

STUDY ON THE AQUATIC VEGETATION IN THE SÃO BENTO COUNTY - BAIXADA MARANHENSE (MARANHÃO, BRAZIL).

Ricardo Barbieri¹
Conceição de M. P. Pinto²

RESUMO

Estudo sobre a vegetação aquática no Município de São Bento – Baixada Maranhense (Maranhão, Brasil).

As macrófitas aquáticas formam grandes comunidades na microrregião da Baixada Maranhense, da qual faz parte o município de São Bento. Elas foram estudadas, de setembro de 1989 a agosto de 1990, nos campos próximos a São Bento quanto à taxonomia, ao seu desenvolvimento sazonal (ciclo de vida) e aos tipos de associação vegetal. Foram identificadas 19 espécies de macrófitas aquáticas e 2 espécies higrófilas, a leste e a oeste da cidade de São Bento. As três famílias mais comuns foram Pontederiaceae, Cyperaceae e Salviniaceae. Três espécies de Poaceae foram bastante frequentes nas áreas estudadas. As associações mais marcantes foram de *Pontederia cordata*-*Eichhornia crassipes* a oeste, e de *Cyperus giganteus*-*Sagittaria lancifolia* e *Thalia* sp.-*S. lancifolia* a leste de São Bento. O crescimento vegetal se inicia em dezembro/janeiro, com o começo do período de inundação, e a morte das plantas ocorre em outubro com a estiagem nos campos (período seco). O ciclo de vida das macrófitas aquáticas na Baixada Maranhense é controlado pelo ciclo hidrológico local.

Palavras-chave: planície de inundação, macrófitas aquáticas, ciclo de vida, associações.

ABSTRACT

Aquatic macrophytes form great communities in the microregion of Baixada Maranhense, where is located the São Bento County. They were studied, from september 1989 to august 1990, in the floodplains near São Bento as its taxonomy, seasonal development (life cycle) and types of plant association. Nineteen species of aquatic macrophytes and two species of marginal habitats were identified in the eastern and the western sides of São Bento. The three most common families were Pontederiaceae, Cyperaceae and Salviniaceae. Three species of Poaceae were frequent in the studied areas. The associations markedly observed were *Pontederia cordata*-*Eichhornia crassipes* at the western side, and *Cyperus giganteus*-*Sagittaria lancifolia* and *Thalia* sp.-*S. lancifolia* at the eastern side of São Bento. Plant growth initiates in december/january, in the beginning of the flooding (wet period), and the plant death occurs in october with the field's drought (dry period). Aquatic macrophytes life cycle in Baixada Maranhense is controlled by local hydrological cycle.

Keywords: floodplain, aquatic macrophytes, life cycle, associations.

¹ Universidade Federal do Maranhão, Depto. de Oceanografia e Limnologia, Av. dos Portugueses s/n, Campus do Bacanga, 64080-040 – São Luis, MA, Brasil - E-mail: rbarbieri@elo.com.br

INTRODUCTION

Vascular aquatic macrophytes integrate a community that inhabits several types of environment like lakes, rivers, wetlands, lagoons, reservoirs and floodplains (Esteves, 1998).

There are few taxonomic and life cycle studies about aquatic macrophytes in Brazil. Rietzler et al. (1998), studying the diversity of the flora in tropical and subtropical freshwaters, have registered around nineteen taxa of aquatic macrophytes in seventeen sand dune lagoons in Lençóis Maranhenses National Park (MA, Brazil), with predominance of the families Poaceae, Cyperaceae and Lentibulariaceae.

Depending on the ecosystem trophic level and the plant abundance, aquatic macrophytes may play an important role in the metabolism of ecosystem or nutrient cycling (Wetzel, 1975; Esteves, 1979; Camargo et al., 1983; Barbieri, 1984; Nogueira, 1989). Aquatic macrophytes are abundant in the floodplains of the microregion named Baixada Maranhense (Maranhão, Brazil), and they do have ecological and economic importance.

The São Bento County is included in the "Baixada Maranhense" region actually known as an EPA (Environmental Protection Area) of Maranhão State. All lands around the city are part of the Aurá River floodplain or they are low wetlands with marine influence forming "sui generis" marshes rich in aquatic plants and animals.

