Hydrological connectivity in the Upper Parana fluvial macrosystem: Influence of upstream Dams (1964-2019)

José A. Arenas

Coastal Ecosystems of Peru Research Group, Carrera de Biología Marina, Facultad de Ciencias Veterinarias y Biológicas, Universidad Científica del Sur  
Lima 15067, Perú

Edvard E. Souza-Filho

Grupo de Estudos Multidisciplinares do Ambiente (GEMA), Departamento de Geografia, Universidade Estadual de Maringá  
Maringá, 87020-900, Brasil

Increased loss of natural conditions of the world's fluvial systems has critically compromised the river's function and biodiversity. The Brazilian Paraná River and its main tributaries are modified to a discontinued river basin because of more than 150 large reservoirs (>15 m), 70% used for hydroelectricity. The only sector without impoundment is a 235 km reach from Porto Primavera dam to Itaipú Hydroelectric Power Station reservoir, the upper Paraná fluvial macrosystem. The Influence of upstream dams in the upper Paraná fluvial macrosystem's hydrological connectivity was evaluated, combining natural flux and connectivity approaches. We reassessed connectivity levels with satellite images that revealed various processes associated with hydrometric records; thus, 3.5 m and 5.5 m hydrometric levels at the Porto Sao Jose Station were established as local and generalized inundation scenarios. The temporal series was separated into four hydrological periods: 1964-1971 (natural period); 1972-1981 (beginning of large dam construction in the basin), 1982-1998 (increased discharges), and 1999-2019 (functioning of the nearest reservoir upstream from the fluvial macrosystem). Several attributes of the ecohydrological function f FITRAS (frequency, intensity, tension, recurrence, amplitude, seasonality) and related indices were used as hydrological connectivity and river dynamics descriptors. Hydrological periods were used as factors, and attribute records were analyzed with factorial randomization ANOVA. Alterations in the dynamic of attributes related to quantity, duration, and intensity of hydrosedimentological pulses were evident after 1964-1971 and intensified in 1999-2019. These changes occurred in both connectivity levels considered, being more pronounced at 5.5 m3/s. This method improves the way to demonstrate changes in hydrological connectivity and its attributes quantitatively.