An Inventory of Brazilian Wetlands

Edited by
Antonio Carlos S. Diegues

With contributions from NUPAUB - Centre for Research on Human Population and Wetlands in Brazil
An Inventory of Brazilian Wetlands
IUCN – The World Conservation Union

Founded in 1948, The World Conservation Union brings together States, government agencies and a diverse range of non-governmental organizations in a unique world partnership: over 800 members in all, spread across some 125 countries.

As a Union, IUCN seeks to influence, encourage and assist societies throughout the world to conserve the integrity and diversity of nature and to ensure that any use of natural resources is equitable and ecologically sustainable. A central secretariat coordinates the IUCN Programme and serves the Union membership, representing their views on the world stage and providing them with the strategies, services, scientific knowledge and technical support they need to achieve their goals. Through its six Commissions, IUCN draws together over 6000 expert volunteers in project teams and action groups, focusing in particular on species and biodiversity conservation and the management of habitats and natural resources. The Union has helped many countries to prepare National Conservation Strategies, and demonstrates the application of its knowledge through the field projects it supervises. Operations are increasingly decentralized and are carried forward by an expanding network of regional and country offices, located principally in developing countries.

The World Conservation Union builds on the strength of its members, networks and partners to enhance their capacity and to support global alliances to safeguard natural resources at local, regional and global levels.

IUCN Wetlands Programme

The IUCN Wetlands Programme coordinates and reinforces activities of the Union concerned with the management of wetland ecosystems. The Programme focuses upon the conservation of ecological and hydrological processes, in particular by developing, testing, and promoting means of sustainable utilisation of wetlands. It does so in collaboration with IUCN members and partners, in particular those other international institutions with a specific wetland mandate, especially the Ramsar Convention Bureau, and the International Waterfowl and Wetlands Research Bureau (IWRB).

The core of the Programme is a series of field projects which develop the methodologies for wetland management, in particular in the countries of the developing world where wetlands are used intensively by local communities which depend upon these for their well-being. Related strategic and policy initiatives draw upon the results of these projects and present their conclusions in a form useful for government decision makers and planners.

The activities of the Programme are designed on the basis of the concerns and information provided by IUCN members. To facilitate this, the Programme works through IUCN’s regional offices. The Programme also works closely with the major development assistance agencies to ensure that conservation considerations are adequately addressed in their projects.

The Wetlands Programme receives generous financial support from the World Wide Fund For Nature (WWF), the Swiss Directorate of Development Cooperation and Humanitarian Aid (DDA), the Finnish International Development Agency (FINNIDA) and the Government of the Netherlands. Project support has been received from the Swedish International Development Authority (SIDA), Norwegian Agency for Development Cooperation (NORAD), United States Agency for International Development (USAID), the Ford Foundation and a number of IUCN members including the Finnish Association for Nature Conservation (FANC), Institut Français pour le Développement en Coopération (ORSTOM), the Royal Society for the Protection of Birds (RSPB), the United States National Park Service (USNPS) and the World Wide Fund For Nature (WWF). It is coordinated from the IUCN Headquarters in Switzerland, with regional coordinators in Central America, South America, Brazil, southern Africa and Asia.
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IUCN
1994
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Acronyms of the Brazilian States

AC  Acre
AL  Alagoas
AM  Amazonas
AP  Amapá
BA  Bahia
CE  Ceará
ES  Espírito Santo
GO  Goiás
MA  Maranhão
MS  Mato Grosso do Sul
MT  Mato Grosso
PA  Pará
PB  Paraíba
PE  Pernambuco
PI  Piauí
PR  Paraná
RM  Roraima
RN  Rio Grande do Norte
RS  Rio Grande do Sul
RO  Rondônia
SE  Sergipe
TO  Tocantins
Introduction to Wetlands of Brazil

Brazil has a great number and variety of wetlands of biological and socio-economic importance. Among these wetlands are the 'Pantanal Matogrossense' (Mato Grosso Floodplains), coastal ecosystems (mangroves, beaches, lagoons, etc.), river floodplains, lagoons and Amazonian wetlands (igapós, igarapés, etc.). Besides these natural ecosystems there are also thousands of kilometres of man-made wetlands such as dams and reservoirs.

Until recently these areas were considered of low economic importance due to the fact that they were temporarily or permanently flooded. As a result of this misconception, significant wetland areas were drained and developed for agricultural, industrial and urban uses.

Nowadays, worldwide conception of wetlands has significantly changed because of the great importance of these habitats and of the essential natural functions they perform. Adams (1983) identified over 75 different natural functions carried out by inland and coastal wetlands. Among the main ones are the capacity to retain and discharge water, flood control and retention, and purification of toxic elements. Most of these ecosystems, for instance mangroves, have high sediment retention capacity which, besides reducing erosion, also stabilise coastlines. Another important function carried out by wetlands is nutrient accumulation, which makes these habitats, as well as adjoining regions, highly productive. Wetlands are also characterized by their great biodiversity.

In Brazil, countless wetlands have been destroyed with no appropriate consideration of the consequent losses in terms of biodiversity, natural renewable resources and functions. Some policies and economic incentives responsible for ecosystem degradation continue to be implemented, as for instance the 'Programa Pró-várzea', responsible for the drainage and destruction of numerous river floodplains for agricultural purposes.

Many continental ecosystems are being converted for agricultural use. High quantities of pesticides are applied to these ecosystems, diminishing fishing productivity, damaging fauna and flora and habitats for waterfowl. The waste from sugar-cane distilleries for alcohol production enter many rivers and estuaries of the northeast. Mercury used in gold mining is a particularly serious threat to many Amazonian rivers and their human population. Coastal wetlands are also severely affected by industrialization.

Riverside forests are destroyed and the consequences of large-scale agriculture can result in the degradation of rivers, lagoons and estuaries. The same can be
said about incentive policies for activities such as large-scale chemical and petro-chemical plant construction.

Conservation of wetlands at international level is the main concern of the Ramsar Convention, established in 1971. In spite of the importance of its wetlands, only recently has Brazil made its first steps to joining the Convention.

Another important international programme is the ‘IUCN Wetlands Programme’, which intends to stimulate government and non-government organizations to elaborate programmes concerning the sustainable development and preservation of wetlands. In Brazil this IUCN Programme is represented by the ‘Centre for Research on Human Population and Wetlands in Brazil (NUPAUB)’, at São Paulo University.

The Centre aims at studying the relationship developed between human communities and wetlands, determining the wetlands’ socio-economic values and proposing alternative and ecologically sustainable strategies for their management. NUPAUB also supports grass-root movements and local associations that are conserving wetlands for traditional uses.

The Centre has published a thorough inventory of Brazilian wetlands, in Portuguese, and a series of case-studies and related papers. A list of these papers is provided at the end of this inventory and can be ordered from:

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Universidade de São Paulo
Butantã
CEP 05508
São Paulo, Brasil

For the preparation of this inventory, NUPAUB received assistance from the IUCN Wetlands Programme, in particular from Patrick Dugan, from the Ford Foundation and from the International Development Research Centre (IDRC).

Objectives

The Inventory of Brazilian Wetlands is a preliminary synthesis of relevant information for evaluating the importance of these ecosystems as well as the various environmental threats to these areas which occur in Brazil. This study also provides some preliminary data on which to assess the ecological and economic value of these areas. The creation of a data bank on wetlands by
NUPAUB is a first step towards assessing relevant information on this issue. Such a project requires collaborative research with scientists from various backgrounds as well as from various national institutions.

This inventory is principally directed towards researchers, students, professionals and environmentalists as well as social groups interested in the preservation, conservation and sustainable use of Brazilian wetlands. It is the first overall study produced in Brazil and is becoming a main source of information for additional studies, contributing to the raising of awareness of the ecological and socio-cultural importance of wetland ecosystems.

Methods

The Inventory of Brazilian Wetlands is essentially based on secondary data. The inventory produced by Derek A. Scott and Montserrat Carbonell for the International Waterfowl Research Bureau (IWRB), World Conservation Union (IUCN) and the World Wildlife Fund (WWF), *A Directory of Neotropical Wetlands* (1986), was the model used for this inventory.

The Inventory of Brazilian Wetlands was organized and published in Portuguese, in a preliminary form, by the Programme on Research and Conservation of Wetlands in Brazil (1990), an interdisciplinary research group of São Paulo University. The Inventory (450 pages) covered 51 large natural ecosystems covering 1,082,466 km², 28 Protected Areas in wetland ecosystems (16,937 km²) and 5 important artificial ecosystems (large dams) (see Figure 1). Maps produced by the Brazilian Institute of Geography and Statistics, which show the potentially flooded area, were used to identify the extent of each large wetland area. Other maps were also used, such as those produced by Radambrasil from the Ministry of Mining and Energy, published from 1973 onwards.

The main source of information for the Inventory was the Radambrasil Project, a large undertaking which so far has produced 36 volumes rich in information on Brazilian ecosystems and their uses; the results of an integrated multi-disciplinary mapping of the natural renewable and non-renewable resources of the national territory through the interpretation of radar images and other remote-sensing techniques. The following issues were covered: geology, geomorphology, pedology, vegetation and potential land uses. Intensive field work also has been accomplished by interdisciplinary teams around the country. In addition to this basic information source, the Inventory Team has consulted a vast bibliography, although no additional field work has been undertaken.
Figure 1 Map showing location of wetlands and river basins discussed in this Inventory
**Introduction**

**Location of wetlands on Figure 1 (opposite)**

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**The Northeast Basin**

45 Pará-Maranhão coast
46 Maranhão Gulf
47 Maranhão eastern coastline and Paraíba Delta
48 Rio Grande do Norte saline zone
49 Potengi River mouth
50 Gofiana River mouth and Ilamaracá Estuary
51 Suape Estuary
52 Mundai and Manguaba coastal lagoons
53 Roteiro and Jequiai coastal lagoons
54 Lençóis Maranhenses National Park
55 Monte Pascoal National Park

**The Southeastern-Southern-Basin**

77 Santos-São Vicente Estuary and Bertioga Channel
78 Iguape-Cananéia and Paranaguá estuary-lagoon system
79 Guaratuba and Babilônia Bays
80 Laguna coastline and adjacent areas
81 Rio Grande do Sul coastal plain
82 Superagui National Park
83 Jurúia-Itatins Ecological Station
84 Taíma Ecological Station
Figure 2  Map showing the biogeographic regions of Brazil
In order to provide a summarized view of Brazilian wetlands, the description of the areas studied encompasses the following information:

**Location:** geographical coordinates and general location of the sites.

**Area:** surface area calculated in square kilometres (km²).

**Altitude:** altimetric measurement of the area.

**Bioma/biogeographic provinces:** the *Classification of the Biogeographical Provinces of the World* by M.D.F. Udvardy (1975) was used as a basis for classifying provinces (see Figure 2).

**Wetland types:** the wetland types described in this Inventory are classified as follows:

1. Bays and straits
2. Estuaries, river deltas
3a. Coastal and Oceanic islands
3b. Fluvial islands
4. Coral reefs
5. Saltmarshes
6. Rocky coasts
7. Sand beaches
8. Intertidal plains
9. Sand plains and dunes
10. Mangroves
11. Lagoons, Salinas and ‘Restingas’
12. Slow rivers
13. Rapid rivers
14. Fluvial lakes, riverine floodplains
15. Freshwater lakes and adjacent floodplains
16. Saltwater lakes
17. Reservoirs, dams
18. Periodically flooded grasslands, savannahs
19. Flooded rice crops
20. Flooded arable fields, irrigated fields
21. Periodically flooded forests
22. Peat soil
Figure 3  Map showing the river basins of Brazil
**General description:** includes a brief characterization of the geomorphology, vegetation, climate and precipitation level, hydrography, flooding patterns, etc.

**Flora:** list of the principal kinds of vegetation. The terminology adopted was the one used by the Radambrasil Project, entitled *Evaluation of Natural Resources of the Minister of Mining and Energy* (Levantamento de Recursos Naturais do Ministério das Minas e Energia).

**Fauna:** list of the most common species of birds, mammals, fish, reptiles, crustaceans and molluscs, specifying whether these species are classified as threatened on the *Official List of Animals Threatened by Extinction from the Brazilian Institute of Geography and Statistics* (IBGE) of 1973 (Lista Oficial de Animais Ameaçados de Extinção do Instituto Brasileiro de Desenvolvimento Florestal).

**Human population:** total number of inhabitants of municipalities which are partially or completely included in the studied area. Data from the *1980 Demographic Census* of the Brazilian Institute of Geography and Statistics (Censo Demográfico do Instituto Brasileiro de Geografia e Estatística - IBGE).

Principal ethno-cultural characteristics of local populations: emphasis on indigenous and other traditional populations which have a specific cultural identity.

**Migration trends:** population mobility, including the arrival and departure of migrants, the principal causes of migration (push and pull factors), as well as the direction of these migratory movements.

**Legal status of the land and land use:** land use, legal status of indigenous lands, rural production (land tenure).

**Principal economic activities:** evaluation of activities such as fisheries, agriculture, cattle rearing, extraction and hunting, industry, mining, the volume of production, the productive structure, occupations etc.

**Protected zones:** located in or close to wetlands.

**Impact of human activities, existing and planned development projects:** list of the factors which affect the environment, such as development projects causing ecological and social degradation.

**Bibliography:** bibliographic material used for describing wetlands, using hydrographic basins as bases (see Figure 3).

**Observations:** the description of each area follows the above mentioned items. The remaining items are summarized according to the river basin to which the areas belong. In the first part there is an introduction to the different types of wetlands in Brazil. In the second part each wetland area is described using the same classification as above. Here the wetland areas are described following the main river basins proposed by IBGE (Brazilian Institute of Geography and Statistics - see Figure 3).
Brazilian Wetlands

Brazil has the world's largest wetland area. The Pantanal region, for instance, is larger than many European countries. Wetlands are important sources of food resources for human beings and function as nursery and permanent or temporary habitats for many species. In addition, wetlands also harbour human populations which earn their livelihood from the natural resources available. Wetlands in Brazil can be divided into two categories: natural and man-made.

Natural wetlands

Natural wetlands are divided into continental and coastal wetlands. Both are characterized by a high biological productivity, an abundance of fauna and flora, and a high genetic diversity, not yet well understood. Continental natural wetlands are those which are part of a hydrographic basin that gives them a biogeographic unity. However, the division between continental and coastal wetlands is somewhat arbitrary since large hydrographic basins may also include coastal and littoral segments culminating in estuaries and deltas where freshwater and saltwater mix. Nevertheless, coastal ecosystems do have a proper set of features that distinguish them from freshwater ecosystems. Both types of wetlands are examined below. In this Inventory, 51 large natural wetlands are analysed.

Continental natural wetlands

According to IBGE, Brazil is divided into nine hydrographic basins. These river basins can be further distinguished in terms of specific wetland ecosystems characterized by the permanent or temporary excess of water which forms the river. In Brazil, the main continental ecosystems are:

Várzea

Várzea are inundated lowlands, more or less flat, which occur close to the river banks, often associated with shallow lakes. They are extremely important in the Amazon and São Francisco Basins.
Floodplains (planície de inundaço)
Floodplains are flat areas in the highlands (terra firme), periodically flooded, forming superficial lake- and marsh-like ecosystems.

Swamps (pântanos)
Swamps form in shallow flooded land, where the bottom soil is more or less muddy; also referred to as bogs (brejos).

Mudflats (lameiros)
Mudflats are wetlands which form along rivers and streams or creeks, as well as meanders from rivers which have temporarily or permanently dried up.

Shallow lakes (lagoas superficiais)
Shallow lakes are freshwater bodies, common in the floodplain of the State of Rondônia.

Coastal natural wetlands
Coastal natural wetlands are coastal systems at the interface between land and sea, periodically covered by salt or brackish water due to the influence of tides. These are:

Estuaries (estuários)
Estuaries are permanently associated with the sea where saltwater mixes with freshwater originating from continental drainage systems. The mixing of nutrient-rich riverine water and coastal water is one of the most important factors of high primary biological productivity in these areas. When the estuary also harbours mangroves, the productivity is even higher. Some of the main Brazilian estuaries are: Amazon Gulf, Maranhão Gulf, Capibaribe, Potengi and Paraíba estuaries, Santos/Cubato and Iguaípe/Cananéia estuaries.

Deltas
Deltas are formed by channels, islands and river mouths, as for instance those associated with the Rivers Oiapoque, Parnaíba, São Francisco, Jequitinhonha, Doce and Parnaíba do Sul.
Mangrove forests (manguezais)
Mangrove forests are areas of high biological productivity as they harbour species representative of many levels of the estuarine food chain. Mangroves are found along almost the entire Brazilian littoral (from Oiapoque in the State of Amapá until Laguna in Santa Catarina), occupying an area of nearly 25,000 km². Mangroves are associated with low energy coasts or estuary areas, lagoons and bays. Over 50% of the Brazilian mangrove areas are concentrated in the northern region, along the Amapá, Pará, Maranhão and Piauí States’ coasts.

Coastal lagoons
Coastal lagoons are bodies of water separated from the ocean by sandbars. Tropical lagoons can have varying degrees of salinity due to rainfall. They have an elongated shape, generally narrow along their principal axis which is parallel to the coast. Sandbars (restingas), reefs, raised terraces formed by fluvial and marine sediment accumulation as well as beaches, contribute to the formation of lagoons. Examples are: Feia, Araruama, Saquarema, Maricá, Sepetiba, Mundai, Manguaba, Roteiro, Jequiá, Mirim and Tramandaí.

Barrier island (restingas)
Barrier islands are stretches of sand deposited in parallel to the coast and created by the dynamic forces (destructive and constructive) of ocean waters. These deposits occur when the coast forms a headland or cape, which often borders a series of small lakes. They are very common in the southern littoral of the State of Bahia or Rio Grande do Sul. The main Brazilian ‘restingas’ are: Ilha Comprida, Marambaia and Juréia.

Beaches (praias)
Beaches are sand deposits accumulated by a combination of fluvial and marine agents (forces), presenting varying widths depending on the importance of tides. Beaches are often associated with other coastal systems such as estuaries, deltas, sandbars (restingas), mangrove forests and sand dunes.
In Brazil, beaches are found along the entire littoral (from the State of Amapá to Rio Grande do Sul) and are greatly threatened by real estate speculation, tourism, harbours, marinas, as well as by industrial urban pollution.
Saltmarshes (marismas)
Saltmarshes are brackish-water environments found in low energy lagoons or estuaries. They are ‘swampy’ (pantanosos) flat coastal areas of shallow water, which develop in intertidal areas and are partially inundated by most high tides, especially in the southern region, as for instance the saltmarshes associated with the Mirin and Peixes coastal lagoons.

Tidal flats (plánícies de marés)
Tidal flats are low littoral tidal flats which are covered by the tides and are of great ecological importance.
Man-made wetlands

Man-made wetlands are created by the transformation of natural environments in order to control hydroelectric resources, which result in flooding of large extents of land. The creation of man-made (or artificial) wetlands is preceded, as a rule, by the transformation or even destruction of previously existing natural wetlands. Such action, in most cases, does not take into account the socio-environmental impacts resulting from the creation of artificial wetlands. This inventory particularly emphasises salt producing areas, reservoirs for storing water (açudes) and reservoirs of hydroelectric plants (dams).

Salt-producing areas (salinas)
Initially obtained in natural salt-producing areas of Brazil, salt is currently extracted on a large scale by pumping seawater into shallow tanks (salinas). This technique presupposes the creation of large reservoirs, the dimension of which is the function of the production unit.

The two principal salt-producing areas of Brazil are located on the littoral of the State of Rio Grande do Norte (Areia Branca, Mossoro and Macau, in Rio Grande do Norte) and on the ‘fluminense’ (around the Rio de Janeiro State) littoral (Cabo Frio, Araruama and São Pedro da Aldeia).

Reservoirs (açudes)
Reservoirs are built in order to store water in the semi-arid regions of the northeast of Brazil. Large projects to build reservoirs (usually by constructing a dam) belong to the public sector (i.e. the State of Brazil), the most important being Orós and Araras in the State of Ceará, and Curemas and Baqueiro in Paraíba. Some of the problems which have occurred in these areas as a result of the construction of reservoirs are the flooding of areas of downstream river margins, which were traditionally used for agriculture during dry seasons; the rapid silting up of lakes; an increase in the salt content of the soil; and the impoverishment of floodplains (várzeas) downstream from the dam because of the retention of fine particles at the bottom of the reservoirs.

Hydroelectric plants
As far as man-made wetlands are concerned, reservoirs for hydroelectric power generation are gaining importance not only because of their relevance to the energy producing sector in Brazil, but also because they are claiming large
Figure 4  Map showing hydroelectric dams larger than 10,000 ha in Brazil
extents of land and have a great socio-environmental impact. The Brazilian hydroelectric power complex (Parque Brasileiro de geração de energia elétrica) has a production potential of nearly 45,780 MW of electricity, of which 90.75% (or 41,548 MW) is actually generated. Most hydroelectric plants operate by the construction of dams to accumulate water in reservoirs.

In this Inventory, five hydroelectric dams (UHE - Usinas Hidroeléctricas) with reservoirs of more than 100 km² (10,000 hectares) were studied (see Figure 4). These plants form part of a complex of 33 hydroelectric dams which are responsible for 98% (or 23,051.9 km²) of all the lands flooded by hydroelectric plants in this country.

This information is taken from the National Plan for Electric Energy (Plano Nacional de Energia Elétrica) 1987-1910 (Plan 2010), which was prepared by ‘Eletrobrás’ (Brazilian Department of Energy) and published in 1984.

In general, most large hydroelectric plants (UHE) are concentrated along the basins of the Rio Paraná and São Francisco. Hydroelectric development in the basins of the Rivers Amazonas and Tocantins/Araguia is proceeding in spite of its environmentally destructive nature which will see the project flood an area in excess of 2,000 km². The basins of the Rivers Uruguai, Jacuí, Paraíba do Sul and Parnaíba already have hydroelectric plants of great importance, whereas the basin of the River Paraguai did not have large reservoirs and dams until 1988.

The expansion phase of the hydroelectric sector, which runs from 1987 to 1997, includes projects for constructing 95 new dams, 35 of which will have a reservoir of more than 100 km². The total surface area of land that would be flooded by these projects is nearly 22,813 km² of which 96.6% (or 22,044 km²) would comprise of reservoirs of more than 100 km². It should be noted that the justification used by the Plan 2010 for the proposed construction of these large hydroelectric plants (UHE) is based on an exaggerated projected need for electricity, as well as on an overprojection of consumption, given the existing economic recession.

The main impacts caused by these large dams are: displacement of populations; loss of soil; loss of plant and animal species; loss of material, historical and archaeological artefacts; loss of wood resources; modification of the hydraulic systems of rivers; modification of sediment load; changes in the flora and fauna; impacts on fisheries and aquaculture; a great increase of aquatic macrophytes; degradation of water quality; and sanitary problems.

Five large hydroelectric plants (UHE) associated with hydrological basins are presented in this study. They are: UHE Tucuruí (Pará), UHE Balbina (Amazonas), UHE Sobradinho (Bahia), UHE Rosana and Taquaruçu (São Paulo/Paraná), and UHE Itaipu (Paraná).
Figure 5  Map showing protected areas of wetlands in Brazil
Protected areas

About 3% of Brazil is protected. This percentage is considered as small when compared to protected areas in other Third World countries such as Indonesia (16%), Venezuela (8%) and Costa Rica (8%).

1.8% out of the 3% of Brazilian protected areas correspond to National Parks (32 units/8,932,243 ha), to Federal Biological Reserves (12 units/2,470,592 ha), and to Federal Ecological Stations (20 units/2,794,455 ha). The remaining areas have other conservation forms (ecological station, national forests, APA., etc.).

Brazil has 30% of the world’s remaining rainforests (approximately 250,000,000 ha) and also the highest number of species of Psittacidae, Primates, Amphibia, Arthropoda, higher plants and freshwater fish. It is also second or third in the number of species of birds, reptiles and palm trees. Such facts show the great ecological importance of Brazil in the world.

