
Paspalidium paludivagum (L.) Stapf	5.5	4.5	4.5	5.5	4.5
Vallisneria neotropicalis M. Vict.	5.5	2.3	2.2	–	–
Typha domingensis (Pers.) Kunth	+.1	–	–	+.1	–
Hydrocotyle umbellata L.		–	–	1.2	2.2
Schoenoplectus validus (L.) T. Koyama	–	–	1.1	–	1.2
Proserpinaca palustris L.	–	+.1	–	–	–
Panicum geminatum Forsk.		–	+.1	–	–
Aeschynomene villosa Poir. in Lam.	–	–	–	–	+.1

lanceolata, Sagittaria lancifolia, Fimbristylis spp., the lower one is formed by *Rhynchospora stellata, Cynodon, Hydrocotyle* and *Echinodorus* spp. Five representative relevés were made by Borhidi in the marshes of Rancho Boyeros and the seaside swamps of Batabanó, in October and December, 1969, Type relevé: no. 1. (Table 72).

Cyperetum articulati Borhidi in Borhidi et al. 1983

This is a two-layered sedge marsh community on regularly flooded, muddy sites along slow swamp streams. The high herb layer is formed by the monodominant *Cyperus articulatus,* mixed with *Rhynchospora stellata, Eleocharis interstincta* and *Paspalum, Aster, Pluchea,* etc. species, the other herb layer is very low, formed by

Fig. 338 Plant community of the swamp areas formed by *Eleocharis cellulosa* and *Sagittaria lancifolia*, at Rancho Boyeros near Habana (Photo: A. Borhidi)

Table 72 Eleocharetum cellulosae Borhidi in Borhidi et al. 1983

	1	2	3	4	5
Cover %:	100	95	100	90	100
Eleocharis cellulosa Torrey	5.5	4.4	5.5	3.4	4.4
Sagittaria lancifolia L.	+.1	—	—	1.1	—
Sporolobus virginicus (L.) Kunth	+.1	—	—	1.1	—
Echinodorus berteroi (Spreng) Fassett	—	+.1	—	—	1.1
Fimbristylis annua (All.) R. and S.	2.2	1.2	2.2	1.2	2.2
Fimbristylis spadicea (L.) Vahl.	—	2.2	—	1.2	1.2
Rhynchospora stellata Griseb.	2.2	1.1	2.2	+.2	+.2
Rhynchospora corniculata (Lam.) A. Gray.	—	+.1	—	+.2	—
Leersia hexandra Sw.	—	—	1.2	—	—
Ludwigia suffruticosa Maza	+.1	+.1	—	—	—
Pontederia lanceolata Nutt.	+.2	+.2	+.1	—	—
Phyla stoechadifolia (L.) Small	—	—	+.1	+.1	—
Hydrocotyle verticillata Thunb.	—	—	—	+.2	1.1
Cynodon dactylon (L.) Pers.	—	—	1.2	2.2	2.2
Ipomoea nil (L.) Roth.	—	—	—	—	+.1
Ludwigia peruviana (L.) H. Hara	—	—	—	+.1	+.2

Table 73 Cypereteum articulati Borhidi in Borhidi et al. 1983

	1	2	3	4	5
Cover %:	100	100	85	95	100
Cyperus articulatus L.	4.5	5.5	4.5	4.4	5.5
Bulbostylis setacea Svens.	+.1	1.1	+.2	+.1	1.1
Rhynchospora stellata Griseb.	1.1	1.2	2.2	2.3	+.1
Limnocharis flava (L.) Buchen.	+.2	—	—	—	—
Paspalum vaginatum Sw.	—	—	1.1	1.1	—
Cyperus filiformis Sw.	—	+.2	+.1	—	1.2
Eleocharis interstincta (Vahl.) R. and S.	+.2	—	—	1.1	—
Aster exilis Ell.	+.1	1.1	2.2	1.2	—
Pluchea purpurascens (Sw.) DC.	—	—	+.1	2.2	—
Pluchea rosea Godfr.	+.1	1.1	—	—	—
Ruellia paniculata L.	—	+.1	—	—	—
Phyla stoechadifolia (L.) Small	—	—	—	2.2	1.1
Nephrolepis biserrata (Sw.) Schott	1.1	—	1.1	—	—
Bacopa monnieri (L.) Pennell	—	2.4	—	2.3	2.3
Nasturtium portoricense Spreng.	2.2	—	2.3	1.3	—
Ipomoea triloba L.	—	+.1	—	—	—
Mikania hastata (L.) Willd.	—	—	—	+.1	—
Commelina erecta L.	+.2	—	—	—	—

Bulbostylis setacea, Phyla stoechadifolia, Bacopa monnieri and *Nasturtium portoricense*. Five representative relevés were made by Borhidi, at the northern edge of the Batabanó wetland, in December, 1969; type relevé: no. 3. (Table 73).

Schoenoplectetum validi Borhidi and Muñiz in Borhidi et al. 1983

This is a tall sedge marash community in the littoral zone of the eutrophic and slightly dystrophic lakes and ponds, where it generally substitutes the lacking reed-grass- and cattail marshes. It has a seasonally flooded terrestrial form (relevés 1—5, Table 61) that consider as subass. *typicum,* characterized by helophytes as *Centella erecta, Pontederia lanceolata, Bulbostylis* and *Fimbristylis* spp. (type relevé no. 3), and a permanently flooded aquatic form (relevés nos 6—10) considered by me as subass. *vallisnerietosum,* characterized by hydrophytes, as *Vallisneria* and *Utricularia* spp. (type relevé: no. 9). Relevés (Table 74) made by Borhidi and Muñiz, in May 1970 and by Borhidi and Del Risco, in March, 1975, in the Laguna del Tesoro, Zapata Swamp.

Acrostycho-Schoenoplectetum americanae Borhidi in Borhidi et al. 1983

This is a halotrophic sedge marsh community of the seaside wetlands in the transitional zone of the eutrophic or dystrophic wetlands or swamps to the mangrove. It is characterized by the co-dominant *Schoenoplectus americanus* and *Acrostichum aureum,* accompanied by helophytes as *Typha* and *Cladium,* and by obligate and facultative halophytes as *Conocarpus erecta, Heliotropium curas-*

savicum, Baccharis halimifolia ssp. *angustior* and *Eleocharis cellulosa*. The five relevés were made by Borhidi (December, 1969) near Batabano. Type relevé: no. 4 (Table 75).

3.3.2 Alliance: ***Rhynchosporo-Eleocharion interstinctae***
Samek and Moncada 1971

Sedge marsh vegetation of the littoral zone in the oligotrophic lakes of the white sand wetland of western-Cuba. It is characterized by acidophilous, small hydro- and helophytes, many of which are endemics.

Table 74 Schoenoplectetum validi Borhidi and Muñiz in Borhidi et al. 1983

	1	2	3	4	5	6	7	8	9	10
Cover (%)	60	65	80	70	55	100	100	100	100	100
Schoenoplectus validus (Vahl.) T. Koyama	3.4	3.5	4.5	4.4	3.4	3.5	4.4	3.3	3.4	4.4
Vallisneria neotropicalis M. Vict.	—	—	—	—	—	5.5	3.5	4.5	5.5	3.4
Utricularia foliosa L.	+.1	—	—	—	1.2	1.1	+.1	1.2	+.1	+.2
Nymphaea ampla (Salisb.) DC.	+.1	—	—	1.1	—	—	—	—	—	—
Hydrocotyle umbellata L.	+.1	+.1	—	—	1.1	+.1	+.2	1.1	1.1	
Centella erecta (L.f.) Fern.	+.1	1.1	1.1	+.1	—	—	—	—	—	—
Sagittaria lancifolia L.	—	—	+.1	—	+.1	—	—	+.1	—	—
Echinodorus berteroi (Spreng.) Fassett	+.1	+.1	—	—	—	—	—	—	—	—
Pontederia lanceolata Nutt.	+.1	1.1	1.2	—	—	—	—	—	—	—
Eleocharis interstincta (Vahl.) R. and S.	1.1	—	—	1.2	2.2	—	—	—	—	—
Rhynchospora corniculata (Lam.) A. Gray.	—	+.1	+.2	1.2	—	—	—	—	—	—
Rhynchospora gigantea Link.	+.1	—	—	—	+.1	—	—	—	—	—
Bulbostylis capillaris (L.) C.B. Clarke	—	+.2	2.2	—	1.2	—	—	—	—	—
Fimbristylis ovata (Burm.f.) Kern.	1.1	+.1	1.2	1.2	2.2	—	—	—	—	—
Fimbristylis castanea (Michx.) Vahl	1.1	1.2	1.1	2.2	+.2	—	—	—	—	—
Paspalidium paludivagum (L.) Stapf	—	—	—	—	—	+.2	—	—	1.1	—

Table 75 Acrostycho-Schoenoplectetum americanae Borhidi in Borhidi et al. 1983

	1	2	3	4	5
Cover %:	100	100	100	100	100
Schoenoplectus americanus (L.) Palla	4.4	3.4	3.3	5.5	4.5
Acrostichum aureum L.	3.4	3.5	4.4	3.3	3.4
Eleocharis cellulosa Torrey	1.1	—	1.2	—	—
Fimbristylis annua (All.) R. and S.	—	1.1	—	+.2	—
Typha domingensis (Pers.) Kunth	—	—	1.1	—	+.1
Baccharis halimifolia ssp. *angustior* (DC.) Borhidi	+.1	—	+.1	+.1	—
Fimbristylis ovata (Burm.f.) Kern	—	+.2	—	—	—
Heliotropium curassavicum L.	—	—	+.1	—	—
Conocarpus erecta L.	—	—	—	+.2	—
Cladium jamaicense Crantz	—	—	—	—	+.1

Characteristic species: *Eleocharis interstincta, E. alveolata, E. minutissima, E. oligantha, Xyris grandiceps, X. fleuxosa, Rhynchospora gigantea, R. cyperoides, Panicum lacustre, P. parvifolium, P. tenerum, Mayaca wrightii.* The alliance has an intermediate position in the oligo-psammosere between *Mayacetalia fluviatilis* and *Rhynchosporeto-Xyridetalia.*

Associations studied in Cuba:

Rhynchosporeto-Eleocharetum interstinctae Samek and Moncada 1971

This association occupies the superior part of the littoral zone of the oligotrophic white sand lakes in the western Cuban wetland. It can be divided into three subassociations, each representing a little belt in the zonation. The subass. *panicetosum parvifolii* occupies the exterior part, the subass. *scirpetosum confervoidis* the central part and the subass typicum the transitional part to the inner side of the littoral zone. (Table 76).

Eleocharetum interstinctae Samek and Moncada 1971

This sedge marsh association occurs in contact with the former one. It forms the inner ring of the littoral belt by three subassociations. The subass. nymphaeetosum is permanently flooded, the subass. typicum is seasonally flooded, generally in autumn, the subass. panicetosum forms the transitional zone to the former association. (Table 77).

3.4 Order: TYPHETO-CLADIETALIA JAMAICENSIS Borhidi and Del-Risco in Borhidi et al. (1979) 1983

(Syn.: *Pontederio-Cladietalia* Knapp 1964 and *Rhynchosporo-Cladietalia* Knapp 1964 p.p.)

Reed-grass and high sedge marshes and swamps generally on permanently flooded sites, with peat accumulation in the soils.

3.4.1 Alliance: ***Typhion domingensis*** Del-Risco in Borhidi et al. (1979) 1983

Reed-grass and cattail marshes, high sedge marshes and *Maranthaceae*-swamps in eutrophic or dystrophic wetlands on peaty soils.

Characteristic species: *Typha domingensis, Phragmites australis, Cladium jamaicense, Pontederia lanceolata, Fuirena umbellata, Cyperus giganteus, Thalia geniculata, Erianthus giganteus,* etc.

Table 76 Rhynchosporeto-Elocharetum interstinctae Samek and Moncada 1971

A: panicetosum (7 rel.); B: scirpetosum (5 rel.); C: typicum (5 rel.)

	A	B	C
Eleocharis interstincta (Vahl.) R. and S.	V. +—4	V. +—3	V. 2—5
Rhynchospora cyperoides (Sw.) Mart.	V. +—2	V. +—2	V. 1—3
Xyris grandiceps p. maj. p. Griseb.	V. +—2	N. r—1	III. 1—2
Utricularia foliosa L.	III. +—2	V. +—2	III. 2—3
Panicum parvifolium Lam.	V. +—3	—	—
Panicum tenerum Beyr.	III. +—2	I. +	—
Panicum lacustre Hitchc. and Ekman	I. 2	I. +	—
Scirpus confervoides Poir.	—	V. 1—4	I. +
Utricularia purpurea Walt.	I. +	I. 1	—
Blechnum serrulatum A. Rich.	I. +	—	—
Caperonia palustris (L.) St. Hill.	—	I. +	—
Rhynchospora gigantea Link	—	—	I. +

Table 77 Eleocharetum interstinctae Samek et Moncada 1971

A: typicum (10 rel.); B: nymphaeetosum (13 rel.); C: panicetosum geminati (9 rel.)

	A		B		C	
Eleocharis interstincta (Vahl.) R. and S.	V.	1—5	V.	+—4	V.	2—3
Paspalum serratum Hitchc. and Chase	II.	1—3	I.	+	—	—
Mayaca fluviatilis ssp. *wrightii* (Griseb.) Borhidi	I.	2—3	I.	2	—	—
Utricularia foliosa L.	I.	3—4	II.	+—2	II.	1
Aeschynomene tuberculata Griseb.	I.	r—+	—	—	I.	1
Rhynchospora cyperoides (Sw.) Mart.	I.	+	I.	+	I.	+—1
Sacciolepis striata (L.) Nash.	I.	r	—	—	—	—
Vigna sp.	I.	1	I.	1	—	—
Panicum lacustre Hitchc. and Ekman	I.	1	—	—	—	—
Scirpus confervoides Poir.	I.	+	III.	2—4	—	—
Nymphaea ampla (Salisb.) DC.	I.	r	V.	1—3	II.	+—2
Xyris grandiceps Griseb.	I.	1	—	—	—	—
Caperonia palustris (L.) St. Hill.	I.	+	—	—	—	—
Pontederia lanceolata Nutt.	I.	+	I.	+	—	—
Brasenia schreberi Gmel.	—	—	II.	+—3	—	—
Utricularia purpurea Walt.	—	—	I.	1—2	—	—
Panicum geminatum Forsk.	—	—	—	—	V.	+—4
Nymphoides aurea (Britt.) Britt. and Millsp.	—	—	—	—	II.	+—3
Fuirena scirpoidea Michx.	—	—	—	—	I.	1
Rhynchospora gigantea Link.	—	—	—	—	I.	+
Ludwigia repens Forst.	—	—	—	—	I.	+
Salvinia auriculata Aubl.	—	—	—	—	I.	+

Table 78 Typhetum domingensis Borhidi and Muñiz in Borhidi et al. 1983

	1	2	3	4	5
Cover %:	100	95	90	100	90
Typha domingensis (Pers.) Kunth	5.5	5.5	5.5	5.5	5.5
Ipomoea triloba L.	1.1	–	–	+.1	–
Mikania hastata (L.) Willd.	1.1	1.1	1.1	+.1	–
Panicum virgatum var. *cubense* Griseb.	–	1.1	1.2	+.1	–
Jussiaea suffruticosa L.	+.1	–	+.1	–	1.2
Polygonum punctatum Ell.	+.1	–	1.1	+.1	+.2
Hymenachne donacifolia (Raddi) Chase	+.1	1.1	+.1	+.1	+.1
Solidago stricta Ait.	–	+.1	–	–	–
Nymphaea blanda GFW. Meyer	1.1	–	–	–	–
Cabomba piauhyensis Aubl.	2.2	+.1	–	+.2	–
Hydrocotyle umbellata L.	+.1	1.2	+.2	1.2	2.2
Cynoctonum mitreola (L.) Britt.	–	+.1	1.2	–	–
Pluchea purpurascens (Sw.) DC.	–	+.1	1.2	–	–
Ipomoea tenuissima Choisy.	–	+.1	+.1	–	–
Centella erecta (L.f.) Fern.	–	–	+.2	–	–
Fuirena umbellata Rottb.	–	–	+.1	–	+.1
Aster exilis Ell.	–	–	–	–	+.1
Fimbristylis ovata (Burm.f.) Kern.	–	–	–	1.2	–

Typhetum domingensis Borhidi and Muñiz in Borhidi et al. 1983

Cattail marshes in eutrophic and dystrophic wetlands commonly as permanently flooded stands of the littoral zone, with a second herb layer formed by aquatic plants. Five representative relevés were made by Borhidi and Muñiz in May, 1970, and by Borhidi and Del Risco in March, 1975, in the Zapata Swamp area. Type relevé: no. 3, (Table 78).

Cyperetum gigantei Borhidi in Borhidi et al. 1983

This is a giant sedge-marsh community up to 3 m high, usually with three herb layers. The first herb layer is formed by the monodominant *Cyperus giganteus*, the second one by *Rhynchospora, Eleocharis* and *Gramineae* species, and the third one by aquatic and helophytic plants such as *Limnocharis flava, Crinum americanum, Sagittaria,* and *Ruellia* spp. Five relevés were made by Borhidi in the wet marshes of Rancho Boyeros, in October, 1969 (Table 79); type relevé: no. 1.

