FRAGILE ECOSYSTEM: THE BRAZILIAN PANTANAL WETLAND

João dos Santos Vila da Silva
Brazilian Agency of Agricultural Research (Embrapa Informática Agropecuária - CNPTIA), Brazil

Myrian de Moura Abdon
National Institute of Space Research (INPE-DSR), Brazil

Arnildo Pott
Brazilian Agency of Agricultural Research (Embrapa Gado de Corte -CNPGC), Brazil

Rodiney de Arruda Mauro
Brazilian Agency of Agricultural Research (Embrapa Pantanal -CPAP), Brazil

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Summary

The Pantanal wetland is placed in the upper Paraguay river basin, in central South America, with territory in Brazil, Bolivia and Paraguay, the Brazilian area being

138 183 km^2 of 361 666 km^2 of the watershed. It is a continuous sedimentary plain, geologically young (Quaternary), with seasonal floods variable year to year, caused by local rain or by river overflow. For its size, the Pantanal is considered the largest continuous continental wetland. We made a survey of the state of art on the knowledge about the physical, biological and socio-economic environments, allowing the environmental characterization of the region. The Pantanal is found in parts of two Brazilian states and covers partial areas of 16 townships, where different flood regimes, soils and vegetation subdivide the region in 11 distinct sub-regions. The climate belongs to the tropical savanna type, with 800 to 1400 mm annual rainfall, concentrated in Summer; mean temperature is 26º C, with maximum mean of 32°C and minimum mean 20° C. The soils are mostly sandy. The vegetation is a mosaic associated to flood level, there being three basic landscapes: woody on flood free ground, seasonal grasslands and water bodies. The productive system in decreasing order is based on cattle ranching on natural grasslands, mining, fishery and tourism, which is fast growing while cattle is about to decline. The characteristics of environmental administration system applied to the watershed are presented, including legislation and institutional aspects. The main impacts occurring on the plain, affecting biodiversity, are river silting intensified by erosion from the highlands, introduction of exotic species (plants and animals), mining (gold on the North), illegal fishing, disorganized tourism, engineering works (roads, hidrovia, dikes). Also, an analysis of space-time dynamics of natural vegetation replacement on the higher watershed and in the Pantanal is depicted. In this analysis the extension and deforestation rates were identified, its distribution and expansion in the Pantanal, in the decades of the 1970s, 1980s and 1990s. In the biological environment, fauna was highlighted, with its problems and alternatives of monitoring and exploiting, showing the population status after poaching stopped.

1. Wetlands

Wetlands are highly diverse environments occupying transition zones between well-drained higher ground and permanent water. Delimitation of these areas is rather difficult due to unclear boundaries, particularly as water levels vary between seasons and land use may change vegetation, soils and water regime. The U.S. Army Corps of Engineers (COE) and the Environmental Protection Agency (EPA) adopted the following definition for wetlands: *areas which are flooded or saturated by surface or underground waters, with frequency and duration enough to support the prevalent vegetation typically adapted to live in conditions of saturated soil.* The definition of wetlands includes three main components: presence of water, wet soils which distinguish them from neighboring plateaus and vegetation adapted to wet conditions.

Flood patterns vary much in frequency, duration and depth. Pattern and time of flood depend on season, localization of rain, drainage type and floodplain shape. However, it is the regularity of flood pattern or flood pulse, which is responsible for the maintenance of structure and functioning of the natural system. Water table can be found close to or at soil surface, or a water sheet covers the ground, at least temporarily.

Wetlands are areas where rapid changes occur under natural or man-made environmental variations. In geological terms, wetlands keep their physical features for short periods. Natural changes in flow and direction of a river, sinking or erosion cause

rapid degradation of wetlands. Wetlands are also sensitive to climatic changes like alterations in rainfall or evaporation rate. Without hydrologic or tectonic disturbances, wetlands gradually progress through a succession of stages to a dry ecosystem of higher land. This succession can be accelerated by drainage, dredging and river deviation.

