

AQUATIC VASCULAR PLANTS OF PALO VERDE NATIONAL PARK, COSTA RICA

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RESUMEN

Un estudio de las plantas acuáticas del Parque Nacional Palo Verde, Costa Rica, se llevó a cabo durante la estación lluviosa de 1984. La zona pantanosa es transitoria, reduciéndose durante la estación seca a solamente pequeños charcos. La vegetación acuática consiste en un mosaico de vegetación emergente predominante y parches intermitentes de plantas sumergidas y flotantes en los charcos y lagunas. Eleocharis mutata es la planta emergente más importante. Otras plantas importantes son Typha domingensis, Canna lutea y Thalia geniculata. También son característicos parches grandes de Neptunia plena y Aeschynomene sensitiva. En las lagunetas son importantes Nymphaea ampla, Eichhornia crassipes, Heteranthera limosa y Najas guadalupensis.

ABSTRACT

A study of the aquatic plants of Palo Verde National Park, Costa Rica, was undertaken during the rainy season of 1984. The swamp habitat is transitory, disappearing during the dry season, leaving only a few pools. The aquatic vegetation consists of a mosaic with emergent vegetation predominant and with intermittent pools and lagunas, characterized by submersed and floating-leaved

vegetation. Eleocharis mutata is the most important emergent. Other important plants include Typha domingensis, Canna lutea and Thalia geniculata. Large patches of Neptunia plena and Aeschynomene sensitiva are also characteristic. In the pools Nymphaea ampla, Eichhornia crassipes, Heteranthera limosa and Najas guadalupensis are important.

Relatively little botanical literature focuses on aquatic ecosystems of Costa Rica (Cole, 1963; Hartshorn, 1983). Recently Luis Diego Gómez (1984) published an excellent manual for the identification of aquatic vascular plants of Costa Rica and Central America (monocots). Bumby (1982) correlated the presence of aquatic plants of 19 sites in Costa Rica with physico-chemical parameters. She notes a conspicuous lack of limnological literature for Costa Rica. We are, however, aware of limnological research projects in progress by biologists of Universidad Nacional and we look forward to the publication of their results.

In view of the fact that there is a sparseness of descriptive literature on aquatic habitats in Costa Rica we felt that it would be of value to biologists to provide descriptive data based on our field work during the rainy season of 1984. The subject