This Inventory covers 10 National Parks (5,558,813 ha), 9 Federal Biological Reserves (1,808,480 ha) and 7 Ecological Stations (721,820 ha), totalling 8,089,113 ha (see Figure 5), located in wetland regions.

Classification of protected areas

According to the classification used by IUCN (1978), based on the work Categories, objectives and criteria for protection areas, the protection units were divided into ten classes:

Category I    Scientific Reserves/Natural Reserves
Category II   National Parks/‘Provincial’ Parks
Category III  Natural Monuments
Category IV   Nature Conservation Reserves/Wild Life Sanctuaries
Category V    Landscape Protection
Category VI   Natural Resources Reserve
Category VII  Anthropologic Reserves/Natural Biotic Areas
Category VIII Multipurpose Areas/Resource Management Areas
Category IX   Biosphere Reserves
Category X    World Treasure Sites
Environmental legislation

Brazil has specific legislation regarding wetlands conservation. The Brazilian Constitution of 1988, article 225, declares the Amazonian rainforest, the Atlantic forest, the ‘Pantanal’ of Mato Grosso and the coastal areas as National Patrimony. This constitution ensures that within these ecosystems resources should be used in a manner which leads to the conservation of the environment, including natural resources.

Moreover, in Article 20 of the Constitution, lakes, rivers and any other aquatic areas which are part of these systems are considered as ‘Goods of the Union’ (Bens da Unio - National Patrimony). Other national ‘goods’ are wetland systems such as fluvial and lacustrine islands in areas bordering other countries, beaches, oceanic and coastal islands, natural resources over the continental platform and within the Exclusive Economic Zone (EEZ - 200 nautical miles), the territorial sea, coastal areas under Federal jurisdiction and its related territories, natural underground caves, etc.

Political and institutional directives

In 1970, the Interministerial Commission for Marine Resources (Comisso Interministerial para os Recursos do Mar) set in place two programmes relevant to littoral wetlands:

1. The National Programme of Coastal Management (PNGC - Programa Nacional de Gerenciamento Costeiro).
2. ‘Sectorial Programme’ of Marine Resources (PSRM - Programa Setorial de Recursos do Mar).

These programmes aim at promoting rational uses of coastal resources in order to improve the quality of life for its population and protect the natural heritage (coral reefs, beaches, seaweed, dunes, ‘restingas’, marine caves, mangrove forests, etc.). These two programmes were recently transferred to IBAMA, the National Institute for Environment.

The creation of the ‘Secretariat of the Environment’ (SEMA - Secretaria Especial do Meio Ambiente) in Brazil in 1973 marked an important step towards the protection of wetlands and other ecosystems. In 1988, IBAMA replaced the Brazilian Institute for Forest Development (IBDF) and the Brazilian Institute for Fisheries Development (SUDEPE). In 1992, the Ministry of Environment was established.
The Law on the Environment (Lei do Meio Ambiente) of 31 August 1981 established the National Policy for the Environment (Política Nacional do Meio Ambiente) and created the National Environmental Council (CONAMA - Conselho Nacional do Meio Ambiente).

On 23 January 1986, CONAMA declared the need for ‘Environmental Impact Assessments’ (RIMA - Relatórios de Impacto Ambiental) in the case of hydroelectric resources development, the construction of navigation channels, drainage and irrigation works, canalization of waters, industrial complexes and agro-industries.

The establishment of protected areas is an important instrument for the conservation of wetlands. In 1983, there were more than 12 million hectares under federal protection, including national parks, ecological reserves and stations. A great number of these protected areas are parts of important wetland ecosystems such as the National Park of Iguaçu, the ‘Pantanal’ of Mato Grosso and the ‘Lençóis’ of Maranhão. There are also areas under the protection of state and county governments. It is noteworthy that the number as well as the extent of these areas is quite small as they do not cover more than 3% of the national territory out of the 10% recommended by UNEP.

A considerable number of these areas are facing serious problems such as the construction of highways, the impact of illegal activities such as tree felling, hunting and fishing, and a lack of financial and human resources.

**International conventions**

Brazil has signed some of the international treaties which in one way or another, deal with wetlands:

- In 1974, the Brazilian Commission for the Programme of Man and the Biosphere (Comissão Brasileira do Programa sobre o Homem e a Biosfera) was established, promoted by UNESCO.

- In 1977, Brazil ratified the International Convention on Civil Responsibility on damages caused by pollution and oil.

- In 1982, Brazil played an important role in the Conference on the Law of the Sea of the United Nations.

- In 1987, Brazil ratified the Convention on the Preservation of the Cultural and Natural World Patrimony, also promoted by UNESCO.

Brazil is now ratifying the Ramsar Convention on Wetlands of International Importance, established in 1971. By signing the Convention, Brazil will designate at least one wetland of international importance.
Wetlands administration

Brazil does not have a unified administration of wetlands and the Protected Areas are administrated by federal, state and county entities. The large hydroelectric dams are administrated by the building companies (usually state owned).

There are also some national programmes of planning and management of river basins, such as the National Programme of Micro-basins (Programa Nacional de Micro-Bacias) and the National Programme of Irrigation (Programa Nacional de Irrigação), in addition to several regional programmes such as those developed by the Company for the Development of the Vale do São Francisco (CODEVASF - Companhia de Desenvolvimento do Vale do São Francisco). However, most of these programmes aim at transforming wetlands into cultivated land.

The National Department of Works Against Drought (DNOCS - Departamento Nacional de Obras contra a Seca) is responsible for the administration of the ‘acuades do Nordeste’ (Northeast dams). The National Department of Hydrography and Navigation (DNHN - Departamento Nacional de Hidrografia e Navegação) and the Sector of the Union’s Patrimony (Serviço do Patrimônio da União) administer all the land owned by the Union as well as the important 33 metres-wide stretch of land along the Brazilian coast.

Mangrove swamps, sand barrier islands (restingas) and beaches are under the responsibility of SPHAN - Sector of the National Historic and Artistic Patrimony (Serviço do Patrimônio Histórico e Artístico Nacional).
The Inventory
Acronyms of the Brazilian States

AC  Acre
AL  Alagoas
AM  Amazonas
AP  Amapá
BA  Bahia
CE  Ceará
ES  Espírito Santo
GO  Goiás
MA  Maranhão
MS  Mato Grosso do Sul
MT  Mato Grosso
PA  Pará
PB  Paraíba
PE  Pernambuco
PI  Piauí
PR  Paraná
RM  Roraima
RN  Rio Grande do Norte
RS  Rio Grande do Sul
RO  Rondônia
SE  Sergipe
TO  Tocantins
The Amazon Basin

Encompassing a total area of 7,000,000 km², the Amazon Basin drains the lands of nine South American countries. Around 4,975,000 km² of this total lies within Brazil, spread throughout the States of Acre, Amazonas, Roraima, Pará, Amapá, Rondônia, and the northwest portion of Mato Grosso, representing 47% of the Brazilian territory. It has been estimated that in Brazil alone there are between 70,000 and 100,000 km² of floodplain habitat, and over 100,000 km² of lakes and swamps. There are 40,000 km of navigable stretches of river, and probably an even greater extent of wetlands in the form of creeks and streams. Thus the total area of wetlands in the Brazilian Amazonia almost certainly exceeds 300,000 km² (30 million ha), and may be much more (Scott and Carbonell, 1986) (see Figure 3, page 8).

Three major aquatic systems are widely recognized:

**Black water systems**

Black water systems arise on bleached sands and podzols of the central Amazon lowlands. The water is rich in dissolved humic substances, dark brownish in colour and transparent, with a low concentration of dissolved minerals and an extremely low pH (about 4). Black waters are amongst the most nutrient-poor waters on earth and have a low productivity.

**White water systems**

White water systems arise mainly in the Andes and their foothills. The water is rich in inorganic particles, with a relatively high concentration of dissolved minerals and a pH of about 7. White waters have a fairly high nutrient content and high productivity.

**Clear water systems**

Clear water systems arise in the crystalline Precambrian shield of southern central Brazil and the Guianas in the north. The water is greenish in colour and transparent, with a very low to relatively high concentration of dissolved minerals, a pH ranging from very acid to neutral, and low to medium productivity. The two main clear water rivers are the Xingu and Tapajós.
The main catchment in this Basin - the Amazon River - has its springs in the eastern slopes of the Andes Cordillera in Peru. It travels through sedimentary ground of low declivity over a distance of some 6,518 km, flowing into the Atlantic Ocean in delta-estuary form. The mouth of the Amazon contains a great many islands, most of them of fluvial origin; Marajó Island, at 53,900 km\(^2\), is the largest.

In so far as the threats in the Amazon Basin are concerned, traditional land use activities, such as slash and burn agriculture, timber extraction, rubber collection and hunting, have concentrated on the riverine forests and floodplains which have always been readily accessible by way of the extensive network of navigable rivers. White water river floodplains, with their fertile soils, have been the ecosystems most seriously affected by human colonization and have almost completely disappeared from large areas in eastern Amazonia (Scott and Carbonell, op. cit.).

Along the rivers are lowlands (várzea and igapó) which remain almost entirely inundated during periods of flood.

The main characteristic of the Amazonian fluvial regime is the lack of prolonged droughts. However, the Amazon River presents some complexity regarding its hydrological regime, its extensive area reaching the tropical zone both in the north and in the south, and thus fed by rains occurring in both hemispheres. Tributaries flow into it from the Central Plateau when flooding occurs from November to March, and from the Plateau of Guyanas, with floods from April to July. This alternate feeding of the Amazon Basin ensures a constant volume of water. The rains spread throughout the year, but are more abundant from January to March, while the short dry period occurs from August to November. The yearly rainfall averages are around 2,000-3,000 mm, although there are areas with lower values.
1 Swamps of the Guaporé River and adjacent wetlands (RO/TO)

**Location:** between 11°45’-16°15’S and 59°30’-64°50’W.

**Area:** 26,230 km².

**Altitude:** 130-230 m.

**Biome/biogeographic province:** wet tropical forest/Savannahs and ‘Cerrados’ (woody meadows).

**Wetland types:** 12/14/18.

**General description:** the basin of the Guaporé River is located within a depression whereon the plains and ‘pantanais’ (lowlands) of the middle stretches of the Guaporé can be found. The swamp areas are comprised between the Barbado River (MT) and the mouth of the Guaporé River. The Guaporé is more than 1,000 km long, mostly in the plains with soft topography. Its low declivity facilitated the intense deposition of sediments resulting in an extensive fluvial plain.

The ‘Pantanal’ of the Middle Guaporé ranges in width from 10-60 km², but reaching 260-230 km² during the floods.

The climate is dominantly tropical, the temperature during the coldest month higher than 18°C. The yearly average temperature is around 24°C. The rainy period is between January and March, while June, July and August are the driest months.

**Flora:** alongside the entire Guaporé Valley there is a Dense Alluvial Rain Forest. In the central region the Pioneer Formations of Fluvial Influence (várzea) predominate, with Park Savannah less prevalent, with or without riverside forest.

The east region is occupied with Alluvial Semideciduous Seasonal Forest and Low Lands with emergent canopy.

**Fauna:** birds, mammals and fish. Endangered species include *Tayassu tajacu* (cateto), *Priodontes giganteus* (tatu-canasta), *Tapirus terrestris* (anta), *Alouatta sp.* (bugio), *Panthera onca* (onça-pintada), *Blastocerus dichotomus* (cervo do pantanal) and *Pteronura brasiliensis* (ariranha).

**Human population:** 93,983 inhabitants.

**Reference number:** (page 4, Figure 1) 1.
2 Upper and middle courses of the Purus River (AM/AC)

Location: between 5°25' - 11°00'S and 64°10' - 70°30'W.
Area: 26,705 km².
Altitude: 50-100 m.
Biome/biogeographic province: Amazonian/wet tropical forest.
Wetland types: 3a/12/14/21.
General description: the area is located in the Amazonian plains and consists of fluvial plains and terraces, with a predominance of the former. The Purus River, southwest-northeast oriented, follows a meandering course with many lakes, horseshoe-shaped lagoons, floating islands, and abandoned meanders.
The floods occur from February to April and they go down in September. The climate is rainy and tropical with an average temperature above 18°C even during the coldest month. Records show high rainfall rates ranging from 2,250 mm to 2,750 mm. The rainy period starts in October and the highest rates are reached from January to March.
Flora: areas of biological tension predominate (contact between Pioneer Formations and Rain Forest) which restricts occurrences of Tropical Dense Forest and Tropical Open Forest, both alluvial.
Fauna: birds, mammals, reptiles and fish. Endangered species include Felis pardalis (jaguatirica), Tapirus terrestris (anta), Lutra enudris (lontra), Pteronura brasiliensis (ariranha), Trichechus inunguis (peixe-boi), Panthera onca (onça pintada), Alouatta sp. (guariba), Podocnemis expansa (Amazonia turtle) and Caiman crocodilus (jacaré-tinga).
Human population: 10 towns, totalling 215,580 inhabitants.
Reference number: (page 4, Figure 1) 2.
3 Javari River
3 Javari River (AM)

Location: between 70°05'–73°35'W and 4°05'–6°45'S.
Area: 15,280 km².
Altitude: 86-200 m.
Biome/biogeographic province: Amazonian/humid tropical forest.
Wetland types: 12/15.

General description: the Javari River has a highly meandering course, that is more pronounced downstream. The navigable stretch runs for 510 km from its mouth up to the mouth of the Javari-Mirin River (left edge). The tropical climate predominates with high rainfall rates, ranging from 2,250 to 2,750 mm. The rainy period starts in September, lasting until May/June. The yearly average temperature is around 24°C.

Flora: the characteristic vegetation is formed by Tropical Open Forest and Tropical Dense Forest.

Fauna: birds, mammals, reptiles and fish. Endangered species include Pilherodius pileatus (garça-real), Felis concolor (onça-parda), Tapirus terrestris (anta) and Trichechus inunguis (peixe-boi).

Human population: some 6,674 people live in the area.
Reference number: (page 4, Figure 1) 3.
4 Juruá River (AM/AC)

**Location:** between 2°30' - 9°40' S and 65°40' - 73°45' W.
**Area:** 38,281 km².
**Altitude:** 0-200 m.
**Biome/biogeographic province:** Amazonian/humid tropical forest.
**Wetland types:** 12/14.

**General description:** the Juruá River follows a highly meandering course, and several lakes and abandoned meanders can be seen along the plain. The river is navigable throughout its 3,120 km, mainly in the mouth/Eirunepe portion; the upstream stretch (Cruzeiro do Sul) is navigable during the floods only. The climate is tropical with high rainfall rates ranging from 2,000 to 2,500 mm. Temperatures vary from 24° to 26°C.

**Flora:** both Dense and Open Rain Forest.


**Human population:** 180,910 inhabitants in 12 towns.

**Reference number:** (page 4, Figure 1) 4.
An Inventory of Brazilian Wetlands

5 Solimões River upper course
5 Solimões River upper course (AM)

Location: between 1°35'-5°10'S and 64°45'-70°10'W.
Area: 58,500 km².
Altitude: 70 m.
Biome/biogeographic province: Amazonian/humid tropical forest.
Wetland types: 12/14/15.
General description: the Solimões River has a slightly meandering course with several islands and alluvial dikes. Its water is white and muddy. Major tributaries are the Iça and Japeirá Rivers.
Flora: vegetation is characterized by Dense Tropical Forest; in the Amazonian alluvial sub-region the ecosystem consists of plains and terraces with contact areas between the Pioneer Formations (floodplain vegetation ‘várzea’) and Forests.
Fauna: birds, mammals, reptiles and fish. Endangered species include Tapirus terrestris (anta), Panthera onca (onça-pintada), Felis concolor (suçuarana), Pteronura brasiliensis (ariranha), Trichechus inunguis (peixe-boi), Caiman crocodilus (jacaré-tinga) and Podocnemis expansa (Amazonian turtle).
Human population: 116,666 inhabitants in 6 towns.
Reference number: (page 4, Figure 1) 5.
6 Negro River lower course (AM)

Location: between 0°10'-3°10'S and 59°50'-65°15'W.
Area: 28,000 km².
Altitude: 25-70 m.
Biome/biogeographic province: Amazonian/humid tropical forest.
Wetland types: 12/14/15/18.
General description: the Black (Negro) River has countless islands (the Anavilhanas Archipelago is one of them), along its 100 km course from Manaus in the north, with a great many abandoned meanders, channels, sandbanks, long plains with lakes and swamps, ‘igapó’ bushes and temporarily flooded fields.
Floods occur from June to September, and the ebb tides from August to December.
The dominant climate is tropical rainy with temperatures around 26°C.
Flora: Tropical Dense Forests dominate, as well as the ‘Campinarana’ (or Amazonian ‘caatinga’) and transition zones between both of them.
Fauna: birds, mammals, reptiles and fish. Endangered species include Tapirus terrestris (anta), Pteronura brasiliensis (ariranha), Trichechus inunguis (peixe-boi), Melanosuchus niger (jacaré-açu) and Caiman latirostris (jacaré-de-papo-amarelo).
Human population: 651,130 inhabitants in 4 towns.
Reference number: (page 4, Figure 1) 6.
An Inventory of Brazilian Wetlands

7 Lower course of the Solimões and Purus Rivers
Lower course of the Solimões and Purus Rivers (AM)

**Location:** between 2°-4°30'S and 64°50'W.

**Area:** 44,000 km².

**Altitude:** 25-70 m.

**Biome/biogeographic province:** Amazonian/humid tropical forest.

**Wetland types:** 30/12/15/18.

**General description:** a complete fluvial system with channels, 'paranás', rivers, islands, floodplains with drowned bushes, and hundreds of permanent and seasonal lakes along the 650 km Solimões River (between the mouth of the Japurá and Black Rivers), and stretching for 150 km down the Purus River.

The predominant climate is tropical rainy with temperatures around 26°C.

**Flora:** predominance of contact between Pioneer Formations of Alluvial Influence (várzeas) and Forestry Formations.


**Human population:** 170,142 inhabitants live in the region.

**Reference number:** (page 4, Figure 1) 7.
8 Middle course of the Amazon River and lower course of the Madeira River
Middle course of the Amazon River and lower course of the Madeira River (AM)

Location: between 1°15' -5° 15'S and 55°40' -59°55'W.
Area: 50,000 km².
Altitude: 10-70 m.
Biome/biogeographic province: woody/humid tropical forest.
Wetland types: 3a/12/14/15.
General description: a vast set of channels, sand beaches, islands, freshwater lakes, lowland bushes and swamps 30-80 km wide on both sides of the Amazon along 550 km, from the confluence with the Black River to Óbitos.

The climate in the lower Madeira River has no dry period, with average temperature in the coldest month higher than 20°C.
Flora: vegetation is characterized by Dense Rain Forest and Pioneer Formations of Alluvial Influence, herbaceous with palm trees.
Fauna: birds, fish, mammals and reptiles. Endangered species include Eudocimus ruber (guará), Phoenicopterus ruber (flamingo), Lutra enudris (lontra) and Podocnemis expansa (Amazonian turtle).
Human population: 350,000 inhabitants in 17 towns.
Reference number: (page 4, Figure 1) 8.
An Inventory of Brazilian Wetlands

9  Tapajós River lower course and adjacent wetlands
9 Tapajós River lower course and adjacent wetlands (AM/PA)

Location: between 1°40'-4°50'S and 53°30'-55°50'W.
Area: 28,450 km².
Altitude: 10-60 m.
Biome/biogeographic province: woody/humid tropical forest.
Wetland types: 3a/12/14.
General description: the area encompasses the last 350 km of the Tapajós River up to its mouth in the Amazon, from Óbitos to Prainha.
Flora: vegetation is characterized by the presence of Dense Rain Forest, with many large trees and Alluvial Pioneer Formations.
Fauna: birds, mammals, reptiles and fish. Endangered species include Harpia harpyja (harpia), Priodontes giganteus (tatu-canastra) and Inia geoffrensis (pink boto).
Human population: 410,000 inhabitants in 7 towns.
Reference number: (page 4, Figure 1) 9.
An Inventory of Brazilian Wetlands

KEY

- Cities
- BR 320 Federal Highway
- PA 372 State Highway
- State border
- Limits of the studied area
- Harbour
- Main rivers
- Flooded area
- Lagoon

SCALE

10 0 10 20 30 40 50 km


10 Xingu River lower course
10  Xingu River lower course (PA)

Location: between 1°30'-3°10'S and 51°40'-53°05'W.
Area: 9,250 km².
Altitude: 10-70 m.
Biome/biogeographic province: woody/humid tropical forest.
Wetland types: 13/14/15/18/21.
General description: the lower course of the Xingu River exceeds 10 m in width, with countless sandy beaches, many islands, bushes and flooded areas, particularly on its left bank.
The climate varies from monsoon tropical to equatorial, with temperatures in the coldest month around 20°C.
Flora: the predominant forestry formation is both Dense and Open Rain Forest.
Fauna: birds, fish, reptiles and mammals.
Human population: 18,200 inhabitants in 2 towns.
Reference number: (page 4, Figure 1) 10.
11 North coast of Amapá
11 North coast of Amapá (AP)

Location: between 4°30’-2°50’S and 52°-50°40’W.
Area: 11,500 km².
Altitude: 0-5 m.
Biome/biogeographic province: woody/humid tropical forest.
Wetland types: 2/8/10/11/12/15/18/21.
General description: important region of swamps and mangrove areas in the mouth of the Oiapoque River and the estuaries of the Caciporé, Uaçá, and Calçoene. The climate is equatorial humid with yearly average temperatures around 26°C. The dry period lasts only 2 months.
Flora: vegetation is characterized by the presence of Broadleaved Dense Rain Forest (without palm trees) and arboreous Pioneer Formations of Fluvimarine Influence (mangrove).
Fauna: birds, fish, mammals and reptiles. Endangered species include Eudocimus ruber (guará), Dendrocygna autumnalis (marreca), Phoenicopterus ruber (flamingo), Felis concolor (suçuarana), Panthera onca (onça-pintada), Trichechus manatus (peixe-boi), Priodontes giganteus (tatu-canastra), Chelonia mydas (green turtle) and Dermochelys coriacea (leather turtle).
Human population: 7,862 inhabitants.
Reference number: (page 4, Figure 1) 11.
12 Lower course of the Araguari River and adjacent wetlands
12 Lower course of the Araguari River and adjacent wetlands (AP)

**Location:** between 2°20'-9°S and 51°10'-49°50'W.

**Area:** 17,600 km².

**Altitude:** 0-5 m.

**Biome/biogeographic province:** woody/humid tropical forest.

**Wetland types:** 2/3/8/10/11/12/14/15/18/21.

**General description:** there are 75 lakes and 850,000 ha of swamps in this area.

The Araguari River outflows into the left bank of the Amazon. Between Macapá and Ponta Grossa (mouth of the Araguari River) there is an area subject to periodic floods with a constant increase in fluvial sediments due to the influence of the North Channel (Amazon River).

The climate is equatorial humid with average temperatures between 25° and 26°C. There is practically no dry season.

**Flora:** the coverage consists of Pioneer Formations of Fluviomarine Influence, both arboreous (mangrove) and fluvial (lowlands and/or swamps), with low areas of broadleaved Dense (Ombófila) Forestry and palm trees.

**Fauna:** birds, mammals, reptiles, fish and crustacea. Endangered species include *Dendrocygna autumnalis* (marreca), *Alouatta fusca* (guariba), *Cebus* sp., *Mazama americana* (mateiro deer), *Procyon cancrivorus* (mo-pelada) and *Dermochelys coriacea* (leather turtle).

**Human population:** 146,959 inhabitants.

**Reference number:** (page 4, Figure 1) 12.
13 Marajó Island (PA)

Location: between 51°10' - 48°20'W and 0°40' - 1°55'S.
Area: 53,900 km².
Altitude: 0-5 m.

Biome/biogeographic province: woody/humid tropical forest.