Polygoneto-Thalietum geniculatae Borhidi in Borhidi et al. 1983

This is a seasonally flooded broadleaved marsh association, in which *Thalia geniculata* of the Marantaceae is associated with high, helophytic grasses as *Vetiveria zizanoides, Panicum virgatum* var. *cubense,* sedges and with *Polygonum portoricense.* There is developed also a species rich, densely closed low herb layer under the protection of the broad-leaved Thalia. In the successional process this

Table 79 Cyperetum gigantei Borhidi in Borhidi et al. 1983

	1	2	3	4	5
Cover %:	90	85	95	100	100
Cyperus giganteus Vahl.	4.5	4.4	4.5	5.5	4.5
Pontederia lanceolata Nutt.	+.1	+.2	—	—	—
Limnocharis flava (L.) Buchen	2.3	2.3	1.3	1.2	2.2
Crinum americanum L.	—	—	+.2	—	+.2
Rhynchospora ligularis	1.2	—	—	2.2	—
Rhynchospora stellata Griseb.	1.3	2.2	2.3	2.3	1.2
Fuirena umbellata Rottb.	+.2	1.2	1.1	1.1	1.1
Phyla nodiflora (L.) Greene	1.2	2.2	2.2	+.1	—
Eleocharis interstincta (Vahl.) R. and S.	—	—	—	+.2	—
Panicum lanceanum Trin.	+.2	—	—		1.1
Polygonum punctatum Ell.	—	—	+.1	—	—
Rhynchospora cyperoides (Sw.) Mart.	—	—	—	1.1	—
Sagittaria lancifolia L.	—	—	—	—	+.r
Panicum virgatum var. *cubense* Griseb.	—	1.2	—	—	—
Vetiveria zizanoides (L.) Nash.	—	+.1	1.1	—	—
Hymenachne donacifolia (Raddi) Chase	—	—	—	1.1	—
Ruellia paniculata L.	+.1	—	—	—	—

Table 80 Polygneto-Thalietum geniculatae Borhidi in Borhidi et al. 1983

	1	2	3	4	5
Cover %:	100	100	100	100	100
Thalia geniculata L.	5.5	4.5	5.5	4.5	4.5
Vetiveria zizanoides (L.) Nash.	1.2	2.2	1.2	2.3	2.2
Panicum virgatum var. *cubense* Griseb.	1.1	1.2	1.3	2.2	2.3
Fuirena umbellata Rottb.	+.1	—	1.2	+.2	—
Pontederia lanceolata Nutt.	+.1	+.2	—	—	—
Typha domingensis (Pers.) Kunth	+.2	+.1	—	+.2	1.1
Polygonum portoricense Bert.	1.2	2.3	2.3	3.3	2.3
Baccharis halimifolia L.	+.1	—	—	—	—
Mimosa pigra L.	—	1.1	—	2.1	—
Sagittaria lancifolia L.	1.2	+.2	—	+.2	—
Rhynchospora stellata Griseb.	—	—	—	—	1.2
Nephrolepis biserrata (Sw.) Schott	2.2	—	1.2	—	—
Cyperus ligularis L.	—	—	+.1	+.1	—
Cyperus flavus (Vahl.) Nees		+.1	—	+.1	—
Phyla nodiflora (L.) Greene	2.3	2.3	—	+.2	—
Ludwigia repens Forst.	—	—	1.2	—	
Centella asiatica (L.f.) Fern.	—	—	—	—	1.1
Cynoctonum mitreola (L.) Britt.	—	—	+.1	—	1.2
Hydrocotyle umbellata L.	—	+.2	—	+.2	+.2
Cyperus filiformis Sw.	—	—	1.2	—	—
Bulbostylis capillaris (L.) C.B. Clarke	—	—	—	+.2	—
Mikania batata (L.) Willd.	+.2	1.1	—	—	—
Ipomoea triloba L.	—	+.1	1.2	—	—
Aster leonis Britt.	—	—	—	+.1	—
Solenipteris Presl.	—	—	1.1	—	—
Cassytha filiformis L.		—	—	1.2	1.3

community develops to a wet shrub savanna by settling of *Mimosa pigra, Paspalum secans* and others. Five relevés were made by Borhidi in the wetland area of Rancho Boyeros, in October, 1969. Type relevé: no. 1 (Table 80).

3.4.2 Alliance: ***Cladion jamaicensis***
Borhidi and Muñiz in Borhidi et al. (1979) 1983

High swamp vegetation of the winter sedge, mostly in dystrophic freshwaters and peaty soils, rarely forming wide extended swinging sedge-bogs on the surface of swamp-lakes.

Characteristic species: *Cladium jamaicense, Crinum americanum, C. oliganthum, Paspalum giganteum, Rhynchospora stellata, Panicum lancearium, P. condensum, P. virgatum, Andropogon glomeratus, Erianthus giganteus, Sacciolepis striata, Thelypteris palustris, Centella erecta, Solidago stricta,* etc.

Association studied in Cuba:

Crino-Cladietum jamaicensis Borhidi and Muñiz in Borhidi et al. 1983

It is a very common and widely distributed sedge-swamp community in the West Indies, represented with the greatest extension in the Zapata Swamp of Cuba and in the everglades of Florida (Fig. 339). The enclosed five relevés were made by Borhidi and Muñiz in May, 1970 and by Borhidi and Del Risco in March, 1975 in the Zapata Swamp. Type relevé: no. 5. (Table 81).

Fig. 339 A very extensive plant community of the swamp areas: the herbaceous swamp of the *Cladium jamaicense* Cr. (Photo: A. Borhidi)

Table 81 Crino-Cladietum jamaicensis Borhidi and Muñiz in Borhidi et al. 1983

	1	2	3	4	5
Cover %:	100	100	100	100	100
Cladium jamaicense Crantz	5.5	4.4	4.5	4.4	5.5
Andropogon glomeratus (Walt.) BSP.	+.1	+.2	1.2	1.1	+.2
Typha domingensis (Pers.) Kunth.	+.r	3.2	+.1	+.r	—
Ipomoea tenuissima Choisy	+.r	+.1	—	—	—
Cassytha filiformis L.	+.r	3.3	1.2	2.3	1.3
Conocarpus erecta L.	+.r	+.r	+.r	—	+.r
Solidago stricta Ait.	—	1.1	+.2	—	1.1
Annona glabra L.	—	+.r	—	+.r	+.r
Hydrocotyle umbellata L.	—	1.2	—	—	—
Mikania hastata (L.) Willd.	—	1.1	+.1	+.2	+.1
Cynoctonum mitreola (L.) Britt.	+.1	1.2	1.2	+.2	1.2
Panicum virgatum var. *cubense* Griseb.	+.2	1.1	1.1	1.2	1.2
Echinochloa crusgalli (L.) Beauv.	—	1.1	+.2	—	—
Rhynchospora cyperoides (Sw.) Mart.	—	1.1	+.1	+.1	—
Phyla nodiflora (L.) Greene	—	1.1	—	—	—
Sagittaria lancifolia L.	—	+.r	+.1	+.1	+.1
Pluchea purpurascens (Sw.) DC.	—	+.r	+.1	—	1.2
Sisyrinchium recurvatum Bicknell	—	+.r	—	—	—
Baccharis halimifolia L.	—	+.r	—	—	—
Chara domingensis	—	3.3	—	—	—
Bacopa monnieri (L.) Pennel	—	2.2	+.2	—	—
Crinum oliganthum Urban	—	(+)	+.2	+.1	+.1
Eriocaulus gigantens (Walt.) Muhl.	—	—	+.2	+.2	—
Panicum lanceatum Trin.	—	—	+.1	+.1	—
Rhynchospora stellata Griseb.	—	—	+.2	+.1	—
Centella erecta (L.f.) Fern.	—	—	1.1	1.2	1.2
Saururus cernuus (L.) Nash	—	—	1.1	+.1	+.1
Thelypteris palustris	—	—	2.3	1.3	—
Nymphaea ampla (Salisb.) DC.	—	—	—	—	+.1
Nephrolepis biserrata (Sw.) Schott	—	—	—	—	+.1
Blechnum serrulatum A. Rich.	—	+.2	—	—	—
Proserpinaca palustris L.	—	—	—	—	+.1
Ludwigia nervosa Ell.	—	—	1.2	—	—

4 Class: **PARVIRHYNCHOSPORO-ERIOCAULETEA** Borhidi 1979 in Bal.—Tul. and Capote 1985

Open and moderately closed short grassland vegetation on humid or at least seasonally wet, mostly oligotrophic acidic soils, poor in nutrients, most frequently on humid white sand seasonally flooded by oligotrophic shallow freshwaters. The vegetation is formed by short or dwarf cyperaceas, xyridaceas, eriocaulaceas, scrophulariaceas and rubiaceas with pygmaeous or creeping stems, accompanied by carnivorous plants as the dwarf rooted *Utricularia* species, *Pinguicula filifolia,*

Drosera intermedia and little rosette hemicryptophytes as *Hyptis pedalipes, Aster grisebachii, Lachnorrhiza, Stenandrium, Sachsia* ssp. *Chaetolepis cubensis, Eriocaulon fuliginosum, Elephantopus* ssp.

4.1 Order: RHYNCHOSPORO-XYRIDETALIA Borhidi (1979) et in Bal.–Tul. et Capote 1985

Short wet grassland vegetation on oligotrophic, mostly white sand soils.

Characteristic species: *Rhynchospora cyperoides, R. filifolia, R. podosperma, R. brachychaeta, R. tenuis, R. tracei. R. leptorrhyncha, Acisanthera quadrata, Rhexia cubensis, Eleocharis capillacea, Herpyza grandiflora, Lachnocaulon ekmanii, Lachnanthes tinctoria, Panicum wrightianum, Scleria* ssp., *Xyris bicarinata, X. navicularis, X. elliottii,* etc.

4.1.1 Alliance: ***Rhynchosporo-Xyridion***
Borhidi (1979) et in Bal.—Tul. et Capote 1985

Closed wet short grasslands highly rich in endemics and plants of northern distribution pattern.

Association observed and studied in Cuba:

Xyridi-Hypericetum fasciculati Borhidi (ined.)

Burmannio bicolori-Hypericetum fasciculati Balátová-Tuláčková in Bal.—Tul. et Capote 1985

Closed wet oligotrophic sandy peat community, shallowly flooded during the rainy season. The substrate is formed by white sand with an admixture of humus on the surface. The community can be found in the south-west part of the white sand area of the Isle of Pines (Isla de la Juventud) between the Hotel Colony and the Siguanea Hills. The association is to be divided into two subassociations: the longer flooded wetter one is named as *utricularietosum fimbriatae* Bal.-Tul. 1985 (Table 82. rel. 1), while the drier variant is considered as the typical representative of the community (rels 2 and 3).

Spigelio sphagnicolae-Paepalanthetum seslerioidis Balátová-Tuláčková et Capote 1985

This is the community the herbaceous clearings of the ammophylous pine woodlands, *Paepalantho-Pinetum tropicalis* association. It develops in the small depressions of the white sand dunes flooded seasonally by shallow acid and nutrient poor water. It forms a dynamic complex with the pine woodland and sandy savanna communities, even scattered *Pinus tropicalis* trees may occur in this association. In its species composition endemics play a relevant role, therefore the community is

considered as an endemic association of the sandy areas of Isle of Pines. Two subassociations are differentiated, the typical one and the *hypericetosum styphelioidis* (Table 83. rel. 1) which represente a transitional variant to the pine woodland communities with a more developed shrub layer.

Chaetolepidi-Rhynchosporetum filifoliae Borhidi

4.2 Order: PAEPALANTHO-ERIOCAULETALIA Knapp (1964), emend. Borhidi (1979), and in Balátová-Tuláčková and Capote 1985

These are seasonally dry oligotrophic open short grasslands, formed by small rosette perennials, dwarf and needle-leaved shrubs, cushion-shaped plants, essentially on white sand, rarely on humid serpentine laterite, both extremely poor in nutrients.

Characteristic species: *Eriocaulon arenicola, E. fuliginosum, E. ovoideum,* etc., *Paepalanthus alsinoides, P. seslerioides, P. lamarckii, Syngonanthus androsaceus, S. insularis, S. lagopodioides, S. leonis, S. wilsonii, Xyris ekmanii, Scleria pauciflora, S. interrupta, S. ciliata, Richardia arenicola, R. ciliata, Nodocarpaea radicans, Borreria strumpfioides, Mitracarpus depauperatus, Cuphea pseudosilene, Cenchrus distichophyllus,* etc.

4.2.1 Alliance: ***Eriocaulo-Paepalanthion*** Borhidi (1979) et in Balátová-Tuláčková and Capote 1985

With the same characteristics as the order.

Associations observed and studied in Cuba:

Syngonantho-Paepalantheum alsinoidis Borhidi (ined.)

Xyridi-Paepalanthetum seslerioidis Borhidi 1979 (ined.)

4.3 Order: HYDROLAEETALIA NIGRICAULIS Balátová-Tuláčková in Balátová-Tuláčková and Capote 1985

Open herbaceous plant communities occurring in the depressions of the sandy savannas of Isle of Pines. The sandy soil is acid regularly flooded during the rainy season and it is covered by a thin layer of mud. Because of this muddy surface, the ecologic character of the site is less oligotrophic than in the other *Parvirhynchosporo-Eriocauletea* communities. This moderately acid and oligotrophic character is reflexed by the characteristic species composition of the community. It is composed of moderately acidophilous white sand elements as *Phyllanthus heliotropus, Eriocaulon fuliginosum, Rhynchospora divergens (?), Chaetolepis cubensis,*

Table 82 Burmannio-bicolori—Hypericetum fasciculati
Balátová-Tuláčková in Balátová-Tuláčková and Capote 1985

	1	2	3	Pr_3
Cover %:	80	92	80	
Characteristic and differential species of the association				
Burmannia bicolor Mart.	+	2	2	3
Panicum albomarginatum Nash	+	2	2	3
Cuphaea cordifolia (Sw.) Koehne	+	—	—	1
Differential species of *utricularietosum fimbriatae* subass.				
Eriocaulon cf. *olivaceum* Mold.	1	.	.	1
Syngonanthus androsaceus (Griseb.) Ruhl.	+	.	.	1
Utricularia fimbriata HBK.	+	.	.	1
Lycopodium meridionale Underw. and Lloyd	r	.	.	1
Blechnum serrulatum A. Rich. ssp. *roigii* Bobrov	r	.	.	1
Characteristic species of the alliance and order				
Hypericum fasciculatum Lam.	3	3	+	3
Xyris elliottii Chapm.	1	3	4	3
Rhynchospora brachychaeta C Wr.	1	1	+	3
Burmannia capitata (Walt.) Mart.	+	r	+	3
Panicum erectifolium Nash	1	—	—	1
Characteristic species of the *Parvirhynchosporo-Eriocauletea* class				
Chaetolepis cubensis (A. Rich.) Triana	1	+	+	3
Lachnorrhiza piloselloides A. Rich.	2	2	+	3
Polygala leptocaulis Torr. and Gray	+	+	+	3
Paspalum nanum C. Wr.	+	1	1	3
Paspalum pulchellum Kunth	—	1	+	2
Xyris bicarinata Griseb.	+	.	.	1
Drosera rotundifolia L.	+	.	.	1
Characteristic species of the *Eriocaulo-Paepalanthion* alliance				
Syngonanthus lagopodioides (Griseb.) Ruhl.	+	1	1	3
Helenium scaposum Britt.	+	.	.	1
Borreria strumpfioides Wr. ex Griseb.	.	.	r	1
Characteristic species of the *Hydrolaeetalia nigricaulis* order				
Phyllanthus heliotropus Griseb.	1	1	1	3
Panicum laxum Sw.	r	+	+	3
Elephantopus pratensis Wr. in Sauv.	—	+	+	2
Companion species, *Curatello-Byrsonimetea*				
Rhynchospora plumosa Ell.	1	+	1	3
Rhynchospora podosperma C. Wr.	2	+	2	3
Panicum tenerum Beyr.	+	1	+	3
Andropogon virginicus L.	+	+	+	3
Agalinis albida Britt. and Penn.	+	+	+	3
Rhynchospora globosa (HBK.) Roem. and Schult.	+	+	—	2
Rhynchospora subimberbis Griseb.	r	—	+	2
Sauvagesia brownei Planch.	r	—	r	2
Phyllanthus selbyi Britt. and Wils.	—	+	+	2
Borreria thymocephala Griseb.	—	+	+	2
Cassia diphylla L.	—	(+)	r	2

Other companions				
Scleria baldwinii (Torr.) Steud.	r	r	r	3
Cassytha filiformis L.	r	2	2	3
Panicum leucothrix Nash	+		r	2
Scleria interrupta A. Rich.	.	r	r	2
Ischaemum rugosum Salisb.	r	(+)	–	2
Fuirena simplex Vahl	(+)	(r)	–	2
Leptocoryphium lanatum (HBK.) Nees	r			1
Aristida vilfifolia Henr.	r	.		1
Aristida brittonorum Hitchc.	r	–	–	1
Andropogon bicornis L.	r	–	–	1
Cuphea pseudosilene Griseb.	r	–	–	1
Colpothrinax wrightii Griseb. and Wendl.	r	–	–	1
Myrica cerifera L.	r	–	–	1
Tabebuia lepidophylla (A. Rich.) Greenm.	r			1
Melochia savannarum Britt.	–	r	–	1
Cyperus polystachyos Rottb.	–	r	–	1
Cyperus ligularis L.	–	r	–	1
Mesosetum wrightii Hitchc.	–	–	1	
Scleria muhlenbergii Steud.	.	.	r	1
Oldenlandia uniflora L.	–		r	1

Elephantopus pratensis, and of species of swamp communities as *Encopella tenuifolia, Panicum laxum, Eleocharis caribaea, Fimbristylis complanata, Pluchea rosea, Centella erecta,* etc.

Balátová-Tuláčková constructed a separate association class for this community (*Hydrolaeetea nigricaulis* Bal.-Tul. in Balátová-Tuláčková and Capote 1985a) but the given characteristic composition does not seem to justify her decision. One half of the listed species proposed as characteristic by Balátová-Tuláčková is a group of both ecologically and phytogeographically widely distributed species, common in several swamp and marshland communities. The other half is composed of oligotrophic species mostly occurring in other moist white sand associations as well, therefore they are to be considered as characteristic species of the *Parvirhynchosporo–Eriocauletea* class. For characteristic species of the order and alliance the following are to be considered:

Hydrolaea nigricaulis, Encopella tenuifolia, Elephantopus pratensis, Phyllanthus heliotropus, Eriocaulon fuliginosum.

4.3.1 Alliance: ***Hydrolaeion nigricaulis***
Balátová-Tuláčková in Balátová-Tuláčková and Capote 1985

With the same characters as in the order.