Wetland productivity is high, and important functions such as improvement of water quality and wildlife habitat, which are associated with this productivity, occur at a rapid rate. These areas continuously store, recycle and export nutrients, which are brought by runoff from highlands. These nutrients give support to an abundant macro and micro vegetation, which converts inorganic into organic matter, producing an important food source for animal life.
Wetlands are responsible for underground water recharge, due to slow flow and long residence time of the water, and discharge can be observed in some places in the dry season. Wetlands and floodplains function as buffer zones between upstream and downstream zones, delaying water flow and feeding other ecosystems in dry periods. A great part of the stored water does not go back to the river system, being lost through evaporation and infiltration. Due to the high rates of evapotranspiration, large wetlands have a strong influence on regional and local climate. These areas have a moderating effect on temperature variations and they produce vapor to become rain.

Regular floods also control soil salinity and the moisture retained during the dry season protects the soil from wind erosion and from water level fluctuations. Wetlands are also responsible for storing large amount of sediments, reducing water turbidity in rivers and improving life downstream. Roots of dense vegetation have a strong effect on sediment stabilization. Toxic substances like pesticides are adsorbed onto suspended particles, so that sedimentation in wetlands has a beneficial effect on water quality. A large proportion of the pollutants entering wetlands are retained and transformed, mainly by vegetation and microorganisms.

Many wetlands are carbon reservoirs and carbon sinks, because the plants convert atmospheric CO^2 (carbon dioxide) into biomass. Carbon may be temporarily stored in wetlands as plants and living animals. The total amount of carbon in wetlands has been estimated at 35% of the total terrestrial carbon. Wetlands can be carbon sinks when the rate of plant production exceeds the rate of decomposition through release of gases or water transport of dissolved carbon or sediments. These carbon reservoirs may supply large amounts of carbon to the atmosphere if water levels are subsequently lowered or land management practices result in oxidation of soils. In addition, wetlands play an important role in the global cycle of gases like CO^2 and CH^4 (methane). However, half of the Pantanal has sandy soils, which do not accumulate much carbon. Increase in concentration of these gases in the atmosphere can enhance the greenhouse effect, leading to global warming. Carbon dioxide is responsible for 55% of global warming and methane for 15%. Natural wetlands are responsible for 5% of total emissions of methane, which is equivalent to less than 1% of global warming.

Wetlands provide abundant water, food, and shelter for migrating and resident wildlife. The range of habitats is important and includes meadows, scrubby woodland and calm open water. Difficulty of access provides tranquility and increases protection to the fauna. Tropical wetlands are very important in the context of seasonal migration of

many bird species, many of them between the northern and southern hemispheres. Many fish species use these habitats for protection, spawning, feeding, and seasonal migration. The vegetation at flood time provides energy sources for wildlife to help them survive the dry season and food shortage.

The production of biomass allows nutrient and energy reserve build-up, through the food web among wetland organisms, leading to ecosystem stability. The food relations and energy flows and losses constitute a self-regulating mechanism to maintain balance among plant and animal communities and the carrying capacity of the ecosystem.

Some functions of wetlands are fundamental to maintenance of other ecosystems such as regulation of salinity and feeding fresh water to rivers, providing nutrients to downstream systems, water purification, preventing eutrophication of downstream lakes, maintenance of the food chain, and the ecological balance of other ecosystems.

Wetlands in tropical environments are mainly associated with the floodplains of rivers and lakes. In Brazil, large floodable areas are found in the Amazon and Paraguay basins.

2. Geopolitical division of the Pantanal

The Pantanal was until recently little known to science and to the public, but the attention paid to wetlands in general, partly for conservation and tourism, also brought attention to this region. Research since the early 1980s has provided a great deal of information about this region.

The Pantanal is placed in the heart of South America and its area covers parts of Brazil, Bolivia and Paraguay. In Brazil the territory lies in the Central-Western region, in the upper Paraguay River basin, which is part of the Plata basin. The area of the Paraguay catchment in Brazil is 361 666 km^2, 38.2% of which or 138 183 km^2 is Pantanal plain. For its size, the Pantanal is considered the largest continuous continental wetland. Different conditions of flood, relief, soils and vegetation concur to subdivide the plain in 11 distinct sub-regions (Figure 1).