Wetland types: 1/8/10/15/18/22.

General description: Marajó Island lies between the mouths of the Amazon and Pará Rivers. In the eastern portion of the island there is an enormous mangrove area, dotted with lakes and lagoons.

The climate is equatorial humid with rainfall rates higher than 1,500 mm. The dry season is short (1 to 4 months), but well marked. The average temperature varies around 26°C.

Flora: the coverage consists of Pioneer Formations of Alluvial Influence, grazing (lowland) and arboreous Fluvimarine (mangrove), spots of Dense Rain Forest and ‘Cerrado’ (woody) Formations.

Fauna: birds, fish, crustacea and reptiles.

Human population: 205,353 inhabitants in 12 towns.

Reference number: (page 4, Figure 1) 13.
14 Amazon River Delta and islands
14 Amazon River Delta and islands (PA)

Location: between 0°-1°50'S and 52°15'-50°55'W.
Area: 17,000 km².
Altitude: 0-15 m.
Biome/biogeographic province: woody/humid tropical forest.
Wetland types: 2/3/8/12/18/21.
General description: the mouth of the Amazon River is subdivided into two branches which surround Marajó Island.
The climate is equatorial humid with rainfall rates over 2,000 mm. There is a well-defined dry season lasting 1 to 4 months. The average temperature is 26°C.
Flora: the coverage is characterized by Dense Rain Forest (broadleaved secondary, land alluvial, with plain and low plateaux) and by Pioneer Formations of land and arboreous Alluvial Influence.
Fauna: birds, fish, crustacea, mammals and reptiles.
Human population: 26,123 inhabitants in 2 towns.
Reference number: (page 4, Figure 1) 14.
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15 Xingu River upper course
15  Xingu River upper course (MT)

**Location:** between 10°05'-12°55'S and 51°55'-54°W.

**Area:** 20,180 m².

**Altitude:** 250-275 m.

**Biome/biogeographic province:** ‘cerrado’/woody fields.

**Wetland types:** 12/14/15/18.

**General description:** the upper course of the Xingu River is located in the centre of the Parecis Plateau, draining, with its tributaries, the whole area. There are lowland lakes, extensive marshes, floodable fields and flooded bushland.

The dominant climate is tropical. The rainy period lasts from September to April with yearly precipitation ranging from 1,750 to 2,750 mm and average temperatures around 24° to 26°C.

**Flora:** predominance of Rain Forest, and Stationary Semidecidual Forest with emerging canopy.

**Fauna:** birds, mammals, reptiles and fish.

**Human population:** 100,166 inhabitants.

**Reference number:** (page 4, Figure 1) 15.
16  Balbina Hydroelectric Power Plant (AM)

**Location:** Balbina is located in the basin of the Uatum River, about 140 km from Manaus (AM), between 60°30'0"-59°20"W and 2°-1°S.

**Area:** the flooded area of the reservoir is 234,600 ha, with power to generate 250 MW.

**Altitude:** ranges from 46 to 50 m.

**General description:** construction of the dam began in 1979, and was completed in 1987, in order to supply electricity to the city of Manaus.

The climate is tropical, favouring dense forest vegetation. The yearly average temperature is 26°C, with rainfall rates around 1,750 mm.

The reservoir’s medium depth is 7.4 m, which prevents navigation in the lake as flooded trees are sometimes 40 m high.

**Flora:** no data available.

**Fauna:** birds, mammals, reptiles and fish.

**Reference number:** (page 4, Figure 1) 16,
(see also Figure 4, page 16).
17 Amazon National Park (AM/PA)

Management category: II.
Biogeographic province: Madeira.
Established: 19 February 1974, by Federal Decree number 73,683.
Location: by the rio Tapajós bank, covers lands in the municipalities of Itaituba and Mariés and has the coordinates 3°45'-4°50'S and 47°21'-56°22'W.
Land tenure: IBAMA (Brazilian Environment Institute).
Altitude: 19-200 m.
Area: 1,000,000 ha.
Site description: priceless example of the Amazon forest, located in the transition zone between the old Escudo Brasileiro and the Sedimentary Basin; includes sections of a large clear-water river, a series of river rapids and several outcrops.
Threats: adverse environmental impacts on habitat and interdependant species brought about by invading prospectors, woodcutters and illegal hunters.
Reference number: (page 4, Figure 1) 17,
(see also Figure 5, page 18).
18 Cabo Orange National Park (AP)

Management category: II.
Biogeographic province: Guyana.
Established: 15 July 1980, by Federal Decree number 84,913.
Location: in the municipalities of Calçoene and Oiapoque in the State of Amapá, between the coordinates 4°26’-3°33’N and 51°09’-51°35’W.
Land tenure: IBAMA.
Altitude: 0-200 m.
Area: 619,000 ha.
Site description: located in the fluviomarine plain, the area has little variation in altitude.
Indiscriminate mangrove soils occur from the maritime shore of rio Cunani up as far as the mouth of rio Uaçá, originating from sediments deposited by the brackish water.
Threats: no information available.
Reference number: (page 4, Figure 1) 18,
(see also Figure 5, page 18).
19 Jaú National Park (AM)

Management category: II.
Biogeographic province: wood.
Location: Rio Jaú Basin, in the State of Amazon, with the coordinates 1°40’-3°S and 61°25’-63°50’W.
Land tenure: IBAMA.
Altitude: less than 100 m.
Area: 2,272,000 ha.
Site description: the land mostly takes the form of large smooth crests and small hills. Marshlands, formed by sand, silt and clay deposits occur along the largest rivers.
Threats: no information available.
Reference number: (page 4, Figure 1) 19,
(see also Figure 5, page 18).
20  Pacaás-Novos National Park (RO)

Management category: II.
Biogeographic province: deciduous scrub-forest savannah.
Established: 21 September 1979, by Federal Decree number 84,019.
Location: it covers areas in the municipalities of Guarajá-Mirim, Ji-Paraná, Ariquemes and Porto Velho, in the State of Rondônia, and with the coordinates 10°30'-11°45'S and 62°30'-64°10'W.
Land tenure: IBAMA.
Altitude: 200-1,126 m.
Area: 764,801 ha.

Site description: the Park area has a diversified elevated relief with rounded hills and scarped edges, typical of the Chapada dos Parecis (Parecis Plateau), while its continuation, the Serra de Pacaás-Novos, is a large residual eroded bedrock composed chiefly of tableland reliefs. This mountain range, together with that of Uopianes and Moreira Cabral, are the most important morphonatural units in the area, which also includes the 3 main basins in the State of Rondônia: Guaporé, Madeira and Mamoré.

The climate is hot and humid (mean annual relative humidity equal to or higher than 80%) and the mean temperature is in the order of 23°C, the hottest months being August to October (an average of approximately 31°C).

Threats: the Park is well protected through its sheer size, difficult access and unsuitability for agriculture.

Reference number: (page 4, Figure 1) 20,
(see also Figure 5, page 18).
21 Abufari Federal Biological Reserve (AM)

Management category: I.
Biogeographic province: Amazon.
Location: State of Amazonas, in areas of the municipalities of Tapuá and Manacapuru, with the coordinates 4°51'5''S and 62°51'-63°21''W.
Land tenure: IBAMA.
Altitude: 0-100 m.
Area: 288,000 ha.
Site description: no information available.
Threats: no information available.
Reference number: (page 4, Figure 1) 21,
(see also Figure 5, page 18).
22 Rio Trombetas Federal Biological Reserve (PA)

Management category: I.
Biogeographic province: Madeira.
Established: 21 September 1979, by Federal Decree number 84,018.
Location: medium rio Trombetas, next to the Pará municipality of Oriximiná, between coordinates 1°00'-1°45'S and 56°15'-57°05'W.
Land tenure: IBAMA.
Altitude: 0-100 m.
Area: 385,000 ha.

Site description: comprising a plain and low Amazonian plateaux, it is drained by the rio Trombetas basin and includes within its boundaries the Lago do Jacaré (Jacaré Lake). The mean annual temperature is 26.5°C and the annual precipitation is around 1,888 mm, the dry period occurring in mid-July to October.

Threats: the Reserve is threatened by hydroelectric power plant construction, where the reservoir will flood a wide area (including the turtle egg-laying tablelands), and by mineral exploitation, deforestation and illegal hunting.

Reference number: (page 4, Figure 1) 22,
(see also Figure 5, page 18).
23 Guaporé Federal Biological Reserve (RO)

Management category: I.
Biogeographic province: deciduous scrub-forest savannah.
Location: State of Rondônia, in areas of the municipalities of Guajará-Mirim and Vilhana, between coordinates 12°10’-12°50’S and 62°10’-63°31’W.
Land tenure: IBAMA.
Altitude: 100-300 m.
Area: 600,000 ha.
Site description: the Reserve region covers the headwaters of the rio Madeira, rio Guaporé and rio Mamoré. It has a hot, humid climate, with 2-3 dry months and is of the equatorial type. The mean annual precipitation is 2,100 mm, relative humidity approximately 80% and the mean annual temperature 25°C.
Threats: the major impacts caused by human activities include the actions of mining companies, lumber companies, deforestation and land burning for agricultural-pastoral purposes.
Reference number: (page 4, Figure 1) 23,
(see also Figure 5, page 18).
24 Lago Piratuba Federal Biological Reserve (AP)

Management category: I.
Biogeographic province: Guyana.
Established: 16 July 1980, by Federal Decree number 84,914.
Location: in the State of Amapá, at the far northern part of the Brazilian coast, coordinates 1°50'-1°27'N and 49°40'-50°30'W.
Land tenure: IBAMA.
Altitude: 0-200 m.
Area: 395,000 ha.
Site description: covers the fluvial terrain of the Marajoara archipelago and the State of Amapá coastal strip. The large part of the reserve consists of alluvial terrain with depressions affected by periodical floods.
Threats: no information available.
Reference number: (page 4, Figure 1) 24, (see also Figure 5, page 18).
Anavilhanas Ecological Station (AM)

Management category: I.

Biogeographic province: Amazon.

Established: 02 June 1981, by Federal Decree number 86,061.

Location: northern region, in the State of Amazon, 100 km at the northwestern Manaus and with the coordinates 2°00'-3°02'S and 60°27'-61°07'W.

Land tenure: IBAMA.

Altitude: 0-50 m.

Area: 350,000 ha.

Site description: a fluvial archipelago located on the rio Negro, 90 km long and 15 km wide (at the widest point) with an area of approximately 250,000 ha of land to the north. The archipelago is almost completely flooded in the rainy season.

Threats: deforestation occurs in some parts of the Station.

Reference number: (page 4, Figure 1) 25, (see also Figure 5, page 18).
26 Ilha de Maracá Ecological Station (RR)

Management category: I.
Biogeographic province: treeless savannas.
Established: 02 June 1981, by Federal Decree number 86,061.
Location: middle rio Uraricoera, at northwestern Boa Vista, in the State of Roraima between coordinates 3°15'-3°35'N and 61°22'-61°58'W.
Land tenure: IBAMA.
Altitude: 100-200 m.
Area: 92,000 ha.

Site description: the Ilha de Maracá constitutes a large fluvial floodable archipelago, formed by two arms of the rio Uraricoera, the channel of Santa Rosa in the north and of Maracá in the south. The area comprises freshwater lakes, grassy marshes, waterways, floodable and swampy fields and lies in a transition region between Amazonian forest and floodable open woodland consisting of shrubs and trees. The prevailing climate is of the Humid Tropical type, with rainfall occurring mostly in winter (April-August), which differs from the rest of the north region. The mean annual temperature ranges around 26°C.

Threats: the Ilha de Maracá is adjacent to the Projeto Calha-Norte (Calha-Norte Project), and its activities, mainly mining and prospecting, may seriously affect the Ecological Station area.

Reference number: (page 4, Figure 1) 26,
(see also Figure 5, page 18).
27  Maracá-Jipióca Ecological Station (AP)

Management category: I.
Biogeographic province: Guyana.
Established: 02 June 1981, by Federal Decree number 86,061.
Location: northern coastline region in the State of Amapá, to the north of the Amazonas mouth, with the coordinates 1°50'-2°15'N and 50°17'-50°40'W.
Land tenure: IBAMA.
Altitude: 0-50 m.
Area: 72,000 ha.
Site description: two Quaternary period islands composed of monotonous, muddy plains. There are no beaches and the waters are turbid.
Threats: overfishing of marine resources; pollution of rivers and sea caused by port and mining activities.
Reference number: (page 4, Figure 1) 27,
(see also Figure 5, page 18).
28 Acre River Ecological Station (AC)

Management category: I.
Biogeographic province: Amazonian.
Established: 02 June 1981, by Federal Decree number 86,061.
Location: North Region, State of Acre, next to the Peruvian and Bolivian borders, in the municipalities of Assis Brasil; coordinates 10°45'–11°03'S and 70°03'–70°31'W.
Land tenure: IBAMA.
Altitude: 0-200 m.
Area: 77,500 ha.
Site description: no information available.
Threats: no information available.
Reference number: (page 4, Figure 1) 28,
(see also Figure 5, page 18).
Summary of the socio-economic and environmental situation of the Amazon Basin

Human occupation in Amazonia started with indigenous tribes, followed thereafter by European colonizers and migrants who came from the northeast of Brazil. They settled along the lowlands, attracted by the resources offered by the rivers and 'igarapés' and the high fertility of the alluvial soils. Two basic activities were developed: farming and cattle raising. Lowlands were thus occupied by 'caboclos' (Brazilians of mixed Indian and White blood) who planted corn, rice, beans and bananas. These activities were complemented with hunting, fishing, animal raising, and extraction of products such as rubber, Brazil nuts, and various palm-tree products (açai). Recent colonization, after construction of the Transamazônica and Belém-Brasília highways parallel to the rivers, has changed the course of settlement in the region. The speed of forestry devastation along the rivers, and on dry land along the newly constructed highways, caused the population centres to move as the timber industry developed and moved away from the riverbanks.

In the mid-seventies, attracted by fiscal incentives granted by the Government, countless farming and cattle raising enterprises were established in Amazonia, transforming large forestry areas into pasture and resulting in the deforestation of hundreds of square kilometres of Amazonia. In contrast to subsistence agriculture, mechanized farming is geared to large scale production, usually for exportation purposes, carried out by large companies. The consequences of such interference with the ecosystem were the alterations in the region’s hydrology, deposition in rivers, depletion of ecosystems, and changes in the local community economy, mainly riparian dwellers and Indians.

Hunting activities are carried out for subsistence and for trade, aiming mainly at easy-to-catch animals such as the 'capivara' (Hydrochoerus hydrochaeris) and the alligator (Caiman) found near the rivers. The turtle (Podocnemis expansa) and manatee (Trichechus inunguis) have practically vanished due to large scale capture. Subsistence fishermen use bows-and-arrows and spears to catch their fish while commercial fishermen use nets and corrals. The increasing presence of the latter in the area has generated conflicts with local fishermen who try to prevent the use of the modern techniques employed on the fishing lakes.

Extraction of plant material is also practised throughout Amazonia, the main products being rubber latex, Brazil nut, sorb, potato, and 'açai'. Countless
aromatic and medicinal plants are cultivated for manufacturing medicines and cosmetics, in some cases threatening species with extinction due to their indiscriminate collection. The extraction of timber, mostly for export, is carried out haphazardly and chaotically. Activities are concentrated in the lowlands where access, extraction and transport are easier. Most of the lumber production supplies the international market. The main species extracted are: cedar (Cedrela), jacareúba (Calophyllum brasiliensis), mahogany (Swietenia macrophylla), andiroba (Carapa guianensis), louro (Aniba), ucuúba (Virola surinamensis) and copaíba (Copaifera vinifera).

In recent years mining activities have seriously affected the environment. Gold extraction in particular is the activity that most threatens the ecosystem. According to a study by the National Department for Mineral Production (DNPM), the most severe cases are located in Serra Pelada, Gurupi (PA), north of the State of Mato Grosso, where the soil is contaminated, and in the region of the Tapajós River. In South Pará contamination has reached some Indians who use the water and eat fish from the rivers. Between 1980 and 1988 gold extraction amounted to 900 tons, discharging 1.8 thousand tons of mercury vapor into the air, contaminating the prospectors as well as the environment. Prospecting for tin ore (cassiterite) in Rondônia led to dredging of thousands of hectares of land alongside the rivers, causing serious siltation and sedimentation and destroying important aquatic resources, especially fish.

Industrial activity in the Amazon Basin is linked mainly to the lumber sector, except for the city of Manaus (AM). Here, following the creation, in 1967, of SUFRAMA (Superintendency of the Duty-Free Zone of Manaus), an industrial centre has been established (mainly electrical and electronic product assembly factories). Agricultural and cattle raising activities are also carried out.

Today, hydroelectric power is mainly generated in plants along tributaries where there are high waterfalls emerging from the plateau. According to ELETROBRAS, around 45% of the non-assessed hydroelectric power potential in Brazil belongs to Amazonia (about 73,380 ha), although conditions to create the necessary dams along the main river courses are not ideal. Three power stations are currently in operation: Coroaci Nunes, Curuá-Una and Balbina, located in the Uatum River, with a flooded area of 2,346 km² and power output of only 250 MW. When Balbina Dam was completed, flooding the Indian area and affecting the flow of the Uatum, Santo Antonio de Albonau, Atrori, and Iguarapé-Taquari Rivers, the impact on the lives of the tribal Indians was colossal. The local flora and fauna disappeared under the water, several unexplored archaeological sites were
flooded, and changes occurred to the micro-climate and the water quality. Additionally, 33,000,000 m$^3$ of wood also disappeared under the water, resulting in the loss of thousands of dollars to the national economy. The fear is that the lake may become eutrophic, making the water unfit for human use, damaging fish reproduction, and ultimately jeopardizing the turbines and cooling tubes in the power station.

The process of economic, social and cultural transformation Amazonia has gone through is affecting its environment on a massive scale, and is also responsible for disrupting the local communities, especially the indigenous societies and cultures.

The main Conservation Units present in the Amazon Basin are:

- Pacaás-Novos National Park, created in 1979, with 764,801 ha;
- Guaporé Federal Biological Reserve, created in 1982, with 600,000 ha;
- Acre River Ecological Station, created in 1981, with 77,500 ha;
- Macauá National Forest, created in 1988, with 173,435 ha;
- Anavilhanas Islands Ecological Station, created in 1978, with 385,000 ha;
- Jaú National Park, created in 1980, with 2,272,000 ha;
- Abufari Biological Reserve, created in 1982, with 288,000 ha;
- Trombetas River Federal Biological Reserve, created in 1978, with 385,000 ha;
- Tapajós National Park, created in 1974, with 600,000 ha;
- Cabo Orange National Forest, created in 1980, with 619,000 ha;
- Lago Piratuba Federal Biological Reserve, created in 1980, with 395,100 ha;
- Maracá-Jipióca Ecological Station, created in 1981, with 72,000 ha.
The Tocantins-Araguaia Basin

Located entirely in Brazil, the Tocantins-Araguaia Basin spreads throughout the States of Pará, Maranhão, Tocantins, Goiás, and Mato Grosso, occupying about 9% of the territory.

The confluence of the Maranhão and Paraná Rivers forms a river, now known as the Tocantins, which flows to the mouth of the Amazon River where it reaches a width of 15 km. 1,710 km long, this river cuts the territory in a north-south direction, passing through crystalline and sedimentary lands, with navigable stretches, waterfalls and rapids.

Its largest tributary, the Araguaia River, joins the Tocantins near the town of Marabá (PA). The Araguaia is equally important due to its hydrological features and good navigability. In the middle of its course is the largest fluvial island in the world, Bananal Island, with an area of around 20,000 km².

The predominant fluvial regime in the Basin, according to Maurice Pardé, is austral tropical with floods during the summer and low tides in the dry season during autumn and winter.

The characteristic climate is hot and semi-humid, with a yearly mean temperature ranging from 22° to 26°C. The annual rainfall rate reaches around 1,500 to 2,000 mm with rains occurring mainly in the summer; thus rainfall is unequally distributed throughout the year. Wooded lands, bushes in the lowlands and ‘igapós’ make up the predominant vegetation.

As in the Amazon Basin, human settlement occurred mainly near the gutter ends of the rivers, close to natural resources made available by the rivers and lowlands. Until the middle of this century, lowland communities, ‘caboclos’ and Indians were scarce, subsisting on Brazil nut and ‘babaçu’ collection, fishing, and extensive cattle raising in pastures which were burnt annually.

After construction of the highways (Belém-Brasília in 1960, and the Transamazonian Highway in 1974), the pattern of occupation has changed markedly along the river channels as the roads have facilitated and attracted a larger flow of migrants to the region.

With benefits brought by the ease of access and, chiefly, the policy of fiscal incentives offered by the government, entrepreneurs, national and international business groups have moved in and occupied enormous areas of land (glebas devolutas) which, until then, were the homes of squatters and indigenous groups. This has, naturally, worsened the existing land conflicts.
29 Tocantins River lower course
29  Tocantins River lower course (PA)

**Location:** between 1°53'-3°25'S and 48°50'-49°45'W; comprises the lower part of the Tocantins River from Ilha Grande de Jatai up to its mouth in the Pará River, in the eastern stretch of Pará State.

**Area:** 6,875 km².

**Altitude:** 0-30 m.

**Biome/biogeographic province:** woody/humid tropical forest.

**Wetland types:** 3a/12/14/15/17/18/21.

**General description:** it is an area profoundly altered after the construction of the Tucurú Power Station and respective lake. The area has alluvial plains with strips of recent alluvia in floodable low portions in the bottom of the valley (mainly in the islands) and scattered, partially floodable, areas of sandy flat depressions, floodable in the lower parts and covered with creeping vegetation.

The climate in the area varies from monsoon tropical - characterized by a dry season in springtime (September-October) and a remarkable wet period with heavy rains by the end of the summer - to equatorial, with the temperature in the coldest month reaching 20°C. In the region of the Tocantins mouth, the seasons are barely distinguishable.

**Flora:** the main type of vegetation is Dense Rain Forest which occurs along the river bed, with small bushes in the lowlands and ‘igapós’.

**Fauna:** birds, mammals, reptiles and fish. Endangered species include *Trichechus inunguis* (peixe-boi), *Chrysocyon brachyurus* (‘guará’-wolf), *Panthera onca* (onça-pintada), *Caiman crocodilus* (jacaré-tinga) and *Podocnemis expansa* (Amazonian turtle).

**Human population:** some 236,000 inhabitants in 6 towns: Baio, Macajuba, Cametá, Limoeiro do Arajau, and part of the towns of Abaetuba and Igarapé-Mirim.

**Reference number:** (page 4, Figure 1) 29.
An Inventory of Brazilian Wetlands

30 Belém coast
30 Belém coast (PA)

Location: between 48°-49°W and 0°40'-2°S; it covers the Marajó Bay from the rio Marú mouth up to rio Barreto, passing through the lower Acará and Guamá Rivers and through Guajará Bay, the location of Belém city.

Area: 6,700 km².

Altitude: 0-5 m.

Biome/biogeographic province: humid rain forest/wood.

Wetland types: 1/2/3/7/10.

Site description: portion of Pará coastline, in rivers, formed by several estuaries and continental islands. The Marajó bay receives Pará and Tocantins river waters. Smaller rivers such as the Maju, Acará, Guamá discharge into it. Mangroves (from Belém toward São Luís) penetrate up to 40 km along the rivers, as far as sea waters reach.

The climate is humid/equatorial with average temperatures ranging from 24° to 26°C. Annual rainfall is over 2,250 mm.

Flora: the prevailing forest cover is Thick secondary-type Rain Forest with broad leaves and Fluvimarine Influence Pioneer Formations (mangrove).

Fauna: birds, mammals, fish, crustacea and molluscs. Endangered species include Eudocimus ruber (gará), Phoenicopterus ruber (flamingo), Trichechus inunguis (Amazonian manatee), T. manatus (marine-manatee), Panthera onca (jaguar), Procyon cancrivorous (crab-eating racoon), Chiropotes satanas (saki monkey), Caiman sp. (caiman) and Dermochelys coriacea (trunk turtle).