Encopello-Hydrolaeetum nigricaulis Bal.-Tul. and Capote 1985

This association grows in the south-west of Isle of Pines and can be divided into two subassociations. The subass *ludwigietosum erectae* occurs on sites with higher water table (Table 84, rels 1—2) than the typical subassociation (rel. 3—5)

Table 83 Spigelio sphagnicolae-Paepalanthetum seslerioidis Balátová-Tulácková and Capote 1985

	1	2	3	Pr_1
Cover %:	80	75	85	
Characteristic and differential species of the association				
Spigelia sphagnicola C. Wr. in Sauv.	r	+	r	3
Diodia ciliata Britt. et Wils.	+	1	+	3
Mitracarpus depauperatus Britt. et Wils.	+	+	—	2
Utricularia pusilla Vahl	—	r	r	2
Differential species of the *hypericetosum styphelioidis* subass.				
Hypericum styphelioides A. Rich.	2	+	—	2
Calyptranthes pinetorum Wils.	2	1	—	2
Miconia androsaemifolia Griseb.	1	(r)	—	2
Characteristic species of *Paepalantho-Eriocauletalia* order	+	2	+	3
Syngonanthus lagopodioides (Griseb.) Ruhl.	+	+	+	3
Borreria strumpfioides Wr. ex Griseb.	+	+	+	3
Helenium saposum Britt.	+	+	—	2
Hyptis ammotropha Wr. ex Griseb.	+	+	—	2
Heptanthus cochlearifolius Griseb.	—	1	+	2
Acisanthera quadrata Juss.	—	—	+	1
Characteristic species of *Hydrolaeetalia nigricaulis* order				
Eriocaulon fuliginosum C. Wr. in Sauv.	+	+	+	3
Panicum laxum Sw.	—	+	—	1
Characteristic species of the *Parvirhynchosporo-Eriocauletea* class				
Chaetolepis cubensis (A. Rich.) Triana	+	+	1	3
Lachnorrhiza piloselloides A. Rich.	+	r	2	3
Cuphea pseudosilene Griseb.	1	1	1	3
Croton cerinus Muell. Arg.	1	1	1	3
Xyris bicarinata Griseb.	+	+	+	3
Pinguicula filiformis Wr. ex Griseb.	+	+	+	3
Drosera rotundifolia L.	+	r	+	3
Elephantopus arenarius Britt. and Wils.	+	r	+	3
Polygala leptocaulis Torr. and Gray	+	+	+	3
Paspalum pulchellum Kunth	+	—	+	2
Polygala uncinata C. Wr. in Sauv.	—	+	—	1
Companion species, *Curatello-Byrsonimetea*				
Rhynchospora globosa (HBK.) Roem. and Schult.	2	+	3	3
Rhynchospora subimberbis Griseb.	2	2	1	3
Sauvagesia brownei Planch.	2	2	1	3
Phyllanthus selbyi Britt. and Wils.	1	1	1	3
Aeschynomene tenuis Griseb.	+	+	+	3
Mesosetum loliiforme (Hochst.) Chase	+	1	1	3
Panicum tenerum Beyr.	+	1	+	3
Rhynchospora podosperma C. Wr. in Sauv.	+	+	+	3
Dichromena seslerioides (Griseb.) Clarke	+	+	+	3
Aristida vilfifolia Henr.	+	+	+	3
Stenandrium droseroides Nees	+	+	+	3
Aristida brittonorum Hitchc.	+	—	+	2
Buchnera elongata HBK.	+	—	—	1

Cameraria retusa Briseb.	—	+	—	1
Agalinis albida Britt. et Penn		-	+	1
Characteristic species of *Byrsonimo-Pinetea* class				
Tabebuia lepidophylla (A. Rich.) Greenm.	—	1	+	2
Brya depressa Borhidi	—	-	+	2
Panicum leucothrix Nash	+	-	+	3
Scleria interrupta A. Rich.	+	-	+	3
Byrsonima wrightiana Urb. et Niedz.	1			1
Ouratea elliptica (A. Rich.) Maza	+	-		1
Acoelorraphe wrightii Wendl.	(+)	—	—	1
Pinus tropicalis Morelet	—	r	—	1
Characteristic species of the *Sclerio baldwinii-Andropogenetea gracilis* class				
Cynanchum savannarum Alain	r	+	+	3
Sachsia polycephala Griseb.	+	+	+	3
Angadenia sagraei A. DC.	—	r	+	2
Scleria baldwinii (Torr.) Steud.	—	—	r	1
Other companions				
Rhynchospora sp. div.	r	-	+	3
Guettarda calyptrata A. Rich.	—	1	+	2
Leptocoryphium lanatum (HBK.) Nees	(+)	—	+	2
Lagenocarpus guianensis Nees	1	+	—	2
Schwenkia americana L.	+	—	+	2
Oldenlandia uniflora L.	r	—	r	2
Cassytha filiformis L.	—	+	2	2
Eragrostis cubensis Hitchc.	r	—	—	1
Schultesia guianensis (Aubl.) Malme	r	-		1
Aristida refracta Griseb.	—	+	—	1
Cyperus surinamensis Rottb.	—	—	+	1
Manisuris loricata (Trin.) kuntze	—	—	+	1
Malpighia horrida Small	—	—	+	1
Coccoloba microphylla Griseb.	-	-	(+)	1
Stigmaphyllum sagraeanum A. Juss.	—	—	(r)	1

5. Class: **ZOSTERETEA** Chapman 1974

Submarine, rooted swards formed by submerged phanerogams of wide, mostly pan-tropical distribution.

5.1 Order: RUPPIETALIA MARITIMAE J. Tx. 1960

Submarine swards of the temperate seas, and submerged vegetation of the continental and insular salt lakes.

Characteristic species: *Ruppia maritima, Najas marina, N. guadalupensis, N. wrightiana, Halodule beaudettii, H. wrightii.*

Table 84 Encopello tenuifoliae-Hydrolaeetum nigricaulis Balátová-Tuláčková and Capote 1985

	1	2	3	4	5
Cover %:	60	50	65	60	65
Characteristic and differential species of the association					
Hydrolaea nigricaulis Wr. ex Griseb.	2	2	1	1	3
Cyperus haspan L. (diff.)	+	+	+	+	+
Encopella tenuifolia (Griseb.) Pennell	—	1	1	4	1
Differential species of the *ludwigietosum erectae* subass.					
Ludwigia erecta (L.) H. Hara	3	3	+	—	—
Paspalum erecta (L.f.) Fern.	+	+	—	—	—
Centella erecta (L.f.) Fern.	2	—	—	—	—
Cyperus surinamensis Rottb.	—	r	—	—	—
Characteristic and differential species of alliance and order					
Panicum laxum Sw.	+	+	+	+	+
Phyllanthus heliotropus Griseb	1	—	3	+	+
Pluchea rosea Godfrey (diff.)	+	+	—	+	+
Rhynchospora divergens Curtis	+	—	+	+	+
Eleocharis cubensis (Rottb.) Blake (diff.)	—	1	3	1	3
Fimbristylis complanata (Retz) Link (diff.)	—	—	+	+	+
Characteristic species of the *Parvirhynchosporo-Eriocauletea* class					
Elephantopus pratensis Wr. ex Sauv.	+	+	+	+	(r)
Chaetolepis cubensis (A. Rich.) Triana	+	r	+	+	—
Eriocaulon fuliginosum Wr. in Sauv.	—	—	1	+	+
Acisanthera quadrata Juss.	—	—	(r)	+	—
Utricularia pusilla Vahl	—	—	r	+	—
Croton cerinus Muell. Arg.	—	+	—	—	—
Lachnorhiza piloselloides A. Rich.	—	—	(r)	—	—
Characteristic species of the *Curatello-Byrsoninetea* class					
Panicum nervosum Beyr.	1	+	2	1	1
Borreria thymocephala Griseb.	+	(+)	+	+	+
Phyllanthus selbyi Britt. and Wilt.	—	—	+	1	—
Jatropha angustifolia Griseb.	—	—	—	—	r
Other companions					
Eragrostis elliottii S. Wats.	+	+	r	—	+
Cassytha filiformis L.	1	+	+	(+)	—
Ischaemum rugosum Salisb.	+	(+)	+	(+)	—
Solera baldwina (Torr.) Steud.	+	+	—	1	—
Dichanthium sp.	—	—	(r)	+	+
Andropogon virginicus L.	—	—	+	—	r
Mansura lonicera (Trin.) Kuntze	—	—	+	+	—
Aristida vilfifolia Henr.	—	—	—	+	—
Cassia diphylla L.	—	—	—	r	—
Bryia depressa Borhidi	—	—	—	r	—
Mikania ranunculifolia A. Rich.	—	—	—	—	(r)

5.1.1 Alliance: ***Ruppion maritimae*** Br.-Bl. 1931

Associations observed and studied in Cuba:

Halodulo-Ruppietum maritimae
Borhidi and Del-Risco in Borhidi et al. 1983

This is a community of the moderately to extremely saline waters of estuaries and the shallow mangrove-areas. Five representative relevés were made by Borhidi in February, 1981, in Las Salinas, Zapata Peninsula, Bahia de Cochinos. Type relevé: no. 2. (Table 85)

5.2 Order: THALASSIO-SYRINGODIETALIA FILIFORMIS Knapp (1964) in Borhidi et al. 1983

Tropical submarine swards in the Caribbean region.

Characteristic species: *Thalassia testudinum, Syringodium filiforme, Halodule wrightii, Halophila baillonis, H. aschersonii, Limnobium laevigatum.*

5.2.1 Alliance: ***Syringodio-Thalassion***
Borhidi in Borhidi et al. (1979) 1983

With the same characteristics as the order.

Associations observed and studied in Cuba:

Syringodio-Thalassietum (Ciferri 1936) Borhidi in Borhidi et al. 1983

Submarine phanerogamic swards of the shallow sublittoral zones of the sandy beaches. Five representative relevés were made by Borhidi in the Casilda Peninsula (Sancti Spiritus Province) in September, 1969, and in Punta Maisi (Baracoa Province) in March, 1970. Type relevé: no. 2. (Table 86)

Limnobietum laevigati Borhidi in Borhidi et al. 1983

(Syn.: *Hydromistrietum stoloniferae* Borhidi in Borhidi et al. 1979 n. nud.)

This is an open submarine sward community formed mostly by stoloniferous phanerogams in shallow sublittoral zone of sandy beaches. Five relevés were made by Borhidi in Jibacoa (November, 1969; May 1974) Varadero (June, 1976) and Casilda (September, 1969). Type relevé: no. 2 (Table 87).

Table 85 Halodulo-Ruppietum maritimae Borhidi and Del-Risco in Borhidi et al. 1983

	1	2	3	4	5
Cover %:	70	80	65	80	70
Ruppia maritima L.	4.4	4.4	3.3	4.5	4.4
Najas guadelupensis (Spreng.) Magnus		+.1	2.2		
Halodule beaudettii (d. Hart.) d. Hart.	–	+.1	–		+.1
Syringodium filiforme Kütz.			–	1.2	

Table 86 Syringodio-Thalassietum (Ciferri 1936) Borhidi in Borhidi et al. 1983

	1	2	3	4	5
Cover %:	90	95	90	85	90
Syringodium filiforme Kütz.	2.3	1.3	3.3	3.4	4.4
Thalassia testudinum Banks and Sol. ex König	4.4	5.5	3.4	2.3	2.2
Halodule wrightii Aschers.	—	—	—	+.2	—

Table 87 Limnobietum laevigati Borhidi in Borhidi et al. 1983

	1	2	3	4	5
Cover %:	70	75	70	80	70
Limnobium laevigatum (H. and B.) Mort.	4.4	4.4	3.4	4.5	4.4
Halodule wrightii Aschers.	—	+.1	—	+.1	—
Syringodium filiforme Kütz.	—	—	—	1.2	—
Ruppia maritima L.	—	—	2.2	—	—
Halophila baillonis Aschers. ex Dickie	+.2	1.2	—	—	+.1

6 Class: **IPOMOEO-MALLOTONIETEA** Knapp 1964 emend. Borhidi in Borhidi et al. (1979) 1983

(Syn.: *Ipomoeo-Tournefortietea* Knapp 1964 p.p.)

Herbaceous and shrubby vegetation of the tropical sandy sea shores.

6.1 Order: CANAVALIO-IPOMOEETALIA Knapp 1964 emend. Borhidi in Borhidi et al. (1979) 1983

Open pioneering vegetation of the beaches formed by creeping lianes and stoloniferous grasses.

Characteristic species: *Canavalia, maritima, Ipomoea pes-caprae, I. alba, Cakile maritima, Cenchrus tribuloides, Diodia maritima, Philoxerus vermicularis, Sporobolus virginicus, Paspalum vaginatum, Stemodia maritima,* etc.

6.1.1 Alliance: ***Ipomoeo-Canavalion maritimae*** Samek 1973

With the same characteristics as the order.

Associations studied in Cuba:

Sesuvio-Ipomoeetum pes-caprae Borhidi in Borhidi et al. 1983

It is a pioneer community of the sandy beaches. Originally it is a very common plant community, but heavily damaged and destroyed by man in most of the sandy shore areas. Five representative relevés were made by Borhidi at Alamar and Tarara near Habana, in August, 1696. Type relevé: no. 4 (Table 88).

Ipomoeo-Canavalietum maritimae Samek 1973

Ambrosio hispidae-Ipomoeetum pedis-caprae Bal.-Tul. et Garcia 1987

Ambrosio hispidae-Ipomoeetum stoloniferae Bal.-Tul. et Garcia 1987

Ipomoeo-Paspaletum distachyi Samek 19783

Paspalo-Sesuvietum portulacastri Samek 1973

Table 88 Sesuvio-Ipomoeetum pes-caprae Borhidi in Borhidi et al. 1983

	1	2	3	4	5
Cover %:	60	80	55	50	60
Ipomoea pes-caprae (L.) Sweet	3.3	4.4	3.4	3.3	3.3
Canavalia maritima (Aubl.) Thouars	+.1	1.1	–	+.1	1.1
Cakile lanceolata (Willd.) Schulz	+.1	–	–	+.1	–
Cenchrus brownii Roem. and Schult.	+.1	–	1.1	–	–
Sesuvium portulacastrum L.	2.3	3.3	2.3	1.2	1.2
Sporobolus virginicus ssp. litoralis (Kunth) Borhidi	2.3	1.2	1.1	1.2	1.1
Mallotonia gnaphaloides (L.) Britt.	+.1	–	–	+.1	r.
Ipomoea alba L.	+.1	–	+.1	+.r	+.1
Eclipta prostrata (L.) L.	+.r	–	–	–	+.r
Chamaesyce buxifolia (Lam.) Small	+.r	+.1	–	+.1	–
Rhizophora mangle L.	+.r	–	–	–	–
Laguncularia racemosa (L.) Gaertn. f.	+.r	–	–	–	–
Stachytarpheta jamaicensis (L.) Vahl	+.r	–	+.r	+.1	–
Ipomoea triloba L.	+.r	–	–	–	–
Eragrostis salzmannii Steud.	+.2	–	–	–	–
Diodia sevulata (Beauv.) Tayl.	–	–	+.1	+.1	–
Sterodia maritima L.	–	+.1	–	–	1.1
Philoxerus vermicularis (L.) R. Br.	–	+.1	+.1	–	+.1

Table 89 Borrichio-Mallotonietum Borhidi in Borhidi et al. 1983

	1	2	3	4	5
Cover %:	85	80	90	80	85
Borrichia arborescens (L.) DC.	3.3	1.3	3.3	2.2	1.2
Mallotonia gnaphaloides (L.) Britt.	1.1	2.2	1.3	2.2	2.3
Ernodea littoralis Sw.	1.2	1.1	+.1	—	+.2
Uniola virgata (Poir.) Griseb.	1.3	2.3	1.1	1.2	—
Sporobolus virginicus ssp. *litoralis* (Kunth.) Borhidi	1.1	2.2	2.2	1.2	1.2
Turnera ulmifolia L.	+.1	—	—	+.r	—
Pectis subsessis (A. Rich.) Griseb.	—	+.r	—	—	—
Distichlis spicata (L.) Greene	+.2	1.2	2.3	1.2	3.3
Chamaesyce hyssopifolia (L.) Small	—	+.1	+.1	—	—
Erithalis fruticosa L.	—	—	—	+.1	+.1
Cenchrus browneiRoem. et Schult.	—	—	+.1	+.1	—
Canavalia maritima (Aubl.) Thouars	+.1	—	—	—	+.1
Sternodia maritima L.	—	+.1	—	—	—
Stachytarpheta jamaicensis (L.) Vahl	—	—	+.1	—	—
Chamaesyce brasiliensis (Lam.) Small	—	—	+.1	—	—
Suriana maritima L.	—	—	—	+.1	+ 1

6.2 Order: BORRICHIO-MALLOTONIETALIA Borhidi in Borhidi et al. (1979) 1983

(Syn.: *Tournefortio-Surianion maritimae* Samek 1973)

These are closed littoral sandy meadows and low coastal scrubs on beaches, formed by leaf-succulent shrubs and suffrutescent plants.

Characteristic species: *Borrichia arborescens, B. cubana, Mallotonia gnaphaloides, Distichlis spicata, Ernodea littoralis, Suriana maritima Scaevola plumieri, Erithalis fruticosa, Spartina juncea, Uniola virgata, Casasia clusiifolia,* etc.

6.2.1 Alliance: ***Borrichio-Mallotonion*** Borhidi in Borhidi et al. (1979) 1983

Closed sandy meadows and seaside prairies on the sandy shores.

Associations studied in Cuba:

Borrichio-Mallotonietum Borhidi in Borhidi et al. 1983

This is a closed sandy sward or prairie community formed by stoloniferous grasses and succulent leaved *hemicryptophytes*, suffrutescents and low shrubs. It is a widely distributed community but mostly heavily damaged and destroyed by the use of the beaches for recreational purposes. Five representative relevés were made by Borhidi at Alamar, Tarara and Guanabo east of Habana, in August-October, 1969. Type relevé no. 3 at Alamar. (Table 89).

Other communities:

Tournefortietum gnaphaloidis Samek 1973

6.2.2 Alliance: ***Suriano-Baccharidion halimifoliae***
Borhidi in Borhidi et al. (1979) 1983

Littoral thickets in the transition of the littoral meadows towards the *Coccoloba*-scrub.

Associations observed and studied in Cuba:

Ernodeo-Surianetum maritimae Ciferri 1936 n. nud

Surianetum maritimae Samek 1973

Suriano-Baccharidetum halimifoliae Borhidi in Borhidi et al. 1983

The *Suriana-Baccharis* thicket is rather common in the seaward slopes of the coastal dunes, forming mostly a thin skirt along the edge of the *Coccoloba*-scrub. It develops in greater extension and with a more species-rich variant in the undisturbed flat beaches and on the edge of the coastal lagoons. Five representative relevés made at Punta del Este, Punta Gorda, Carapachibey, all in the south part of Isla de Pinos. Type relevé: no. 3 (Table 90). Carapachibey, December, 1969. A. Borhidi.