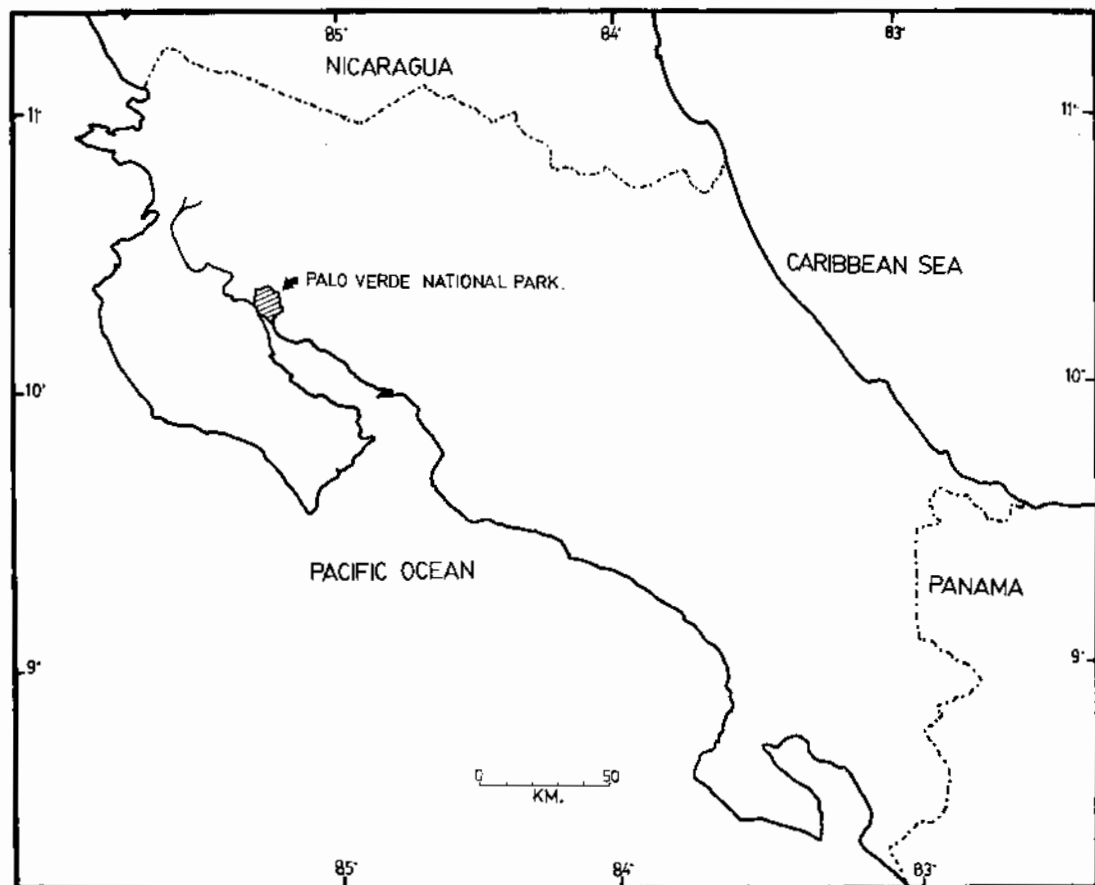


Figure 1

Location of Palo Verde National Park, Costa Rica.

of this paper in the aquatic vegetation of Palo Verde National Park, Guanacaste Province. We recognize that the list of species may be incomplete, especially since the swamp at Palo Verde is very large. However, we feel that we can, at this time, provide a characterization of the aquatic vegetation of this swamp.

Palo Verde National Park (Fig. 1) was established in 1980 to increase the area of outstanding waterfowl habitat already under protection at adjacent Refugio de Fauna Silvestre Dr. Rafael Lucas Rodríguez Caballero (originally established as Palo Verde Refuge in 1978 and renamed in 1979). The Refuge occupies an area of ca. 7.524 hectares (Vaughan et al, 1982), while the National Park adds another 9.467 hectares (Boza and Mendoza, 1981). During the rainy season (mid-May to mid-

November) a very large swamp develops on the flat terrain adjacent to Río Tempisque, as an overflow of the river. During this period aquatic vegetation emerges and soon covers the entire wetland. The terrain is slightly undulating and the resultant vegetation represents a mosaic of aquatic vegetation, with emergent vegetation predominant, along with intermittent pools and lagunas which are characterized more by submersed and floating-leaved vegetation. Toward the end of the rainy season the water level gradually drops and the swamp disappears during the dry season, leaving only a few pools in the deepest spots.



Figure 2

Dense stand of *Eleocharis mutata* and scattered trees of *Parkinsonia aculeata*.



Figure 3

Large stand of *Thalia geniculata* in foreground, edges, and background, and a large patch of *Neptunia plena* in the central portion of photograph.

AQUATIC VEGETATION

Emergents

By far, the most extensive areas of Palo Verde swamp are dominated by emergents. The terrain is marked by scattered pools and lagunas (ca. 1.5 m. deep) and shallower sites (ca. 0.5 m. deep) and broad areas (ca. 1 m. deep). The predominant emergent is *Eleocharis mutata* (Fig. 2), a tall sedge which sometimes forms nearly pure stands. *Typha domingensis* also forms large, conspicuous colonies due to its vigorous, rhizomatous vegetative reproduction. Other large, conspicuous colonial species include *Thalia geniculata* (Fig. 3) and *Canna lutea*.

Rather large patches of the herbaceous legume *Neptunia plena* (Fig. 3) are also characteristic of the emergent zone of the swamp. The vegetation is especially dense due to the development of horizontal floating stems, bouyed by a thick layer of external aerenchymatous tissue.

Another leguminous plant, *Aeschynomone sensitiva* is also abundant, but not as predominant as *Neptunia plena*. Its stems are nearly horizontal beneath the surface, then become erect and emergent. The stems lack aerenchyma but are covered with a thick matting of adventitious roots.

In some areas large, dense floating mats of the sedge *Oxycarium cubense* develop.

Two species of grasses are also important in the emergent zone. Perhaps the most important grass is *Paspalum repens*. Its adaptation of inflated leaf sheaths allows it to form fairly thick stands and plants are often encountered on the edges and extending into the pools and lagunas. *Leersia hexandra*, another important grass, is more likely to be well developed in shallower sites (ca. 0.5 m. deep). *Oryza latifolia*, *Hymenachne amplexicaulis* and *Echinochloa polystachya* are also common, but occur more scattered and seldom forming stands.

Lagunas and pools

The largest laguna observed was Laguna Nicaragua (Fig. 4). The laguna is shallow, ca. 1.5-2 m. deep, and is conspicuous for its lack of emergents. Diversity within the laguna is somewhat limited and is characterized by submersed and floating-leaved forms of aquatic plants. The most abundant submersed aquatic vascular plant is *Najas guadalupensis* (frequently burdened with epiphytic algae) and grows in association with the macrophytic alga, *Nitella* cf. *furcata*. The floating aquatics include *Nymphaea ampla*, *Eichhornia crassipes*, *Eichhornia heterosperma* and *Heteranthera limosa*. During the dry season this laguna dries out completely and is covered by a dense growth of the grass *Hyparrhenia rufa*.

