Ecohydrological Background for the Conservation of Pantanal and Everglades National Parks

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Aim

• Illustrate:

• how hydrology “works” in the Pantanal and in the Everglades at the scale of the entire ecosystem

• How hydrological connectivity locally controls habitat diversity, ecosystem productivity/services in both wetlands
Both wet lands are quite similar. However: Everglades National Park has a *growing* marine component.
Pantanal
At continental scale

A “head water” region

A water and sediment collector

Flood (water & sediments) /
climate regulator
A pulsing system
A pulsing system

135,000 ha

1350 km²
1700 species
200 Grasses
200 leguminous
240 forages
10 palms

Ecosystem Productivity

Terrestrial Phase

Aquatic Phase

> 665
> 246
> 1000
> 260
> 160
> 95
> 40
Floodpulse vs plants & animals

Levee

Elevation (m)

Distance from Cuiabá River (km)

Topography
- 1971
- Tr=2
- Tr=5
- Tr=10
- Tr=15
- Tr=40

doi:10.1016/j.jhydrol.2011.01.014
Flood regime vs fish reproduction

Fish – hydrology relationships matters:
Value of recreational fishing
= $54 – 86 millions /year

Figure 2. Monthly mean IRA values of the four reproductive strategies (vertical bars) and monthly mean river levels of the Cuiabá River (solid lines). Dashed lines = division of the study years. Horizontal bars = duration of reproductive period.
Everglades
Changes in Everglades habitats

- Eastern Flatwoods: 70% loss
- Swamp Forests: 100% loss
- Sawgrass Plains: 83% loss
- Ridge and Sloughs: 28% loss
- Southern Marl Prairies: 23% loss

Pre-Drainage System (1850’s) vs. Current
Heterogenous hydrologic conditions caused by compartmentalization (levees-canals)

“Drier than normal”

Natural

“Wetter than normal”
Density of foraging birds modeled as function of hydrology

Water levels in central ENP

Dry season recession

Average water level

Intercept

Disruptions to linear trend

Hindcast numbers of foraging birds

Kwon et al. 2011
Value of “non-consumptive” wildlife recreation (e.g. bird watching) in Florida Everglades:

$1.43 billion per year*

*McCormick et al. Mather Economics 2010
Other Changes to the Ecosystem

• Hyper salinity conditions on the coast

• Salt water intrusion into freshwater marshes

• Invasive exotic plants and animals

• Extreme peat-burning fires
Concluding remarks

• Pantanal, represents a unique source of information on wetland hydro-ecological functioning that may assist in the development of hydrologic targets for Everglades restoration.

• Everglades’ habitat responses to human disturbances may provide field-based metrics for assessing the more recent human impacts in the Pantanal.

• Methods and research approaches developed in the Everglades for this purpose are likely to contribute to the elaboration of appropriate research strategies that will yield the needed information in the Pantanal.
Thank you!
Flood -> recharge

Wet season

Dry season

Ground water sustains channel flow

All piezometers dry

All piezometers submersed

Flood -> recharge

Why spend money to compare Pantanal and Everglades?

- Both wetlands provide valuable ecological services and park were established to conserve wildlife and crucial ecological functions for society.
- Human interventions in the Everglades have substantially modified the original landscape.
  
  +
  
- The Pantanal is relatively pristine
  
  =
  
- Lessons learned in the Everglades maybe useful in the Pantanal -> orient research in an objective way
- Pantanal may provide “targets” for the restoration of the Everglades (provided we understand enough about the Pantanal ecohydrology)
Population Growth in Mato Grosso and Mato Grosso do Sul States

Area and Amount of Agricultural Production (soybean, maize and cotton) in Mato Grosso State, Brazil

Plateau booming Economy

Agriculture: habitat conversion Erosion/sedimentation Fertilizers/biocides

Energy: Large and small dams for hydrower

Transport: Hidrovia, roads; railways

Urbanization: sewage

Industries: food processing, mining
Environmental Pressures

GEF-ALTO PARAGUAI - ANA MMA OAS

- **Water**: Contamination of superficial and underground water; alteration of the flood pulsing (dams);
- **Fishing**: contamination, over-fishing, change in species composition;
- **Urbanization and Industrialization**
- **Soil degradation**: Estimated in 300 tons/km²/ano at the superior sub-basin; wet-land draining, agroindustry.
- **Wet-lands**: Decline in diversity of species in terrestrial flora; decline in number of animal species
## Commercial values of the Pantanal

<table>
<thead>
<tr>
<th>Aquatic</th>
<th>Terrestrial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fishes</td>
<td>Cattle and other domestic animals</td>
</tr>
<tr>
<td>Other aquatic animals</td>
<td>Terrestrial game animals</td>
</tr>
<tr>
<td>Aquatic crops</td>
<td>Terrestrial crops</td>
</tr>
<tr>
<td>Recreation and tourism</td>
<td>Recreation and tourism</td>
</tr>
<tr>
<td>Fluvial transport</td>
<td>Timber</td>
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<tr>
<td>Hydroelectric energy</td>
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</table>
Non-commercial values and services of the Pantanal

Water storage
Buffering of water level fluctuations
Water purification
Buffering of local and regional climate (temperature, air humidity)
Maintenance of biodiversity
Scenic beauty
High quality of life for local people
Negative: Water born diseases and pests
Mean values of “natural capital” of different ecosystems: sum of commercial and non-commercial values (Constanza et al. 1997).

Wetlands and rivers: \( \text{US$ 8.498 ha}^{-1} \text{ yr}^{-1} \)
Forests \( \text{US$ 969 ha}^{-1} \text{ yr}^{-1} \)
Grasslands \( \text{US$ 232 ha}^{-1} \text{ yr}^{-1} \)