Table 90 Suriano-Baccharidetum halimifoliae Borhidi in Borhidi et al. 1983

	1	2	3	4	5
Cover %:	75	85	100	95	85
Suriana maritima L.	3.3	3.3	3.4	4.5	4.5
Baccharis halimifolia L.	2.3	3.3	2.3	1.1	+.1
Borrichia arborescens (L.) DC.	+.1	+.1	1.2	1.2	+.1
Uniola paniculata L.	2.2	1.2	2.3	1.1	+.1
Ernodea litoralis Sw.	—	—	1.2	+.1	2.2
Erithalis fruticosa L.	+.1	—	1.1	—	+.1
Malotonia gnaphaloides (L.) Britt.	—	+.1	1.1	—	+.1
Sporobolus virginicus ssp. *litoralis* (Kunth.) Borhidi	1.2	1.2	—	2.3	+.1
Turnera ulmifolia L.	—	—	+.r	+.1	—
Fimbristylis spathacea Roth	1.2	1.1	—	—	—
Torulinium filiforme Clarke	—	—	—	+.2	—
Distichlis spicata (L.) Greene	—	—	1.2	+.2	+.2
Batis maritima L.	+.2	+.2	—	—	—
Chamaesycelyss apifolia (L.) Small	—	—	+.1	—	+.1
Cassia lineata Sw.	—	—	—	+.2	—
Flaveria trinervia (Spr.) Mohr	+.1	—	—	—	+.2
Eclipta prostrata (L.) L.	—	+.r	—	+.r	—
Ipomoea triloba L.	—	+.r	+.r	—	—
Paspalum fimbriatum HBK.	—	+.2	—	—	—
Dactyloctenium aegyptium (L.) Richt.	—	—	+.1	—	—
Senecio portulacastrum L.	—	—	—	—	+.2
Cynodon dactylon (L.) Pers.	—	—	—	+.2	—

7 Class: **SESUVIO-RACHICALLIETEA**
Borhidi in Borhidi et al. (1979) 1983

Orophilous halophytic vegetation of the supratidal rocky shores, conditioned by the influence of salt spray, the unprotected exposure and the extremely poor soil conditions. In the hard limestone coastal areas it can extend inlandwards to a 100—200 m wide range.

7.1 Order: TRIANTHEMO-SESUVIETALIA
Borhidi in Borhidi et al. (1979) 1983

Pioneer rock vegetation on the coastal cliffs and supratidal rock pavements, formed mostly by creeping, leaf-succulent plants, under a continuous influence of the tidal spray.

Characteristic species: *Sesuvium portulacastrum, S. maritimum, Trianthema portulacastrum, Lithophila muscoides,* etc.

7.1.1 Alliance: ***Trianthemo-Sesuvion***
Borhidi in Borhidi et al. (1979) 1983

Open, species poor coastal rock pavement vegetation, formed mostly by prostrate, leaf-succulent plants.

Association studied in Cuba:

Lithophilo-Trianthemetum portulacastri Borhidi in Borhidi et al. 1983

Open prostrate vegetation formed by *Lithophila muscoides* and *Trianthema portulacastrum* in the outmost strip of the rocky shore zonation. Five representative relevés made by Borhidi at Jibacoa, (October, 1969), at Alamar (August, 1969) and at Punta Colorados (Cienfuegos Province) in September, 1969. Type relevé: no. 2 at Jibacoa (Table 91).

Table 91 Lithophilo-Trianthemetum portulacastri Borhidi in Borhidi et al. 1983

	1	2	3	4	5
Cover %:	25	35	30	40	20
Lithophila muscoides Sw.	1.2	2.3	1.2	2.2	1.2
Trianthemum portulacastrum L.	2.2	2.2	2.3	3.4	2.3
Rhachicallis americana (Jacq.) Hitchc.	+.r		-	+.1	
Conocarpus erecta L.		+.1			.
Sesuvium portulacastrum L.		+.1	+.1	+.r	

Trianthemo-Sesuvietum portulacastri Borhidi in Borhidi et al. 1983

Somewhat closer prostrate vegetation on the landward range of the pioneering zone of the rocky shore zonation (petrohalophytia) formed by *Sesuvium portulacastrum* and *Trianthema portulacastrum* and a few accompanying littoral halophytes. Five relevés were made by Borhidi at the same places as the former association. Type relevé: no. 4 at Jibacoa, (Table 92).

Table 92 Trianthemo-Sesuvietum portulacastri Borhidi in Borhidi et al. 1983

	1	2	3	4	5
Cover %:	45	55	50	60	40
Sesuvium portulacastrum L.	3.3	3.4	3.3	4.4	2.3
Trianthema portulacastrum L.	1.2	1.3	2.2	1.2	2.2
Rhachicallis americana (Jacq.) Hitchc.	–	+.1	+.1	–	–
Conocarpus erecta L.	–	–	–	+.2	–
Heliotropium humifusum HBK.	–	–	–	+.1	–
Chamaesyce buxifolia (Lam.) Small	–	+.r	–	–	–
Lithophila muscoides Sw.	–	–	–	–	+.1
Flaveria linearis Lag.	–	–	+.r	–	–

7.2 Order: BORRICHIO-RACHICALLIETALIA Borhidi in Borhidi et al. (1979) 1983

Moderately closed vegetation of the rocky shores formed mostly by cushion-shaped hemicryptophytes, and dominantly by succulent-leaved dwarf shrubs and shrubs. This plant community group is distributed all over the Caribbean shores.

Characteristic species: *Rachicallis americana, Borrichia arborescens, B. cubana, Conocarpus erecta* f. *caespitosa, Heliotropium humifusum, Chamaesyce buxifolia, Pectis* spp., *Strumpfia maritima, Erithalis vacciniifolia, Flaveria linearis, Opuntia dillenii,* etc.

7.2.1 Alliance: ***Rachicalli-Borrichion*** Samek 1973

With the same characteristics as the order.

Associations observed and studied in Cuba:

Sesuvio-Rachicallietum americanae Borhidi (ined.)

Conocarpo-Rachicallietum americanae Borhidi in Borhidi et al. 1983

This is the plant association of the high, seaside, intensively eroded limestone banks, a humid, saline dog-tooth site. The prostrate form of *Conocarpus erecta* may

Table 93 Conocarpo-Rachicallietum americanae Borhidi in Borhidi et al. 1983

	1	2	3	4	5
Cover %:	45	45	60	70	80
Rachicallis americana (Jacq.) Hitchc.	3.3	2.3	3.4	3.3	1.2
Conocarpus erecta L. f. *caespitosa*	1.2	2.2	1.2	3.4	4.4
Chamaesyce buxifolia (Lam.) Small.	+.2	+.1	+.1	–	–
Chamaesyce adenoptera (Bertol.) Millsp.	+.r	–	+.1	–	–
Pectis leptocephala (Cass.) Urb.	–	+.1	+.1	–	–
Heliotropium humifusum HBK.	1.1	+.1	+.1	+.2	+.r
Cassia lineata Sw.	–	+.1	–	–	–
Melochia tomentosa L.	+.1	–	–	–	–
Flaveria linearis Lag.	–	+.1	1.1	–	–
Tephrosia senna HBK.	+.r	+.1	–	–	–
Coccoloba uvifera L.	+.1	–	–	–	–
Suriana maritima L.	+.1	+.1	–	+.1	–
Opuntia dillenii Ker.-Gawl.	1.1	1.1	–	–	1.1
Turnera ulmifolia L.	+.1	+.1	–	+.1	–
Stachytarpheta jamaicensis (L.) Vahl.	+.r	–	+.r	–	–
Chenopodium ambrosioides L.	+.r	–	–	–	–
Cassia clarensis (Britt.) Howard	+.1	–	–	–	–
Pectis rilandi Howard et Briggs	+.r	–	–	–	–
Morinda royoc L.	+.1	–	1.1	1.2	–
Chamaesyce hirta (L.) Millsp.	–	–	+.r	+.1	–
Canavalia maritima (Aubl.) Thouars	–	–	+.1	+.1	+.1
Solanum bahamense L.	–	+.1	–	–	–
Borrichia arborescens (L.) DC.	–	+.1	+.1	+.2	+.1
Sesuvium portulacastrum L.	+.2	+.1	+.1	1.2	1.2
Mallotonia gnaphaloides (L.) Britt.	+.2	+.1	–	–	–
Catesbaea parviflora Sw.	–	–	–	–	+.1
Castela oxicicola (Britt. and Small) Elan. et Urb.	–	–	+.1	–	1.2
Jacquemontia jamaicensis (Jacq.) Hall f.	–	–	+.2	–	1.2
Ipomoea pes-caprae (L.) Sweet	–	–	–	–	+.2

constitute a continuous closed carpet together with *Rachicallis, Catesbaea, Castela, Opuntia* intertwined by xerophytic lianes as *Morinda royoc, Jacquemontia jamaicensis* and *Ipomoea spp.* Five representative relevés were made by Borhidi at Punta Colorados in September, 1969, at Mal Paso in May, 1970 and at Punta del Holandés (Peninsula of Guanahacabibes) in December, 1974. Type: relevé no. 3. Mal Paso (East of Playa Girón), (Table 93).

Borrichio-Rachicallietum americanae (Uphof 1924) Samek 1973

Erithali-Strumpfietum Borhidi in Borhidi et al. 1983

It is an endemic littoral dwarf shrub community of the southern seaside limestone cliffs in South Oriente and Hispaniola mostly distributed along the coastal belt between Siboney and Maisi. The association is formed by two co-dominant leaf

Table 94 Erithali-Strumpfietum Borhidi in Borhidi et al. 1983

	1	2	3	4	5
Cover %:	60	70	40	50	70
Erithalis vacciniifolia (Griseb.) Wr. in Sauv.	3.4	4.4	3.3	2.3	3.3
Strumpfia maritima Jacq.	2.3	2.3	1.2	3.3	3.4
Conocarpus erecta L. f. *caespitosa*	–	–	+.1	+.1	–
Rhachicallis americana (Jacq.) Hitchc.	–	1.1	–	–	+.1
Sesuvium portulacastrum L.	–	–	+.1	–	–
Trianthema portulacastrum L.	+.1	–	–	–	–
Lithophila muscoides Sw.	+.1				
Caribaea littoralis Alain					–.2
Caesalpinia pauciflora (Griseb.) Wr. in Sauv.	–	–	–	+.2	–

succulent dwarf shrubs the subendemic *Erithalis vacciniifolia* and the West Indian *Strumpfia maritima*. A notable companion is the endemic Cuban littoral cushion-plant: *Caribaea littoralis*. Five relevés were made by Borhidi at Siboney and Macambo (near to San Antonio del Sur) in January and February, 1976. Type: relevé no. 1. E. of Playa Siboney, (Table 94).

8 Class: **BATIDI-SALICORNIETEA** Knapp (1964) in Borhidi hoc loco

Vegetation of the salines formed by leaf-succulent dwarf shrubs and annual or perennial succulents and by grasses of high osmotic tension. This belt of the salt vegetation is developed inlandwards behind the mangrove-zone, in the area flooded only twice a year by the high aequinoctial tides, where the salt tends to concentrate extremely by evaporation, and allows the development of herbaceous flats with *Salicornia* mats and/or low *Batis maritima* scrub.

8.1 Order: BATIDI-SALICORNIETALIA AMBIGUAE Knapp (1964) in Borhidi hoc loco

Tropical vegetation of saline sites formed mostly by succulent plants.

Characteristic species: *Batis maritima, Salicornia ambigua, S. perennis, Suaeda fruticosa, S. linearis, Fimbristylis spathacea,* etc.

8.1.1 Alliance: ***Fimbristyli-Salicornion perennis*** (Chapman 1960)

Open vegetation of saline sites formed by suffrutescent plants.

Table 95 Fimbristyli-Salicornietum perennis Borhidi in Borhidi et al. 1983

	1	2	3	4	5
Cover %:	35	40	40	50	45
Salicornia perennis Mill.	2.3	2.3	3.3	3.3	1.2
Fimbristylis spathacea Roth	2.2	1.2	1.2	2.2	2.3
Distichlis spicata (L.) Greene	—	1.2	—	+.2	—
Heliotropium curassavicum L.	+.1	—	+.1	—	—
Basis maritima L.	—	—	—	+.2	1.2
Suaeda linearis Moq.	+.1	—	—	—	—
Nostoc commune L.	—	—	—	—	+.2

Associations studied in Cuba:

Fimbristyli-Salicornietum perennis Borhidi in Borhidi et al. 1983

This is the community of saline vegetation developed on humid, seasonally flooded shallow sandy seaside sites. Five representative relevés were made by Borhidi at the Guanahacabibes Peninsula and the southern shore of the Pinar del Rio Province at La Coloma in March, 1976. Type relevé: no. 1. at El Veral (Table 95).

Salicornietum bigelowii Samek 1973

Salicornietum perennis Samek 1973

8.1.2 Alliance: ***Batidion maritimae***
Borhidi (1979) hoc loco

(Syn.: *Conocaspo-Batidion* Samek 1973 p. p.)

Closed vegetation of the saline belt, formed mostly by succulent suffrutescent plants.

Association studied in Cuba:

Batidetum maritimae (Ciferri 1936) Samek 1973

8.2 Order: DISTICHLIO-SPARTINETALIA
(Chapman 1974) Borhidi and Del-Risco in Borhidi et al. (1979) 1983

Saline prairie vegetation of the supratidal belt formed by grasses and sedges of high osmotic tension.

Table 96 Salicornio-Distichlietum spicatae Borhidi in Borhidi et al. 1983

Cover %:	85	90
Distichlis spicata	5.5	5.5
Heliotropium curassavicum	+.r	+.1
Portulaca oleracea	+.r	+.1
Fimbristylis annua	+.r	+.1
Conocarpus erecta var. *prostrata*	1.2	
Salicornia perennis	+.r	

Characteristic species: *Distichlis spicata, Spartina juncea, Sporobolus virginicus* ssp. *littoralis, Chloris sagraeana, Eragrostis salzmannii, Philoxerus vermicularis, Heliotropium curassavicum,* etc.

8.2.1 Alliance: ***Distichlion spicatae***
(Chapman 1960) Borhidi and Del-Risco in Borhidi et al. 1979, 1983

With the same characteristics as the order.

Association studied in Cuba:

Salicornio-Distichlietum spicatae (Ciferri 1936)
Borhidi and Del-Risco in Borhidi et al. 1983

It is a species poor, monodominant saline prairie community in the higher flat terrains of the mangrove belt. The type relevé made by Borhidi and Del-Risco in March, 1975 in Las Salinas, Peninsula de Zapata, (Table 96). The *Distichlis*-community described by G. K. Mueller and P. Gutte from Willa (Peru) in 1983 seems to be identical with the Cuban association.

9 Class: **RHIZOPHORO-AVICENNIETEA GERMINANTIS** Knapp (1964) emend. Borhidi and Del-Risco in Borhidi et al. 1979

Neotropical mangrove vegetation.

9.1 Order: RHIZOPHORETALIA Cuatrecasas 1958

Steadily flooded mangrove vegetation with anchoring aerial roots and viviparismus.

9.1.1 Alliance: ***Rhizophorion occidentalis*** Cuatrecasas 1958

Characteristic species: *Rhizophora mangle, Rh. occidentalis.*

Table 97 Dalbergio-Rhizophoretum manglis Borhidi ass. nova

Number of relevés	1.	2.	3.	4.	5.	C_s
Canopy layer, 15–22 m high, cover %:	90	100	90	85	95	
Rhizophora mangle L.	5.5	5.5	5.5	5.5	5.5	V
Laguncularia racemosa L.	+.1	1.1	+.1	–	+.1	IV
Bucida palustris Borhidi	–	+.1	–	+.1	+.1	III
Conocarpus erecta L.	+.1	–	+.1	–	–	II
Tabebuia angustata Britt.		+.1		+.1	–	II
Roystonea regia (HBK.) Cook	–	–	–	+.1	–	I
Sabal parviflora Becc.	–	–	–	–	+.1	I
Shrub layer, 1–3 m high, cover %	1	3	5	5	1	
Dalbergia ecastophyllum (L.) Taub.	+.2	+.2	1.3	1.3	+.2	V
Pavonia spicata Cav.	+.1	+.1	+.1	+.1	+.1	V
Rhabdadenia biflora (Jacq.) Muell. Arg.	+.1		+.1	+.1	–	III
Lianes, cover %	5	5	5	10	5	
Dalbergia ecastophyllum (L.) Taub.	1.2	+.2	+.2	1.3	1.3	V
Rhabdadenia biflora (Jacq.) Muell. Arg.	+.1	1.1	1.1	1.1	+.1	V
Sarcostemma clausum L.	–	–	–	+.1	+.1	II
Cissus trifoliata L.				+.1	–	I
Epiphytes, cover %	–	1	–	1	1	
Hohenbergia penduliflora (A. Rich.) Mez.	–	–	–	+.1	+.1	II
Tillandsia fasciculata Sw.	–	1.+	–	+.2	–	II
T. usneoides L.	–	–	–	+.3	+.3	II
T. valenzuelana A. Rich.	–	+.1	–		+.2	II

Dalbergio–Rhizophoretum manglis Borhidi hoc loco

Mangrove forest community of the estuaries flooded regularly by brackish water during the rainy season and by more or less salty water during the dry season. It forms a rather narrow fringe along the shores of the bigger lowland rivers near to the estuaries. The canopy is 15—22 m high formed mostly by the dominant *Rhizophora mangle* with anchoring aerial roots hanging from 5—8 m height. Scattered individuals of *Laguncularia racemosa* and other trees of the swamp forests are mixed mostly at the landward side of the community belt. A scarce shrub layer and a more densely developed stratum of climbers are characteristic. In both of them *Dalbergia ecastophyllum* is common and the constant presence of *Pavonia spicata* can be also considered as a characteristic feature of the commmunity. Herb layer is completely lacking. Some xerophytic epiphytes are also present. Five relevés were made in the Zapata Peninsula, in the estuary of the Rio Negro, by A. Borhidi, in 23 August, 1984 (Table 97). Type relevé is No. 2.

9.2 Order: AVICENNIETALIA Cuatrecasas 1958

Seasonally flooded mangrove vegetation, or steadily by shallow saltwater, which permits the root-respiration by pneumatophores.

9.2.1 Alliance: ***Avicennion occidentalis*** Cuatrecasas 1958

Characteristic species: *Avicennia germinans, Batis maritima, Rhabdadenia biflora, Lycium tweedianum,* etc.

Association studied in Cuba:

Rhizophoro-Avicennietum germinantis Borhidi and Muñiz in Borhidi et al. 1979

Batidi-Avicennietum germinantis Borhidi and Del-Risco ass. nova

This association is developed on flat rocky shores, where the reef platform is somewhat higher and inundated only by tidal storms. Six representative relevés were made by Borhidi and Del-Risco in Las Salinas, Peninsula de Zapata, in March, 1975 and by Borhidi in February, 1981 (Table 98). Type relevé: no. 1.