Scattered throughout the area there are similar pools, slightly deeper than the general expanse



Laguna Nicaragua, with *Nymphaea ampla*.

of swamp and nearly devoid of emergents. In addition to the above mentioned species we frequently find the following aquatics associated with these pools: *Najas arguta*, *Bacopa repens*, *Ludwigia inclinata*, and *Pistia stratiotes*.

Interspersed within the emergent zone shallow pools also develop which have a mixture of floating-leaved aquatics such as *Nymphaea prolifera*, *Sagittaria guyanensis*, and *Hydrocleys parviflorus*, submersed *Utricularia foliosa*, and such emergent species as *Echinodorus andrieuxii*, *Limnocharis laforesti*, *Marsilea deflexa* (amphibious), and *Ceratopteris pteridoides*.

Surprisingly, free-floaters such as *Salvinia auriculata*, *Azolla mexicana*, and *Lemna gibba* appear to play a very minor role in the aquatic ecosystem at Palo Verde.

Trees

While herbaceous plants are predominant in the Palo Verde swamp, tree species also occur scattered throughout, chiefly in shallower areas which experience inundation for a shorter period of the year. The most conspicuous woody plant is the Palo Verde tree, *Parkinsonia aculeata*. Occasional individuals of *Crataeva tapia*, *Acacia farnesiana*, *Coccoloba floribunda*, and *Pithecellobium dulce* were also encountered. The small tree/shrub *Mimosa pigra* is most common in marginal sites, especially along a levee built out into a portion of the swamp near the Park's administration buildings.

The spiny palm, *Bactris guinensis*, was conspicuous near the flooded forest margins.

Flooded forests were not sampled in this study. However, Poveda et al (1982) report four additional tree species from flooded forests at the adjacent Refuge: *Acacia collinsii* and *Acacia cornigera* (Mimosaceae); *Acrocomia vinifera* and *Bactris balanoides* (Palmae). Hartshorn and Poveda (1983) also add *Capparis odoratissima* (Capparidaceae) and *Erythrina lanceolata* (Fabaceae) from swamp areas of the Refuge. Thus these tree species might be expected to also occur in wet areas of the Palo Verde National Park.

FLORA

Collections were made in 1984 during the months of September, October, and November and voucher specimens are deposited in the herbaria of Museo Nacional de Costa Rica (CR), University of New Hampshire (NHA), the Missouri Botanical Garden (MO), and the Field Museum of Natural History (F). Collection numbers are those of the authors.

Twelve species reported for Palo Verde National Park in this paper represent new records for Guanacaste Province (cf. Janzen and Liesner, 1980; Gómez, 1984) and three, *Polygonum hispidum*, *Bergia capensis* and *Ceratophyllum muricatum*, are new to Costa Rica (cf. Standley, 1937-38; Burger, 1983; Dr. Donald Les, personal communication).

ANNOTATED CHECKLIST OF AQUATIC VASCULAR PLANTS IN PALO VERDE NATIONAL PARK SWAMP

Pteridophytes

Salviniaceae

Azolla mexicana Schlect. and Cham. A free-floating plant; occasional, at scattered sites, sometimes locally abundant. 5968, 6041.

* *Salvinia auriculata* Aubl. A free-floating plant; occasional, at scattered sites. 6042, 6277.

* New to Guanacaste province. ** New to Costa Rica. *** New to Central America.

Marsileaceae

Marsilea deflexa A. Br. Amphibious plant, leaves floating or emergent, rhizome submersed, trailing among vegetation; occasional, at scattered sites, in shallow water. 6053, 6054.

Pteridaceae

Ceratopteris pteridoides (Hook.) Hieron. A dimorphic fern, rosette, rooted or with petioles inflated and free-floating, abundant asexual propagules (gemmae) produced in lobe sinuses on fronds; frequent, scattered sites. 5955, 5975.

Angiosperms

Monocotyledons

Alismataceae

Echinodorus andrieuxi (Hook. and Arn.) Small an emergent, often large-herb (up to 1 m.); frequent, at scattered sites. 5964, 6000, 6048, 6059.

* *Sagittaria guyanensis* H.B.K. (= *Lophocarpus guyanensis* (H.B.K.) J. G. Smith). An herb with floating leaves; frequent, can be easily mistaken for *Nymphaea*. 5976, 6279.