Human population: 1,245,041 people in 11 municipalities. The major concentration is in Belém.

Reference number: (page 4, Figure 1) 30.
31 Middle Araguaia River and Bananal Islands
31 Middle Araguaia River and Bananal Islands (GO/TO/MT/PA)

Location: situated between 8°30’-15°30’S and 49°35’-53°05’W. The Bananal Island is between the major and the minor arm of rio Araguaia. Araguaia’s main tributaries on this reach are the Mortes and Formoso Rivers.

Area: 71,370 km².

Altitude: 180-300 m.

Biome/biogeographic province: savannas and stunted-tree wood savannas/deciduous scrub-forest savannas.

Wetland types: 12/14/18/21.

Site description: on rio Araguaia’s medium reach, the wetlands are about 750 km long and up to 100 km wide, and on some sections constitute a very wide marshy system covering two swamps and the largest fluvial island in the world (Ilha do Bananal). The marshy areas are known as ‘Araguaia River’s lowlands’.

Two well-defined seasons occur: a rainy one, lasting 4 to 5 months (December to April) and a strong drought season (June to December). The annual mean rainfall is around 2,000 mm.

Flora: the principal vegetation formations are: Thick Arboreal Savannah (extensive tract of waste land - ‘cerrado’), Alluvial Forest with emerging canopy and Savannah region, Park with gallery forest.

Also occurring is Open Rain Forest with predominancy of large palms (Orbignya spp.) and areas of Alluvial Influence Pioneer Formations (floodplain vegetation).

Fauna: waterfowl, mammals, fish and reptiles. Endangered species include Chrysocyon brachyurus (lobo-guará), Panthera onca (jaguar), Lutra enudris (otter), Tapirus terrestris (tapir), Blastoscerus dichotomus (swamp deer), Ozoterocerus bezoarticus (pampas deer), Mirmecophaga tridactyla (great anteater), Priodontes giganteus (giant armadillo), Caiman crocodilus (Paraguay caiman) and Podocnemis expansa (Amazonian turtle).

Human population: 180,000 inhabitants in 16 municipalities. The principal population concentrations are: Barra do Garça (MT), Santana do Araguaia (MT), Formoso do Araguaia (TO) and Araguarema (TO).

Reference number: (page 4, Figure 1) 31.
32 Middle Tocantins River and lower Araguaia River
32 Middle Tocantins River and lower Araguaia River (PA/TO/MA)

Location: between 5°07' - 8°30' S and 47°15' - 49°30' W. It includes the middle Tocantins River between the Estreito River (TO) up to the municipality of Marabé (PA), and the lower Araguaia River from the municipality of Couto Magalhes (TO) up to its mouth on the Tocantins River.

Area: 13,800 km².

Altitude: 45 up to 200 m.

Biome/biogeographic provinces: humid rain forest, savannas and stunted-tree woods/wood, deciduous scrub-forest savannahs.

Wetland types: 3a/12.

Site description: the area is in a depression of the middle Tocantins. The lower Araguaia follows a slightly meandering S/NE route (being more pronounced at its mouth), with a number of islands. The middle Tocantins flows in a southern-northern direction up to the municipality of Imperatriz (MA), where it bends northwest up to the Araguaia confluence, location of the Marabé municipality (PA). Separating the river’s channels is the Serra do Estrondo mountain range. The climate is tropical with dry winters, according to Koppen, with an annual mean rainfall ranging from 1,600 to 1,700 mm. The mean temperature is around 24° - 26°C.

Flora: along both banks of the Araguaia River lies a succession of different forestal formations, with Rain Forest and open forest prevailing.

In the far south of the area, following the Araguaia arm along its right bank, areas of stunted woodland occur. In the far north, a region known as Bico do Papagaio consists mostly of Rain Forest. To the south, the formations of deciduous scrub-forest savannah and extensive tracts of wasteland predominate.

Fauna: birds, mammals, reptiles and fish. Endangered species include Chrysocyon brachyurus (guará wolf), Pteronura brasiliensis (river otter), Lutra enudris (otter), Panthera onca (jaguar), Melanosuchus niger (black Amazon caiman), Caiman crocodilos (Paraguay caiman) and Podocnemis expansa (semi-aquatic freshwater turtle).

Human population: 706,415 persons in 17 municipalities along the river channels. The following are the main population centres: Marabé, Conceição do Araguaia (PA); Imperatriz (MA); Araguaiana, Tocantinópolis (TO).

Reference number: (page 4, Figure 1) 32.
33 Tucuruí Hydroelectric Power Plant (PA)

**Location:** on the lower Tocantins River, 13 km from the city of Tucuruí, in the State of Pará, 48°40'–48°55'W and 3°50'–5°10'S.

**Area:** the reservoir has a surface area of 243,000 ha, and is 170 km long in a N/S direction. It has a 45.8 billion m³ water storage capacity. The plant's power generation amounts to 7,300 MW, of which 4,000 MW will be produced in the first stage. The lake's formation required the partial flooding of the municipalities of Tucuruí, Jacundá and Itupiranga, as well as two Indian reserves.

**Site description:** the reservoir is situated in the southern Pará peripheral depression. The soils have a high acidity, a high rate of aluminum toxicity and a low content of nutritious elements. They are characterized by the formation of thick residual or flooded layers, masking the outcrops. The climate is humid/tropical. The power plant construction began in 1975 and power generation started in 1984.

**Flora:** data obtained on vegetation are prior to the reservoir flooding process when vegetation was characterized by Thick Rain Forest, Open Rain Forest and a section containing stunted woodland and forest.

The original forests were replaced by secondary forest, pastures and small cultivated parcels. Following flooding of the reservoir, no information is available on remaining or introduced vegetation.

**Fauna:** birds, mammals, reptiles and a large variety of fish. Endangered species include *Bradypus tridactylus* (three-toed sloth), *Coendou* sp. (hedgehog) and *Cebus apella* (capuchin monkey).

**Human population:** according to Eletronorte (northern Brazil power plants): “By 1986 there was no human population at the dam construction site. Nevertheless, 2 Indian Reserves were flooded - Gavio and Parakan - and 1986 data show that 211 Indians were affected by the reservoir, and 139 at Paranaty village and 72 at Marudjewara village. About 3,350 families (17,319 persons) were forced to leave their lands” (Sigaud, L.).

**Reference number:** (page 4, Figure 1) 33, (see also Figure 4, page 16).
34 Araguaia National Park (GO)

Management category: II.
Biogeographic province: deciduous scrub forest savannahs.
Established: 31 December 1959, by Federal Decree number 45,570.
Location: northwestern State of Goiás and on the northern third of Ilha do Bananal, with the coordinates 9°50' - 11°10'S and 49°56' - 50°30'W.
Land tenure: IBAMA.
Altitude: 200-240 m.
Area: 562,312 ha.
Site description: this large-sized Park covers part of the 2,000,000 ha of the Ilha do Bananal, which is the largest fluvial island in the world. It is extremely important in that it lies between the two largest biomes in the country: the Amazon forest and the stunted woodland. Being a wide plain, the Park is subject to periodic flooding from the Araguaia and Javaés Rivers, thus creating many swampy zones.
Threats: cattle pasturing activities inside the Park (an estimate of approximately 1,000,000 head of cattle); wetland drainage for transformation into rice crops, also leading to water contamination by pesticides; and the hydroelectric construction projects along rio Araguaia, which can drastically affect the hydrologic dynamics of the Park area.
Reference number: (page 4, Figure 1) 34,
(see also Figure 5, page 18).
Summary of the socio-economic and environmental situation of the Tocantins-Araguaia Basin

The Tocantins-Araguaia Basin area is populated mainly with ‘caboclos’ (Brazilians of mixed Indian and White blood), basically small farmers who make their living out of family-based agriculture complemented by hunting, fishing, extraction and trade activities. All activities depend on periods of heavy rainfall. About 4,500 Indians inhabit the region, originating from the Anambe, Karajá, Ava-Canoeiro, Javaé, Tapirapé, Xavantes, Apinajés, Guarani, Tembé, Suruí, Guajá, Krikati, Gavio and Parakan tribes. The last two tribes have been affected by the Tucuruí Reservoir, as well as by nut gatherers and riparian dwellers. The construction of Tucuruí attracted a high number of workers (Tucuruí grew by 517% from 1970 to 1980), as well as to Albrás, in the lower Tocantins region. On the other hand, the construction of the hydroelectric power plant made it necessary to remove the population from the area to be flooded. In all, about 17,000 people from 14 rural settlements were forced to leave their lands.

In recent decades several regions in Pará have become pioneering fronts, drawing people from different parts of the country, mainly from the south, centre-south and northeast. Their destinations have been the mining and agricultural areas, and the city of Belém has become the focal point of passage and support for the various activities developed in the State. These migrations were generated, among others, by POLAMAZNIA (Amazon Program of Agricultural, Cattle Raising and Mineral Development plants), mainly the Xingu-Araguaia and Araguaia-Tocantins Development plants which attracted rural workers and their families, large estate owners, squatters, farmers and businessmen.

In the middle Tocantins and lower Araguaia regions a new process of human occupation began with the construction of Belém-Brasilia (1950s to 1960s) and Transamazônica Highways (1970s). Whereas before there were squatters (from Maranhão, Goiás and the Northeast region) and traditional large estates, government tax-free subsidies gave rise to a new wave of enterprises, domestic and multinational interests which established agricultural and cattle-rearing projects in lands ‘considered’ as unoccupied government lands. Several conflicts for land ownership caused the federal government to establish, in 1980, the GETAT (Araguaia-Tocantins Executive Land Group) with the purpose of promoting and taking the necessary actions required to regularize land issues and to colonize the southeast of the Pará, Tocantins and Maranhão States. However, this goal has not been achieved because of the
pressures exerted by the economic interests prevailing in the area. Moreover, the implementation of development projects set forth by Programa Grande Carajás (Great Carajás Program) has worsened still further the land tenure problems owing to the high migratory flow of people into the area.

Squatters, tenants and smallholders live on subsistence agriculture (corn, bean, manioc, rice, sugar-cane, banana, pumpkin, etc.) and also on market-orientated agriculture. The technology used is rudimentary with no technical support or rural credit. Producers sell their products for low prices, transferring most of their income to middlemen. In recent decades agricultural production has stagnated for lack of support from the government, small producers have been expelled from their lands and agricultural activity is beginning to undergo mechanization (southern Maranhão).

Most riverbank fishermen do not sell their produce. The lack of ice and difficulties in transporting produce to nearby cities are factors that limit this activity. The fishing methods used are: line and fish-hook, casting net, knotted nets and trotline. Canoes, small boats with outboard motors, and freezer boats are also used.

The peak fishing period corresponds to the ‘piracema’ (spawning time) when men leave other activities such as planting and mining to concentrate on fishing. The fishermen sell their produce to a single middleman who handles all the marketing of the fish caught.

Wood extraction has recently taken place on a large scale and in an extremely haphazard way. With the construction of pig iron and ferroalloy plants (Projeto Grande Carajás-PGC) with the purpose of producing charcoal-based iron, deforestation will increase considerably, since plants will require approximately 1,100,000 tons of charcoal/year, equivalent to an annual deforestation of 40 to 50,000 ha.

The Greater Carajás Project was established by Decree-law number 1,813 of 24 November 1980 and is managed by an Interministerial Council. It covers Southern Pará, Northern Tocantins and Northwestern Maranhão, representing over 10% of the Brazilian territory. It includes several activities: forestal exploitation, agriculture, cattle-rearing, mining and metallurgy. Cia Vale do Rio Doce (CVRD) controls the iron and manganese mine, the 890 km Carajás-Itaqui railroad and the Itaqui port. CVRD intends to achieve an annual output of 35 million tons of iron ore making use of the railroad and Itaqui port in the State of Maranhão.
A PGC-backed corridor is also being established in the lower Tocantins area, connecting the Tocantins Metallurgical Centre (Marabá-Tucuruí) with Belém-Barcarena Metallurgical Centre.

In Barcarena, the Albrás-Alunorte complex (integrating with the Tocantins Centre) started to be constructed by 1984. The good navigable conditions of the lower Tocantins (2.2 m depth 90% of the time) will be exploited to boost export production from the Tocantins Industrial Centre.

Besides the large economic centres of the region, the highest concentration of industrial activities in North Region is in Belém, the food, wood, liquor, rubber and textile producing sectors being the most prominent. Away from the centre lie manure and fertilizer industries, plus others.

Prospecting for gold is done in open pits, using simple technology, small resources and a large number of workers. Controls differ with each situation. Illegal prospecting goes on on private property, without the owner’s permission, and in Indian land, while licensed prospecting takes place in government-controlled areas (Serra Pelada - PA) and on private property with the consent of the owner. About 20,000 people prospect for gold in Serra Pelada, with a current annual yield of 800 kg. In 1983, 14 tons of gold were extracted.

Mechanized mining and exploitation of mineral deposits is carried out by private companies. The region’s mining potential was first discovered by a North American company - United States Steel - in the late 1960s.

AMZA (Amazônia Mineração S.A.) was established in 1970 as a partnership between US Steel (49%) and CVRD (51%). The greatest iron ore deposits in the world are in Serra dos Carajás. Besides iron, manganese, bauxite, copper, zinc, nickel and chrome are extracted.

One of the greatest social and environmental impacts of the Tocantins-Araguaia Basin began with the Tucuruí Hydroelectric Power Plant construction. The population was forced to leave their lands along with their traditional activities. The settlement of expropriated people in Parakan Glebe brought about conflicts between them and the Indians who claimed occupation of the remaining area in the flooded reserve. Construction of the plant generated a disorderly and indiscriminate occupation of the area around the reservoir and disproportionate growth of the city of Tucuruí. Approximately 1,250 km² were affected by deforestations (about 51% of the reservoir area). In addition to the loss of local flora brought by the flooding of forested land, putrefaction of the vegetation has affected the quality of water in the reservoir.
Populations along the riverbank and in the towns downstream of the dam are prevented from using the Tocantins River water. Pollution has already reached the ground water, rendering inadequate the construction of supply wells. The ‘piracema’ fish reproduction process is impaired, as they are not able to bypass the dam.

In the middle Tocantins and lower Araguaia region the deforestation is increasing due to charcoal production for the pig iron mills. A 2,500 ton/year pig iron production is envisaged, requiring 10,000,000 m³ of charcoal (about 500,000 ha of native forests) yearly. The great demand for charcoal by the pig iron mills results in the opening of farms covered by native forest (including the chestnut area) to supply the mills and in the transformation of the small farmers into charcoal ‘bóias-frias’ (low-wage workmen who have to take their food to their work sites).

Similarly, impacts occur in Araguaia’s National Park, where inspection is not able to control the pasturing of cattle, extraction and illegal hunting. The illegal settlement occurs along the road which crosses the Park. Outside the protected area there are problems due to drainage of wetlands for the creation of rice plantations, causing modifications to the hydric system, as well as pesticide contamination of water, which occurs mainly in the Formoso River project area.

Several hydroelectric power plants to be constructed in the Araguaia and das Mortes Rivers will affect the region both at social and ecological levels. In Belém region, the industrial districts (Icoroaci, Ananindena and Barcarena) are responsible for the biological degradation of mangroves, rivers, estuaries and islands caused by manures, salt, fishing residues, amianthus, etc.

Only three protected areas exist in the Tocantins-Araguaia Basin:
- Araguaia National Park; 1959; 562,312 ha;
- Côco-Javaés Ecologic Station; 37,000 ha (not decreed);
- Lagoa Grande State Biological Reserve; 1986; 38,000 ha.
The São Francisco River Basin

Situated entirely in Brazilian territory, the São Francisco Basin has a drainage area of the order of 631,133 km². The São Francisco headwaters are located in Serra do Espinhaço and Serra da Canastra (MG) and flow in a general S-N/NE direction up to the vicinities of the city of Cabrod (BA), from where it bears S/SE to reach the Atlantic Ocean on the border of the States of Alagoas and Sergipe (see Figure 3, page 8).

The prevailing pluvial rate in the São Francisco Basin area corresponds to the Austral Tropical Rate, characterized by a period of rainfall concentration in the southern hemisphere summer (November-April), according to the classification proposed by Maurice Pardé.

Although crossing semi-arid areas and having its flow reduced in drought periods, the São Francisco flows throughout the year, which increases its importance in terms of regional supply and of water resource water scarcity areas.

Intermittent rivers associated with the semi-arid fluvial rate exist in the northern part of the Basin which covers part of the region known as ‘Polígono das Secas’ (Drought Polygon).

The São Francisco River Basin is traditionally divided into four subregions, based on morphologic characteristics of the areas crossed by the main drainage channel:

1. Upper São Francisco - from source up to Pirapora (MG);
2. Middle São Francisco - from Pirapora to Sobradinho UHE (Hydro-electric Power Plant);
3. Lower-middle São Francisco - from Sobradinho to Paulo Afonso waterfalls;
4. Lower São Francisco - from Paulo Afonso to the mouth.

The flooded areas and the ‘headwater swamps’ of some of São Francisco’s tributaries are the main types of inner wetlands present along the Basin.

The construction of hydroelectric power plant dams along the São Francisco Basin - mainly on the main channel - is systematically reducing the flooded lowlands, besides bringing about a number of other environmental impacts.
An Inventory of Brazilian Wetlands
The areas with the highest industrial concentration along the Basin are located on the upper São Francisco. The rio das Velhas, among other tributary streams, drains areas of Belo Horizonte metropolitan region as well as other, predominantly industrial, locations in the state. The major concentrations of population and the largest network of the Basin cities also lie in these areas. The São Francisco is of major importance in terms of public water supply (both domestic and industrial), besides the use of its waters for irrigation, watering of stock, navigation - especially in the middle valley - electric power generation, fishing and fish breeding; the latter being developed along the basins, reservoirs and weirs.
35 The São Francisco River estuary and floodplains
35 The São Francisco River estuary and floodplains (AL/SE)

**Location:** between 10°05’-10°40’S and 36°20’-36°58’W; it comprises the lower São Francisco region, from Amparo to São Francisco (SE) up to its mouth at Pontal da Barra (AL).

**Area:** 1,580 km².

**Altitude:** 0-100 m.

**Biome/biogeographic province:** humid rain forest/Serra do Mar.

**Wetland types:** 2/3/3a/7/10/11.

**Site description:** a fluviomarine plain constituted of marshlands and fluvial and marine terraces, formed by Quaternary deposits and round hills, sculptured on sedimentary rocks, surrounded by remains of tableland formed over Tertiary deposits of the Barrier Group. As typical coastal relief forms, the dunes are 20-30 m high and are located mainly on the north part of São Francisco delta, near Piaçabuçu, where they are mobile.

The area’s climate is characterized by two well-defined seasons: a rainy season in winter and a dry season in summer. Mean annual rainfall ranges from 700-1,800 m, and the average temperature during the year is around 25°C.

**Flora:** this area is mainly used for agricultural and cattle-rearing activities, especially in regions located more towards the interior. The coastline presents wide areas of arboreal Marine Influence Pioneer Formations (restingas), while on a smaller scale, arboreal Fluvimarine Influence Pioneer Formations (mangrove) occur. Further inland lie Fluvial Influence Pioneer Formations (marshlands).

**Fauna:** birds, crustacea and fish.

**Human population:** 156,242 inhabitants in 12 municipalities.

**Reference number:** (page 4, Figure 1) 35.
36 Sobradinho Hydroelectric Power Plant (BA)

**Location:** Sobradinho is located on the lower middle São Francisco River, about 50 km from Juazeiro (BA) at 43°05' and 40°50'W and 9°-11°20'S.

**Area:** the flooded area covers 4,214 km². Land on the right bank in Juazeiro, Sento Sê and Xique-Xique municipalities, and Casa Nova, Remanso and Pilo Arcado on the left bank were partially flooded to form the lake. It has capacity for 34 billion m³ of water, with 1,050 MW power generation. The lake is 350 km long and 5 to 40 km wide.

**Site description:** the reservoir area includes the two geomorphologic units: the Serra do Espinhaço, with crest formations and Crystalline Scarp, and the São Francisco Depression with Dune formations.

The regional climate is the semi-arid tropical type. The beginning of the dam construction was in 1972 and it was inaugurated in 1978. By 1979 the plant was supplying power to northern and northeastern regions, as well as regularizing the São Francisco River’s annual flow.

**Flora:** this region is characterized predominantly by the vegetation of stunted spare forest (steppe), zones of contact between this and Seasonal Forest, and areas of Alluvial Influence Pioneer Formations (marshland).

**Fauna:** no information available.

**Human population:** the population displaced from the area due to the inundation numbered 60,000 people, according to CHESF (Companhia Hidrelétrica do São Francisco - São Francisco Hydroelectric Company), and 72,000 people according to CONTAG (Confederação Nacional dos Trabalhadores na Agricultura - National Confederation of Agricultural Workers). 25 housing developments were built on the lakeside, where most of the rural population affected by the inundation was resettled.

**Reference number:** (page 4, Figure 1) 36,
(see also Figure 4, page 16).
Summary of the socio-economic and environmental situation of the São Francisco Basin

Approximately 1,062 Cariri-Xocó Indians inhabit the São Francisco estuary region in a reserve located in the municipality of Porto Real do Colégio (AL). Those who were formerly fishermen are now becoming fishermen-farmers, alternating their subsistence activities as fish become scarcer. Cultural traditions among the people reveal themselves in their artistic techniques, chiefly in clay, but also in leather, wood and metal.

Before Sobradinho was inundated to form a lake, regional settlements consisted fundamentally of closely linked family groups. The rural population was divided into two different groups, those settled by the riverbank, and farming in the inundated lowland, and those settled in the stunted open forest area practising dry land agriculture. After the lake was formed, land value in the area increased and parcels were transferred to enterpreneurs, through either sale or lease, bringing about the proletarization and expropriation of the smallholders.

In the lower São Francisco River region, people migrate from towns like Brejo Grande to São Paulo, Aracajú, northern Paraná and the Arapiraca zone in Alagoas where the pastures are expanding. When irrigation projects were started, traditional rice cultures were disrupted, thus releasing labour for Aracajú and other major cities in the region. Only by the time of the sugar-cane harvest in the treeless tablelands is there some movement of workers into the area. Most of the land’s ownership is not entitled legally, giving rise to conflicts, mainly in the inundation lowlands below the level of the lake where land grabbing for the best agricultural land goes on.

Along the coast and in the São Francisco River fishing is mostly carried out by skilled artisans, with middlemen in control of the commercial side. Traditional fishing techniques include nets, including an encircling fishing net, hooks and wicker fish traps. Rowing boats are frequently used. Natural marshland stocks have been decreasing due to the sugar-cane industry of the CODEVASF (Companhia de Desenvolvimento do Vale do São Francisco - São Francisco River Valley Development Company) irrigation projects, with a significant reduction in the edible fish and crustacea which complement the food of the riverbank populations.

At the coastline periphery, agricultural activity is essentially based on sugar-cane cultivation and has recently been diversified to include the production of alcohol. In Alagoas (in the relief areas) mechanization is
present, along with the use of biocides. Manioc, corn, rice and bean cultivation provide the basic subsistence food for the population, along with fishing.

Rice planting is being stimulated by CODEFASF's irrigation projects which aim at settling parcel owners in marshlands protected by flood retention dikes or areas irrigated by sprinkling, gravity or inundation. Areas where the irrigation projects have already been implemented include: Propiá, Cotinguiba-Pindoba, Itiuba and Betume. The areas still to be implemented are Marituba and Boacica. These projects have adversely altered the functions of these marshlands and only few locals have benefited. The rice industry, very new to the region, is represented by some traditional companies in Própria Neópolis and Penedo, connected mainly with the food sector.