Table 98 Batidi-Avicennietum germinantis Borhidi et Del-Risco ass. nova 1983

	1	2	3	4	5	6
Tree layer: 5–8m high cover %:	55	65	75	80	70	70
Avicennia germinans (L.) L.	4.5	4.5	4.5	5.5	4.5	4.4
Laguncularia racemosa (L.) Gaertn. f.	–	–	–	–	–	+.1
Herb layer: 30–50cm high cover %:	35	30	25	20	25	50
Batis maritima L.	3.3	2.3	2.3	2.2	2.3	3.4
Conocarpus erecta L. var. *sericea* (Forst.) Borhidi	+.1	–	–	–	–	+.2
Baccharis halimifolia L.	–	+.1	+.1	+.1	–	–
Ivacheiranthifolia L.		–	–	–	–	+.2
Heliotropium curassavicum L.	+.r	–	–	–	–	–
Distichlis spicata (L.) Greene	–	–	–	–	–	1.3
Fimbristylis spathacea Roth	–	+.1	–	–	–	–
Rhabdadenia biflora (Jacq.) Muell. Arg.	–	–	–	+.1	–	–
Sarcostemma clausum (Jacq.) R. and S.	–	+.r	–	–	+.r	–
Sesuvium portulacastrum L.	+.1	–	–	–	–	+.2
Salicornia perennis Mill.	–	–	+.1	–	–	+.1

Fig. 340 Plant community of the salt swamp forest: *Acrostycho-Conocarpetum erectae*, with large populations of *Batis maritima* near Playa Larga, Zapata Peninsula (Photo: A. Borhidi)

9.3 Order: COMBRETALIA Cuatrecasas 1958

Seasonally flooded mangrove vegetation on extremely saline silt, with or without pneumatophores.

9.3.1 Alliance: ***Conocarpo-Laguncularion***
(Cuatrecasas 1958) Borhidi in Borhidi et al. 1979

Characteristic species: *Conocarpus erecta, Laguncularia racemosa, Acrostichum aureum, A. danaifolium,* etc.

Association studied in Cuba:

Conocarpo-Laguncularietum racemosae Del-Risco ined

Acrosticho-Conocarpetum erectae Borhidi and Del-Risco ass. nova

This community is forming a rather large subzone at the inner edge landward the mangrove belt, mostly in deeper isolated lagoons with highly concentrated stagnant saltwater. (Fig. 340) Three relevés were made by Borhidi and Del-Risco in the Zapata Swamp in March, 1975 and by Borhidi and Muñiz between Santiago de Cuba and Siboney. Type relevé: no. 1. at Zapata (Table 99).

Table 99 Acrosticho-Conocarpetum erectae Borhidi et Del-Risco ass. nova

	1	2	3
Tree layer, 4—5 m high, cover %:	75	80	70
Conocarpus erecta L.	4.5	5.5	4.5
Laguncularia racemosa (L.) Gaertn, f.	—	—	+.1
Herb layer, 1—2 m high, cover %:	80	35	45
Conocarpus erecta L.	1.1	—	+.1
Acrostichum aureum L.	3.3	2.3	2.3
Acrostichum danaifolium Lengsd. and Fisch.	2.2	—	+.1
Cladium jamaicense Cr.	1.2	1.2	1.1
Fimbristylis spadicea (L.) Vahl	+.1	1.2	—
Schoenoplectus americanus (L.) Pall.	+.1	—	—
Eleocharis cellulosa Torr.	—	1.1	1.2
Baccharis halimifolia L.	+.1	—	—
Epiphytes:			
Tillandsia valenzuelena A. Rich.	+.1	+.1	—
Tillandsia flexuosa Sw.	+.1	—	—
Lianes:			
Ipomoea triloba L.	—	—	+.1

10 Class: **CHRYSOBALANO-ANNONETEA GLABRAE** Borhidi and Muñiz in Borhidi 1979 et al. et hoc loco

Evergreen or deciduous swamp forests and shrub vegetation on steadily humid silty or peaty soils. They develop in basins and lowlands of deficient drainage, in the shores of lakes and large rivers, in the subcoastal swamps, estuaries of rivers, all sites flooded during the rain period. This vegetation group is distributed in the West Indies, Florida, in the coastal belt of the Caribbean area from Mexico to South America.

Characteristic species: *Chrysobalanus icaco, Annona glabra, Myrsine cubana, M. guianensis, Bucida buceras, B. spinosa, B. plaustris, B. subinermis, Metopium brownei, Pterocarpus officinalis, Sterculia caribaea, Acoelorraphe wrightii, Copernicia glabrescens, Dryopteris patens, D. serra, Osmunda regalis, O. cinnamomea,* etc.

10.1 Order: CHRYSOBALANO-ANNONETALIA Glabrae Borhidi and Del-Risco in Borhidi et al. 1979 et hoc loco

Swamp woodlands and low swamp forests seasonally flooded by rather deep eutrophic, distrophic, oligotrophic or slightly saline freshwater.

Fig. 341 Community of the permanent swamp forest: *Chrysobalano-Annonetum glabrae* with "high footed" individuals of *Annona glabra* L. in the Zapata Peninsula (Photo: A. Borhidi)

10.1.1 Alliance: ***Chrysobalano-Annonion glabrae***
Borhidi and Muñiz in Borhidi et al. 1979 et hoc loco

Seasonally flooded swamp- and marsh-woodlands with an extreme fluctuation of water supply. Plant communities with one seasonal aspect or two alternant seasonal aspects, an aquatic one in summer and a dry one in winter.

Association studied in Cuba:

Chrysobalano-Annonetum glabrae (Ciferri 1936) Borhidi and Del-Risco ass. nova

This is a swamp woodland association community on shallow peat with limestone underground (Fig. 341) The type relevé was made by Borhidi and Del-Risco in the Zapata Peninsula near El Maiz, in March, 1975 (Table 100).

Osmundo-Chrysobalanetum icaconis Borhidi (ined.)

Copernicio-Bucidetum spinosae Borhidi and Capote ass. nova

It is a seaside rocky limestone swamp-woodland dominated by *Bucida spinosa* with a mosaic of grassland patches. The shallow peaty soil is slightly saline. Type relevé was made by Borhidi and Capote near La Coloma (Pinar del Rio Province) at Playa Las Canas in September, 1975 (Table 101).

10.1.2 Alliance: ***Salicion carolinianae***
Del-Risco in Borhidi et al. 1979

These are low monodominant riparian forest communities along the shores of the eutrophic or slightly dystrophic lakes. Communities rather poor in species.

Characteristic species: *Salix caroliniana, Myrica cerifera, Dalbergia monetaria, D. ecastophyllum,* etc.

Table 100 Chrysobalano-Annonetum glabrae (Ciferri 1936) Borhidi et Del-Risco ass. nova

Canopy layer, 3—5 m high, cover 35%	
Annona glabra L.	3.2
Chrysobalanus icaco L.	1.2
Lianes:	
Sarcostemma clausum L.	+.r
Epiphytes: cover 20%	
Tillandsia valenzuelana A. Rich.	2.2
T. fasciculata Sw.	1.1
T. recurvata L.	1.1
T. bulbosa Hook.	+.1
T. flexuosa Sw.	+.1
T. usneoides L.	+.2
T. balbisiana Schult.	+.r
T. pruinosa Sw.	+.r
Herb layer, up to 1.5 m high, cover 80%	
Elocharis interstincta (Vahl) R. et S.	4.5
Hydrocotyle umbellata L.	2.2
Capraria biflora L.	1.2
Eragrostis hypnoides (Lam.) BSP.	1.2
Heliotropium procumbens Mill.	1.2
H. antillanum Urb.	1.1
Sida rhombifolia L.	1.1
Annona glabra L.	+.1
Bacopa monnieri (L.) Penn.	+.1
Centella erecta (L.f.) Fern.	+.1
Ludwigia palustris L.	+.1
Panicum coerulescens Hack.	+.1
Phyla stoechadifolia (L.) Small	+.1
Polygonum punctatum Ell.	+.1
Aeschynomene villosa Poir. in Lam.	+.r
Rhynchospora cyperoides (Sw.) Mart.	+.r
Solanum torvum Sw.	+.r
Soil layer, up to 20 cm high, cover 80%	
Chara domingensis	4.5

Table 101 Copernicio-Bucidetum spinosae
Borhidi et Capote ass. nova

Tree layer, 3—4 m high, cover: 50—60%	
Copernicia glabrescens Wendl. ex Becc.	3.1
Bucida spinosa (Northrop) Jennings	3.3
Conocarpus erecta L.	1.1
Cameraria retusa Griseb.	+.1
Coccoloba microphylla Griseb.	+.1
Shrub layer, 0.5—1.5 m high, cover: 20%	
Bucida spinosa (Northrop) Jennings	2.2
Copernicia glabrescens Wendl. ex Becc.	1.2
Cameraria retusa Griseb.	1.1
Herb layer, 0.3—1 m high, cover 50—60%	
Distichlis spicata (L.) Greene	3.3
Fimbristylis spathacea Roth	2.2
Andropogon pertusus (L.) Willd.	1.2
Chloris inflata Link	1.2
Manisuris loricata (Trin.) Kuntze	1.1
Sporobolus virginicus (L.) Kunth ssp. *littoralis* (Kunth) Borhidi	1.1
Iresine flavescens H. and B.	+.1
Heliotropium procumbens Urb.	+.1
H. curassavicum L.	+.1
Paspalum fimbriatum HBK.	+.1
Sesuvium portulacastrum L.	+.1
Stenotaphrum secundatum (Walt.) Kuntze	+.1
Lianes: cover 10%	
Echites umbellata Jacq.	1.1
Heteropteris laurifolia (L.) Juss.	1.1
Mesechites rosea (A. DC.) Miers	1.1
Stigmaphyllum diversifolium (Kunth) Juss.	1.2

Association studied in Cuba:

Salicetum carolinianae Del-Risco (ined.)

10.2 Order: TABEBUIO-BUCIDETALIA (Lvov 1967) Borhidi and Del-Risco in Borhidi et al. 1979 et hoc loco

Swamp forest vegetation flooded by freshwater or slightly saline water during the whole year. Soil is mostly rather deep vertisol, frequently gleyzed, somewhere the underground is gravillous or rocky originating from the littoral coral reefs,

sometimes covered by a shallow peaty soil layer. The tree layer is 6—20 m high, with an abundant shrub layer.

Characteristic species: *Tabebuia angustata, Bucida palustris, Bucida subinermis, Fraxinus caroliniana* ssp. *cubensis, Manilkara wrightii, M. jaimiquii, Ilex cassine, Myrsine cubana, Xylopia obtusifolia, Guettarda combsii, Erythroxylon confusum, Sabal parviflora, Smilax laurifolia,* etc.

10.2.1 Alliance: ***Tabebuio-Bucidion***

Borhidi and Del-Risco in Borhidi et al. 1979 et hoc loco

With the same characteristics as the order.

Table 102 Tabebuio angustatae—Bucidetum palustris Borhidi and Del-Risco ass. nova

	1	2	3	4	5
First tree layer, 8—15 m. high, cover %:	60	70	65	25	55
Bucida palustris Borhidi	3.3	4.4	3.4	1.1	3.3
Lysiloma bahamense Benth.	3.3	+.1	—	—	1.1
Swietenia mahagoni (L.) Jacq.	2.1	—	—	+.1	
Tabebuia angustata Britt.	+.1	1.1	+.1	+.1	1.2
Metopium brownei (Jacq.) Urb.	1.1	—	1.1	—	1.1
Myrsine cubana A. DC.	—	—	1.1	1.1	+.1
Calphyllum antillanum Britt.	—	—	+.1	—	+.1
Manilkara jaimiqui (Wr. ex Griseb.) Dub.	—	—	+.1	—	—
Sabal parviflora Becc.	—	—	—	2.2	—
Second tree layer 3—8 m. high, cover %:	40	50	40	45	40
Metopium brownei (Jacq.) Urb.	2.2	—	1.1	—	+.1
Coccoloba diversifolia Jacq.	2.2	+.1	1.2	—	+.2
Acoelorraphe wrightii Wendl.	—	1.1	2.2	3.4	+.2
Bucida palustris Borhidi	1.1	2.2	1.1	+.1	+.1
Lysiloma bahamense Benth.	1.1	+.1	—	—	+.1
Myrsine cubana A. DC.	1.1	—	2.2	1.2	1.2
Tabebuia angustata Britt.	+.1	1.1	+.1	+.1	+.1
Guettarda combsii Urb.	+.1	1.1	1.1	1.2	1.2
Annona glabra L.	+.r	—	1.1	—	+.1
Myrica cerifera L.	—	+.1	1.2	1.1	+.1
Ilex cassine L.	—	1.1	2.2	—	—
Ouratea nitida (Sw.) Engl.	—	2.2	1.2	—	—
Erythroxylum arcolatum L.	+.1	—	+.1	—	+.1
Erythroxylum confusum Britt.	+.1	—	—	+.1	+.1
Sabal parviflora Becc.	—	—	—	+.1	—
Calophyllum antillanum Britt.	+.1	—	+.1	—	+.1

Swietenia mahagoni (1), *Chrysophyllum oliviforme* (1), *Dipholis salicifolia* (1), *Nectandra coriacea* (1), *Cassine xylocarpa* (1), *Ateleia apetala* (1), *Xylopia obtusifolia* (1), *Citharexylum caudatum* (2), *Manilkara jaimiqui* (3), *Conocarpus erecta* (4), *Byrsonima lucida* (5).

Shrub layer 1—3 m high, cover %:	40	30	20	30	25
Metopium brownei (Jacq.) Urb.	2.2	+.r	1.1	+.1	+.1
Guettarda combsii Urb.	+.r	—	+.1	+.1	+.r
Myrsine cubana A. DC.	+.1	+.r	+.2	+.1	+.1
Bucida palustris Borhidi	1.1	1.1	+.r	+.1	+.1
Coccoloba diversifolia Jacq.	2.2	+.1	1.2	1.1	+.1
Ouratea nitida (Sw.) Engl.	+.r	1.1	1.1	—	—
Chrysobalanus icaco L.	1.1	—	2.2	—	2.2
Myrica cerifera L.	+.r	1.1	—	2.2	+.r
Annona glabra L.	1.1	+.1	+.1	+.r	+.1
Caloptranthes pallens (Poir.) Griseb.	+.1	—	+.1	—	+.1
Calophyllum antillanum Britt.	+.1	—	+.r	+.r	+.1
Sabal parviflora Becc.	+.1	1.1	—	—	—
Tabebuia angustata Britt.	+.r	+.1	—	—	+.r
Erythroxylum areolatum L.	—	+.1	—	+.1	—
Acoelorraphe wrightii Wendl.	—	1.1	1.1	—	—
Rauvolfia cubana A. DC.	—	1.1	+.1	+.r	—
Ilex cassine L.	—	2.2	1.2	1.2	—
Erythroxylum confusum Britt.	—	+.1	+.r	+.1	—
Ficus jacquinifolia A. Rich.	—	+.r	+.r	—	—
Manilkara jaimiquii (Wr. ex Griseb.) Dub.	—	—	+.r	+.r	—

Salvia bahamensis +.r (1), *Swietenia mahagoni* +.1 (1), *Ouratea ilicifolia* +.1 (1), *Diospyrus crassinervis* +.1 (1), *Jacquinia stenophylla* 1.1 (1), *Polygala scabridula* +.1 (1), *Dipholis salicifolia* +.r (1), *Ilex nitida* +.r (1), *Psychotria revoluta* +.r (1), *Amyris elemifera* +.r (1), *Bursera simaruba* +.r (1), *Allophylus cominia* +.r (1), *Roystonea regia* +.1 (2), *Hibiscus elatus* +.r (2), *Citharexylum caudatum* +.r (4)

Herb layer 30—200 cm high, cover %:	5	40	60	80	40
Cladium jamaicense Cr.	1.1	2.4	3.4	4.4	2.3
Typha domingensis (Pers.) Kunth.	—	—	+.r	—	—
Blechnum serrulatum A. Rich.	—	2.2	2.2	2.1	1.1
Lasiacis rugelii (Griseb.) Hitchc.	1.1	—	—	+.r	+.1
Pluchea purpurascens (Sw.) DC.	+.r	+.1	+.1	+.1	1.1
Sagittaria lancifolia L.	+.1	+.1	+.r	+.r	+.1
Pavonia spicata Cav.	—	1.1	+.r	—	—
Scleria lacustris Wr.	—	+.1	1.2	—	—
Acrostichum danaifolium Lengsd. et Fisch.	—	+.r	—	+.1	—
Justicia reptans Sw.	—	—	+.r	+.r	—
Psilotum nudum (L.) Griseb.	—	—	+.r	—	+.r
Baccharis halimifolia L.	—	—	+.r	+.r	+.1
Rhynchospora stellata Griseb.	+.r	+.1	1.2	+.2	1.2
Crinum oliganthum Urb.	—	—	+.1	—	+.r
Osmunda regalis L.	—	—	—	1.1	+.1
Dryopteris sclerophylla (Ktze) C. Chr.	—	—	—	+.r	+.1
Panicum coerulescens Hack.	—	—	—	+.r	+.r
Centella erecta (L.f.) Fern.	—	—	—	+.2	+.1
Panicum virgatum var. *cubense* Griseb.	—	+.1	—	+.1	—

Scleria phylloptera +.1 (1), *Malpighia urens* +.1 (1), *Eleocharis interstincta* +.1 (4), *Sisyrinchium recurvatum* +.r (4)

Lianes:

Smilax laurifolia L.	—	1.1	2.1	1.2	—
Smilax havanensis Jacq.	2.2	2.1	+.1	+.1	1.1

Cissus grisebachii Planch.	—	—	—	+.1	+.r
Echites umbellata Jacq.	—	—	—	+.1	+.r
Urechites lutea (L.) Britt.	1.1	—	—	+.r	—
Cassytha filiformis L.	—	—	+.1	2.2	—
Securidaca virgata Sw.	—	+.r	—	+.1	+.1
Chiococca alba (L.) Hitchc.	+.1	+.1	+.1	—	+.2
Passiflora suberosa L.	—	+.r	—	+.r	+.1
Morinda royoc L.	+.r	—	—	+.r	+.1
Selenicereus grandiflorus (L.) Britt. et Rose	+.1	—	+.r	—	+.1
Mesechites rosea (A. DC.) Miers	—	1.1	+.1	—	—
Serjania diversifolia (Jacq.) Radlk.	+.r	+.1	—	—	+.r
Merremia cissoides (Lam.) Hall f.	—	+.1	—	+.1	—
Vanilla phaeantha Rchb. f.	+.1	+.1	1.1	—	+.1
Pisonia aculeata L.	+.1	—	—	—	+.2
Sarcostemma clausum L.	+.1	—	—	—	+.1
Stigmaphyllum diversifolium A. Juss.	+.1	—	—	—	1.2

Vanilla articulata +.r (1), *Mikania hastata* +.r (4), *Mikania ranunculoides* +.1 (2), *Cayaponia racemosa* +.r (4), *Ipomoea tenuissima* +.r (4)

Epiphytes:

Tillandsia valenzuelana A. Rich.	4.4	+.r	—	—	+.2
Tillandsia fasciculata Sw.	2.2	—	+.r	—	1.2
Tillandsia festucoides Brogn. ex Mez	+.1	+.r	+.r	+.r	—
Tillandsia pruinosa Sw.	+.r	—	—	—	+.1
Catopsis floribunda (Brogn.) L. B. Sm.	+.r	—	—	—	+.r
Hohenbergia penduliflora (A. Rich.) Mez	+.r	—	—	+.1	—
Epidendrum cochleatum L.	+.r	—	—	—	+.1
Epidendrum phoenicum Lindl.	+.1	—	+.1	—	—
Cattleyopsis ortgiesiana (Rchb. f.) Cogn.	+.r	—	—	+.r	—
Polystachya luteola (Sw.) Hook.	+.r	—	—	—	+.1
Phlebodium aureum (L.) Gmel.	—	+.r	—	—	+.2

Association studied in Cuba:

Tabebuio angustatae-Bucidetum palustris Borhidi and Del-Risco ass. nova

The dominant swamp forest association of the Zapata Swamp in Cuba, with two tree layers, a well developed shrub layer and a rather poor and scarce herb layer. Lianes are few, epiphytes rather frequent. Five representative relevés were made by Borhidi and Del-Risco in March, 1975, in the Peninsula de Zapata. Type relevé: no. 1. (Table 102).