The aquatic macrophyte species, main plant species seasonal behavior (life cycle), community distribution as well the species that show some relation with *Biomphalaria*

spp snails were studied in São Bento County.

MATERIAL AND METHODS

Characterization of the Area

The São Bento County, 2°41' S and 45°50' W, belongs to the "Baixada Maranhense" microregion - Maranhão State, Brazil (figure 1). It is surrounded by a great impoundment of fresh water where population develops domestic, professional and sportive activities. These lands are part of the Aurá River floodplain.

This floodplain has absolute absence of tall trees and herbaceous vegetation predominates with irregularity and Poaceae has been noted as the main plant family in this microregion.

Soils are originated from fine sediments transported by the rivers; they are clayish and fertile, which use for agriculture is limited by floods and some salinity in the northeastern part of the floodplain, where the Aurá River suffers some influence of tides from the Baía de São Marcos.

Climate in the region is type Aw, hot and wet according Koeppen classification. Medium temperature is 26,4 °C (23-32 °C) and precipitation 1,774 mm (1,500-2,200 mm) irregular originating a dry period from june to november and a rainy period from december to may (figure 2).

Physical and Biological Data

Data were collected from september 1989 to august 1990 in six points selected for the study. Superficial water temperature and pH were measured respectively with a

pocket Revi Goaf apparatus and a D.IGIMED potentiometer, in the eastern side of São Bento at the points **b** (figure 1).

Aquatic macrophytes were identified by using taxonomic keys (Cook et al., 1974; Fassett, 1975; Hoehne, 1948). Plant associations were evaluated by making appropriate transections from 20 to 30 m long (Alegre Village and eastern side) in november 1989 and parcels of 1 m² (points **a**) and 25 m² (points **b**) in area were made once a month, according to the species association. Counting of the individual, flower and fruit numbers was made monthly for each species.

The phases of the aquatic macrophyte life cycle were observed every month (seasonality of the vegetation): juvenile, unfertile and fertile adult, fruiting and senescent plant developing stages.

The mapping of the aquatic macrophyte associations was made by using data of transections and parcels, comparing with areas of distinct contrast observed and delimited in ortophotocharts of the ITERMA (Maranhão Land Institute), in a 1:10,000 scale.

RESULTS

Air temperature varied from 29 to 32 °C and water temperature from 28 to 30 °C during the period of study. Water temperatures were stable and varied a little in surface with occurrence of rains (rainy period). The lowest value of pH was 4,5, measured in little portions of water in the dry period and the highest value was 7,1 in the rainy period at the East side of São Bento (figure 3).

Fifteen genera and nineteen species of aquatic macrophytes, and two are herblike resistant to flooding (*Ipomoea fistulosa* and *Marsilea* sp) were identified in all sites visited, pertaining to fourteen families (table 1). Three Poaceae species are common in the region. Some species are especially abundant in the study area: Pontederiaceae (*Eichhornia crassipes*, *Pontederia cordata*), Cyperaceae (*Cyperus giganteus*, *Eleocharis mutata*) and Salviniaceae (*Salvinia* sp).

Salvinia sp and *Neptunia oleracea* are the species more frequent in Alegre Village. However, *E. crassipes* and *P. cordata* form the most dense community.

Hydrological cycle controlled vegetational cycle as it is presented in figure 4. Aquatic plant growth iniciates in december-january with the beginning of inundation and vegetation reaches maximum growth and fructification in june, final of the rainy period. Its death or disappearance comes with the field drought in october (figure 5). *P. cordata*, *Salvinia* sp, *E. crassipes* and *N. oleracea* are species resistant to drought by while exists some humidity on the sediment mainly because they occur in plant associations, maintaining favorable conditions for the existance and growth of new plant structures in the dry period.

Figure 6 shows the distribution of aquatic macrophytes at Alegre Village. *P. cordata* and *E. crassipes* make the main associations in this place and occupy almost all the area there. The margins of the area are colonized by *I. fistulosa*, and the elevated parts by *Orbygnia martiana* ("babaçu"). Differently, at the East side of São Bento there are two types of plant

association: *Cyperus* sp-*E. mutata*, at the left margin of Aurá River, and *C. giganteus*-*Sagittaria lancifolia*-*Thalia* sp, at the right margin. Mangrove vegetation appears 1 km far from this side of São Bento (figure 7).