In the upper São Francisco region the discharge of untreated home and industrial wastewaters, as well as the disposal of mineral extraction and processing wastes, are the main sources of water degradation along the Basin. On the treeless tableland of the coastal area, sugar-cane cultivation causes degradation by leaching, and erosion is increased by digging and planting the cane. This erosion action increases with the constant use of poisons, fertilizers and other products which alter the structure of soil aggregates and when transported to the rivers cause silting up and chemical pollution. Linked to the cane agricultural industry is the rivers' pollution by liquid residues coming from the alcohol plants.

The Sobradinho UHE construction strongly affected the pattern of the local population. Settlements were dismembered and the population scattered. The São Francisco River has always had a marked regulating effect on local life. With the construction of the dam the natural, seasonal water flows have altered, and the release of water from the reservoir at any time of year has caused unexpected flooding downstream, thus impairing the inundation lowland agriculture. Fishing, too, has been adversely affected in that the old fishing boats cannot cope with the swell on the reservoir, which sometimes produces waves 5 m high. Meanwhile the government has only given encouragement to large scale fishing, as well as to large agricultural and cattle-rearing projects.

The 5,322 ha 'Estaço Ecológica da Foz do Rio São Francisco' (Rio São Francisco Mouth Ecological Station)/Praia do Peda has yet to be decreed.
The Platina Basin

The Bacia Platina is formed by the basins of the Rivers Uruguay, Paraná and Paraguay, amounting to 1,415,245 km$^2$ (17% of the territory). Each has its source in Brazilian territory and they all discharge into the Prata estuary (on the Atlantic Ocean).

The Uruguay River Basin

Along its course, until reaching the Plata River estuary, the Uruguay River marks the border between the territories of Brazil-Argentina and Argentina-Uruguay.

The Brazilian section of the Uruguay Basin (see Figure 3, page 8) has an area of 178,235 km$^2$. According to Maurice Pardé’s classification, the rate of flow in the Uruguay River and its tributaries equates to a subtropical rate, conditioned by two flood and low water periods during the year.

The damming of the large drainage canals to form reservoirs for hydroelectric power plants is a threat to the existing marshlands, grassy marshes and river plains, as well as effecting a number of socio-environmental impacts. Concentrated along the Uruguay and Ibicuí Rivers, the floodplains are being converted to irrigated rice crops associated with extensive cattle-rearing and large stock farms.

Expansive polyculture and wheat growing, together with the expanding cultivation of soybean, with their attendant mechanization, are the other modes of land use present in the western portions of Rio Grande do Sul and Santa Catarina, drained by the Uruguay Basin.

These areas also have a high urban and industrial density, represented by major regional centres such as Lages, Joaçaba and Chapecó (SC); Santo Angelo, Erexis and Passo Fundo (RS), etc.
Lower Ibicuí River and grassy marshes of the Uruguay River
37 Lower Ibicuí River and grassy marshes of the Uruguay River (RS)

Location: between 28°40′-30°20′S and 55°40′-57°40′W. It comprises the lower Ibicuí River and the Uruguay River grassy marshes.

Area: 9,400 km².

Altitude: 0-60 m.

Biome/biogeographic province: temperate and subtropical rain forest/Brazilian humid forest.

Wetland types: 12/14/18/19.

Site description: the relief is characterized by a plain morphology gradually increasing westwards towards the Uruguay River.

The Ibicuí River, corresponding to the largest sub-basin of the Uruguay River, rises beyond the Planalto da Campanha and follows a general S-N direction. Entering the Planalto, it alters its course to the NW, and in its lower stages changes to a general E-W direction. The area grassy marshes of the Uruguay River is located in Coxilha de Santana, the interfluvial Quarai and Ibicuí area. The prevailing climate is humid and subhumid with rainfall concentrated in October and March, the mean annual rainfall between 1,400 and 1,600 mm.

The mean annual temperature ranges from 18° to 20°C.

Flora: high predominance of steppe formation plus some formations of dense gallery forest of medium to high size.

Fauna: birds, mammals and fish. Endangered species include Euxenura maguari (American stork), Procyon cancrivorus (crab-eating racoon) and Tapirus terrestris (Brazilian tapir).

Human population: 278,209 people, mainly in the cities of So Borja, Itaqui and Uruguaiana.

Reference number: (page 4, Figure 1) 37.
Summary of the socio-economic and environmental situation of the Uruguay River Basin

Most inhabitants of the Uruguay River Basin are of European origin (Portuguese and Spanish) due to colonization and the immigrants who arrived at the beginning of this century. The major and most traditional activity developed by these plainsmen is cattle and horse ranching. There is an Indian area inhabited by Guaranis; the number of inhabitants cannot be accurately assessed because the area has no demarcation.

Despite the fact that it is a major cattle-rearing area, conditions are so poor, and so few people are employed by the activity, that it does not contribute to the settlement of a rural population. Other forms of agriculture, fishing (carried out by autonomous fishermen) and industry (particularly food production) are also established. There are also a number of self-employed tradespeople.

The Ibicuí valley soils are helpful for the irrigated rice crop. Rice is planted from October onwards, and the harvest extends until May. Soybean and wheat are also cultivated, together with corn and sorghum which are basically used for animal food. Mechanized agriculture, supported by credit mechanisms, consists mainly of cyclic crops. Cattle-rearing plays a major role in the food industry, which employs a high percentage of the area’s industrial workforce; the main product is packed meat.

The region has undergone intense deforestation since the onset of colonization. There is almost no original vegetation left, since settlement and cultivation did not take into consideration the preservation of natural areas. This has greatly affected the ecological balance and, as deforestation continued, the soil gradually became poorer, worsened by steady floods caused by the elimination of bank and headwater vegetation. A desertification process has occurred in the area, due probably to inadequate agriculture, excessive pasturing or a combination of both.

No federal protected areas exist in the Uruguay River Basin, only the following state units:

- Espinillo State Park, established in 1975, with 276 ha;
- Ibirapuit Biologic State Reserve, established in 1976, with 351 ha;
- São Donato Biologic Reserve, established in 1975, with 4,392 ha.
The Paraná River Basin

Extending over an area of 891,309 km², the Paraná Basin, in its Brazilian section (see Figure 3, page 8), covers the upper and part of the middle stretches of the Paraná River, draining lands in the States of Goiás, Mato Grosso do Sul, Minas Gerais, Paraná and São Paulo.

The fluvial rate prevailing in the Basin corresponds to the Austral Tropical, according to Maurice Pardé’s classification, marked by the occurrence of summer floods and low water in the autumn/winter dry season.

The Paraná River and its main tributaries show profiles marked by stressed slope ruptures. This aspect has enabled an intense hydroelectric development of the Basin, in some cases nearly total, completely changing the natural profiles of rivers such as the Tietê, Grande and Paranapanema, and partially the Paranaíba and Paraná Rivers.

Destruction of wide areas of marshlands, grassy marshes and alluvial plains, which follows the construction of reservoirs, represents a high reduction in natural wetlands in the Basin, along with the prolongation of ciliary woods - important corridors for the region’s fauna whose natural habitats are being systematically reduced.

Cattle ranching prevails along the northwestern portion of the State of São Paulo, Triângulo Mineiro and Southern Goiás, while some crops grown for export (e.g. coffee and soybean) are distributed along the whole Basin, with soybean cultivation concentrated mostly in the States of Paraná and Mato Grosso do Sul. In the so-called ‘Depresso Periférica Paulista’ (São Paulo Peripheral Depression), fruit growing prevails, with production of citrus fruits destined for the juice and concentrates export industry. The ‘Pró-álcool’ (pro-alcohol) programme implemented during the 1970s has seen the concentration and expansion of sugar-cane monoculture in lands formerly marked by a diversification of agricultural production.

Dairy farming, crops grown for domestic use, horticulture/fruit growing/stock farming belts and silviculture tied to pulp and paper plants, and more recently to rubber production, are the other soil-based activities present along the Basin, although with a more scattered distribution.

The Paraná Basin drains industrial areas such as the São Paulo and Curitiba metropolitan regions, as well as large urban centres such as Campinas, Americana, Uberaba, Goiânia, Londrina, Campo Grande and Maringá, characterizing this region as having the highest urban-industrial density in the inner country.
PARANÁ RIVER ALLUVIAL PLAIN (SP/PR/MS)

KEY
- Main cities
- Other cities
- BR - 262 Federal Highway
- PR - 180 State Highway
- * International border
- - - - State border
- - Limits of the studied area
- Harbour
- Main rivers
- Lagoon
- Flooded area
- Itaipu dam limits

SOURCE: IBGE, Folha SP-20, 1974
IBGE, Folha SP-10, 1974
IBGE, Folha SP-10, 1976
IBGE, Folha SP-10, 1979

SCALE
14.3 0 14.3 28.6 42.9 57.2 71.5 km

38 Paraná River alluvial plain
38 Paraná River alluvial plain (SP/PR/MS)

Location: between 20°05'-24°45'S and 51°10'-54°17'W, comprising the course of the Paraná River from Jupiá Dam up to the municipality of Guafra. Area: 15,000 km². Altitude: 240-266 m. Biome/biogeographic province: pluvial subtropical forest/Brazilian rain forest. Wetland types: 12/14/18/21.

Site description: the area follows the Paraná River bed from Jupiá Dam (SP) upstream to the vicinity of Itaipú Hydroelectric Power Plant (PR). It is located on the basaltic plateau of the Paraná Basin, characterized by a tabular relief and basalt exposition only on the main river channels and valleys.

The prevailing climate is hot with dry winters. The mean annual temperature varies around 22°C. Annual precipitation is about 1,300 mm, January being the most rainy month.

Flora: the region is deeply deforested, mainly on the São Paulo side, but still retains some areas of semideciduous seasonal forest, as well as fluvial influence pioneer formations (marshland).

Fauna: the regional fauna is now quite endangered by the advance and development of agriculture and cattle-rearing. Some species of mammals, birds, fish and reptiles, however, still remain. Endangered species include Hydrochoerus hydrochaeris (capybara), Cebus sp. (capuchin monkey) and Tayassu tajacu (wild pig).

Human population: 26 cities in the States of São Paulo (5), Paraná (8) and Mato Grosso do Sul (13) with a total population of around 562,185 inhabitants.

Reference number: (page 4, Figure 1) 38.
39 Rosana and Taquaruçu Hydroelectric Power Plants (SP/PR)

Location: the dams of these power plants are situated on the Paranapanema lower river at the State of São Paulo and Paraná border; the Rosana UHE lies 350 km from the Paranapanema River mouth, while the Taquaruçu UHE is 2.5 km upstream of the Pirapó River (Paranapanema left bank tributary) mouth. Coordinates: 22°15' and 20°S and 51°30'-53°W.

Area: the Rosana Reservoir flood area covers 24,100 ha and has a storage capacity for 1,920 x 106 m³ of water. The plant has the capacity to produce 320 MW.

The Taquaruçu Reservoir has flooded an area of 8,800 ha with storage capacity for 700 x 106 m³ of water. The plant has a 500 MW capacity.

Site description: the Rosana UHE was started in March 1987 while Taquaruçu UHE began in 1990.

The climate, according to Koppen classification, meets two types: AW and Cfa. The mean temperature is 21°C; the lowest temperatures are reported to occur in May and August (13°C) while the highest are reported to occur between January and March (32°C). Rainfall rate is around 1,500 to 1,600 mm on the Paraná side and around 1,100 to 1,300 mm on the São Paulo side.

Flora: the flooded area comprises formations of Primary Semideciduous Rain Forest, Secondary Semideciduous Rainforest, Ciliary Vegetation and Marshland Fields.

Fauna: reptiles, birds, mammals and fish. Endangered species include Cercocyon thous (wild dog), Felis wiedii (margay) and Coendou sp. (hedgehog).

Human population: the area of influence of the two reservoirs reaches 19 municipalities (partially affected by the flood), of which 6 are in São Paulo and 13 in Paraná, amounting to 9,909 km².

The municipalities of Paranavaí (PR) and Pirapozinho (SP) are important urban centres.

The flooded area housed 2,771 inhabitants in the urban zone and 255 in the rural zone, amounting to 3,026 inhabitants.

Reference number: (page 4, Figure 1) 39, (see also Figure 4, page 16).
40 Itaipú Hydroelectric Power Plant (PR)

**Location:** the Itaipú UHE is located on the Paraná River between Brazil and Paraguay, its reservoir headwaters being in Guaiíra (Brazil) and Saltos del Guairá (Paraguay) and the dam in Foz do Iguaçu (Brazil) and Hernandárias (Paraguay) at 25°30'S and 54°20'W.

**Area:** the flooded area covers 1,460,000 ha (835,000 ha in Brazil and 62,500 ha in Paraguay), over a length of 151 km, inundating municipalities and provinces. The plant’s total forecast power is 12,600 MW.

**Altitude:** 200-400 m approximately.

**Site description:** the Itaipú region belongs to the Guarapuava Plateau and is characterized by the plateau’s geologic uniformity, and the presence of large volcanic lava sheets, with red and yellow, podzol-type, hydromorphic and organic soils.

The mean annual precipitation ranges from 1,200-1,300 mm in Guaiíra and from 1,600-1,700 mm in Foz do Iguaçu, the wettest season being December to February. Construction began in 1975 and power generation started in 1983.

**Flora:** a forest inventory was made due to the Itaipú interest in planting trees on the reservoir banks. 900 species were identified. After the reservoir was flooded, 1,000,000 cuttings of native species were planted in about 28,000 ha (on the Brazilian side), in the form of a 14,000 km long hedge around the dam.

**Fauna:** 9,300 animals were rescued on the Brazilian bank during the lake filling phase. With the exception of the venomous animals, which were sent to ‘Instituto Butant’ (an institution for scientific research) in São Paulo, the other animals were released in biologic refuges located in a 3,460 ha area in Foz do Iguaçu and Santa Helena. As to the ichthyofauna, 82 species were recorded after the flooding of the dam, of which 15 were not recorded prior to the filling. The following scarce animals were rescued: *Mymecophaga tridactyla* (great anteater), *Felis concolor* (puma), *Felis pardalis* (spotted leopard cat) and *Cerdocyon thous* (wild dog).

**Human population:** the area covered by the lake housed 100,000 inhabitants. Most of them were resettled on the left bank of the Paraná, between the municipalities of Foz do Iguaçu and Guaiíra. Apart from the settlements, the districts of Alvorada do Iguaçu (Foz do Iguaçu) and Itacarí (São Miguel), amounting to 11,000 inhabitants, were entirely flooded.

**Reference number:** (page 4, Figure 1) 40,

(see also Figure 4, page 16)
Summary of the socio-economic and environmental situation of the Paraná River Basin

The Paraná River Basin includes four Guarani Indian settlements (about 150 inhabitants). A process of rural migration is presently ongoing, most noticeably on the Paraná bank. This process arose when coffee was replaced by soybean, the cultivation of which is highly mechanized. On the Mato Grosso do Sul and São Paulo banks the migration results from the growth in cattle ranching at the expense of farming, which employs more labour.

Land ownership is highly concentrated in the hands of the major cattle-rearers, which gives rise to conflict. Land use is dominated by pastures, which occur mostly on the Mato Grosso bank, while the São Paulo bank is cultivated. Farming is carried out in small to medium-sized plots. The small properties produce basic food, employing family labour. Squatters, small crop sharers and lessees with restricted capital are also found in the area.

Soil potential and the demand for meat contribute to the increasing expansion of cattle-rearing at the expense of crops. The area of pastureland widely outstrips that of cultivation. In Mato Grosso do Sul cattle-rearing concentrates mainly on reproduction, while in São Paulo the main activity is the fattening of cattle for slaughter at the cold storage plants.

Damming of the Paraná River in Jupiá, where Porto Primavera UHE was built, has seriously affected the aquatic environment. Some species, such as pintado (Pseudoplatistoma corruscans), dourado (Salminus maxillosus) and jaú (Paulicea luetkeni), migrate upstream to reproduce. The dam interrupts this process, affecting reproduction, reducing egg-laying and resulting in fewer young fish. Catching of fish at their reproductive stage worsens the situation and in the medium to long term populations of these fish may decrease.

The prevailing industrial sector in the São Paulo and Mato Grosso municipalities is that of food production, based on cattle-rearing, followed by the non-metallic minerals, textile and wood sectors.

For the environment, the major problem is degradation in the quality of the Basin’s water resources, linked with the disposal of untreated home and industrial effluents in almost every city, industry and industrial complex. Considerable investment is required for the supply and treatment of water for both public and industrial consumption. The presence of herbicides and fungicides used in farming and cattle-rearing development may also become a considerable source of pollution.

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The construction of Itaipú, Rosana and Taquaraçu UHE’s (hydroelectric power plants) brought about fundamental changes to the Basin. A considerable number of workers has been attracted to the region by the available work. People have moved away from the dammed and flooded areas. Following the Itaipú lake inundation, commercial fishing has developed in the region, under the control of three fishing guilds who have implemented infrastructures for the unloading, handling and transportation of fish.

The following protection areas are located in the Paraná Basin:
- Morro do Diabo State Park (SP), established in 1986, with 34,441 ha;
- Iguaçu National Park (PR), established in 1939, with 170,086 ha.
The Paraguay River Basin

With an area of 345,701 km², the Brazilian section of the Paraguay River Basin (see Figure 3, page 8) comprises essentially the upper course of this river, located in the States of Mato Grosso and Mato Grosso do Sul.

The Paraguay River’s headwaters are located in Chapada dos Parecis (MT) and, after passing through the lower terrain of the upper Paraguay depression, it enters the wide plain of the ‘Pantanal Matogrossenses’ (Mato Grosso lowlands).

The extent of the network of tributaries converging into rio Paraguay, associated with the extremely low declivity of the lowland depression, is the reason why this region is one of the major wetlands of the earth, extending over some 140,000 km².

About 10 lowlands (Pantanais) are individualized, comprising specific associations of physiographic, hydrological and biotic elements.

Generally the ‘Pantanais Matogrossenses’ as well as the other drainage areas of the Paraguay Basin are affected by the action of a tropical climate alternating two well-defined seasons - a dry winter (April to September) and a wet summer (October to March).

The distribution of the seasonal rainfall gives the basin an Austral Tropical climate consisting of two distinct periods during the year: one of floods, and one of low water.

The main types of wetland present in the Paraguay Basin are associated with the lowland plain, namely: ‘corixos’ (lake outlets), ‘bafas’ (river lakes) or permanent lagoons, meandering and connected water courses, swampy terrains, marshlands and periodically flooded fluvial plains. Among other features are the locally named ‘vazantes’ (low damp lands) and ‘salinas’.

Traditionally, the activities developed along the Basin are associated with fishing, hunting, extraction of raw material, and small agriculture practised by the several Indian peoples and other groups inhabiting the region. Extensive cattle-rearing and prospecting for precious minerals is also carried out.

In recent decades, agricultural modernization through the expansion of mechanized soybean cultivation and agricultural development of stunted woodland areas - projects promoted by the government have affected a number of transformations along the Basin.
Hydroelectric development is taking place along rivers located in the mountain range in northern Cuiabá, where the Manso Hydroelectric Power Plant is under construction. This is the first large-scale energy development in the Upper Paraguay Basin.

Considering that the subbasins forming the large drainage ditches in the Pantanal (Mato Grosso lowlands) are fundamental areas for reproduction of fish stocks, special attention should be given to hydroelectric development planning.
41 Pantanales Matogrossenses (MT/MS)

Location: between 15°8'-22°S and 55°-59°W. It covers the upper rio Paraguay Basin, upstream of the rio Apa confluence.

Area: 140,000 km².

Altitude: 80-100 m.

Biome/biogeographic province: savannas and stunted-tree woodland/deciduous scrub forest savannas.

Site description: the Mato Grosso lowlands are the largest aquatic environments in the world, extending over some 140,000 km². It is a sedimentary plain of fluvial and fluvio-lacustrine sediment accumulation, drained mainly by the Paraguay River, which flows westwards across the plain, and its left bank tributaries. These lowlands are bordered by plains and residual elevations: the Taquari-Itigura and Maracaju-Campo Grande plateaux to the east, the mountain range to the north, the residual Bodoquena plateaux to the south, and the Urucum-Amolar hills to the west.

The slow natural drainage means that the lowlands are subject to great seasonal fluctuations in the extent of flooding. The climate is hot with two well-defined seasons: the rainy one, in summer (October to March), and the dry season, in winter (between April and September). The rainfall rate ranges between 1,000 and 1,500 mm. Mean temperatures range between 23° and 25°C. The area with the highest temperatures is situated in the Cuiabá River region (exceeding 40°C in December), while some regions drop as low as 0°C in the winter months (July).

In view of the huge size of the region, it may be divided into 10 lowlands:

1. Pantanal do Corixo Grande Jauru-Paraguai;
2. Pantanal do Cuiabá - Bento Gomes - Paraguaizinho;
3. Pantanal do Itiquira - São Lourenço - Cuiabá;
4. Pantanal do Paraguay;
5. Pantanal do Taguari;
6. Pantanal do Negro;
7. Pantanal do Miranda-Aquidauana;
8. Pantanal do Jacadigo - Nabireque;
9. Pantanal do Tarum-Jibóia, Aquidad and Branco Amonquijá;
Flora: the ‘Pantanal Matogrossense’ vegetation varies widely, not only in terms of the number of existing species but also in relation to the formations and, mainly, in relation to the peculiar ecological associations and interactions developed between them.

Generally, the formation prevailing in the area is of Savannah (stunted-tree woodland).

Forest formations occur, strictly associated with the savannah, mainly characterized by Semideciduous Seasonal Forest in inundation areas bordering the rivers, and also by Deciduous Seasonal Forest (submontane and in low lands). Restricted proportionally but nevertheless occupying a large area in total, Steppe Savannah (swamp vegetation) covers wide, periodically flooded plains.

Fauna: the variety of ecosystems in the region give rise to a wide variety of species, a majority of them becoming scarce.

Mammals: Alouatta caraya (howling monkey), Speothos venaticus (wild dog), Tayassu tajacu (white collared peccary), Felis pardalis (spotted leopard cat), F. concolor (puma), Panthera onca (jaguar), Bradipus tridactylus (three-toed sloth), Felis pardinaoides (margay), Chrysocion brachyurus (agouara), Myrmecophaga tridactyla (great anteater), Blastocerus dichotomus (swamp deer), Tolypeutes tricinctus (three-banded armadillo), Priodontes giganteus (giant armadillo), Ozotocerus bezoarticus (pampas deer), Pteromura brasiliensis (giant river otter), Lutra platensis (otter), Tapirus terrestris (tapir).

Birds: Anodorhynchus hyacinthinus (blue macaw), Spizaetus ornatus, Harpia harpya (harpy eagle), Penelope obscura (guan), Pipile cumanensis (black-fronted piping guan), Crax fasciolata (Natterer’s curassow), Oryzoborus crassirostris (Wied’s rice grosbeak).

Reptiles: Caiman jacare (alligator).

Human population: the ‘Pantanal’ is one of the least populated areas in the country, with an approximate overall population of 420,000 inhabitants in 15 municipalities.

Reference number: (page 4, Figure 1) 41.
Pantanal Matogrossense National Park
42 Pantanal Matogrossense National Park (MT)

Management category: II.

Biogeographic province: deciduous scrub-forest savannah.


Location: in the southern region of the State of Mato Grosso, next to the municipalities of Poconé and Cáceres and between coordinates 17°23'-17°53'S and 57°10'-57°41'W.

Land tenure: IBAMA.

Altitude: 80-100 m.

Area: 135,000 ha.

Site description: considered as an ecological sanctuary, this Park may be described as an enormous delta, and a prolongation of the Brazilian stunted-tree woodland, forming a distinct region, unique and uniform. One of its main physical characteristics concerns the prevailing hydrologic dynamics, the constant alternation of flood and low water periods. The climate is hot with two well-defined seasons: a rainy one in summer (October to March) and a dry one in winter (between April and September), with variations occurring in different areas. Annual rainfall varies between 1,000 and 1,500 mm and mean temperatures range from 23°-25°C.