Rhizophoro-Chrysobalanetum icaconis Del-Risco and Borhidi ass. nova

It is a pioneer shrubforest community in the succession of the swamp vegetation of the Zapata Peninsula, exhibiting round stands in the higher level of the swamp basin covered by sawgrass, cattail and sedge marshes. The individual stands are highest at the center, occupied mostly by a *Sabal parviflora* palm surrounded by a dense shrub population tending to be lower centrifugally. The edge of the stands is formed by a dense populations of ferns, most frequently by *Blechnum serrulatum*.

Table 103 Rhizophoro-Chrysobalanetum icaconis
Del-Risco and Borhidi ass. nova

14 km de Jagüey Grande, Playa Larga

E_3 4–6 m 70%

Rhizophora mangle L.	2.2
Conocarpus erecta L.	3.2
Sabal parviflora Becc.	1.1
Myrica cerifera L.	2.2
Ilex cassine L.	1.1
Tabebuia shaferi Britt.	+.1
Erythroxylum confusum Britt.	+.1
Chrysobalanus icaco L.	1.1
Salix longipes Schuttl.	+.r
Cladium jamaicense Cr.	1.1
Ouratea nitida (Sw.) Engl.	+.r
Smilax laurifolia L.	1.1
Myrsine cubana A. DC.	+.1

E_2 1–3 m 50%

Cladium jamaicense Cr.	3.5
Ilex cassine L.	2.2
Ouratea nitida (Sw.) Engl.	1.1
Conocarpus erecta L.	1.1
Nephrolepis biserrata (Sw.) Schott	+.r
Rhizophora mangle L.	+.1
Chrysobalanus icaco L.	2.3
Blechnum serrulatum A. Rich.	+.r
Annona glabra L.	+.r
Typha domingensis (Pers.) Kunth	+.r

E_1 1 m 5%

Myrica cerifera L.	1.1
Ouratea nitida (Sw.) Engl.	+.1
Ilex cassine L.	1.1
Chrysobalanus icaco L.	+.1
Conocarpus erecta L.	+.1
Dichromena colorata (L.) A. S. Hitchc.	+.r
Sagittaria lancifolia L.	+.r
Sabal parviflora Becc.	+.r

40%

Ludwigia natans Ell.	2.2
Proserpinaca palustris L.	2.2
Centella erecta (L.f.) Fern.	1.1
Bacopa monnieri (L.) Penn.	1.2

Epiphytes: 5%

Tillandsia fasciculata Sw.	+.1
Tillandsia valenzuelana A. Rich.	+.2

Tillandsia fleuxosa Sw.	+.r
Tillandsia pruinosa Sw.	+.r
Lianes:	
Mikania hastata (L.) Willd.	+.r
Cassytha filiformis L.	1.2

Table 104 Conocarpo-Bucidetum palustris Borhidi and Del-Risco ass. nova

	1	2	3
Canopy layer, 3–8 m high, cover %	70	65	80
Bucida palustris Borhidi	2.2	4.4	3.4
Conocarpus erecta L.	4.4	2.3	3.3
Tabebuia angustata Britt.	+.1	+.1	+.1
Salix caroliniana Michx.	+.r	+.1	—
Myrica cerifera L.	2.2	+.1	—
Erythroxylum areolatum L.	+.r	—	+.1
Calophyllum antillanum Britt.	—	—	1.1
Sabal parviflora Becc.	—	+.1	—
Shrub layer, 1–3 m high, cover %	20	35	15
Bucida palustris Borhidi	+.1	1.1	+.r
Conocarpus erecta L.	1.1	1.2	1.1
Chrysobalanus icaco L.	+.r	2.3	1.2
Myrica cerifera L.	2.2	1.1	+.r
Myrsine cubana A. DC.	—	+.1	+.1
Erythroxylum areolatum L.	±.1	+.1	—
Tabebuia angustata Britt.	+.r	—	+.r
Herb layer, 0.5–2 m high, cover %	65	70	55
Cladium jamaicensis Crantz	4.3	4.4	3.3
Acrostichum aureum L.	2.2	1.2	+.2
Blechnum serrulatum A. Rich.	+.r	1.1	1.1
Nephrolepis biserrata (Sw.) Schott	+.r	—	1.2
Agalinis maritima (Rat.) Raf. var. *grandiflora* (Benth.) Shinn.	+.r	+.r	—
Dalbergia ecastophyllum (L.) Taub.	—	+.2	+.r
Baccharis halimifolia L.	—	1.1	+.r
Fimbristylis spathacea Roth	—	+.1	—
Cassia lineata Sw.	—	—	+.1
Ernodea littoralis Sw.	—	+.1	—
Sesuvium maritima L.	—	—	+.r
Proserpinaca palustris L.	+.r	—	—

Type relevé No.1. made by Borhidi and Del-Risco at Guamutal, March 1975. Relevé nos 2. and 3. were made by Borhidi et Hato de Jicarita, Zapata Swamp, April, 1983

The type relevé was made by Borhidi and Del-Risco, near Laguna del Tesoro, Zapata Swamp in March, 1975 (Table 103).

Conocarpo-Bucidetum palustris Borhidi and Del-Risco ass nova

It is a swamp forest association flooded seasonally by freshwater and seasonally by slightly salt water. This community forms a rather wide intermediate subzone between the mangrove and high swamp forest belts. The type relevé (no. 1.) was made by Borhidi and Del-Risco at Guamutal, Zapata Swamp in March, 1975 (Table 104).

Bucido-Fraxinetum cubensis Borhidi and Del-Risco hoc loco

It is a rather rare community of the Zapata Peninsula characterized by the co-dominance of the *Fraxinus caroliniana* ssp. *cubensis* and *Bucida palustris*. It represents a higher stage in the swamp succession than *Tabebuio-Bucidetum* does. The stands of this community tend to be more reduced by exploitation of charcoal woods.

11 Class: **SWIETENIO-BROSIMETEA** Knapp (1964) in Borhidi hoc loco

Lowland and submontane rainforest vegetation (in Cuba till 800 m a.s.l.) with three tree layers or with two tree layers or with two tree layers and emergents, formed by evergreen trees, the emergents sometimes can be deciduous. Lianes, epiphytes and epiphyllous plants are scarce or not very abundant.

11.1 Order: DIPHOLI-CALOPHYLLETALIA Knapp (1964) in Borhidi hoc loco

Submontane rainforest vegetation of the Caribbean area, — in Cuba between 250 and 800 m a.s.l. — conditioned by a continuously humid climate with 0—1 dry month per year and with an annual precipitation over 2000 mm.

11.1.1 Alliance: ***Calophyllo-Dipholion*** Borhidi in Borhidi et al. 1979 et hoc loco

Submontane rainforests of the Greater Antilles. In Cuba they are represented only in the eastern provinces (Oriente), (Fig. 342).

Characteristic species in Cuba: *Dipholis jubilla, D. ekmanii, Calophyllum utile, Carapa guianensis, Ochroma pyramidalis, Terminalia maestrensis, Zizyphus*

Fig. 342 The submontane rainforests of the grope of Yumuri River near Baracoa (Photo: A. Borhidi)

rhodoxylon, Ficus berteroi, F. wrightii, Manilkara albescens, Bactris cubensis, Cordia sulcata, Miconia elata, Heliconia caribaea, Oxandra laurifolia, Dalbergaria cubensis, C. tincta, Hillia spp., *Psychotria guadelupensis, Phaius tankervilliae,* etc.

Association studied in Cuba:

Calophyllo-Carapetum guianensis Borhidi and Muñiz ass. nova

It is zonal submontane rainforest community of the Sagua-Baracoa Massif in north-eastern Oriente, especially well-developed in the valleys of the Rio Toa and Rio Jaguani. For its detailed description see pages 389—391 A synthetic list of five relevés shows its composition (Table 25. Appendix column no. 19). A structure profile of the community is found on p. 390 (Fig. 273).

Oxandro-Dipholietum jubillae Borhidi ass. nova

It is the zonal submontane rainforest association of the Sierra Maestra range, developed mostly on yellow-red mountain soils derived from andesite and granodiorite rocks. Its detailed description can be found on page 405 and for its composition see the column no. 24 of the Table 25 (Appendix) the synthetic list of five relevés made by Borhidi and Muñiz in December, 1969.

11.1.2 Alliance: ***Alchorneo-Pseudolmedion spuriae***
Borhidi in Borhidi et al. 1979 et hoc loco

Seasonal evergreen submontane rainforest of Central and West Cuba, in Yucatan and northern Central America, between 300 and 800 m a.s.l.

Characteristic species in Cuba: *Matayba oppositifolia, M. apetala, Alchornea latifolia, Pseudolmedia spuria, Trophis racemosa, Margaritaria nobilis, Tabebuia shaferi, Antirhea radiata, Terminalia intermedia, Sloanea amygdalina, Dendropanax arboreus, Zanthoxylum martinicense, Z. ekmanii.*

Mataybaeo-Pseudolmedietum spuriae Borhidi and Capote in Capote et al. 1985

This is the zonal seasonal rainforest association of theSierra del Rosario at the submontane level, between 250 and 600 m a.s.l. It contains two tree layers and high emergent trees, which are mostly lacking in consequence of forest exploitation. The most important timber trees of this community, as *Cedrela odorata, Swietenia mahagoni, Manilkara grisebachii, Cynometra cubensis* occur very rarely in the forest stands. The overwhelming dominance of *Matayba* and *Pseudolmedia* indicates as certain human influence, which is more accentuated by the frequent presence of trumpet wood *(Cecropia peltata)* and the royal palm *(Roystonea regia)* in the second-growth stands (see Figs 288—289 and Table 105).

11.1.3 Alliance: ***Calophyllo-Guettardion valenzuelanae***
Capote and Borhidi in Capote et al. 1985

Evergreen tropical forests in West Cuba characterized by a great participation of micro- and sclerophyllous trees and shrubs growing on lixiviated yellowish-red fersiallitic soils derived from limestone but influenced by components of serpentine or other ultrabasic rocks. Characteristic species: *Dipholis neglecta, Zanthoxylum cubense, Calophyllum calaba ssp. pinetorum, Coccoloba retusa, Pachyanthus tetramerus, Trichlia trachyantha, Dendropanax cuneifolius, Calyptranthes caroli, Picramnia reticulata, Myrcia valenzuelana, Acunaeanthus tinifolius, Lagetta wrightiana, Malpighia wrightiana,* etc.

Associaton studied in Cuba:

Calophyllo-Coccolobetum retusae Capote and al. 1985

Table 105 Mataybaeo–Pseudolmedietum spuriae Borhidi and R. Capote ass. nova

	1	2	3	4	5
Emergent Trees 25—30 m high, cover %	25	50	25	35	30
Matayba oppositifolia (A. Rich.) Britt.	2.2	1.1	—	1.2	2.2
Pseudolmedia spuria (Sw.) Griseb.	1.1	3.3	1.1	1.2	1.1
Fagara ekmanii Urb.	—	—	—	—	+.1
Prunus occidentalis Sw.	1.1	1.2	—	—	1.1
Mastichodendron foetidissimum (Jacq.) Cronq.	—	—	1.1	—	+.1
Alchornea latifolia Sw.	—	—	—	2.2	—
Hyeronima havanensis Urb.	—	—	—	+.1	—
Fagara martinicensis Lam.	1.1	—	—	1.1	—
Drypetes alba Poit.	—	—	1.1	—	—
Calophyllum antillanum Britt.	—	—	1.1	—	—
Antirhea radiata (Griseb.) Urb.	—	—	1.1	—	—
Cinnamomum triplinervis (R. et P.) Kosterm.	1.1	—	—	—	—
Sapium jamaicense Sw.	1.1	—	—	—	—
Margaritaria nobilis L.f.	1.1	—	—	—	—
Cedrela mexicana Roem.	+.1	—	—	—	—
High tree layer 15—20 m high, cover %:	90	75	90	60	60
Pseudolmedia spuria (Sw.) Griseb.	5.5	3.3	3.3	3.3	3.3
Mastichodendron foetidissimum (Jacq.) Crong.	1.1	—	—	—	1.1
Tabebuia shaferi Britt.	—	1.1	—	—	—
Trophis racemosa (L.) Urb.	—	2.2	2.3	1.2	+.1
Fagara martinicensis Lam.	—	1.1	—	—	—
Hibiscus elatus Sw.	—	—	2.2	—	1.1
Matayba oppositifolia (A. Rich.) Britt.	—	—	1.1	+.1	1.1
Alchornea latifolia Sw.	—	—	1.1	1.1	—
Ficus subscabrida Warb.	—	—	1.1	—	—
Cinnamomum elongatum (Nees) Kosterm.	—	—	—	1.1	—
Chionanthus domingensis Lam.	1.1	—	—	1.1	—
Wallenia bumelioides (Griseb.) Mez	1.1	—	—	—	—
Sapium jamaicense Sw.	—	—	—	—	+.1
Oxandra lanceolata (Sw.) Baill.	—	—	—	—	+.1
Rauvolfia nitida Jacq.	—	—	—	—	+.1
Calophyllum antillanum Britt.	—	—	—	—	—
Nectandra earlei Britt	—	—	—	—	—
Low tree layer 5—12 m high, cover %:	50	75	60	85	70
Pseudolmedia spuria (Sw.) Griseb.	2.3	3.3	3.3	3.4	3.4
Trophis racemosa (L.) Urb.	2.3	1.2	2.2	1.2	2.3
Oxandra lanceolata (Sw.) Baill.	1.2	2.3	+.1	1.2	2.2
Matayba oppositifolia (A. Rich.) Britt.	+.1	+.1	1.1	+.1	1.2
Dendropanax arboreus (L.) Dec. et Planch.	1.1	+.1	+.1	2.2	1.1
Mastichodendron foetidissimum (Jacq.) Cronq.	1.2	1.2	—	+.1	+.1
Nectandra coriacea (Sw.) Griseb.	—	—	+.1	+.1	+.1
Wallenia laurifolia (Jacq.) Sw.	1.2	+.1	+.1	1.1	+.1
Enallagma latifolia (Mill.) Small	+.1	—	+.1	+.1	+.1
Guarea guidonia (L.) Sleumer	+.1	—	+.1	—	+.1
Exostema ellipticum Griseb.	—	—	—	—	+.1
Alchornea latifolia Sw.	—	+.1	—	—	+.1

Bursera simaruba (L.) Sarg.	–	–	–	–	+.1
Geoffroya inermis W. Wright	–	–	–	–	+.1
Chrysophyllum oliviforme L.	–	–	–	+.1	–
Faramea occidentalis (L.) A. Rich.	–	+.1	+.1	–	–
Prunus occidentalis Sw.	–	–	+.1	–	–
Fagara martinicensis Lam.	–	+.1	+.1	–	–
Syzygium jambos (L.) Alst.	–	+.1	+.1	–	–
Margaritaria nobilis L.f.	–	+.1	–	–	–
Psychotria grandis Sw.	+.1	+.1	–	–	–
Calophyllum antillanum Britt.	+.1	–	–	–	–
Ocotea leucoxylon (Sw.) Mez	–	–	–	+.1	–
Shrub layer 2—4 m high, cover %:	50	40	20	30	25
Oxandra lanceolata (Sw.) Baill.	2.3	2.3	+.1	+.1	2.2
Dendropanax arboreus (L.) Dec. et Planch.	+.1	–	–	+.1	1.1
Matayba oppositifolia (A. Rich.) Britt.	1.2	1.2	+.1	+.1	1.1
Pseudolmedia spuria (Sw.) Griseb.	2.2	1.1	1.2	2.3	1.1
Trophis racemosa (L.) Urb.	1.1	1.1	2.2	1.2	+.1
Wallenia laurifolia (Jacq.) Sw.	1.1	+.1	+.1	–	+.1
Calophyllum antillanum Britt.	+.1	–	–	–	+.1
Pouteria domingensis (Gaertn. f.) Baehni	1.1	–	–	–	–
Mastichodendron foetidissimum (Jacq.) Cronq.	+.1	+.1	+.1	1.1	–
Faramea occidentalis (L.) A. Rich.	+.1	+.1	+.1	1.1	–
Drypetes alba Poir.	+.1	–	+.1	–	–
Chrysophyllum oliviforme L.	+.1	+.1	+.1	+.1	+.1
Picramnia pentandra Sw.	+.1	+.1	+.1	–	–
Tabernaemontana amblyocarpa Urb.	+.1	+.1	+.1	–	–
Licaria triandra (Sw.) Kosterm.	+.1	+.1	–	–	–
Cinnamomum triplinervis (R. et P.) Kosterm.	+.1	–	+.1	–	–
Gonzalagunia sagraeana Urb.	+.1	+.1	+.1	–	+.1
Eugenia farameoides A. Rich.	+.1	+.1	–	–	+.1
Prunus occidentalis Sw.	–	1.1	–	–	+.1
Psychotria horizontalis Sw.	+.1	1.1	+.1	+.1	2.2
Samyda macrantha P. Wils.	–	+.1	–	–	–
Trichilia glabra L.	–	+.1	+.1	+.1	–
Hibiscus elatus Sw.	–	+.1	+.1	+.1	–
Palicourea domingensis (Jacq.) DC.	–	–	–	–	1.2
Psychotria grandis Sw.	–	+.1	–	–	–
Clerodendron grandiflorum (Hook.) Schau.	–	+.1	–	–	–
Pisonia aculeata L.	+.1	+.1	+.1	+.1	+.1
Casearia silvestris Sw.	–	+.1	–	+.1	–
Urera baccifera (L.) Gaud.	–	–	–	+.1	+.1
Nectandra coriacea (Sw.) Griseb.	–	–	–	+.1	+.1
Ocotea leucoxylon (Sw.) Mez	–	–	–	–	+.1
Vernonia havanensis DC.	–	–	–	–	+.1
Psychotria undata Jacq.	–	–	+.1	+.1	+.1
Cordia valenzuelana A. Rich.	+.1	–	–	–	+.1
Simaruba laevis Griseb.	–	–	+.1	–	+.1
Herb layer 20—200 m high, cover %:	50	50	70	35	5
Oplismenus hirtellus (L.) Beauv.	1.1	1.1	1.1	–	1.2
Olyra latifolia L.	1.2	–	1.1	1.2	1.1
Cupania glabra Sw.	+.1	+.1	–	–	+.1
Oxandra lanceolata (Sw.) Baill.	2.2	1.1	–	+.1	+.1