DISCUSSION

The low values of pH are caused mainly by decomposition of large amounts of organic matter originated from aquatic macrophytes, during the dry period, as it was pointed out also by Esteves & Nogueira (1995) and Esteves (1998) for subtropical lakes.

The number of aquatic macrophyte species observed in the São Bento County is smaller than the right number. Probably there is more than thirty species of plants in the area studied. The distinction of communities from one place to another is notable, with respect to dominant or more frequent species. Reis & Barbosa (1993), studying the composition of aquatic macrophytes in Lagoa dos Mares (MG), pointed out that *Salvinia herzogii* was the more frequent species in the macrophyte community.

However it is necessary additional studies on the distribution of the aquatic vegetation in Baixada Maranhense and on the factors determining it, ones observed the influence of tides in the field at the East side of São Bento, which species have some tolerance to brackish water, while at the West side wind and slightly acid water seem to be the factors that affect the distribution of vegetation. Barbieri (unpublished data) verified a water salinity of 0.12 to 1.45 and

a soil salinity of 10.7 at the northeastern part of the floodplain.

Aquatic vegetation obviously depended of water level variation in the environment to perform its life cycle normally and to produce biomass. Certainly, macrophytes adapt their growth to the water level and make their vegetative or sexual reproduction in the rainy period. In dry period Baixada Maranhense floodplains become arid fields, aquatic plants die and the environment changes to grasslands in some places. Species such as *E. crassipes*, *Nymphoides indica* and *N. oleracea* present a change in their vegetative habit in dry period. By means they lose aquatic structures, stay in stress and form horizontal stems with small leaves, sometimes originated directly from rhizomes. *P. cordata* loses its aquatic leaves and stays in a state of dormancy, only maintaining the rhizome under the soil till the next rainy period when it forms new structures.

In Infernã Lake, an oxbow lake in Mogi-Guaçu River floodplain (SP), Nogueira (1989) observed variation of biomass of *E. azurea* associated with water level variation in the river floodplain. Da Silva & Esteves (1993) also registered the same association for various species of macrophytes in the Pantanal of the Mato Grosso (MT).

Although many Brazilian aquatic ecosystems have similar water level variation, as a consequence of pluviometric regimes characterized by alternation of a rainy and a dry period, the patterns of seasonal variation in biomass and life cycle of aquatic macrophytes are distinct for each region.

Snails of *Biomphalaria* spp, responsible for transmission of Schistosomose Manson, were observed on plants of *P. cordata*, *Nymphaea* sp and *N. indica*. Ecological relations between snails and aquatic plants are not well defined but observations made in the field let us to think about a feed dependency, unless indirectly, because they may use the leaf epiderm or microalgae and other organisms attached to plants (periphyton). The protection and egg nestling is made by using leaves of aquatic plants. Pointier et al. (1988) verified an intimate relation between *B. glabrata* and aquatic macrophytes as *Nymphaea* sp and *Pistia stratiotes*, mainly feed dependency in bogs and lakes in French Antilles. During the period of study it were not observed populations of *Biomphalaria* but in dry period eggs and juveniles snails were found under dead leaves of *P. cordata*. The snail *Ampullaria* sp was observed in great number at Alegre Village, what permits suppose a competition for space in the places visited.