Threats: the main threats to the Park’s environment are, in general, hunting and fishing; the illegal trade in wild species; contamination by mercury and rivers silting up due to mineral extraction activities (mainly of gold); contamination by agrochemicals, industrial sewers and alcohol mill liquid residues; and road and hydroelectric power plant construction which, in spite of being carried out in areas outside the Park, may affect its ecological balance.

Reference number: (page 4, Figure 1) 42,
(see also Figure 5, page 18).
43 Cará-Cará Federal Biological Reserve (MT/MS)

Management category: I.

Biogeographic province: deciduous scrub forest.

Established: 28 May 1971, by Federal Decree number 68,091.

Location: in the west of Pantanal Matogrossense, close to the Brazil-Bolivia border, with the coordinates 17°25'-17°53'S and 57°22'-57°41'W.

Land tenure: IBAMA.

Altitude: 61,126 ha.

Site description: Mato Grosso lowland region comprising marshes, lakes and bays. At the western edge lie 350 m high mountains, and to the north the Reserve is bordered by Serra do Amolar and several large lakes. The lowland areas are subjected to large-scale seasonal flooding.

Threats: illegal hunting; smuggling of the spectacled caiman; and lack of inspection to protect the Reserve area.

Reference number: (page 4, Figure 1) 43, (see also Figure 5, page 18).
44 Taíamá (or Taimá) Ecological Station (MT)

Management category: I.

Biogeographic province: deciduous scrub-forest savannah.

Established: 02 June 1981, by Federal Decree number 86,061.

Location: mid-west of the State of Mato Grosso, 250 km in a southeast direction from the city of Cuiabá, with the coordinates 16°50’S and 57°23’-57°30’W.

Land tenure: IBAMA.

Altitude: 0-50 m.

Area: 14,325 ha.

Site description: no information available.

Threats: extensive cattle-rearing, contamination by mercury resulting from mining activities, hunting and fishing.

Reference number: (page 4, Figure 1) 44,

(see also Figure 5, page 18).
Summary of the socio-economic and environmental situation of the Paraguay Basin

Several Indian populations inhabit the area, but figures are inaccurate. The majority of Indians belong to the Kadiwéu, Terena, Kinkinao, Guarani (Kaiowá), Guató, Boror, Umutina, Pareci and Komba, people who basically live in FUNAI (National Indian Foundation) reserves, although an increasing number now live in suburbs. The Kadiwéu culture represents one of the most significant Amerindian cultures, famous worldwide for its ceramics, metalwork, leather engravings, weaving and also for its music.

Traditional lowland cultures are divided equally among various groups, e.g. cattle-rearers, farmers, leather dealers, fishermen, prospectors and wood cutters.

Cattle-rearing in the natural pastures is extensive and highly traditional. The annual cattle migrations away from lowland pastures during the seasonal floods are among the largest in the world. Amongst stock reared for the slaughterhouse, cattle are the most important, followed by pigs and the experimental raising of bubalis (antelope), which was developed in Diamantino and Corumbá.

Fishing activity in the 'Pantanal' represents a major nutritional and income source to the local riverbank population. The best catching period is from April to October (drought), due to the reduced volume of water in the rivers. In the flood season, fish move to the lagoons (the main lowland fish biotypes). The migrating fish represent a high percentage of target species, the most caught species being: pintado (Pseudoplatistoma corruscans), cachara (P. fasciatum), curimbatá (Prochilodus), dourado (Salminus maxillosus) and pacu (Mylossoma). The current fishing production in the Mato Grosso do Sul lowlands is estimated to be around 2,000 tons/year.

The city of Cáceres is the main wood trade and industrial centre. Among the most sought after wood is cherry (Amburana acreana), angico (Piptadenia), piuna (Tabebuia) and castelo (Albus).

In the lowland region the smuggling of alligator (Caiman), jaguar (Panthera onca), agouara (Chrysocyon brachyurus) and snake skins is widespread, as it is the trade in live animals such as parrots and blue macaw (threatened with extinction). The illegal alligator hunting, the largest smuggling activity, is carried out by skin dealers, and is a threat both to the animals and to the safety of the local population. However, international skin trafficking goes unpunished on both sides of the Paraguay River border.
Aside from traditional industrial manufacturing activities, e.g. jerked (thinly cut and cured) beef produced for export, alembics (distilling) and ceramics, the Basin’s industrial activity concentrates on the processing of raw materials for food, clothing and shoes, mainly serving the local trade. Cuiabá is the largest industrial complex in the region, followed by Corumbá, where the installation of a steel-making plant is being widely questioned.

Diamond and gold extraction are the main economic interests in the northern ‘pantanal’ region, where about 700 dredges exist, functioning illegally on the Cuiabá River. Other minerals encouraging hydroelectric development are, e.g. ferromagnesium deposits in Corumbá region, uranium in Bonito region, molybdenum, copper and silver. Non-metallic mineral, e.g. fluoride and limestone (the latter used in cement manufacturing), may come to occupy a significant economic position. Mining of ferromagnesium ores in Corumbá is fairly sophisticated, with underground mines for manganese and open cast mining for iron and limestone. A pig iron plant is also under construction in Corumbá.

Marsh drainage and deforestation of river headwaters and ciliary woods for conversion to pastures and for INCRA (National Colonization and Agrarian Reform Institute) settlements are contributing considerably to environmental degradation. The result is soil impoverishment, increased water turbidity, and rivers silting up due to soil erosion. Eventually the rivers are rendered useless as means of circulation, their biological capacity is compromised, and deltas form in the estuaries which, even though surrounded by dikes, restrict water circulation. Water pollution by toxic chemicals used in agriculture, industrial sewage and by alcohol plant residues is a problem that remains unsolved.

Local government development projects include the construction of roads and hydroelectric power plants which may change seasonal river dynamics (flood, ebb tide and drought), one of the most influential factors of the ‘pantanal’s’ ecology.

Chaotic tourism should also be listed as a threat to the ‘pantanal’ ecosystem, worsened by rapacious hunting and fishing. An appropriate management plan to regulate these activities would benefit the local economy. Legalization of trade in animals such as capybara and alligator is proposed through the regulations governing the ranching system. Unfortunately, although it may become profitable, this would not stop the illegal hunting associated with tradition and with international smuggling.

Such a management plan should include the protection of springs and water tables, and the control of erosion, silting up and pollution caused by current agricultural and agro-industrial (alcohol plant residues) practices.
An Inventory of Brazilian Wetlands

The following protection areas are located in this basin:
- Pantanal Matogrossense National Park, established in 1981, with 135,600 ha;
- Taimá Ecological Station, established in 1981, with 12,000 ha;
- Cará-Cará Federal Biological Reserve, established in 1971, with 61,126 ha.
The Northeast Basin

The Northeast Basin includes the States of Piauí, Ceará, Rio Grande do Norte and parts of the States of Maranhão, Paraíba, Pernambuco and Alagoas, amounting to 884,835 km² (see Figure 3, page 8).

It comprises three large relief compartments: the Maranhão-Piauí Plateau, which represents a set of low sedimentary plateaux and cuestas; the Planalto Nordestino with low altitudes (200-500 m) where mountain ranges and sedimentary plateaux overlap; and the plains and low coastal lands - a narrow strip of northeastern coastline with Tertiary terrains on barriers along the seashore or tablelands and Quaternary terrains on the alluvial lowlands.

The Maranhão rivers are important for their different characteristics compared to the other northeastern rivers. Originating from mountain ranges and the Maranhão and Piauí Plateaux (Serra do Gurupi, Chapada das Mangabeiras, etc.), these rivers - among them the Gurupi, Turiaçu, Pindaré, Grajaú, Meaum and Itapecuru - are tributaries of the Golfo Maranhense, their sources lying in rainfall rate zones of between 1,500 and 2,000 mm annually. The porous nature of the high valley terrains provides a remarkable and important water storage role.

Rainfall occurs mostly in autumn-winter. The interaction of rainfall and the wet and humid conditions provided by the Borborema Plateau escarpment also contribute to river feed and consequent rate.

From north to south the Rivers Potengi (RN), Corimataú (PB), Paraíba do Norte (PB), Capibaribe (PE) and Una (PE) are noteworthy.
KEY
- Main cities
- Other cities
BR - 010 Federal Highway
MA - 106 State Highway
--- State border
- - Limits of the studied area
★ Harbour
\ Main rivers
L Lagoon
\\ Flooded area

SCALE
25 0 25 50 75 100 km

SOURCE: IBGE - Projeto Radenfbrasil, Amazônia Legal, 1983

45 Pará-Maranhão coast
45  Pará-Maranhão coast (PA/MA)

Location: between 44°15’-48°W and 0°-3°S. It comprises the considerably indented coastline of Pará and Maranhão reentrances, including the lower stretches of the rivers Marapanim, Maracan, Gurupi, Turiaçu and Pericum.

Area: 20,856 km².

Altitude: 0-5 m.

Biome/biogeographic province: humid rain forest/wood.

Wetland types: 2/3/7/9/10/11/14.

Site description: extensive developing coastline, indented by over 35 bays and estuaries with wide mangroves, frequently interrupted by white-sand beaches, coastal dunes and sand banks. Fronting the coast are a number of low islands, such as Manuel Luís Reef (coral bank) and the Silva and Mestre Ivaro shoals. The bays and estuaries are among the most important and valuable waterfowl refuges in the whole of Brazil, sheltering over 350,000 birds.

The regional climate is hot and humid with a temperature ranging from 25° to 26°C. The rainfall rates are high, the yearly period without rains being short.

Flora: the regional forest cover is characterized by secondary, broad-leaf Thick ‘Ombrófila’ Forest (Rain Forest), as well as by fluviomarine influence pioneer formations (mangrove).

Fauna: birds, mammals, fish and crustacea. Endangered species include Harpia harpya (harpy eagle), Morphnus guianensis (crested eagle), Crax fasciolata pinima (Natterer’s curassow), Aratinga guarouba (golden paroquet), Trichechus manatus (manatee), Procyon cancrivorus (crab-eating racoon), Panthera onca (jaguar), Tapirus terrestris (tapir) and Tayassu tajacu (white-lipped peccary).

Human population: the area covers municipalities in both Pará and Maranhão States, amounting to 615,058 inhabitants in 23 municipalities.

Reference number: (page 4, Figure 1) 45.
Maranhão Gulf
46 Maranhão Gulf (MA)

Location: between 43°55'-45°28' W and 0°22'-2°22' S. It comprises the Baía de São Marcos, Ilha dos Caranguejos, swampy marshlands of the Rivers Pindaré-Mirim, Grajaú, Mearim, Baía de São José and Ilha de São Luís.

Area: 23,200 km².

Altitude: 0-15 m.

Biome/biogeographic province: savannahs and stunted-tree woodland/babassu.

Wetland types: 1/2/3/8/10/14.

Site description: wide estuarine-lacustrine system with extensive riverbank and coastal mangroves forming a single huge expanse of water during the Baixada Fluminense floods, covering, among others, the Mearim, Pindaré and Grajaú Rivers. Along the increasingly urbanized, industrialized and polluted western coast of the Ilha de São Luís lie the Madeira, Itaqui and Alcoa ports (Carajás export corridor terminal). The climate is hot and humid with high rainfall concentrated in the January-June period and drought from July to December. Tidal penetration extends far inland from the estuaries, reaching a depth of up to 6.5 m.

Flora: the vegetation is composed mostly of pioneer formations, where those of arboreal fluvio marine influence (mangrove), marine influence (sand bank), and alluvial influence (marshland) are most important.

In addition, areas of combined secondary forest with babassu (palm tree) occur.

Fauna: well diversified, with birds, mammals, reptiles, molluscs, crustacea and fish. Endangered species include Porphyryla martinica (rail), Dendrocygna autumnalis (black-bellied tree duck), Alouatta fusca (howling monkey), Felis concolor (puma), Procyn cancrivorus (crab-eating racoon), Tricherus manatus (manatee), Bradypus torquatus (three-toed sloth) and Caiman crocodilus (Paraguay caiman).

Human population: 1,118,270 inhabitants in 28 municipalities, Viana, Cajari, Alcântara and São Luís being the largest centres.

Reference number: (page 4, Figure 1) 46.
Maranhão eastern coastline and Parnaíba Delta
Maranhão eastern coastline and Parnaíba Delta (MA/PI)

**Location:** between 2°15′-3°25′S and 41°32′-43°50′W, covering the eastern coast of the State of Maranhão and the Parnaíba Delta (PI).

**Area:** 10,750 km².

**Altitude:** 0-100 m.

**Biome/biogeographic province:** savannas and stunted-tree woodland/babassu.

**Wetland types:** 1/2/3/9/10/11.

**Site description:** extensive coastline surface characterized by two distinct geomorphologic units: a ‘rivers’ coastline in the western section of the Maranhão coast, extending as far as the rio Piriá; and the ‘Lençóis Maranhenses’ (Maranhão Groundwaters) which extend eastwards up to the Parnaíba Delta. The former is characterized by a covering of extensive mangroves along the several channels and islands, while the ‘Lençóis Maranhenses’ coastline consists of mobile dune systems and sand banks shaped by the actions of the northeastern trade winds and by high amplitude tides. The result of these processes can be seen by the presence of wide dune fields which prevent the water courses from reaching the ocean. The mouths of these rivers are, in general, diverted to the west, when not dammed, forming lines of extensive lagoons and ponds. The presence of dune systems, which stretch inland for up to 50 km, does not prevent ‘Barrier Formations’ from occurring along the extreme coastal range. The region’s climate is characterized by the transition between hot semi-arid and semi-humid tropical types. The eastern sector has the lowest rainfall (1,250-1,500 mm yearly) and the longest dry period (6 months - June to November), while westward the annual precipitation totals are higher (1,500-2,000 mm) and the dry period decreases to 3-5 months. Over the region as a whole, the climate is very hot, mean annual temperatures above 26°C.

**Flora:** the coastal region is totally occupied by pioneer formations, where those of fluvimarine arboreal (mangrove) and marine influence (sand banks) are prominent. Inland are secondary combined deciduous forest formations.

**Fauna:** rich in birds, mammals, fish, molluscs and crustacea. Endangered species include *Eudocimus ruber* (agouara), *Trichechus manatus* (marine manatee), *T. inunguis* (manatee), *Hydrochoerus hydrochaeris* (capybara), *Pteronura brasiliensis* (otter) and *Tapirus terrestris* (tapir).

**Human population:** 382,162 inhabitants in 12 municipalities (7 of which are in Maranhão and 5 in Piauí).

**Reference number:** (page 4, Figure 1) 47.
Rio Grande do Norte saline zone (RN)

Location: between 36°-37°45′W and 4°45′-5°34′S. It comprises the Mossoró and Macau saline zone.
Area: 32,000 km².
Altitude: 0-100 m.
Biome/biogeographic province: ‘dry’ tropical or deciduous/stunted ‘sparse’ forest.
Wetland types: 2/4/7/9/10/11.
Site description: the area lies in the north coastline plateaux, which are part of the northeastern coastal tableland region.
On the coastal strip, overlapping with the tablelands, are mobile dune systems of marine and/or continental origin, located chiefly in Areia Branca and Galinhos municipalities.
The Areia Branca and Macau region offers ideal conditions for salt production: level topography with natural depressions enabling storage of sea water, tidal water penetration for tens of km, compacted soils, plus high heat, wind and dry weather. Owing to these facts, the area is responsible for about 75% of the country’s salt production. The region’s climate is semi-arid, with a mean annual temperature around 26°-27°C. Mean annual rainfall is around 650 mm. For about 76% of the year rainfall is under 60 mm, while precipitation amounts to over 180 mm during the short rainy period (February to April).
Flora: the inner part of the area’s prevailing vegetation is stunted forest, open areas of scattered native trees and bushes, and parkland of human origin resulting from deforestation. Also occurring are herbaceous fluviomarine influence pioneer formations.
Fauna: birds, fish and crustacea.
Human population: 281,192 inhabitants in 12 municipalities.
Reference number: (page 4, Figure 1) 48.
An Inventory of Brazilian Wetlands

KEY

- Main cities
- Other cities
BR - 101 Federal Highway
BR - 106 State Highway
--- Limits of the studied area
* Harbour
- Main rivers
- Intermittent river
- Lagoon

SCALE

5 0 5 10 15 20 km

SOURCE: Min. dos transportes-DNER
Aluena rodoviaria cartografica - 1982

49 Potengi River mouth
49 Potengi River mouth (RN)

Location: between 5°15' -6°22'S and 35° -35°30'W.
Area: 435 km².
Altitude: 0-10 m.

Biome/biogeographic province: dry rain forest/stunted ‘sparse’ forest.

Wetland types: 2/7/8/10/11/15.

Site description: the Potengi estuary is located on the eastern coastline of Maranhão State at the NE limit of Brazil. The estuary, which receives intermittent, though small, discharges from three rivers (Potengi, Jundiaí and Doce), empties into a bay. The region is marked by a high-intensity wind in spite of the occurrence of a secondary marine breeze which blows the whole year round.

Poorly developed urbanization exists among the extensive dune systems along the coastal strip.

Flora: the inner areas are used for agriculture of cyclic crops, located in areas originally occupied by steppe and Semideciduous Seasonal Forest.

Fauna: birds, fish and crustacea.

Human population: 478,962 inhabitants in 3 municipalities and part of the capital city, Natal.

Reference number: (page 4, Figure 1) 49.
Goiana River mouth and Itamaracá Estuary
Goiana River mouth and Itamaracá Estuary (PE)

Location: between 34°46' -35°01'W and 7°30' -7°56'S. The Itamaracá Island is located to the east.

Area: 485 km².

Altitude: 0-5 m.

Biome/biogeographic province: humid rain forest/Serra do Mar.

Wetland types: 2/3/7/8/10.

Site description: the area is a fluviomarine plain resulting from levelling through the combination of fluvial and marine accumulation processes, generally subject to periodical floods (7 to 9 months a year), hence the occurrence of mangrove woods.

The climate is hot and humid, with a dry season in summer and autumn-winter rains. The most severe drought occurs in October/November and December. Temperatures are high with annual averages around 24°C.

In the extreme north the tropical rainy monsoon climate prevails, with dry summers (less than 60 mm in the driest month) and high annual precipitation.

Flora: originally, the inner portions were occupied by Thick Rainforest and, more to the north, by a Savannah-Seasonal Forest Contact region. Currently, however, all these regions are under strong agricultural pressure (cyclic crops).

Fauna: birds, fish, molluscs and crustacea.

Human population: the main population centres are located inland, while on Itamaracá Island the population is mostly coastal. The total population is 257,275 inhabitants.

Reference number: (page 4, Figure 1) 50.
SUAPE ESTUARY (PE)

51 Suape Estuary
Suape Estuary (PE)

Location: between 35°5'-34°55'W and 8°15'-8°30'S; it comprises the estuary complex of Jaboato, Pirapama and Ipojuca Rivers, as far as the Porto de Galinhas settlement 350 km away at southern Recife (PE).

Area: 520 km².

Altitude: 0-15 m.

Biome/biogeographic province: humid rain forest/Serra do Mar.

Wetland types: 2/4/7/9/10/11.

Site description: the region comprises an estuary complex formed, in the north, by the Jaboato and Pirapama Rivers and, in the south, by the confluence of Massangana, Tatuoca, Ipojuca and Marepe Rivers. The estuary discharges into Suape bay which was once protected by 9 km long reefs. The reefs were blasted for the construction of the Suape Port Industrial Complex mooring berth. The region contains two huge mangrove zones, which are also being destroyed by the complex, as well as sand banks, beaches and alluvial plains which extend uninterruptedly from the Santo Agostinho cape to Galinhas Port. The regional climate is hot and humid - an average of 27°C annually - and quite rainy, with precipitations between 1,800 to 2,000 mm/year.

Flora: the vegetation in this area is constituted by Marine Influence Pioneer Formations (sand bank) and arboreal Fluvimarine Influence (mangrove).

Fauna: birds, fish, molluscs and crustacea.

Human population: the area comprises part of the municipalities of Cabo and Ipojuca, amounting to 104,157 inhabitants.

Reference number: (page 4, Figure 1) 51.
52 Mundaú and Manguaba coastal lagoons
52 Mundaú and Manguaba coastal lagoons (AL)

Location: between 35°58’-35°44’W and 9°35’-9°46’S; the lagoons are located in southern Maceió and are formed mainly by rio Mundaú (lagoa Mundaú) and by the Rivers Paraíba and Sumaúma Grande (lagoa de Manguaba).

Area: 600 km².

Altitude: 0-5 m.

Biome/biogeographic province: humid rain forest/Serra do Mar.

Wetland types: 3/7/9/10/11.

Site description: the Mundau and Manguaba lagoons comprise a lagoon ecosystem which receives the waters from both the rio Mundau and Paraíba do Meio watersheds, as well as tidal inflows. Incoming nutrients carried by the inner water courses create a highly productive system, and a complex food web which supports an important food source for man.

The regional climate is hot with mean annual temperatures around 24°C. The lagoons are interconnected, with a single channel connecting them to the sea.

Flora: the vegetation is restricted to Pioneer Formations, both of herbal marine influence (sand banks) and of arboreal fluvimarine influence (mangrove).

Fauna: birds, fish, crustacea and molluscs.

Human population: 452,971 inhabitants in 5 municipalities located on the banks of the lagoons.

Reference number: (page 4, Figure 1) 52.
53 Roteiro and Jequiá coastal lagoons
53 Roteiro and Jequiá coastal lagoons (AL)

**Location:** between 36°12'–36°09'W and 9°48'–10°10'S; it comprises Roteiro, Jequiá and Posa lagoons.

**Area:** 151,18 km².

**Altitude:** 0-100 m.

**Biome/biogeographic province:** humid rain forest/Serra do Mar.

**Wetland types:** 2/7/8/10/11/15.

**Site description:** a Quaternary plain, originating from fluvio marine deposits; part of Roteiro and Jequiá is of recent formation.

Next to eight lagoons, on the area’s west side, lie coastal tablelands pertaining to the Barrier Formation; the terrains surrounding the lagoons also being Quaternary, with dendritic covers which prevail almost the whole area over, except for the Boca da Mata municipality region, which belongs to the Presidente Juscelino Complex. Dense water drainage (resulting in the formation of the lakes) has cut steeply sloping valleys with ravines.

Climate is the monsoon rainy tropical type, with dry summers and wet winters. The annual rainfall rate is 1,600 mm at the coast, lowering to 1,400 mm towards the interior.

**Flora:** almost the whole region was occupied originally by Open Rain Forest and is now under severe pressure from agricultural activities, mainly cyclic crops.

On the coastal region are small areas of Arboreal and shrub Marine Influence (sand banks) Pioneer Formations.

**Fauna:** birds, fish, crustacea and molluscs.

**Human population:** 129,578 inhabitants.

**Reference number:** (page 4, Figure 1) 53.
54  Lençóis Maranhenses National Park (MA)

Management category: II.
Biogeographic province: Guyana.
Established: 02 July 1981, by Federal Decree number 86,060.
Location: in the State of Maranhão, in the municipalities of Barreirinhas and with Primeira Cruz; coordinates 2°20'-2°45'S and 42°45'-43°30'W.
Land tenure: IBAMA.
Altitude: 0-50 m.
Area: 155,000 ha.

Site description: beaches, mobile dune systems, rivers and lakes. There are no substantial areas of forest in the Park. Recent alluvial deposits are common, constituted by gravels, sands and clays, which appear as coastline strips along the rivers.
Threats: none to date.
Reference number: (page 4, Figure 1) 54,
    (see also Figure 5, page 18).
55 Monte Pascoal National Park (BA)

Management category: II.

Biogeographic province: Serra do Mar.


Location: far southern part of the State of Bahia, in the municipality of Porto Seguro; coordinates 16°45'-16°55'S and 39°08'-39°30'W.

Land tenure: IBAMA.

Altitude: 0-100 m (Monte Pascoal 586 m).

Area: 14,000 ha.

Site description: the relief is characterized by beach deposits, sometimes as reef banks, large coastal plains, sea cliffs, hills and small mountain ranges.