Cinnamomum elongatum (Nees) Kosterm.	—	—	+.1	+.1	+.1
Matayba oppositifolia (A. Rich.) Britt.	+.1	1.1	1.1	+.1	+.1
Faramea occidentalis (L.) A. Rich.	+.1	+.1	+.1	+.1	+.1
Dryopteris normalis C. Chr.	+.1	—	—	+.r	+.1
Vernonia havanensis DC.	—	+.1	—	—	+.r
Cordia valenzuelana A. Rich.	—	—	—	+.1	+.1
Prescottia stachyoides (Aw.) Lindl.	—	—	—	—	+.1
Erythrodes sagraeana (A. Rich.) Leon	—	—	—	—	+.1
Adianthum cristatum L.	—	+.r	+.1	+.1	+.1
Tectaria heracleifolia (Willd.) Underw.	—	—	+.r	—	+.1
Clerodendron grandiflorum (Hook.) Schau.	+.1	—	+.r	—	+.1
Trichilia glabra L.	+.1	+.r	+.1	—	+.1
Prunus occidentalis Sw.	+.r	2.2	1.1	+.1	+.1
Hibiscus elatus Sw.	—	—	1.1	+.1	+.1
Pharus glaber HBK.	+.1	+.1	+.1	1.1	+.1
Schoepfia didyma Wr. ex Griseb.	+.r	+.r	+.1	+.1	—
Polygala stipitata Blake	—	+.r	+.1	+.r	—
Malpighia biflora Poir.	+.r	+.r	+.r	+.r	—
Blechnum occidentale L.	+.r	—	—	+.1	—
Ardisia dentata (A. DC.) Mez	—	+.r	—	+.1	—
Dryopteris patens (Sw.) Ktze	—	+.r	+.1	+.1	—
Tournefortia glabra L.	—	—	—	+.1	—
Psychotria horizontalis Sw.	+.1	2.3	3.4	2.1	1.1
Miconia laevigata (L.) DC.	—	—	—	+.1	—
Trophis racemosa (L.) Urb.	—	1.1	2.1	1.1	—
Psychotria pubescens Sw.	—	—	—	+.1	—
Wallenia laurifolia (Jacq.) Sw.	+.1	—	—	+.1	—
Picramnia pentandra Sw.	+.r	+.r	+.r	+.r	—
Cupania americana L.	—	+.1	+.r	+.r	—
Psychotria grandis Sw.	—	—	—	+.r	—
Mastichodendron foetidissimum (Jacq.) Cronq.	—	+.1	+.1	+.r	—
Dendropanax arborens (L.) Dec. et Planch.	—	—	+.1	+.r	—
Casearia hirsuta Sw.	+.r	—	—	+.r	—
Cordia gerascanthus L.	—	—	—	+.r	—
Fagara martinicensis Lam.	—	+.1	+.1	—	+.1
Pseudolmedia spuria (Sw.) Griseb.	—	+.1	1.1	—	+.1
Wallenia laurifolia (Jacq.) Sw.	—	+.1	+.1	—	—
Piper umbellatum L.	—	—	+.1	—	—
Cinnamomum triplinervis (R. et P.) Kosterm.	+.r	+.1	+.1	+.1	—
Syzygium jambos (L.) Alst.	—	+.1	+.1	+.1	—
Cestrum laurifolium L'Hér.	+.1	—	+.1	—	—
Chrysophyllum oliviforme L.	—	—	+.r	—	—
Alchornea latifolia Sw.	—	+.1	+.r	—	—
Drypetes alba Poir.	—	+.r	—	—	—
Nectandra coriacea (Sw.) Griseb.	+.1	+.r	—	—	—
Cedrela mexicana Roem.	—	+.r	—	—	—
Roystonea regia (HBK.) Cook.	+.r	+.r	+.r	—	—
Cordia nitida Vahl.	+.1	+.1	—	—	—
Licaria triandra (Sw.) Kosterm.	+.r	+.r	—	—	—
Psychotria undata Sw.	1.1	+.r	+.1	—	—
Hyperbaena columbica (Eichl.) Miers	+.1	—	—	—	—
Ixora floribunda (A. Rich.) Griseb.	+.r	—	—	+.r	—
Tabebuia shaferi Britt.	+.r	—	—	—	—
Mappia racemosa Jacq.	—	—	—	+.r	—
Bunchosia nitida (Jacq.) DC.	—	+.r	—	—	—

Lianes:					
Gouania lupuloides Urb.	1.1	1.1	+.r	1.1	+.1
Smilax domingensis Willd.	1.1	2.2	+.1	1.1	1.1
Philodendron krebsii Schott	+.1	—	+.r	+.1	+.1
Polypodium heterophyllum L.	+.1	+.1	—	—	+.1
Davilla rugosa Poir.	1.1	—	—	+.1	2.2
Merremia cissoides (Lam.) Hall f.	—	1.1	+.r	—	+.1
Lygodium cubense HBK.	—	+.r	—	—	—
Lasiacis divaricata (L.) Hitchc.	—	+.r	—	—	—
Forsteronia corymbosa (Jacq.) G. Meyer	—	1.2	—	—	—
Triopteris rigida Sw.	—	+.r	—	—	—
Cissius sicyoides L.	—	—	—	+.1	1.1
Cydista diversifolia (HBK.) Miers	—	—	—	+.1	—
Pristimera coriacea (Nr.) Miers	—	—	—	+.r	—
Heteropteris laurifolia A. Juss.	—	—	—	—	+.1
Chiococca alba L.	—	—	—	+.1	+.1
Vanilla phaeantha Rchb. f.	—	—	—	—	+.1

12 Class: **CEIBETEA OCCIDENTALIS** Knapp (1964) Borhidi hoc loco

Lowland seasonal evergreen forests extending to the lower zone of the middle ranges of the Caribbean area, conditioned by a seasonal tropical climate with 1400—2000 mm annual precipitation and 2—4 dry months. The structure of the forests is characterized by two tree layers with mostly deciduous emergents, by the high frequency and abundance of macro- and mesophyllous climbers and those of xerophytic epiphytes (*Tillandsia* spp.)

Characteristic species in Cuba: *Ceiba pentandra, Guazuma ulmifolia, Luehea speciosa, Calycophyllum candidissimum, Cedrela odorata, C. cubana, Swietenia mahagoni, Hibiscus elatus, Calophyllum antillanum, Cupania glabra, Lonchocarpus domingensis, L. latifolius, Roystonea regia, Dipholis salicifolia, Mastichodendron foetidissimum,* etc.

12.1 Order: LONCHOCARPO-CEIBETALIA Borhidi and Muñiz in Borhidi 1979 et hoc loco

Lowland seasonal evergreen forests in the Antilles, distributed mainly in the alluvial plain of the rivers and in the regularly flooded basins at the edge of the swamps, etc. They have two tree layers with some deciduous elements. Characteristic species as in the class.

12.1.1 Alliance: ***Guazumo-Cupanion*** Borhidi and Del Risco in Borhidi et al. 1979 et hoc loco

Meso-macrophyllous seasonal evergreen forests with few deciduous elements.

Association studied in Cuba:

Guazumo-Ceibetum Borhidi ass. nova

This is probably the dominant zonal lowland evergreen forest community of Cuba and the Greater Antilles, but it is everywhere destroyed and substituted by second-growth deciduous forests, palm-brakes and overwhelmingly by savannas and sugarcane fields. Nearly natural stands were studied by Borhidi near Polondrón, Jagüey Grande, Torriente y Pedro Betancourt, Matanzas Province in May, 1974 (Table 106. type relevé: no. 1). Its structure is characterized by two tree layers and deciduous emergents. Dominant tree and shrub layers are developed, the herb layer is almost completely missing. Lianes are frequent and abundant, epiphytes occur rather rarely. Nearly each isolated remnant stand represents a different species combination resulting from various kinds of natural, seminatural and mostly human interferences.

Table 106 Guazumo-Ceibetum occidentalis Borhidi ass. nova

	1	2	3	4	5	C_5
Emergent trees, 25—30 m high, cover %:	30	20	5	10	5	
Ceiba pentandra L.	1.2	+.1	+.1	+.1	+.1	V
Roystonea regia (HBK.) O. F. Cook	1.1	1.2	+.1	+.1	+.1	V
Spondias mombin L.	2.1	1.1	+.1	1.1	+.1	V
Mastichodendron foetidissimum (Jacq.) Cronq.	+.1	1.2	—	+.1	+.1	V
Lonchocarpus domingensis (Pers.) DC.	2.2	—	+.1	1.1	—	III
Andira inermis (Sw.) HBK.	—	1.1	+.1	—	—	II
Dipholis salicifolia (L.) DC.	—	1.1	—	+.1	—	II
Ficus membranacea C. Wr. in Sauv.	—	1.1	—	+.1	—	II
Canopy layer, 20—25 m high, cover %:	80	85	50	60	50	
Guazuma ulmifolis Lam	3.3	2.3	2.2	3.3	2.3	V
Dipholis salicifolia (L.) DC.	+.1	+.1	1.2	2.2	1.2	V
Mastichodendron foetidissimum (Jacq.) Cronq.	2.1	2.1	2.2	1.2	2.3	V
Spondias mombin L.	1.1	1.2	2.2	1.2	2.2	V
Andira inermis (Sw.) HBK.	+.1	1.1	—	+.1	+.1	IV
Bursera simaruba (L.) Sarg.	—	+.1	+.1	1.1	+.1	IV
Ficus membranacea C. Wr. in Sauv.	+.1	+.1	—	1.2	+.1	IV
Lonchocarpus domingensis (Pers.) DC.	2.2	+.1	2.2	—	+.1	IV
Cedrela mexicana Roem.	—	—	1.1	+.1	+.1	III
Cordia gerascanthus L.	+.1	—	—	+.1	+.1	III
Cupania macrophylla A. Rich.	2.2	+.1	+.1	—	—	III
Drypetes alba Poit.	—	+.1	—	+.1	+.1	III
Guettarda combsii Urb.	—	1.1	+.1	+.1	—	III
Metopium brownei (Jacq.) Urb.	—	—	1.1	+.1	+.1	III
Poeppigia procera Presl	+.1	—	—	1.1	+.1	III
Samanea saman (Jacq.) Merrill	2.1	—	+.1	—	+.1	III
Swietenia mahagoni (L.) Jacq.	—	—	+.1	1.2	+.1	III
Calophyllum antillanum Britt.	—	—	+.1	+.1	—	II

Chlorophora tinctoria (L.) Gaud.	–	+.1	–	–	+.1	II
Cordia collococca L.	1.3	+.2	–	–	–	II
Cupania glabra Sw.	1.2	2.2	–	–	–	II
Guarea guidonia (L.) Sleumer	1.2	+.1	–	–	–	II
Hibiscus elatus Sw.	–	–	1.2	+.1	–	II
Guapira obtusata (Jacq.) Little	–	–	1.1	+.1	–	II
Licaria jamaicensis (Nees) Kosterm.	+.1	1.2	–	–	–	II
Luehea speciosa Willd.	1.2	+.1	–	–	–	II
Spondias purpurea L.	+.1	+.1	–	–	–	II
Trichilia hirta L.	+.1	1.2	–	–	–	II

Beilschmiedia pendula 1.1 (1), *Faramea occidentalis* +.1 (1.1), *Trophis racemosa* +.1 (1), *Genipa americana* +.1 (1), *Casasia calophylla* +.1 (2), *Trichilia havanensis* +.2 (1), *Jambosa vulgaris* (1), *Cupania americana* (1), *Ficus aurea* (2), *Nectandra amillana* (1).

Low canopy layer, 8–12 m high, cover %:	30	25	60	80	60	
Allophylus cominia (L.) Sw.	1.2	+.1	+.1	+.1	+.1	V
Diphalis salicifolia (L.) DC.	+.1	+.1	+.1	+.1	+.1	V
Eugenia axillaris (Jus.) Radlk.	2.2	1.2	+.1	+.1	3.3	V
Guazuma ulmifolia Lam.	+.1	+.1	+.1	1.2	1.2	V
Lonchocarpus domingensis (Pers.) DC.	+.1	+.1	2.3	+.1	1.1	V
Mastichodendron foetidissimum (Jacq.) Cronq.	+.1	+.1	+.1	2.2	2.2	V
Nectandra coriacea (Sw.) Griseb.	1.2	1.2	3.3	1.2	1.1	V
Adelia ricinella L.	+.1	+.1	+.1	–	+.1	IV
Drypetes alba Poit.	+.1	–	+.1	+.1	1.2	IV
Eugenia maleolens Poir.	+.1	+.1	1.2	1.2	–	IV
E. rhombea (Berg) Kr. et Urb.	+.1	2.2	2.2	2.3	–	IV
Ocotea lancolata (Sw.) Baill.	+.2	2.1	–	2.3	1.2	IV
Guapira obtusata (Jacq.) Little	–	–	+.1	+.1	+.1	III
Guettarda combsii Urb.	–	+.1	2.2	2.3	–	III
G. elliptica Sw.	–	–	1.2	2.2	1.1	III
Hibiscus elatus Sw.		–	+.1	+.1	+.1	III
Picramnia pentandra Sw.	+.1	+.1	–	–	+.1	III
Swietenia mahagoni (L.) Jacq.	–	–	+.1	1.1	+.1	III
Bursera simaruba (L.) Sarg.	–	–	–	+.2	+.1	II
Calophyllum antillanum Britt.	–	–	1.1	–	+.1	II
Espadaea amoena A. Rich.	+.1	+.1	–	–	–	II
Guettarda calyptrata A. Rich.	+.1	+.1	–	–	–	II
Hamelia patens Jacq.	+.1				+.1	II
Casearia hirsuta Sw.	+.1	+.1	–	–	–	II
Hypelate trifoliata Sw.	–	–	–	+.1	1.2	II
Schoepfia chrysophylloides (A. Rich.) Planch	–	+.1	–	–	+.1	II

Faramea occidentalis (1), *Trophis racemosa* (1), *Erythroxylum havanense* (1), *Casearia oculeata* (2), *C. spinescens* (1), *Alibertia edulis* (1), *Chrysophyllum oliviforme* (1), *Zanthoxylum fagara* (1), *Samyda macrantha* (2), *Erythroxylum areolatum* (3), *Hebestrigma cubense* (2), *Annona glabra* (3), *Thrinax morrisii* (3), *Margaritaria nobilis* (3), *Zuelania guidonia* (3), *Clusia rosea* (3), *Plumeria emarginata* (3), *Drypetes lateriflora* (4).

Shrub layer 2–5 m high, cover %	30	40	70	20	20	
Eugenia axillaris (Sw.) Willd.	+.1	1.2	2.3	2.2	2.1	V
E. maleolens Poir.	+.1	1.2	2.2	1.1	2.2	V
Nectandra coriacea (Sw.) Griseb.	1.2	1.2	3.3	+.1	+.1	V

Adelia ricinella L.	+.1	+.1	1.1	—	+.1	IV
Allophylus cominia L.	+.1	+.1	1.2	1.2	—	IV
Coccoloba diversifolia Jacq.	+.1	+.1	+.1	1.2	—	IV
Oxandra lanceolata (Sw.) Baill.	1.1	1.2	—	+.1	+.1	IV
Aterumnus lucidus (Sw.) Rothm.	—	—	2.2	+.1	2.2	III
Casearia hirsuta Sw.	+.1	+.1	—	—	+.1	III
Erythroxylum havanense Jacq.	+.1	1.2	—	—	+.1	III
Eugenia rhombea (Sw.) Kr. et Urb.	1.1	+.1	2.2	—	—	III
Guettarda combsii Urb.	—	—	+.1	1.2	+.1	III
G. elliptica Sw.	—	—	+.1	1.2	+.1	III
Hamelia patens Sw.	+.1	—	—	+.1	+.1	III
Picramnia pentandra Sw.	1.1	2.2	—	—	1.2	III
Psychotria horizontalis Sw.	+.1	—	—	+.1	+.1	III
Casearia aculeata Jacq.	+.1	1.2	—	—	—	II
C. spinescens (Sw.) Griseb.	+.1	+.1	—	—	—	II
Malvaviscus arboreus Cav.	—	—	—	+.1	+.1	II
Plumeria emarginata Griseb.	—	—	+.1	+.1	—	II
Swietenia mahagoni (L.) Jacq.	—	—	+.1	—	+.1	II

Alibertia edulis (1), *Rauvolfia ligustrina* (1), *R. tetraphylla* (1), *Ouratea nitida* (1), *Tournefortia hirsutissima* (1), *Psychotria brownei* (1), *P. grandis* (1), *Eugenia galalonensis* (1), *Zanthoxylum fagara* (1), *Guettarda calyptrata* (2), *Trichilia havanensis* (2), *Casearia sylvestris* (2), *Zuelania guidonia* (3), *Bourreria succulenta* (4), *Colubrina ferruginea* (4), *Polygala montana* (4), *Terminalia intermedia* (4).