Araceae

Pistia stratiotes L. A free-floating, rosette plant; common, especially in lagunas. 5959.

Cannaceae

Canna lutea Mill. A tall emergent herb, conspicuous, colonial; at scattered sites, sometimes forming large stands. 5972, 5999.

Commelinaceae

Commelina diffusa Burm. f. A small, trailing herb, among emergent vegetation (easily overlooked); infrequent, scattered individuals. 6067.

Cyperaceae

Cyperus articulatus L. A tall emergent, usually in shallow water; occasional, forming large clumps. 5979.

* *Cyperus digitatus* Roxburgh. A tall emergent, up to 3 m.; locally abundant, at scattered sites. 5973, 6275.

Cyperus flavicomus Michx. (= *C. albomarginatus* (Nees) Steud.; *Pycreus albomarginatus* Nees; see Tucker, 1985). An emergent; occasional. 5995.

Eleocharis elegans (H.B.K.) Romer and Schultes. A coarse, emergent; stems hollow, spikes white when young, becoming brown with age; locally abundant, at scattered sites. 5980.

Eleocharis mutata (L.) Romer and Schultes. A coarse emergent, stem strongly triangular; probably the most abundant plant in the swamp. 5981.

Fimbristylis spadicosa (L.) Vahl. An emergent herb, forming tussocks; very local. 6274.

Oxycarium cubense (Poeppig and Kunth) K. Lye. An erect herb, forming large, dense, floating mats; sometimes predominant, especially adjacent to the levee. 6273.

Lemnaceae

* *Lemna gibba* L. Free-floating; infrequent, at scattered sites, seldom abundant. 6070.

Limnocharitaceae

Hydrocleys parviflorus Seubert. (= *H. standleyi* Steyermark in Gómez, 1984; see Holm-Neilsen and Haynes, 1985). A floating-leaved aquatic; occasional, local. 6280.

Limnocharis laforesti Duchass. Submersed aquatic, inflorescence emergent, flowers yellow; occasional, local. 5991, 6058, 6288.

Marantaceae

Thalia geniculata L. A large, coarse herb, up to 3 m. tall, usually in shallow water; common. 6002.

Najadaceae

Najas arguta H.B.K. A submersed aquatic, much branched, fragmenting readily; in lagunas. 5971, 5998.

Najas guadalupensis (Spreng.) Magnus. A submersed aquatic; abundant in lagunas, often covered with epiphytic algae; especially abundant in Laguna Nicaragua. 5974, 5997, 6064, 6065.

Palmae (Aracaceae)

Bactris guinensis (L.) H. E. Moore. Spiny shrub, up to 3 m. tall, at edge of flooded forest. 6294.

Poaceae (Gramineae)

Echinochloa polystachya (H.B.K.) Hitchc. A tall emergent; frequent, at scattered sites. 5961, 6049.

Hymenachne amplexicaulis (Rudge) Nees. An emergent grass, stem weak below; common, but seldom forming stands. 5962.

Leersia hexandra Sw. An emergent grass; frequent in shallower sites, usually locally abundant, forming well-developed stands. 5960, 6057.

Oryza latifolia Desv. A tall emergent grass; common, but usually not forming stands. 5954.

Paspalidium geminatum (Forssk.) Stapf. An emergent grass. 5994.

Paspalum repens Berg. An emergent grass, lower portion of stem weak, stems usually somewhat floating due to inflated sheaths, upper portion of stem emergent; common, especially on edges of lagunas. 6040.

Paspalum vaginatum Swartz. An emergent grass. 5978.

Pontederiaceae

Eichhornia crassipes (Mart.) Solms. A free-floating, rosette plant, leaves usually with spreading blades and inflated petioles, leaves becoming erect and petioles less inflated in very dense growth; abundant, especially in lagunas. 5958, 5992.

* *Eichhornia heterosperma* Alexander. A floating-stemmed aquatic, leaves somewhat ascending, blades emergent; abundant, especially in lagunas. 5987, 6056.

Heteranthera limosa (Sw.) Willd. An aquatic herb with dimorphic leaves, submersed leaves ribbon-like; abundant, especially in Laguna Nicaragua. 5982, 5983, 5990, 6062.

Typhaceae

* *Typha domingensis* Pers. A tall, coarse, emergent herb, up to 3-4 m. tall; pistillate spike cinnamon-brown; forming large stands. 6044.

Dicotyledons

Amaranthaceae

Achyranthes indica (L.) Mill. An emergent herb; occasional, especially along levee. 5965.