REFERENCES

- BARBIERI, R. 1984. *Estudo da composição química de algumas espécies de macrófitas aquáticas e suas implicações no metabolismo da represa do Lobo (Broa), SP*. Dissertação de mestrado. PPG-ERN, UFSCar, São Carlos. 225 p.
- CAMARGO, A.F.M., ISHII, I.H. & ESTEVES, F.A. 1983. Liberação de compostos orgânicos e inorgânicos para a coluna d'água durante o processo de decomposição de duas espécies de macrófitas aquáticas tropicais. *An. Sem. Reg. Ecol.*, III: 87-99. São Carlos, SP.
- COOK, C.K., GUT, B.J., RIX, E.M., ECHNELLER, J. & SCITZ, M. 1974. *Water plants of the world: a manual for the identification of the genera of freshwater macrophytes*. The Hague: Dr. W. Junk B.V. Publishers. 561 p.
- DA SILVA, C.J. & ESTEVES, F. A. 1993. Biomass of three macrophytes in the Pantanal of the Mato Grosso, Brazil. *Intern. J. Ecol. Environ. Scien.* 19: 11-23.
- ESTEVES, F.A. 1979. Die Bedeutung der aquatischen Makrophyten für den Stoffhaushalt des Schöhsees. I. Die Produktion an Biomasse. *Arch. Hydrobiol. (Suppl.)*, 57: 117-143.
- ESTEVES, F.A. 1998. *Fundamentos de Limnologia*. Rio de Janeiro: Interciência-FINEP. 602 p.
- ESTEVES, F.A. & NOGUEIRA, F. 1995. The influence of floating meadows and hydrological cycle on the main abiotic characteristics of a tropical oxbow lake. *Oecologia Brasiliensis*. 1: 117-128.
- FASSETT, N. 1975. *A manual of aquatic plants*. The University of Wisconsin Press, Ltd. 405 p.
- HOEHNE, F.C. 1948 (reimpresso em 1979). *Plantas aquáticas*. Publicação da série "D" Instituto de Botânica. Secretaria de Agricultura, São Paulo. 168 p.
- NOGUEIRA, F.M.B. 1989. *Importância das macrófitas aquáticas Eichhornia azurea Kunth e Scirpus cubensis Poepp & Kunth na ciclagem de nutrientes e nas principais características limnológicas da lagoa do Infernã (SP)*. Dissertação de mestrado. PPG-ERN, UFSCar, São Carlos. 147 p.

- POINTIER, J.P., THÉRON, A. & MBERT-ESTABLET, D. 1988. Decline of aylvatic focus of *Schistosoma mansoni* in Guadeloupe (French West Indies) following the competitive displacement of the snail host *Biomphalaria glabrata* by *Ampullaria glauca*. *Oecologia*, 75: 38-43.
- REIS, S.P.W. & BARBOSA, F.A.R. 1993. Estudo da composição de macrófitas aquáticas da lagoa dos Mares, município de Lagoa Santa, com ênfase em aspectos ecológicos de *Salvinia herzogii* (Aubl.). *Acta Limnol. Brasil*. 6: 196-208.
- RIETZLER, A.C., POMPEO, M.L.M., ROCHA, O., ESPÍNDOLA, E.L.G., MOSCHINI-CARLOS, V. & BARBIERI, R. 1998. A comparative study on the diversity of the flora in tropical and subtropical freshwaters, II: The macrophyte community. *An. Acad. Bras. Ci.* 70(4): 785-791.
- WETZEL, R.G. 1975. *Limnology*. Philadelphia: W.B. Saunders Company. 743 p.

Table 1. Aquatic macrophyte species and other herbaceous (*) with tolerance to flooding, and species habitat, in the São Bento County (MA).

Family	Species	Habitat
Alismataceae	<i>Sagittaria</i> cf. <i>guyanensis</i>	floating leaf/rooted
	<i>Sagittaria lancifolia</i>	emerge/rooted
Araceae	<i>Pistia stratiotes</i>	free/floating
Convolvulaceae (*)	<i>Ipomoea fistulosa</i>	emerge/rooted
Cyperaceae	<i>Cyperus giganteus</i>	emerge/rooted
	<i>Cyperus</i> sp	emerge/rooted
	<i>Eleocharis</i> cf. <i>mutata</i>	emerge/rooted
Leguminosae-Faboideae	<i>Neptunia oleracea</i>	free/floating
Lemnaceae	<i>Lemna</i> sp	free/floating
Lentibulariaceae	<i>Utricularia</i> sp	free/floating/submersed
Marantaceae	<i>Thalia</i> sp	emerge/rooted
Marsiliaceae (*)	<i>Marsilea</i> sp	emerge/rooted
Menyanthaceae	<i>Nymphoides indica</i>	floating leaf/rooted
Nymphaeaceae	<i>Nymphaea</i> sp	floating leaf/rooted
Poaceae	3 sps comuns	emerge/rooted
Pontederiaceae	<i>Eichhornia crassipes</i>	free/floating
	<i>Eichhornia azurea</i>	emerge/rooted
	<i>Pontederia cordata</i>	emerge/rooted
Salviniaceae	<i>Salvinia</i> sp	free/floating