Lianes:

Chiococca alba (L.) Hitchc.	2.2	1.2	2.2	2.2	2.2	V
Securidaca elliptica Turcz.	1.1	+.1	1.1	+.1	1.2	V
Lasiacis divaricata (L.) Hitchc.	2.2	2.2	1.2	—	+.1	IV
Rourea glabra HBK.	—	+.1	2.2	1.2	+.1	IV
Cydista diversifolia (HBK.) Miers	1.2	2.1	—	—	+.1	III
Serjania diversifolia (Jacq.) Radlk.	—	1.2	—	1.2	+.1	III
Bauhinia divaricata L.	—	—	—	1.2	+.1	II
Echites umbellata Jacq.	—	—	—	+.1	+.1	
Gouania lupuloides (L.) Urb.	2.2	2.1	—	—	—	II
G. polygama (Jacq.) Urb.	—	+.1	+.1	—	—	II
Heteropteris laurifolia (L.) Juss.	1.2	—	—	—	+.1	II
Lasiacis sloanei (Griseb.) Hitchc.	1.1	+.1	—	—	—	II
Morinda royoc L.	+.1	+.1	—	—	—	II
Passiflora suberosa L.	+.1	+.1	—	—	—	II

Serjania atrolineata (1), *S. occidentalis* (5), *Abrus precatorius* (2), *Tournefortia volubilis* (2), *Galactia dubia* (1), *Mucuna pruriens* (1), *Platygyne hexandra* (1), *Tragia volubilis* (1), *Vigna luteola* (1), *Selenicereus grandiflorus* (3), *S. urbanianus* (3), *Smilax havanensis* (1), *Vanilla eggersii* (3), *Rajania cubensis* (4).

Herblayer, 0.5—2 m high, cover %:	30	20	15	10	10	
Lithachne pauciflora Sw.	2.2	1.2	2.2	2.2	2.1	V
Olyra latifolia L.	1.2	1.2	+.1	+.1	+.1	V
Desmodium canum (Gmel.) Sch. et Thell.	—	+.1	+.1	+.1	+.1	IV
Ichnanthus nemorosus (Sw.) Doell.	2.2	+.1	+.1	+.1	—	IV
Oplismenus hirtellus (L.) Beauv.	1.1	2.2	+.1	—	+.1	IV
Imperata contracta (HBK.) Hitchc.	1.1	1.1	—	+.1	—	III
Setaria tenax (L. C. Rich.) Desv.	—	1.2	+.1	+.1	—	III
Heliotropium procumbens Mill.	—	+.1	+.1	—	—	II

Panicum zizanoides HBK.	+.1	–	+.1	–	–	II
Oplismenus setarius (Lam.) R. et S.	+.1	–	+.1	–	–	II
Triumfetta semitriloba Jacq.	–	+.1	–	+.1		II

Leptochloa fascicularis (1), *Lasiacis rhizophora* (1), *Gayoides crispum* (2), *Panicum pilosum* (2), *P. joorii* (3), *P. coerulescens* (4).

Epiphytes:

Polypodium aureum L.	+.1	+.1	–	+.1	+.1	IV
T. valenzuelana A. Rich.	2.2	2.2	1.2		1.2	IV
Hohenbergia penduliflora (A. Rich.) Mez	+.1	–	–	+.1	+.1	III
Polypodium heterophyllum (L.) Watt	+.1	+.1			+.1	III
Tillandsia flexuosa Sw.	+.1	–		+.1	+.1	III
Polypodium phyllitidis L.	+.1	–	–		+.1	II

Hibisco-Calophylletum antillanae Del-Risco

This is a seasonally flooded evergreen forest community occurring on the higher plains, of the swamp basins and in the supralittoral marsh-zone, mostly in the great peninsulas (Guanahacabibes, Zapata, South Isle of Pine) and along the low southern coastal area of the Cuban plain.

Mastichodendro-Dipholietum salicifoliae Borhidi and Muñiz ass nova

It is the limestone evergreen seasonal forest of the Cuban plains and colline areas. It is widely distributed from the Guanahacabibes Peninsula, South Isle of Pine, and in the foothills of the limestone middle ranges of West and Central Cuba. It occurs in many types of forest, with different species combinations due to the different human interferences. In the Appendix Table 25 two variants are listed, each based on 5—5 relevés made by Borhidi and Muñiz in 1969 and 1970. Column 29 gives the synthetic list of a variant from Isla de Pinos, column no. 30. represents a Central Cuban hill-variant of the limestone ranges of Matanzas and Las Villas provinces.

Spondiato-Roystonietum Ciferri 1936

This association described by Ciferri from Hispaniola as a lowland rainforest association is obviously a second-growth forest community on the sites of once existed lowland evergreen seasonal forests, as it can be observed also in similar Cuban examples.

12.1.2 Alliance: ***Hibisco-Swietenion mahagoni***
Del-Risco and Borhidi in Borhidi et al. 1979 et hoc loco

Seasonal evergreen forests of the regularly flooded alluvial and swamp areas, characterized by noto- and microphyllous elements and deciduous trees.

Associations studied in Cuba:

Lysilomo-Metopietum brownei Borhidi and Del-Risco ass. nova

This is an alluvial seasonal evergreen forest association on regularly flooded lowland limestone areas. Column 38 of the Appendix, Table 25 presents a synthetic list of 5 relevés made by Borhidi and Muñiz in 1969—70 in the areas of Isla de Pinos and Zapata Swamp of an association-complex of this alliance.

Calophyllo-Swietenietum mahagoni Del-Risco (ined.)

12.2 Order: OXANDRO-BURSERETALIA Borhidi and Muñiz in Borhidi et al. 1979 et hoc loco

Semi-deciduous forests of the West Indies with two tree layers, the upper one up to 20—25 m high, formed mostly by deciduous trees. To this order belong very common and frequently occurring communities of the lowland and colline zones, conditioned by a seasonal tropical climate with 3—6 dry months and 800—1600 mm annual precipitation. Soils are moderately deep, gravillous brown tropical or red latosolic soils on limestone rock. The second-growth forests resulting after the clear cut of the seasonal evergreen lowland forests belong also to this community group.

Characteristic species in Cuba: *Bursera simaruba, Spondias mombin, Andira inermis, Cordia collococca, C. gerascanthus, Zanthoxylum elephantiasis, Casearia hirsuta, C. spinescens, Jacaranda coerulea, Samanea saman, Pithecellobium cubense, Buchenavia capitata, Hypelate trifolia, Amyris elemifera, A. balsamifera, Trichilia* spp., etc.

12.2.1 Alliance: ***Oxandro-Burserion*** Borhidi and Muñiz in Borhidi et al. 1979 et hoc loco

With the same characteristics as the order.

Associations studied in Cuba:

Mastichodendro-Cupanietum glabrae Borhidi and Muñiz ass. nova

This is the semi-deciduous tropical forest association in the colline zone of the Central Cuban limestone ranges. The high tree level is often reduced to emergents due to deforestation. Type relevé was made by Borhidi and Muñiz in the Cerro Taubaquey, Sierra de Cubitas (prov. Camagüey) in southern exposition; declination 15°, at approximately 150 m. a.s.l.; October, 1977. (Table 107).

Table 107 Mastichodendro–Cupanietum glabrae Borhidi and Muñiz ass. nova

Emergents:	cover 30%:	height: 18—20 m	
Roystonea regia	1.1	*Cedrela mexicana*	+.1
Gastrococos crispa	+.1	*Swietenia mahagoni*	1.2
Coccotrhinax salvatoris	1.1	*Mastichodendron foetidissimum*	2.2
Hypelate trifoliata	1.1	*Spondias mombin*	1.2
Andira inermis	1.2		
Tree layer:	cover 70%:	height: 10—15 m	
Cupania glabra	3.3	*Andira inermis*	1.1
Cupania grandifolia	1.1	*Plumeria emarginata*	+.1
Trichilia hirta	2.3	*Guettarda calyptrata*	+.1
Hypelate trifoliata	1.2	*Guettarda scabra*	+.1
Eugenia confusa	+.1	*Guettarda munizii*	+.1
Eugenia axillaris	1.2	*Exothea paniculata*	2.1
Casearia silvestris	+.1	*Coccoloba retusa*	+.1
Casearia spinescens	1.1	*Bursera simaruba*	2.2
Trichilia havanensis	+.1	*Amyris elemifera*	1.1
Erythroxylum rotundifolium	+.1	*Ateramnus albicans*	1.1
Erythroxylum havanense	1.1	*Ateramnus lucidus*	1.2
Coccothrinax salvatoris	1.2	*Gastrococos crispa*	+.1
Shrub layer:	cover 60%:	height: 2—6 m	
Eugenia confusa	1.1	*Schaefferia frutescens*	2.2
Eugenia maleolens	3.3	*Savia bahamensis*	1.2
Eugenia asperifolia	+.1	*Ateramnus lucidus*	2.2
Casearia spinescens	1.2	*Ateramnus albicans*	1.1
Hypelate trifoliata	+.1	*Diospyrus crassinervis*	+.1
Cupania glabra	1.1	*Callicarpa cubensis*	+.1
Trichilia havanensis	+.1	*Polygala montana*	+.1
Trichilia hirta	1.1	*Comocladia dentata*	1.2
Erythroxylum havanense	1.1	*Picramnia pentandra*	+.2
Erythroxylum rotundifolium	+.1	*Guettarda scabra*	1.1
Roystonea regia	+.1	*Exothea paniculata*	1.1
Coccothrinax salvatoris	1.2	*Amyris elemifera*	+.1
Oxandra lanceolata	1.2		
Psychotria revoluta	+.1	*Hamelia patens*	+.1
Psychotria nervosa	1.1	*Espadaea amoena*	+.1
Herb layer:	cover 1%		
Oplismenus hirtellus	1.1	*Isachne leersioides*	+.1
Lasiacis divaricata	+.2	*Panicum boliviense*	+.1
Dryopteris patens	+.1	*Tectaria heracleifolia*	+.1
Dryopteris megalodus	+.1	*Adiantum cuneatum*	+.1
Adiantum cristatum	+.2	*Adiantum tenerum*	+.1
Lianes:	5—8%		
Smilax havanensis	1.1	*Duranta repens*	1.2
Platygyne hexandra	1.1	*Serjania diversifolia*	2.1
Gouania polygama	2.1	*Hyperbaena domingensis*	+.1

Epiphytes:

Polypodium polypodioides	+.1	*Polypodium aureum*	+.1
Tillandsia canescens	+.1	*Tillandsia fasciculata*	+.2

Mastichodendro-Trichilietum hirtae Schubert et al. 1979

A rather common semi-deciduous tropical forest association at the feet and slopes of limestone hills, mostly on shallow gravillous rendzina soils. The tree layer is lower and the shrub layer is generally more intensively developed. Deciduous and spiny elements are more frequent than in the former community.

13 Class: **TABEBUIO-BURSERETA**
Knapp (1964) Borhidi hoc loco

Semi-deciduous or deciduous tropical forests with one or two tree layers. The upper one is formed by deciduous trees, the lower one is composed of evergreen sclerophyllous and deciduous elements. They are distributed in the lowland and colline limestone areas, mostly on shallow gravillous soils, conditioned by a considerably dry seasonal tropical climate with 5—7 dry months per year, or by a more humid climate but controlled edaphically in the areas of the limestone cliffs of the haystack mountains, or in the dry littoral dog-tooth areas.

Characteristic species in Cuba: *Bursera simaruba, Gossypiospermum praecox, Cordia gerascanthus, Cordia alliodora, Celtis trinervia, Hebestigma cubense, Drypetes mucronata, Lysiloma bahamense, Catalpa punctata, Bombacopsis cubensis, Hildegaardia cubensis, Tabebuia* spp. *Chionanthus bumelioides, Piscidia* spp., *Guettarda elliptica, G. amblyocarpa, Savia sessilifolia, Hypelate trifoliata, Pithecellobium lentiscifolium, Alvaradoa amorphoides* ssp. *psilophylla, Crescentia cujete* (Fig. 343) with cacti in the shrub layer and abundance of xerophytic climbers.

13.1 Order: TABEBUIO-BURSERETALIA
Knapp (1964) Borhidi hoc loco

With the same characteristics as the class.

13.1.1 Alliance: ***Lysilomo-Burserion simarubae***
Borhidi in Borhidi et al. 1979 et hoc loco

Mesophilous deciduous tropical forests with evergreen sclerophyllous elements living near the littoral zones, frequently at the edge of swamp areas, under a seasonal climate with an emphasized dry season.

Fig. 343 The famous "güira", *Crescentia cujete* L. in a deciduous tropical forest of the Zapata Peninsula (Photo: A. Borhidi)

Association studied in Cuba:

Lysilomo-Burseretum simarubae Borhidi and Del-Risco ass. nova

This forest association is rather common in the humid limestone areas and swamps. It was studied in the southern Island of Pine and in the Zapata Swamp by Borhidi and Muñiz (see column no. 37. in the Appendix, Table 25.) and a profile is presented in Fig. 229. made by Borhidi and Del Risco, in the Zapata Swamp, March, 1975.

13.1.2 Alliance: ***Pithecellobion lentiscifolii***
Del-Risco in Borhidi et al. 1979 et hoc loco

Deciduous, microphyllous tropical forests, mostly on dry limestone reefs and dog-tooth areas. (Fig. 344.). They are rather low, the tree layer is up to 15 m high, all layers are poor in species.

Spondiato-Pithecellobietum lentiscifolii Borhidi and Del-Risco ass. nova

This community can be found in the eastern basin of the Zapata swamp, developing on a former quaternary limestone reef. The type relevé was made by

Fig. 344 Semi-deciduous littoral forest on rough limestone dog-tooth formation in the Zapata Peninsula (Photo: A. Borhidi)

Table 108 Spondiato-Pithecellobietum lentiscifolii Borhidi et Del-Risco ass. nova

High tree layer, cover: 35—40%; height: 10—15 m	
Lysiloma bahamense	2.2
Chrysophyllum oliviforme	+.1
Spondias mombin	1.1
Pithecellobium lentiscifolium	1.1
Low tree layer, cover: 60%; height: 3—8 m	
Pithecellobium lentiscifolium	3.3
Eugenia axillaris	1.1
E. maleolens	+.1
Erythroxylum havanense	+.1
Celtis trinervia	+.r
Lysiloma bahamensis	1.1
Clusia rosea	+.r
Spondias mombin	2.2
Antirhea lucida	+.1
Ficus subscabrida	+.r
Shrub layer, cover: 65%; height: 1—3 m	
Erythroxylum havanense	3.3
Zanthoxylum fagara	1.1
Croton lucidus	2.2
Picramnia pentandra	+.r
Simaruba glauca	+.r
Coccothrinax litoralis	+.r
Cordia globosa ssp. *humilis*	+.1
Chrysophyllum oliviforme	+.1
Eugenia maleolens	1.1
Mimosa sp.	+.1
Comocladia dentata	+.r
Guapira pemnsularis	+.r
Herb layer, cover: 5%	
Eugenia ligustrina	+.r
Simaruba glauca	+.r
Eugenia maleolens	+.1
Casearia silvestris	+.r
Mimosa sp.	+.r
Chrysophyllum oliviforme	+.r
Celtis trinervia	+.r
Cordiaglobosa ssp. humilis	+.1
Erythroxylum havanense	+.1
Lantana involucrata	+.1
Croton lucidus	1.1
Picramnia pentandra	+.1
Adelia ricinella	+.r
Zanthoxylum fagara	+.1
Justicia alainii	+.r
Rhynchospora diodon	1.2

Lianes: 20%	
Stigmaphyllum sagraeanum	2.2
ledifolium	+.1
Triopteris rigida	1.1
Gouania lupuloides	+.1
Cryptostegia grandiflora	1.2
Serjania subdentata	1.1
Mimosa sp.	+.1
Tournefortia volubilis	+.r
Pisonia aculeata	+.r
Epiphytes: 1%	
Tillandsia valenzuelana	+.2
recurva	+.r

Borhidi and Del-Risco near Cocodrilo in March, 1975 (Table 108). It is presumably a second growth community which replaced a sclerophyllous littoral forest. (Fig. 345.)

14 Class: **COCCOTHRINACETO-PLUMERIETEA** Knapp (1964) Borhidi hoc loco

Low, partly deciduous shrub forests of the West Indies rich in climbers and in sclerophyllous evergreen elements. They are named commonly as dry forests, "monte seco". They grow mostly on the eroded limestone of the coastal and seaside terraces and on the karstic mountains of Central Cuba and Oriente, conditioned by a seasonal, frequently bixeric climate with 7—9 dry months and 600—1200 mm of annual precipitation.

Knapp (1964) included in this class the serpentine pine forests and the sand pine woodlands as well which obviously do not belong to this group based on either physiognomic or floristic criteria. The Cuban pinelands must be divided into two independent classes: the West Cuban pineland belongs to the *Byrsonimo-Pinetea,* and the East Cuban serpentine pinelands to the *Caseario-Pinetea,* as discussed below.

Characteristic species: *Coccothrinax,* spp., *Plumeria* spp., *Bumelia* spp., *Coccoloba diversifolia, Canella winterana, Omphalea trichotoma, Ateramnus* (Gymnanthes) *lucidus, Gyminda latifolia, Crossopetalum rhacoma, Eugenia maleolens, Amyris balsamifera, A. diatrypa, Tabebuia myrtifolia, Jaquinia brevifolia, J. keyensis, Guajacum officinale, G. sanctum, Erythroxylon* spp., *Capparis* spp., *Malpighia* spp., *Krugiodendron ferreum, Grimmeodendron eglandulosum, Picrodendron macrocarpum, Metopium toxiferum, M. brownei, Guapira* (Torrubia) spp., *Lantana involucrata, Cordia globosa* ssp. *humilis, Bourreria succulenta, Ficus jacquinifolia, Hippomane mancinella, Diospyros grisebachii, Selenicereus grandiflorus, Pilosocereus robinii, Dendrocereus nudiflorus,* etc.

Fig. 345 Dry deciduous limestone forest in the Zapata Peninsula with *Pithecellobium lentiscifolium, Bursera simaruba, Spondias mombin* and with *Dendrocereus nudiflorus,* an endemic tree-shaped cactus (Photo: A. Borhidi)