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Aquatic food webs of the oxbow lakes in the Pantanal: A new site for fisheries guaranteed by alternated control?

Ronaldo Angelini[a,*], Ronny José de Morais[b], Agostinho Carlos Catella[c], Emiko Kawakami Resende[c], Simone Libralato[d]

[a] Departamento de Engenharia Sanitária e Ambiental, Universidade Federal do Rio Grande do Norte, UFRN, BR-101, Campus Universitário, Natal, RN 59078-970, Brazil
[b] Mestre em Ecologia e Evolução, Universidade Federal de Goiás, Goiânia, GO, Brazil
[c] Centro de Pesquisa Agropecuária do Pantanal, EMBRAPA, Corumbá, MS, Brazil
[d] Istituto Nazionale di Oceanografia e di Geofisica Sperimentale – OGS, Trieste, Italy

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ABSTRACT

Flood pulse and biotic interrelationships control the food web dynamics of river floodplain systems. The Pantanal Plain in the Paraguay River Basin (Brazil) occupies 140,000 km^2 of periodically flooded areas and is divided into 12 subregions with different characteristics related to the flood pulse duration, the vegetation, the type of soil, and the resources used in activities, particularly fishing. In this study, we used Ecopath with Ecosim (EwE) to model three oxbow lakes in the South Pantanal Plain, where there is no fishing activity, to test the similarity of the ecosystems, to identify the keystone species and the types of food web controls, and to determine whether these environments can support moderated fishing pressure. We found that the food webs of the oxbow lakes are similar to each other because, although they depend mainly on the presence or absence of predators, flood pulses similarly homogenize the lakes. The results highlight the importance of detritus in these food webs. In addition, the highest values of the keystoneness species index in the three models highlight the role of top predators (*Hoplias malabaricus*, *Serrasalmus* spp., *Pseudoplatystoma reticulatum*, birds, and mammals). Therefore, we suggest that the food webs in the three systems are subjected to an alternated control process: detritus controls the food web during the flood season and by the top predators during the dry season. The simulation outputs indicate that these oxbow lakes can sustain only moderate fishing because increasing the fishing pressure reduces the biodiversity and can negatively impact the top predators.

1. Introduction

The hydrological regime in river floodplain systems is considered the key factor that determines the structure and functioning of the communities in these areas (Junk et al., 1989; Jepsen and Winemiller, 2002; Agostinho et al., 2007). This assumption is true because the flood pulse determines the exchange of nutrients among the terrestrial and the aquatic environments, and this exchange influences the productivity, allows the migration of species, and thus increases the possibility of interactions between species (Zeug and Winemiller, 2008; Alho, 2008; Hamilton, 2010).

In addition to the flood pulse, the biotic interrelationships also regulate the dynamics of the communities of river floodplain systems (Thomaz et al., 2007; Luz-Agostinho et al., 2008), and the food web may be affected by different food web controls (Hunter and Price, 1992; Pace et al., 1999; Cury et al., 2000; Hunter, 2001; Hunt and McKinnell, 2006; Yaragina and Dolgov, 2009).

In a top-down control system, the higher trophic levels (*TLs*) determine the bulk of the lower *TLs* through direct and indirect effects (Carpenter et al., 1985; Leibold et al., 1997; Dyer and Letourneau, 2003; Moore et al., 2003; Dinnen and Robertson, 2010). In a bottom-up control system, the basis of the food chain (producers or detritivores) regulates the productivity and abundance of the higher *TLs* (Nielsen, 2001; Lorentsen et al., 2010). The species in the intermediate *TLs* may exert a type of control called wasp-waist, in which changes in the abundances of these species affects both their predators and their prey (Cury et al., 2000; Shannon et al., 2004). However, the dynamics of some communities are determined through a mixed control, i.e., with some influence from both the producers and the predators (Achá and Fontúrbel, 2003; Hunt and McKinnell, 2006).

The species that most influence these types of controls are considered key species because they play a dominant role in the development of the ecosystem. This role is independent of the biomass (Mills et al., 1993; Piraino et al., 2002; Libralato et al., 2006;

* Corresponding author. Tel.: +55 8487433020.
E-mail addresses: ronangelini@yahoo.com.br (R. Angelini), ronnybio@hotmail.com (R.J. de Morais), catella@cpap.embrapa.br (A.C. Catella), emiko@cpap.embrapa.br (E.K. Resende), slibralato@ogs.trieste.it (S. Libralato).

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