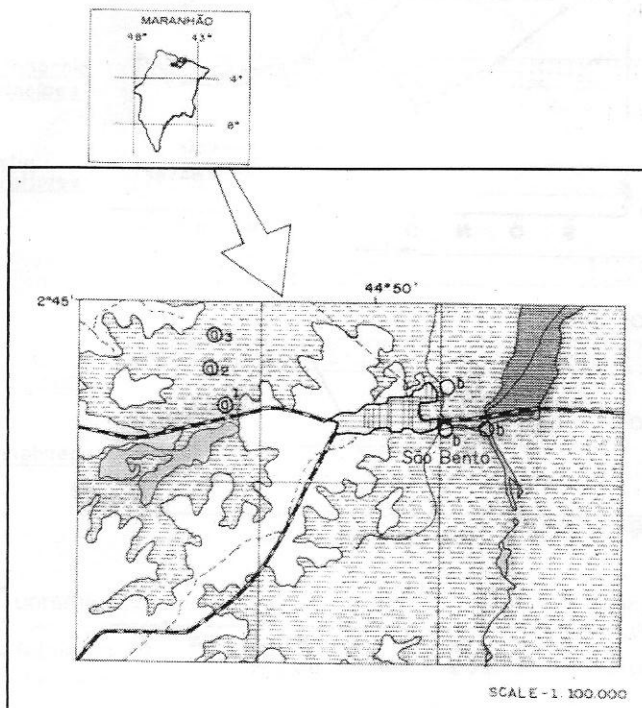


Figure 1. Localization of São Bento town (MA) and points of data collection (a1-Alegre Village, a2-João Donato Is., a3-Cauaçu and points b-eastern side). Dashed area corresponds to floodplains.

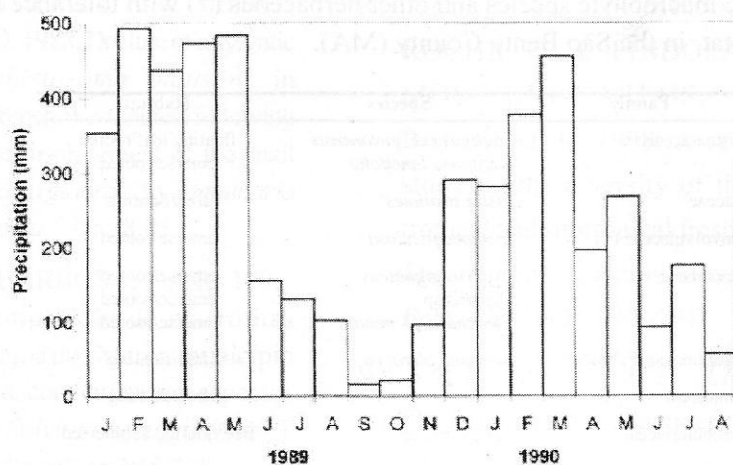


Figure 2. Change in precipitation at São Bento town, in 1989 and 1990.

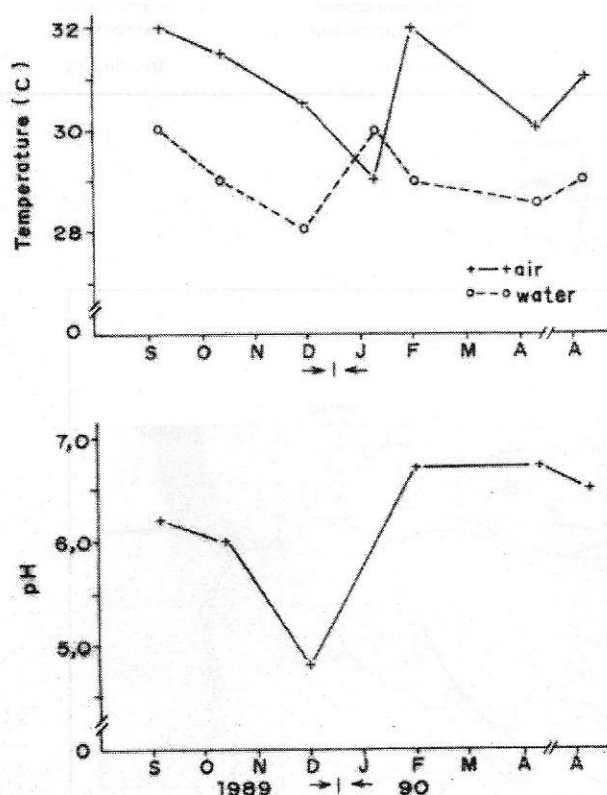


Figure 3. Change in air and water temperature, and pH in the study period.