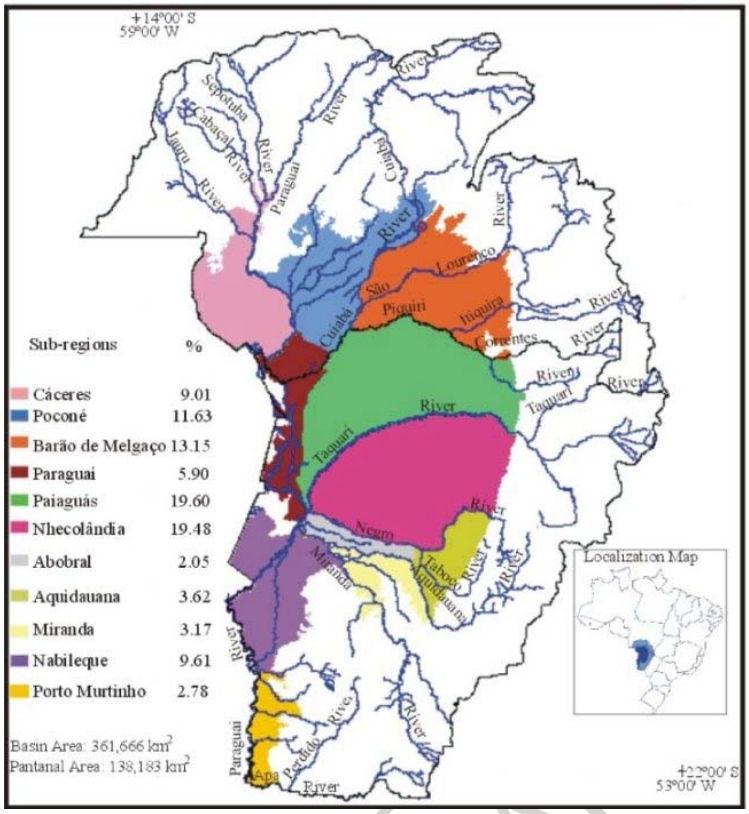

Figure 1: Sub-regions of the Brazilian Pantanal wetland.

On the plain, 48 865 km^2 (35.4%) are found in the state of Mato Grosso and 89 318 km^2 (64.6%) in Mato Grosso do Sul. This large area covers parts of 16 townships, seven in the North and nine in the South (Figure 2).