Threats: serious difficulties for its actual consolidation, since it has insufficient facilities for the ever increasing number of visitors and undergoes constant land-burning, mainly during drought periods.

Reference number: (page 4, Figure 1) 55,

(see also Figure 5, page 18).
56 Fernando de Noronha Marine National Park (PE)*

Management category: II.

Biogeographic province: Fernando de Noronha Island.

Established: 15 September 1988, by Federal Decree number 96,693.

Location: northeastern Brazil, 345 km from the State of Rio Grande do Norte coast; coordinates 3°48′21″-3°52′51″S and 32°22′48″-32°28′36″W.

Land tenure: IBAMA.

Altitude: 0-500 m.

Area: 9,300 ha.

Site description: the Fernando de Noronha archipelago is composed of several islands, each with an irregular relief due to volcanic activity, the largest being some 17 km². At the northeastern end of the archipelago a line of islands acts as a barrier against currents and winds, thus giving the two sides of the islands differing characteristics. The National Park covers 70% of the archipelago, 10% of which corresponds to land, and 90% to marine area.

The mean annual temperature is 25.4°C.

Threats: mainly fishing, the increased activities related to tourism, the introduction of exotic species such as Tupinambis sp. (teiu) (bringing about biological unbalance) and sand extraction for civil construction.

Reference number: (page 4, Figure 1) 56, (see also Figure 5, page 18).

* Wetland Protected Areas of the northeastern Brazilian coast not enclosed by the Northeast Basin.
Atol das Rocs Federal Biological Reserve (RN)*

Management category: I.
Biogeographic province: Fernando de Noronha Island.
Established: 05 June 1979, by Federal Decree number 83,549.
Location: on the Brazilian coast, 232 km from Natal, in the State of Rio Grande do Norte, and about 128 km to the west of Fernando de Noronha Island; coordinates 3°45'-3°56'S and 33°37'-33°56'W.
Land tenure: IBAMA.
Altitude: 0-3 m.
Area: 36,249 ha.
Site description: coral reef in the form of a nearly circular ring, with four openings linking the sea to the inner lagoon, where two small sand islands (hillocks) are located; the Ilha do Farol and the Ilha do Cemitério. The climate is that of the equatorial zone, where the hottest month is August, the lowest temperature being 22°C.
Threats: no information available.
Reference number: (page 4, Figure 1) 57,
(see also Figure 5, page 18).

* Wetland Protected Areas of the northeastern Brazilian coast not enclosed by the Northeast Basin.
Summary of the socio-economic and environmental situation of the Northeast Basin

In the Northeast Basin, traditional livelihood is still well represented, e.g. by skilled river and sea fishermen, craftsmen, the ‘sabineiros’, coconut gatherers, and babassu (*Orbignya martiana*) and carnaúba (*Copernica cerifera*) palm extractors (yielding oil and wax respectively). Since the last century this region has had a high population mobility. In recent years the flows headed for the Amazon, to development centres such as Grande Carajás (Rondônia), as well as to oil production areas, and industrial complexes (Mossoró/ Areia Branca-Macau - RN); Suape complex (Cabo/Ipojuca-PE); Salgema, Chloro-chemical Centre (Maceió - AL). Large influxes also occur for the sugar-cane harvest.

The high mobility generated chiefly by the search for jobs brings about another serious problem - land ownership. Most of the land is concentrated into a small number of large acreages, while the great majority of farms are run on small parcels of land. Usually fishermen and farmers, who work on shared land, do not possess any deed of property.

Among the economic activities developed in the Northeast Basin, fishing and the recent implementation of development centres, mainly in port capital cities and adjacent areas, are most prominent. In Maranhão, fishing in inner rivers and lakes is a common practice. Transportation of fish to the trading centres is one of the main problems faced by fishermen. Fish loss due to poor conditions and dependence on middlemen reduces the profitability of this activity in the whole Northeast Basin.

Farming and cattle-rearing is based on rice cultivation sometimes associated with corn, manioc, bean and banana, which characterize the subsistence crops in Pará and Maranhão. In the other States of the region, sugar-cane, tobacco and cocoa bean prevail. Babassu nuts are the main extraction product in Maranhão, 100% of which is processed, either for food or as a construction material. In the other northeastern regions the mauritia palm (*Mauritia flexuosa*), carnaúba (*Copernica cerifera*), spiny club palm (*Bactris setosa*) and babassu (*Orbignya martiana*) are harvested. From mangroves, besides tannin extraction for textile mills and ceramic painting, wood is also cut for boat masts, as well as for constructing warehouses bordering the sea.

In the mining sector, salt is the main product. The Rio Grande do Norte saline zone is the major salt producer in the country. Salinas are located mainly in the towns of Macau, Mossoró and Areia Branca. The great salt-producing
companies are mechanized, and are responsible for the large decrease in the local labour force.

The industrial basin development has occurred mainly in three different areas: Golfo Maranhense, Suape Estuary, and Mundau and Manguaba Lagoons. The major industrial boom in the Golfo region occurred at the beginning of the 1980s with the implementation of the mineral-metallurgic complex of Grande Carajás Project on São Luís Island (MA). The complex now occupies about 14,000 ha, approximately one fifth of the island. In the region of Mundaú and Manguaba (AL) lagoons, the main industrial plants are the Alagoas Chloro-chemical Complex (PCA) and Complexo Salgema S.A. An Alagoas Chemical Complex is also installed in Maceió.

The Northeast Basin is undergoing a high degree of environmental degradation, due to several factors:

- Industrial use of the last drinkable water springs which has changed the estuary salinity with the implementation of the industrial complex in São Luís (MA).

- Construction of the missile and submarine base, inaugurated in 1988, in the city of Alcântara (MA) (declared by UNESCO as a historical site). Here, over 8,000 families were expelled from their land. For over a century they had lived by fishing, shrimp salting and agriculture.

- The existence of salinas which degrade coastline ecosystems and destroy mangroves, and disposal of salt production residues (gray bar) into the sea.

- Silting up of the Potengi River estuary by the port installations, thereby raising water levels, flooding the banks, increasing water turbidity and creating navigation problems due to erosion. Moreover, urbanization itself has generated problems such as production of high amounts of domestic effluents which are thrown untreated into the estuary.

The cutting of mangroves is threatening fauna and flora, also impairing local fishing production and agriculture:

- The Suape Industrial-Port Complex has already brought about environmental hazards. The first impact was the construction of the highway in areas cultivated by small farmers and settlers residing in lands owned by regional sugar mills; the port construction and destruction of mangroves for the industrial complex resulted in changes to the estuaries’ morphology, sediment deposition and the physical-chemical conditions of estuary waters and of the bay itself, up to then protected by the reef occurring parallel to the coastline; the opening of the reef for the harbour construction modified the circulation of water in the zone of the so-called ‘inland sea’ and brought coastal marine erosion.
Pollution of Mundaú River basin waters, which receive a high amount of fertilizers, pesticides and organic material resulting from the washing of sugar cane.

The outflow dumping of chemical effluents into the ocean is generating complex problems since the dumping site coincides with that part of the area the local fishermen call ‘Lama Grande’ (Great Sludge), the main habitat of shrimps.

The degradation of lagoons and channels is bringing about severe social impacts since the fishermen are abandoning fishing and moving to the capital city, Maceió, increasing the unemployed labour population in the urban periphery.

The following protection units are found in the Northeast Basin:

- Gurupi Federal Biologic Reserve, established in 1988, with 341,650 ha;
- National Lençóis Maranhenses Park, established in 1981, with 155,000 ha.
The East Basin

The East Basin includes part of the States of Sergipe, Bahia, Minas Gerais, Espírito Santo, Rio de Janeiro and São Paulo north coastline, covering an area of 569,312 km\(^2\) (see Figure 3, page 8).

Geomorphologically, the basin is formed by part of the Northeastern Plateau, coastal plains and lowlands, eastern and southeastern mountain ranges and plateaux. It is the largest highland region in the country, with the Serra do Mar, Serra da Mantiqueira and Serra do Espinhaço mountain ranges constituting a typical undulating landscape - the so-called ‘Mares de Morros’ (Hill Seas).

The rivers may be divided into two groups: those occurring mainly in drier areas of modified tropical climate where rainfall occurs mainly in the autumn-winter; and those in austral tropical areas with sources in the Chapada Diamantina and Chapada do Espinhaço hills and which flow directly to the sea, and which flood in summer and have low water periods in the autumn-winter.
58  Sergipe River estuary (SE)

Location:  between 10°40'-11°02'S and 36°-37°15'W.
Area:  700 km².
Altitude:  0-50 m.
Biome/biogeographic province:  humid rain forest/Serra do Mar.
Wetland types:  2/3/7/10/11.
Site description:  the estuary is fed by the rio Sergipe and its tributaries, forming a wide, deltaic plain, with beaches, and in some areas infilled for urban development.
The climate may be described as humid hot, with a mean annual rainfall of 1,110 to 1,300 mm. The region has a drought period from March to August. The steady winds in the area correspond to the trade winds whose direction varies little during the year.
Flora:  the most common formations are Thick Rain Forest and Pioneer Formations, both of herbal, shrub, and arboreal Marine Influence (sand banks) and arboreal Fluvimarine Influence (mangrove).
Fauna:  birds, fish and crustacea.
Human population:  353,237 inhabitants in 7 municipalities.
Reference number:  (page 4, Figure 1) 58.
59 Vaza-Barris Estuary and Barra da Estância
59  Vaza-Barris Estuary and Barra da Estância

Location: between 11°-11°35'S and 37°05'-37°35'W.
Area: 1,320 km².
Altitude: 0-100 m.
Biome/biogeographic province: humid rain forest/Serra do Mar.
Wetland types: 2/3a/7/8/9/10/11.

Site description: it is a Quaternary plain including alluvia, dunes, sandy beaches and strips of coastline. The climate is extremely humid, with little rain in summer and significant rainfall in winter. The mean annual rainfall rate is around 800-1,500 mm, with a mean annual temperature over 25°C.

Flora: the inner area immediately abutting the coastal strip has areas of competing Savannah and Seasonal Forest, as well as agricultural land (pasture and cyclic crops).
Along the coast, Pioneer Formations are predominant, and in the estuaries those of arboreal Fluvimarine Influence (mangrove) prevail.

Fauna: birds, fish, crustacea, reptiles. Endangered species include Caiman latirostris (broad-nosed caiman), Chelonia mydas (large green turtle) and Caretta caretta (leatherback turtle).

Human population: 93,313 inhabitants in 5 municipalities.
Reference number: (page 4, Figure 1) 59.
Todos os Santos Bay
Todos os Santos Bay (BA)

**Location:** between 39°-35°05'W and 12°30'-13°10'S.

**Area:** 5,100 km².

**Altitude:** 0-15 m.

**Biome/biogeographic province:** humid rain forest/Serra do Mar.

**Wetland types:** 1/3/4/5/7/9/10/11.

**Site description:** the large Baía de Todos os Santos has a segmented coastline with bays and small inlets, around which the coastal lowlands are developed. Itaparica Island, about 30 km long, lies at the entrance to the bay. The region’s climate is hot and excessively humid, with a mean temperature of 24°C.

**Flora:** Pioneer Formations both of arboreal Fluvimarine Influence (mangrove) and of Marine Influence (sand banks).

**Fauna:** fish, crustacea and birds; the area provides important winter pasture for a large number of migratory birds.

**Human population:** 1,975,735 inhabitants in 16 municipalities surrounding the Bay.

**Reference number:** (page 4, Figure 1) 60.
62 Southern estuaries of the Bahia State:
Ilhéus Estuary
65  Mucuri Estuary and Marshlands (BA)

Location: between 18°-18°22'S and 39°30'-39°55'W.
Area: 975 km².
Altitude: 0-100 m.
Biome/biogeographic province: humid rain forest/Serra do Mar.
Wetland types: 2/4/7/10/12.
Site description: the lower rio Mucuri crosses Tertiary terrains of Barrier Formation, from a plain to gently undulating tablelands, and Quaternary sediments in the coastal zone. Annual temperatures average 23°-24°C and mean pluviometry ranges from 1,750 mm on the coast to 1,000 mm in the western extremes.
Flora: the inner area is occupied by Thick Rain Forest which, despite agricultural pressure, still retains a high number of floral remnants. The coastal region is occupied by Marine and Fluvimarine Influence Pioneer Formations.
Fauna: birds, fish, molluscs and crustacea. Endangered species include *Falcò peregrinus* (Peregrine falcon), *Ara ararauna* (Canindé macaw) and *Leucoptermis palionota* (Big dove).
Human population: 15,143 inhabitants in the municipalities of Mucuri.
Reference number: (page 4, Figure 1) 65.
Mateus River mouth, Linhares grassy marshes and Doce River delta
Mateus River mouth, Linhares grassy marshes and Doce River delta (ES)

Location: between 18°33’-19°58’S and 39°43’-40°43’W.
Area: 655.7 km².
Altitude: 0-50 m.
Biome/biogeographic province: humid rain forest/Serra do Mar.
Wetland types: 2/7/10/11/12/15/16.
Site description: the rio Doce coastal plain is drained by a dozen water courses, of which rio Doce and rio São Mateus perform the most important roles in the Quaternary sedimentation. The area has 43 lagoons, the majority of which appear to be former drainage areas inside coastal strips or sand banks.
This area is marked by a hot-humid tropical climate with wet summers and dry winters. Mean annual rainfall ranges between 1,000 and 1,250 mm, while the mean temperature is 25°C.
Flora: Inland, Thick Rain Forest slightly outweighs agricultural land (pasture and arable). Mangrove and sand bank Pioneer Formations prevail along the coast.
Fauna: birds, mammals, reptiles and fish. Endangered species include Crypturellus noctivagus (zabele red-footed tinamou), Leucopternis polionata (small hawk), Myrmecophagus tridactyla (great anteater), Bradypus torquatus (three-toed sloth), Priodontes giganteus (giant armadillo), Panthera onca (jaguar), Lutra enudris (otter), Chaetomys subspinosus (black hedgehog) and Dermochelys coriacea (trunk turtle).
Human population: 242,434 people.
Reference number: (page 4, Figure 1) 66.
67 Vitória Bay and North Lagoons
67  Vitória Bay and North Lagoons (ES)

**Location:** between 20°25'S and 40°10'-40°25'W.

**Area:** 1,120 km².

**Altitude:** 0-100 m.

**Biome/biogeographic province:** humid rain forest/Serra do Mar.

**Wetland types:** 1/2/3/7/10/11.

**Site description:** sandy sedimentary deposits and sandy-clayey fluvial deposits, forming coastal tablelands in the northern part, reaching their limit in the west with coastal hills and bedrock. The climate is hot and humid, with summer rainfall (December to February) and dry winters (June to August). The mean annual rainfall ranges from 1,200 to 2,500 mm. The mean annual temperature ranges between 22°C and 24°C.

**Flora:** area originally covered by Thick Rain Forest, now altered by human development. Pioneer Formations (mangrove and sand banks) are found along the coast.

**Fauna:** birds, fish, molluscs and crustacea. Endangered species include reptiles such as *Chelonia mydas* (green turtle).

**Human population:** 682,823 inhabitants in 4 municipalities.

**Reference number:** (page 4, Figure 1) 67.
An Inventory of Brazilian Wetlands

68 Lagoa Feia and Paraiba do Sul grassy marshes
Lagoa Feia and Paraíba do Sul grassy marshes (ES/RS)

Location: between 21°02'-22°23'S and 40°59'-41°38'W.
Area: 5,350 km².
Altitude: 0-60 m.
Biome/biogeographic province: humid rain forest/Serra do Mar.
Wetland types: 2/9/11/15.

Site description: now some 17,000 ha, Lagoa Feia's surface areas was once 33,000 ha, its reduction the result of sanitation programmes commenced in 1993. However, it is still the largest lagoon in the region.
The climate is hot humid tropical with monthly mean temperatures always above 18°C and annual precipitations between 1,000 and 1,250 mm.
Flora: composed of Pioneer mangrove or sand bank type Formations.
Fauna: area of major importance to several species of birds, both resident and migratory.
Human population: 523,824 inhabitants in 5 municipalities (3 in Rio de Janeiro and 2 in Espírito Santo).
Reference number: (page 4, Figure 1) 68.
69 Fluminenses coastal lagoons

KEY

- City

BR - 101 Federal Highway

RJ - 106 State Highway

- - - Limits of the studied area

* Harbour

> Main rivers

Lagoon

Flooded area

Saline

SCALE

5 10 15 20 25 km

SOURCE: Min. dos transportes-DNER
Album rodoviário cartográfico - 1983

Atlantic Ocean

An Inventory of Brazilian Wetlands

Digitalized by Google
69 Fluminenses coastal lagoons (RJ)

Location: between 22°50'–23°S and 42°–43°25'W.
Area: 260 km².
Altitude: 0-1 m.
Biome/biogeographic province: humid rain forest/Brazilian humid forest.
Site description: extensive complex of eleven fresh and brackish water coastal lagoons, between the cities of Rio de Janeiro and Cabo Frio, located behind the sand bank region, from Maricá Lagoon in the west, to Araruama Lagoon (the largest at 150 km long), in the east.
Flora: nearly all of the coastal hillsides are occupied by Pioneer Formations (mangrove, sand bank). In the far east of the area Esteppe formations (stunted spare forest) occur.
Fauna: despite the urban expansion, birds, fish, crustacea and molluscs are found in the region.
Human population: 219,151 inhabitants in 5 municipalities.
Reference number: (page 4, Figure 1) 69.
70 Guanabara Bay (RJ)

**Location:** between 43°01'-43°16'W and 22°40'-23°55'S, NE of the city of Rio de Janeiro.

**Area:** 1,509.4 km².

**Altitude:** 0-2 m.

**Biome/biogeographic province:** humid rain forest/Serra do Mar.

**Wetland types:** 1/2/3/7/10/11.

**Site description:** the area has a deep, wide bay located between the cities of Rio de Janeiro and Niterói. It is a large estuarine area with several watersheds, bays and islands. The second largest urban area in Brazil, it is currently severely degraded.

The climate is hot and humid (annual averages of 22°C), with rainfall prevailing in summer.

**Flora:** the original vegetation is almost non-existent due to the intensive urbanization. The north shore still has areas occupied with mangrove.

**Fauna:** birds, mammals, fish, crustacea, molluscs and reptiles.

**Human population:** the area covers 7 municipalities surrounding the Baia de Guanabara, amounting to 7,358,957 inhabitants.

**Reference number:** (page 4, Figure 1) 70.
Ilha Grande Bay and Sepetiba
71  Ilha Grande Bay and Sepetiba (RJ)

**Location:** between 23° 19′-22° 53′ S and 44° 45′-43° 32′ W.

**Area:** 397 km².

**Altitude:** 100 m.

**Biome/biogeographic province:** humid rain forest/Serra do Mar.

**Wetland types:** 1/3/7/10/11.

**Site description:** the Ilha Grande Bay is limited by the Serra do Mar fault scarp, which, in this part of the State of Rio de Janeiro, lies close to the coast, resulting in an extremely indented coastline, with several bays and islands. The Ilha Grande island is the largest, covering an area of 190 km².

The Sepetiba Bay marks the southwest limit of ‘baixada fluminense’ (fluminense lowland) and comprises the Sepetiba coastal lagoon, small deltas, tide-influenced plains, and Marambaia sand bank, an extensive sandy strip about 50 km long, isolating this coastal system from the Atlantic Ocean. The climate is hot humid tropical with monthly average temperatures of 18°C and precipitation over 1,500 mm, mostly falling from January to March.

**Flora:** the existing formations are Thick Rain Forest and Pioneer Formations (sand bank and mangrove).

**Fauna:** birds, reptiles, mammals, molluscs, crustaceans and fish.

**Human population:** 182,243 people in 5 municipalities.

**Reference number:** (page 4, Figure 1) 71.
72  **Tijuca National Park (RJ)**

**Management category:** II.

**Biogeographic province:** Brazilian humid forest.

**Established:** 06 July 1961, by Federal Decree number 50,925.

**Location:** in downtown Rio de Janeiro; coordinates 22°05'-22°15'S and 41°30'-41°45'W.

**Land tenure:** IBAMA.

**Altitude:** 150-300 m.

**Area:** 3,300 ha.

**Site description:** relatively large green area within the city of Rio de Janeiro, with large private properties, some of them functioning as restaurants and others as tourism outlets. It has also several highly popular tourist areas, such as the ‘Mirante Dona Marta’ (Dona Marta belvedere), the ‘Vista Chinesa’ (Chinese View) and the ‘Corcovada’, with the ‘Cristo Redentor’ (an enormous statue of an open-armed Christ).

It has a good infrastructure and receives approximately 2 million visitors annually.

**Threats:** the Park suffers for being located within a highly urbanized area.

**Reference number:** (page 4, Figure 1) 72,

(see also Figure 5, page 18).
Córrego do Veado Federal Biological Reserve (ES)

Management category: I.
Biogeographic province: Brazilian humid forest.
Established: 17 April 1970, by Portaria (Administrative Rule) number 1415.
Location: centre-west of the State of Espírito Santo, in the municipality of Pinheiros, with the coordinates 18°19'–18°31'S and 40°11'–40°14'W.
Land tenure: IBAMA.
Altitude: 0-100 m.
Area: 2,400 ha.

Site description: coastal plain with sedimentary and sandy soils, nearly isolated within a region whose forest areas are highly devastated.

Threats: aside from the lack of efficient inspection systems and protection, the area is very restricted, which deeply impairs the existing fauna.

Reference number: (page 4, Figure 1) 73,
(see also Figure 5, page 18).
74  Poço das Antas Federal Biological Reserve (RJ)

Management category: I.

Biogeographic province: Brazilian humid forest.

Established: 11 March 1974, by Federal Decree number 73,792.

Location: central coastal part of the State of Rio de Janeiro, in the municipality of Silva Jardim, between 22°30'–22°33'S and 42°15'–42°19'W.

Land tenure: IBAMA.

Altitude: 0-198 m.

Area: 5,063 ha.

Site description: the area presents a relatively plain topography with small valleys and hills and a tropical, hot and humid climate, the maximum temperature reaching 40°C. Annual rainfall averages 1,000 mm, with peaks occurring in the months of October to April.

Threats: these include the lack of infrastructure for efficient inspection and protection, the construction of a dam which would flood a significant part of the Reserve and farming and cattle-rearing activities which are causing considerable deforestation.

Reference number: (page 4, Figure 1) 74,
(see also Figure 5, page 18).
75 Sooretama Federal Biological Reserve (ES)

Management category: I.
Biogeographic province: Brazilian humid forest.
Location: northeastern State of Espírito Santo, in the municipality of Linhares; coordinates 18°55'–19°05'S and 39°55'–40°10'W.
Land tenure: IBAMA.
Altitude: 0-30 m.
Area: 24,242 ha.

Site description: located in the Barrier Formation strip, with a relatively plain relief and a hot humid tropical climate, the mean annual temperature being about 24°C, mean annual precipitation around 1,100 mm, and relative humidity of approximately 82%.

Threats: there are two major threats to the Reserve: illegal hunting and the presence of BR 101 (a highway), which crosses the reserve and is a hazard to wildlife.

Reference number: (page 4, Figure 1) 75,
(see also Figure 5, page 18).
76 Una Federal Biological Reserve (BA)

Management category: I.
Biogeographic province: Serra do Mar.
Established: 10 December 1980, by Federal Decree number 85,463.
Location: in the southern part of the State of Bahia; coordinates 15°05’-15°15’S and 39°12’W.
Land tenure: IBAMA.
Altitude: 40-123 m.
Area: 11,400 ha.

Site description: the area is primarily constituted by small hills and lowered plains and is well irrigated, with well distributed and regular rainfall.

Threats: the lack of infrastructure for its inspection and protection allowed the invasion of cocoa bean plantations and the illegal exploitation of lumber, which probably affected about half the Reserve area.