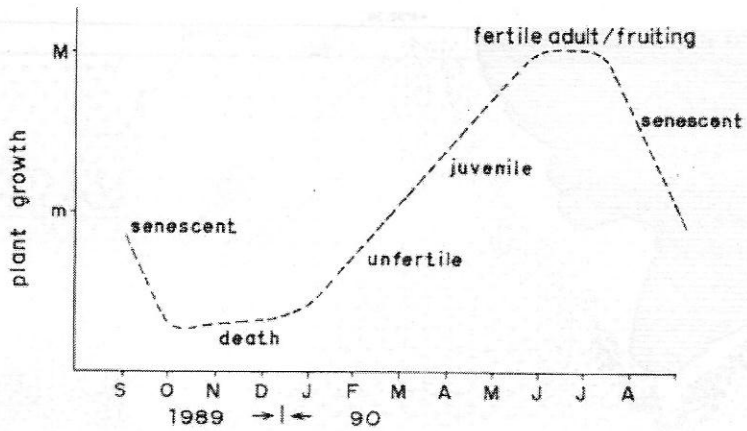


Figure 4. Representation of the macrophyte community seasonality in Alegre Village - São Bento (MA), in 1989 and 1990 (m-medium growth, M-maximum growth) (based in Wetzel, 1975).

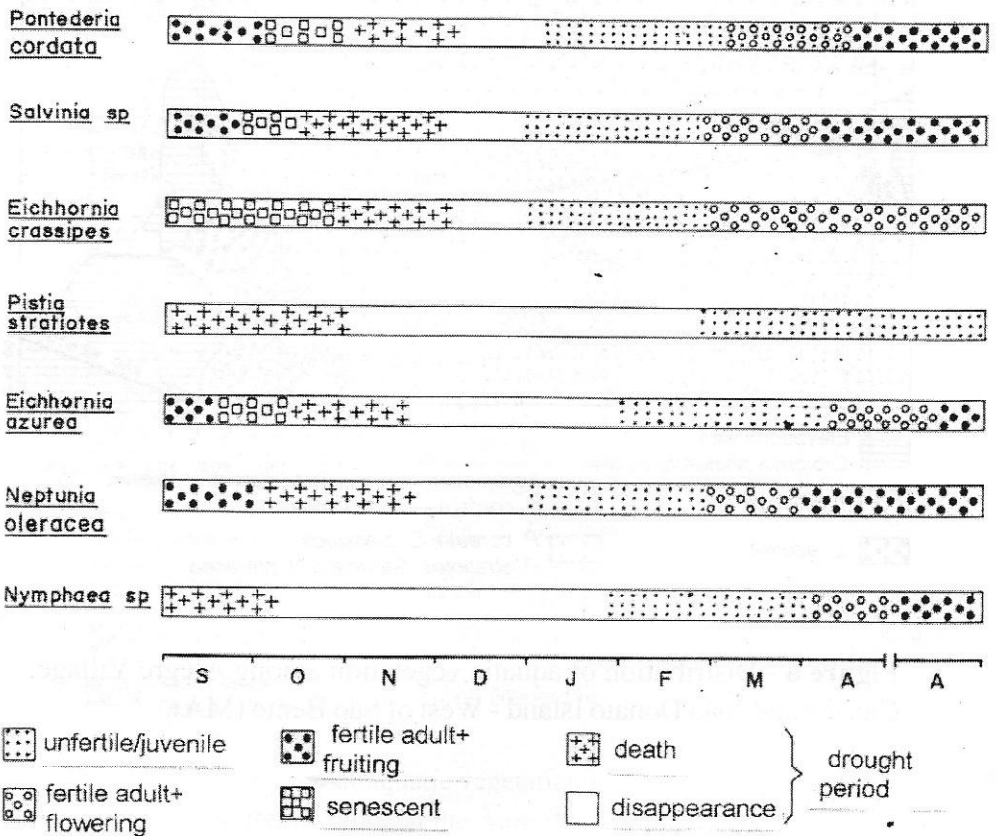


Figure 5. Life cycle of some aquatic macrophyte species at Alegre Village - São Bento (MA).