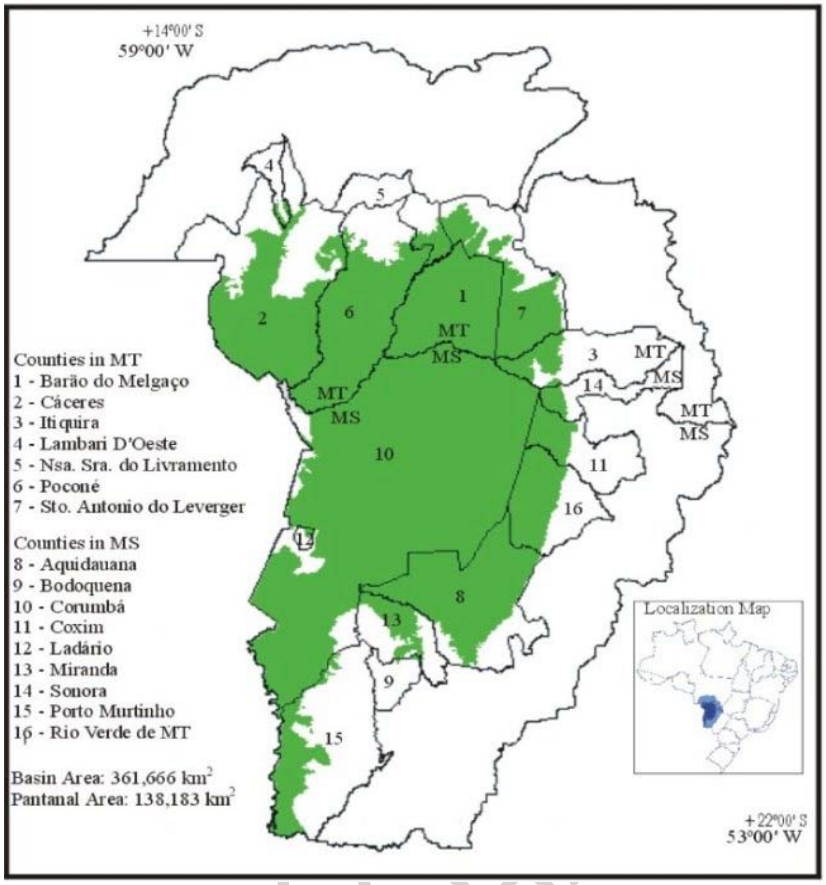

Figure 2: Municipality net of the Brazilian Pantanal wetland.

The process of settlement of the region began more than 280 years ago, around 1719, with cattle ranching and town building on the boundaries of the plain. Today, cattle raising, tourism, mining and fisheries comprise the productive system of the Pantanal. Cattle raising, however, is the basis of the Pantanal economy. In spite of settlement going back nearly three centuries, the plain is well preserved. The original vegetation covered 95% of the Pantanal area in 1994. This is in strong contrast to the highlands, where the original cover has been reduced to around 53.7%. Nevertheless, it is a still a good situation compared to other ecosystems of the world, particularly in Europe, where the original vegetation has almost been eliminated.

Settlement of the Pantanal happened from North to South. Large properties were created from a very early date, a tradition typical of Latin America. A land unit used to measure 6 km wide by 18 km long, or 10 800 ha, and ranchers often had more than one each.

The first maps showed a vague area named “Mar de Xaraiés” (“Xaraiés Sea”), later called Pantanal de Mato Grosso or Pantanal Mato-grossense, but Pantanal is the most common designation today. The first settlers started to raise cattle, which thrived on the native grasslands, becoming the mainstay of the economy, which it still is today.

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Biographical Sketches

João dos Santos Vila da Silva, Lic. Mathematics, Universidade Federal de Mato Grosso do Sul (UFMS). M.Sc. Remote Sensing, Brazilian Space Research Institute (INPE). Doctoral student of Planning and Sustainable Rural Development, Universidade de Campinas (UNICAMP). Researcher at the Brazilian Agricultural Research Agency (Embrapa) since 1982, working on geotechnologies, evaluation of remote sensing data, environmental mapping and planning.

Myrian de Moura Abdon, B.Sc. Marine Biology, Universidade Federal do Rio de Janeiro (UFRJ). M.Sc. Remote Sensing, Brazilian Space Research Institute (INPE). Doctoral student of Environmental Engineering Sciences (Evaluation of Environmental Impact), Universidade de São Paulo (USP). Researcher at the Brazilian Space Research Institute (INPE) since 1978, working on remote sensing of natural resources and floodplains.

Arnildo Pott, B.Sc. Agronomy and M.Sc. Pastures, Universidade Federal do Rio Grande do Sul (UFRGS). Ph.D. Tropical Pastures, University of Queensland (Australia). Researcher at the Brazilian Agricultural Research Agency (Embrapa) since 1980, working on natural pastures and flora of Pantanal wetland.

Rodiney de Arruda Mauro, B.Sc. Biology, Universidade Federal de Mato Grosso do Sul (UFMS). M.Sc. Ecology, Conservation and Management of Wildlife, Universidade Federal de Minas Gerais (UFMG). D.Sc. Tropical Ecology, Universidad de Los Andes (ULA, Mérida, Venezuela). Researcher at the Brazilian Agricultural Research Agency (Embrapa) since 1989, working on ecology, conservation and management of wildlife.