Reference number: (page 4, Figure 1) 76,
(see also Figure 5, page 18).
Summary of the socio-economic and environmental situation of the East Basin

Artisanal fishermen are the predominant social group in the East Basin (estuary, sea and rivers). The most important cultural aspects are the coconut gatherers on the Bahia coastline and the salt workers of the State of Rio de Janeiro lagoons. Generally, rural and coastline populations live on subsistence agriculture, fishing, the gathering of shellfish, crabs, etc., and extraction. Work is divided among men and women, the latter in charge of salting the fish and gathering crabs, etc. As to land structure, there is a high concentration in the form of large estates. The existing Indian communities fight for regulation of their lands. On the Bahia coastline up to Rio de Janeiro, the expansion of summer houses is expelling the secular land owners, transforming them into 'bóias frias' (low-salary workers who take their meals to work) and unqualified workers at the periphery of the urban centres.

After Aracruz Celulose (a cellulose mill) was established in Espírito Santo, the areas formerly used for agricultural purposes were converted into eucalyptus plantations to supply the mill.

Among the economic activities fishing, associated (in part) with agriculture, is the subsistence base of several municipalities. Fishing in channels, rivers, estuaries and the sea is carried out by skilled and small-scale fishermen. In some areas, fishing is becoming unfeasible due to industrial and urban garbage pollution. Cattle-rearing and rice, corn, bean and manioc cultivation are the farming activities. As for commercial crops, coconut, citrus fruits (irrigation projects), sugar-cane and cocoa bean production, chiefly in southern Bahia, are the most important. Product trading is done through export companies or intermediary companies. Extraction of mangrove timber is common in the whole East Basin. The extraction of large-sized trees and hardwood for cellulose manufacture is an economically significant activity, as is salt extraction in the region of Lagoas Fluminenses where 40 productive salinas make the region one of the most productive in the country.

The large industrial complexes are situated in the large port regions. In Todos os Santos Bay (BA) the industrial centre is situated between and over the main water resources of Salvador Metropolitan Region. The Aratu Industrial Center (CIA) currently has about 140 industries, mostly chemical, petrochemical, cement and lime, employing over 20,000 people. The Camaçari Petrochemical Complex (COPEC), near Aratu, produces basic
petrochemical products, olefins, aromatic products, synthetic fibres, thermoplastics, etc. In Linhares (ES) region, the implementation of the Aracruz Cellulose project brought about the build-up of other industries. Aracruz (a Swedish-Danish multinational company) is situated in lands belonging to Tupi-guarani Indians and dumps its effluents into the Perequê-Açú River, contributing highly to the degradation of the estuary. In Vitória Bay (ES) two major industrial complexes include the Cia Siderúrgica de Tubaro (CST), with national capital (Siderbrás), Japanese (Kawasaki Steel) and Italian (Finsider) steel producing companies, and the Cia Vale do Rio Doce's pellet mills. Other industries produce detergents, phosphates, sodium hydroxide, etc. A well-developed industrial park with approximately 2,300 industries is situated on Guanabara Bay, its main product sectors being oil sub-products, metallurgy, chemistry, plastics, synthetic rubber in addition to a petrochemical complex. Oil exploitation is the main activity in the East Basin, occurring mainly on Bacia de Campos, at the continental platform in Campos - Macaé (RJ) region; it is the second highest oil producing region in Brazil.

Environmental degradation occurs in Aratu, where the chemical companies dump industrial residues with high mercury content. This mainly affects the Enseada dos Tainheiros (Tainheiros Bay), location of the Alagados shantytown, which was constructed on and around the city's garbage dump. The population lived by gathering crustacea and molluscs. Due to the high mercury content the catching was forbidden, causing extreme impoverishment. Recently the area was filled with earth, thereby increasing the environmental problems since the garbage was unable to settle. The removal of exotic fish by underwater trapping at the entrance of Todos os Santos Bay is seriously depleting the region's exotic fish species.

The Bahia Forestal and Industrial Project (Sul Celulos S.A.), partially installed in the Mucuri River estuary region (BA), is the major modifying factor in the area. A 420,000 tons/year production of short-fibre sulphate-bleached cellulose, produced from eucalyptus, is expected. The plant installation covers an area of 1,100 ha, with a further 97,000 ha earmarked for 9 municipalities between southern Bahia and northern Espírito Santo for the forest project. The Aracruz Cellulose Project brought indiscriminate tree cutting and burning in the whole Linhares region, as well as in adjacent areas, also affecting the State of Rio de Janeiro woods. The plant's operation also brought about problems such as decreased fishing activity, the disappearance of molluscs and the weakening of crab and oyster shells. In Vitória, the amount of suspended particles in the air, already reaching levels three times
over that allowed by the World Health Organization, is due, mainly, to the Companhia Siderúrgica de Tubarão. Fishermen have already witnessed the elimination of several species of fish as well as the mutated growth of others resulting from an accumulation of ore dust on the sea bottom. In the Rio de Janeiro (RJ) port region, silting up is occurring at a rate of 435 cm per hundred years, and of 57 cm per hundred years at the channel region, caused mainly by intensive deforestation and earth-filling in mangrove areas. In Guanabara Bay 4,106 tons of sediments are dumped per year.

The rapid destruction of the forest cover in mountain ranges near the coast results from the effects of polluting agents released by the petrochemical complex, plus acid rain and hydrocarbons. Construction of the Almirante Ivaro Alberto nuclear complex in Angra dos Reis (Ilha Grande Bay - RJ) has brought a series of negative impacts of varying nature. Chief among them is the total inadequacy of the nuclear plant site, considering its proximity with an active geologic fault, representing yet one more risk of nuclear accident. The lack of an evacuation plan for the local population and the plant's proximity with the large southeastern Brazilian urban centres also represent extreme cause for concern in case of leakages and accidents.

In spite of the high degree of environmental degradation, the East Basin includes the following protection areas:

- Una National Biologic Reserve, established in 1980, with 11,400 ha;
- Monte Pascoal National Park, established in 1951, with 22,500 ha;
- Marinho de Abrolhos National Park, established in 1983, with 91,300 ha;
- Comboios Federal Biological Reserve, established in 1984, with 833 ha;
- Duas Bocas State Biological Reserve, established in 1966, with 3,176 ha;
- Mestre Ivaro State Biological Reserve, established in 1976, with 2,461 ha;
- Pedra Azul State Biological Reserve, established in 1960, with 1,100 ha;
- Tijuca State Biological Reserve, established in 1961, with 3,300 ha;
- Tamoios Ecologic Station, with 70 ha (not yet decreed);
- Ilha Grande State Reserve, established in 1978, with 15,000 ha;
- Praia do Sul State Biological Reserve, established in 1981, with 3,600 ha;
- Guartiba Biological and Archeological Reserve, established in 1974, with 2,500 ha.
The Southeastern-Southern Basin

The Southeastern-Southern Basin covers part of the States of São Paulo, Paraná, Santa Catarina and Rio Grande do Sul, amounting to 223,688 km² (see Figure 3, page 8).

Besides the typical formations of mountain ranges and plateaux in the east and southeast, the meridional plateau and the Uruguayan-Rio Grande do Sul plateau form part of the relief.

The Ribeira de Iguape River basin lies between the Serra de Paranapiacaba and the Serra de Itatins and Serra do Jaguaré, their headwaters located in the crystalline plateau. Its position, south of the Tropic of Capricorn, gives it a climate which varies between tropical and subtropical, with rainfall distribution and rate varying widely throughout the year.

The Basin is for the most part drained by the rivers Itajaí, Tubarão and Camaquã, the catchments of which all receive good amounts of rainfall, thus maintaining a fairly even flow of water all year round.
Santos-São Vicente Estuary and Bertioga Channel (SP)

Location: between 23°48’-24°3’S and 46°07’-46°30’W; it comprises the central area of São Paulo coastline, extending inland up to the Serra do Mar scarp at the foot of which lies the city of Cubatão with its industrial complex.
Area: 556.25 km².
Altitude: 0-100 m.
Biome/biogeographic province: humid rain forest/Serra do Mar.
Wetland types: 2/3/7/10/13.
Site description: the lowland comprises Santo Amaro, São Vicente, and Porchat Islands and isolated outcrops, and a mainland area, separated by the Santos Estuary and Bertioga Channel.
The climate is hot and humid, with a great temperature variation averaging 22°C. Highest temperatures occur in February (25°C) and the lowest in July (17°C), daytime amplitudes sometimes exceeding 15°C. Rainfall is very high, with annual totals of 2,000 to 2,500 mm; the highest concentration occurring in summer (791 mm from January to March), compared with the relative drought in winter (332.6 mm from July to August). Humidity is always over 80%.
Flora: the formations prevailing in the area, which in some places are extremely degraded, are Thick Rain Forest (mainly in Serra do Mar) and, nearer the coast, Marine (sand banks) and Fluviomarine (mangrove) Influence Pioneer Formations.
Fauna: fish, crustacea, molluscs and mammals. Endangered species include Ozotocerus bezoarticus (pampas deer) and Felis pardalis (puma).
Human population: the total population is 1,070,244 inhabitants, Santos and São Vicente being the most populated municipalities.
Reference number: (page 4, Figure 1) 77.
Iguape-Cananéia and Paranaguá estuary-lagoon system
Iguape-Cananéia and Paranaguá estuary-lagoon system (SP/PR)

Location: between 24°25'-25°35'S and 47°5'-48°50'W. The area is bordered to the north by the Juréia rock mass, and extends up to the Serra da Canavieira, covering the southeastern part of the State of São Paulo coastline and the northern portion of the State of Paraná coastline.

Area: 2,950 km².

Altitude: 0-50 m.

Biome/biogeographic province: humid tropical forest/Serra do Mar.

Wetland types: 1/2/3/10/11/13/14/22.

Site description: the area is partially covered by the Mata Atlântica (Atlantic Wood), with extensive mangroves as well as beaches and coastal dunes; it is one of the main habitats of a number of southern/southeastern Brazil's marine species. In the south, Paranaguá Bay extends for about 46 km inland, with a maximum width of 10 km and a depth of up to 10 m.

The climate can best be described as 'always humid equatorial', with a mean annual temperature of over 20°C. The region has high rainfall rates of over 200 mm/year (mainly in summer - from December to February).

Flora: Thick Rain Forest occupies the hillsides of the mountain range, and Pioneer Formations, both of Marine Influence (sand banks) and of Arboreal Fluvimarine Influence (mangrove), occur along the coastal strip.

Fauna: the natural environment in this area is largely intact, so that the fauna is still very rich and diversified. Several species of birds, mammals, fish, molluscs and crustaceae occur. Endangered species include Bubo virginianus (jacurutu), Cebus apella (macaco-prego), Tayassu tajacu (cateto), T. pecari (queixada), Procyon concrivorus (mo-pelada) and Tapirus terrestris (anta).

Human population: 153,164 inhabitants in 6 municipalities.

Reference number: (page 4, Figure 1) 78.
An Inventory of Brazilian Wetlands

KEY

- City
- BR - 116 Federal Highway
- SP - 185 State Highway
- State border
- Limits of the studied area
- Harbour
- Main rivers
- Lagoon

SCALE

7.5  0  7.5  15  22.5  30 km

SOURCE: Min. dos transportes-DNER
Album rodoviario cartografico - 1982

79 Guaratuba and Babitonga Bays
Guaratuba and Babitonga Bays (PR/SC)

Location: between 25°47'-26°28'S and 47°27'-48°52'W; it comprises the Baía de Guaratuba, Praia Grande do Saí and Baía de Babitonga, where the Ilha de São Francisco (São Francisco Island) is located.

Area: 1,350 km².

Altitude: 0-100 m.

Biome/biogeographic province: humid rain forest/Serra do Mar.

Wetland types: 1/3/9/10/11.

Site description: two systems of associated bays and coastal plains embedded in the Serra do Mar crystalline complex.

The Baía de Guaratuba, with an entrance of about 700 m, surrounded by granitic domes, penetrates 12 km into the continental mass, its maximum width reaching 5 km.

The Baía de Babitonga, housing the 300 km² São Francisco Island, as well as other islands of smaller size, is bordered by the Serra do Mar to the north, buttresses to the south and coastal plains to the west. A wide chain of channels penetrate about 30 km into the continent, extending a further 25 km to the northeast.

The climate is one of transition between the markedly hot north, which averages over 18°C the whole year round, and a southern climate with two different periods: hot (averages between 18° and 22°C) and fresh (averages between 15° and 18°C). The annual precipitation, in the order of 1,800 mm, is concentrated in January to March.

Flora: the prevailing formations in this area are Thick Lowland Rain Forest and Fluviomarine Influence Pioneer Formations (mangrove).

Fauna: birds, fish and crustacea. Endangered species include Ajaia ajaja (colhereiro).

Human population: 291,918 people inhabit the region in 6 municipalities.

Reference number: (page 4, Figure 1) 79.
80 Laguna coastline and adjacent areas
80 Laguna coastline and adjacent areas (SC)

**Location:** between 28°02'-28°40'S and 48°36'-48°58'W.

**Area:** 1,000 km².

**Altitude:** 0-50 m.

**Biome/biogeographic province:** humid rain forest/Serra do Mar.

**Wetland types:** 2/7/10/11.

**Site description:** narrow strip of coastal plains extending along the southern coastline of the State of Santa Catarina between the cities of Garopaba and Jaguaruna, where a group of small-sized coastal lagoons is found, as well as the Laguna estuary-lagoon complex. The regional climate is of humid subtropical type, without a dry season, the mean annual temperatures ranging from 18°-20°C and annual precipitation between 1,000 and 1,250 mm, concentrated in the months of January to March.

**Flora:** occupied predominantly by cyclic crops, except for a strip along the coastline, where Marine Influence (sand banks) and Fluvial Influence Pioneer Formations occur.

**Fauna:** birds, fish and crustacea.

**Human population:** 181,806 inhabitants in 6 Santa Catarina municipalities.

**Reference number:** (page 4, Figure 1) 80.
Rio Grande do Sul coastal plain
81 Rio Grande do Sul coastal plain (RS)

**Location:** between 29°20’-33°45’S and 49°42’-53°42’W; it comprises the whole southern Rio Grande do Sul coast and inner areas located by the banks of Lagoa dos Patos and Mirim (dos Patos and Mirim Lagoons).

**Area:** 37,300 km².

**Altitude:** 0-35 m.

**Biome/biogeographic province:** humid rain forest/Serra do Mar; subtropical rain forest/ Brazilian humid forest, Uruguayan fields/pampas.

**Wetland types:** 2/7/9/11/14/15/18/19/20/22.

**Site description:** large area covered by sedimentary terrains, lying SW/NE, located on the eastern portion of Rio Grande do Sul. A group of several lagoons and lakes with varied dimensions occupies the Rio Grande do Sul coastal plain, among which the following are outstanding as having the greatest water volumes: Lagoa dos Patos, Mirim and Mangueira. Other unconnected (cordiformes) lagoons, ponds and lakes lie in the transition areas between the sedimentary plain and the first levels of Planalto Meridional (Meridional Plateau), where wide areas of marshlands and grassy marshes also occur.

The Lagoa dos Patos is the largest Brazilian lagoon, with a surface area of about 10,360 km², 250 km long and 60 km wide, extending in a SSW-NNE direction. The total drainage area discharging into the Patos-Mirim system is about 201,626 km², covering the Rio Grande do Sul plateau areas, as well as Uruguayan lands; it connects with the sea through Barra do Rio Grande, which has an important estuary zone.

The regional climate is the mesothermal type (Koppen), the mean annual temperatures ranging from 16° to 20°C, with 1,000 to 1,500 mm annual rainfall. These general climate characteristics vary along the coastal plain, in terms of both rainfall periods and thermal amplitudes. Most rainfall in the far south of the coastal plain occurs in the months of March to May, while in the north this happens from August to October. Mean, maximum and minimum temperatures are also unevenly distributed across the region during the year.

**Flora:** the prevailing regional forest cover comprises Marine Influence (sand banks) and Fluvial Influence (marshlands and lowlands) Pioneer Formations.

**Fauna:** birds, mammals, fish, crustacea and reptiles. Endangered species include *Hidrochoerus hidrocharis* (capybara), *Myocastor* sp. (swamp deer) and *Caiman latirostris* (broad-nosed Caiman).

**Human population:** 2,060,587 inhabitants in 17 municipalities.

**Reference number:** (page 4, Figure 1) 81.
82 Superagui National Park (PR)

Management category: II.
Biogeographic province: Serra do Mar.
Established: 25 April 1989, by Federal Decree number 97,688.
Location: northern coastline of the State of Paraná, in the municipality of Guaraqueçaba; coordinates 25°13’-25°29’S and 48°02’-48°21’W.
Land tenure: IBAMA.
Altitude: 0-100 m.
Area: 24,100 ha.

Site description: the Park comprises two islands, the Ilha das Peças and the Ilha de Superagui (the latter not including the area designated for real estate exploitation), the whole ocean strip and also the north spit of land. Both islands are well preserved, an important fact since the forest cover prevailing on them - the ‘Mata Atlântica’ - is an environment in an extremely advanced state of degradation, mainly in the southeastern region of the country. Another notable characteristic is the presence of about 2,000 inhabitants, divided into approximately five Caïçaras communities on each island, living traditionally on the exploitation of existing natural resources.

Threats: the Park is threatened by real estate speculation and by frequent, periodical contamination from activities in nearby Paranaguá port, mainly oil leakages.

Reference number: (page 4, Figure 1) 82, (see also Figure 5, page 18).
83 Juréia-Itatins Ecological Station (SP)

Management category: I.
Biogeographic province: Serra do Mar.
Established: 20 January 1986, by State Decree number 24,646.
Location: municipality of Peruíbe, meridional State of São Paulo coastline; coordinates 24°30'-24°31'S and 47°14'-47°16'W.
Land tenure: IBAMA.
Altitude: 0-900 m.
Area: 82,000 ha.

Site description: the Station area comprises the Juréia mountain mass and the coastal plain, and is reasonably preserved. Crests, mountain ridges and isolated hills form the relief, while along the coast an important part of the Mata Atlântica ecosystem is now considerably threatened, along with the vegetation of the beach, sand bank and mangrove. The climate is classified as subhot tropical, super humid and without a drought period; the local mean temperature is 22.7°C (mean minimum 18.6°C and mean maximum 27°C) and the rainfall is high, around 4,000 mm yearly, the months of February and March being the wettest ones. Approximately 350 families live within the Station limits.

Threats: the main threats to the Station environment are: irregular land subdivisions, deforestation, extraction (mostly trumpet tree and heart of palm) and road construction.

Reference number: (page 4, Figure 1) 83,
(see also Figure 5, page 18).
84 Taim Ecological Station (RS)

Management category: I.
Biogeographic province: Brazilian humid forest.
Established: 21 July 1986, by Federal Decree number 33,995.
Location: far southern part of the country, in the State of Rio Grande do Sul, next to the municipality of Rio Grande; coordinates 32°02'-32°50'S and 52°26'-52°36'W.
Land tenure: IBAMA.
Altitude: no information available.
Area: 33,995 ha.
Site description: this protection unit is located in a large grassy marsh environment (approximately 60,000 ha), which starts next to Lagoa Mirim and nearly reaches the Atlantic Ocean. It has several different ecosystems covering, in addition to the grassy marshes, the ocean, lagoons, fields, native woods and a dune system.
The regional climate is the mild mesothermic type, where the mean annual temperatures range between 16° and 20°C and the precipitation between 1,000 and 1,500 mm per year, the period of most rainfall occurring in the months of March to May.
Threats: the Station has no effective inspection and thus is invaded by a number of human activities, mainly extensive cattle raising.
Reference number: (page 4, Figure 1) 84, (see also Figure 5, page 18).
Summary of the socio-economic and environmental situation of the Southeastern-Southern Basin

The Santos (SP) estuary region up to Paranaguá (PR) is still an area of Caiçara culture extending from Espírito Santo up to the north of Santa Catarina. Economically, this culture is characterized by complementary activities such as fishing, small agriculture, extraction, hunting and skilled arts. Other areas along the coast of Santa Catarina and Rio Grande do Sul were occupied by Azorian settlers in the 18th century, forming fishing communities which still retain some traditional characteristics.

This portion of the Brazilian coastline has seen rapid urban growth in recent decades, with a remarkable process of land speculation and occupation of mangroves, hills and mountain range hillsides. The great majority of the rural inhabitants has no deed of property. Where land tenure is located in the coastline areas, the problem becomes more serious, since the secular inhabitants lose their lands through the establishment of real estate projects which also privatise the beaches.

In Rio Grande do Sul and in Santa Catarina the small and medium sized farms are prevalent. Fishing is the main economic activity of regional inhabitants and is carried out in the estuary, lagoon, river or along the coast. Artisanal fishermen of the Iguape/Paranaguá adopted new techniques (influence of Santa Catarina fishermen), which allowed them to live on fishing the whole year round. They use methods such as fish-net, knot, dragnet and trotline. Industrial fishing mostly takes place in the southern part of the country, particularly in Santa Catarina. In Lagoa dos Patos (RS) fishing is especially important, the area being the natural breeding ground of several species of fish and crustaceans along the Brazilian southern-southeastern coast.

Farming in the State of São Paulo is confined to the growing of bananas, citrus fruits, as well as manioc, bean, rice and corn. Buffalo raising is widespread, mainly in Guaraqueçaba (PR) (area number 45), and serves as a means to facilitate land grabbing. In the States of Santa Catarina and Rio Grande do Sul rice and manioc are the main products, followed by corn, bean and tobacco. Cattle-ranching for meat production and by-products, and on a smaller scale, milk production. The extraction of palm heart, and ornamental plants is considerable, despite its prohibition by environmental legislation. The same occurs with 'caxeta' (Tabebuia cassinoides) which represents an important part of family income in several rural villages of the Iguape/Paranaguá region.
The main industrial complex in the Southern/Southeastern Basin is located in Cubatão city (SP). Around 23 giant industries alone contribute 2.6% of the Brazilian G.N.P., amongst them Petrobras S.A., COSIPA and Ultrafertil. Between Iguape and Paranaguá lie the fish processing industries. Another important industrial complex is located in Joinville (SC), with a diversified product base: textiles, food, mechanical, metallurgical, plastics, electric goods, etc. In the South Petrochemical complex and in the industrial districts in Porto Alegre metropolitan region (RS), the metallurgical, paper, chemical, plastics and leather industries are the most prominent.

The Southeastern-Southern Basin has important port systems, e.g. at Santos (SP), São Francisco (SC) and Imbituba (SC), through which the industrial production of this part of the country flows. The Southeastern/Southern Basin is highly industrialized and thus has the most serious environmental problems in the country. Baixada Santista (SP) constitutes the major concentration of these problems, the Cubatão industrial complex being the main source of pollutants.

In Paraná, the soybean terminal and the influx of inflammables and chemicals at the Paraguá port cause environmental degradation. In Babitonga Bay (SC), the pollution of water and of sediments in the north shore bay comes about by the dumping of urban and industrial effluents from the city and from the industrial district of Joinville, exceeding the maximum allowable limits for heavy metals (chrome and zinc). The most dangerous environmental impacts in the Laguna coastline and adjacent areas (SC) come from the activities connected with coal production. Lagoa dos Patos is also deeply affected by effluent disposal, both organic and chemical, dumped untreated into the lagoon waters.

The Southeastern-Southern Basin has several protected areas. The southern part of the country, in spite of its environmental problems, has established several protection areas in recent decades. They are:

- Serra do Mar State Park, established in 1977, with 309,938 ha;
- Superagui National Park, established in 1989, with 21,400 ha;
- Guaraqueçaba, established in 1982, with 13,638 ha;
- Ilha do Cardoso State Park, established in 1962, with 22,500 ha;
- Jacupiranga State Park, established in 1969, with 150 ha;
- Serra do Tabuleiro State Park, established in 1975, with 90,000 ha;
- Taim Ecological Station, established in 1968, with 33,815 ha;
- Lagoa do Peixe National Park, established in 1986, with 34,000 ha;
- Aparados do Serra National Park, established in 1959, with 10,250 ha.
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