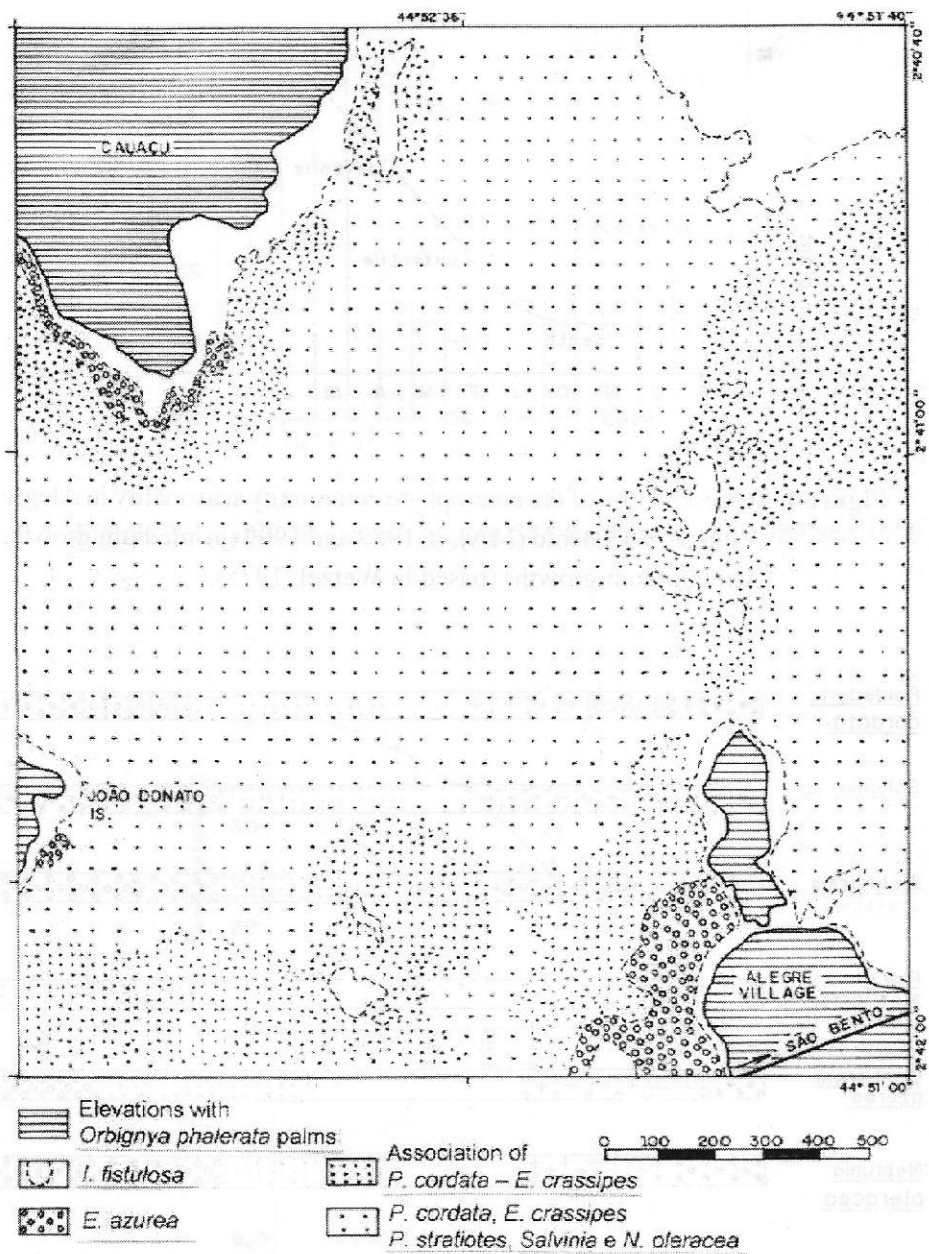


Figure 6 - Distribution of aquatic vegetation among Alegre Village, Cauaçu and João Donato Island - West of São Bento (MA).