Asteraceae (Compositae)

Eclipta alba (L.) Hassk. An emergent herb; occasional, at scattered sites. 5993.

Cacsalpiniaceae

Parkinsonia aculeata L. A small tree; common, especially in shallower sites. 5951, 5986, 6292.

Capparaceae

Crataeva tapia L. A tree, monoecious, pistillate flowers on long peduncles, exerted beyond clusters of staminate flowers; frequent, scattered individuals. 6290.

Ceratophyllaceae

** *Ceratophyllum muricatum* Cham. A submersed aquatic; local, especially in partial shade along levee. 6276.

Convolvulaceae

Ipomoea carnea Jacq. A woody, emergent shrub, up to 2 m. tall; occasional. 6047.

Ipomoea panamensis complex. A viny herb, twining on emergent vegetation. 6283.

Cucurbitaceae

Cayaponia attenuata (Hook. and Arn.) Cogn. A viny herb, climbing on aquatic emergents at edge of levee. 3043.

Elatinaceae

*** *Bergia capensis* L. An emergent herb, lower stem somewhat inflated and floating (adventitious roots numerous), stem hollow, with pie-like partitions in cross-section; locally abundant. 6068a, 6285.

Euphorbiaceae

Caperonia palustris (L.) St. Hil. A weakly emergent aquatic herb, stems trailing, somewhat infla-

ted toward middle, submerged stems surrounded with well-developed aerenchyma tissue; frequent. 6963.

Fabaceae

Aeschynomene sensitiva Swatz. A weak-stemmed emergent herb, lower stem often floating (matted with adventitious roots); common, locally abundant. 5952, 6050.

Undetermined. Vine scrambling on emergent vegetation. 6284.

Lentibulariaceae

* *Utricularia gibba* L. A submersed aquatic; tangled in vegetation, difficult to see. 5970, 6278.

* *Utricularia foliosa* L. A submersed aquatic, inflorescence emergent; in shallow pools and common at margin of Laguna Nicaragua. 6055, 6281.

Lythraceae

Rotala ramosior (L.) Koehne. An emergent herb; locally abundant. 6068, 6293.

Malvaceae

Kosteletzkia pentasperma (Bert. ex DC.) Griseb. A tall, slender emergent herb; frequent. 6069.

Malachra radiata L. A coarse, emergent herb; frequent. 5966, 6046.

Meliaceae

Trichilia trifolia L. A small tree; occasional. 6289.

Mimosaceae

Acacia farnesiana (L.) Willd. A small tree; occasional. 6061, 6286.

Albizzia guachepele (HBK.) Little. A small shrub; occasional. 6272.

Mimosa pigra L. A low, spreading shrub; especially frequent in shallow water along levee. 5953.

Pithecellobium dulce (Roxb.) Benth. A large tree; seeds partially surrounded by bright red arils, lining of legume red; occasional. 6291.

Neptunia plena (L.) Benth. A floating herb, stems hollow, surrounded by well-developed aerenchyma tissue; very abundant, often forming large patches. 5950, 6270.

Nymphaeaceae

* *Nymphaea ampla* (Salisb.) DC. A floating-leaved aquatic herb; very abundant, best developed in lagunas. Very variable in leaf morphology and flower size. 5957, 5988, 5989, 6001, 6052.

Nymphaea blanda G. F. W. Mey. A floating-leaved aquatic; apparently night-blooming; scattered. 6269.

Nymphaea prolifera Wiersema. A floating-leaved aquatic herb, with leaves reddish beneath, plants bearing submersed, densely woolly tuberiferous "flowers"; frequent. This recently described species is said to rarely, if ever, produce fruits and seeds (Wiersema, 1984). 6287.

Onagraceae

* *Ludwigia inclinata* (L.f.) Gómez. A floating aquatic herb; common, especially in lagunas. 5949, 5985.

Polygonaceae

Polygonum segetum H.B.K. An emergent herb, stem hollow; common, at scattered sites. 5967.

** *Polygonum hispidum* H.B.K. A coarse, emergent herb, stem pith of aerenchyma tissue (white in younger stems, brown in older), herbage very glandular; local, along levee. 5969, 6045.

Coccoloba floribunda (Benth.) Lindau (= *C. venosa* L. in Burger, 1983. Dr. Richard Howard, personal communication, now regards this species as distinct from *C. venosa*; *C. floribunda* is the more common species in Costa Rica, occurring in the northwestern Pacific lowlands). A large tree with wide crown, ca. 10 m. tall, sepals fleshy; occasional. 6060.

Rubiaceae

* *Borreria* sp. An emergent herb, usually entangled in other vegetation; occasional. 6051, 6066, 6282.

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