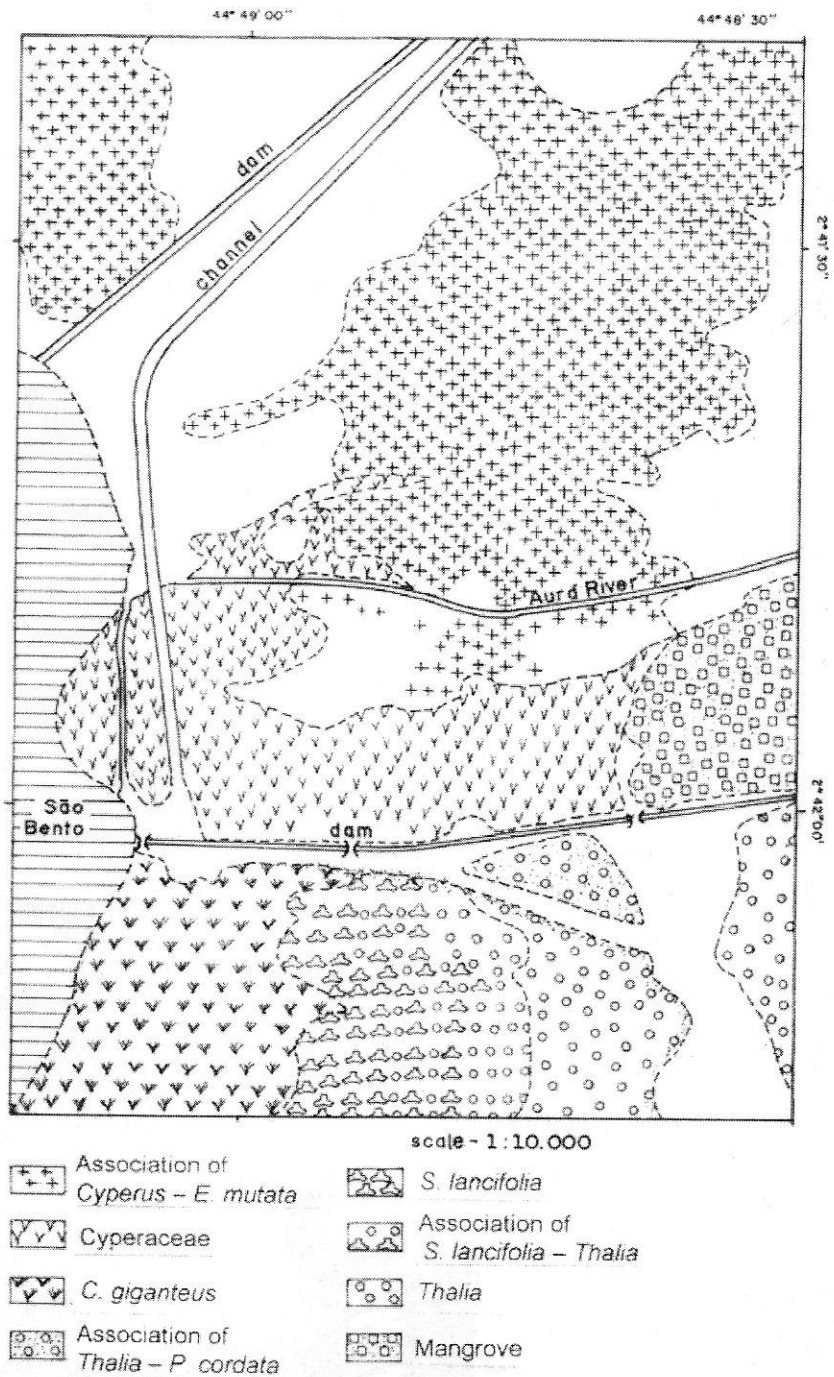


Figure 7. Distribution of aquatic vegetation in the eastern side of São Bento (MA), at the Aurá floodplains.