



Limnología

XVII CONGRESS OF THE IBERIAN ASSOCIATION OF LIMNOLOGY
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SS1.1

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BASES TO INCLUDE ZOOPLANKTON IN THE ECOLOGICAL QUALITY ASSESSMENT OF RESERVOIRS: THE CASE OF ZOOPLANKTON IN SPANISH MEDITERRANEAN RESERVOIRS

The implementation of the EU Water Framework Directive does not include zooplankton as a biological quality element (BQE) despite it is largely known as an important and integrated component of the pelagic systems. Recent works are illustrating the scientific bases to claim for their inclusion. It is in this way, and because we dispose of an extent information on zooplankton in reservoirs across a wide trophic gradient, that we try to demonstrate its close relationship with quality of water in reservoirs and then its indicator value.

Zooplankton was studied in 20 reservoirs from several Mediterranean hydrological basins (Confederación Hidrográfica del Júcar). The study included two seasons (summer and winter) along three hydrological years (2006-2009). We obtained density and biomass of zooplankton populations and we analyzed limnological variables: age of the system, morphology (area, depth,...), environmental conditions (temperature, conductivity, turbidity, Secchi disc depth, pH, dissolved O₂), resource's concentration (NO₃, NH₄, total-Nitrogen, PO₄, total-Phosphorous) and pelagic primary producers (chlorophyll a concentration and phytoplankton biomass). Different zooplankton metrics were calculated. We conducted an ordination analysis based on the Jaccard similarity index and subsequent ANOSIM to study the reservoirs grouping based on zooplankton composition. Statistical relationship between zooplankton and environmental variables was analyzed by redundancy analysis and multiple correlations.

According to our results zooplankton composition and abundance are mainly related to variables associated to aquatic trophic state (light penetration, total phosphorous and primary producers concentrations). The clusters of reservoirs, obtained using zooplankton composition, are mostly related to their trophic status, separating to a greater degree the more eutrophic systems; thus, they can be considered as a good bioindicators for these features. Nevertheless, the likely co-variation and overlapping with different variables and the cost of obtaining the zooplankton metrics is an issue to consider in order to find the most useful metrics at the regional level through Europe. We have demonstrated that zooplankton respond to changes in the environmental conditions, and as other BQEs is a good indicator and should be considered in order to evaluate the ecological status of reservoirs.

EH.6

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A PROPOSAL FOR THE MODIFICATION OF THE “EL INFIERNILLO” DAM DISCHARGES REGIME, LOCATED IN THE CENTRAL-WEST REGION OF MEXICO, CONSIDERING ECOLOGICAL FLOWS.

This work proposes a discharges regime modification for the Infiernillo dam, located at the low area of the Balsas river basin, within the 18th Mexican Hydrological region, including the ecological conservation usage altogether with the other usages of water.

The Hydrological region number 18 Balsas, is located at the South-West region of Mexico, encompassing a hydrological surface of 117,405 square Kilometers, which equals a 6% of the national territory, including different parts from nine States and from Mexico City. It is limited by the Sierra Madre del Sur and Sierra de Juárez, as well as by the Trans-Mexican Volcanic Belt. It is an elongated depression with narrow valleys, where most of the territory is formed by high reaches with steep slopes. This is a difficult geological arrangement for controlling and saving the run-off from an average annual precipitation of 900 millimeters.

In the Balsas Hydrological Region it is used a total of 47,332.70 million cubic meters of water by year, where 45,477.84 million refer to surface water (i.e. 96.1%) and the remaining 1,855.86 million refer to underground water.

The main user of the surface water in the Balsas hydrological Region is the Electricity Federal Agency (CFE), who uses 80.99% of the water through hydroelectric power stations. One of these power stations was built in The Infiernillo dam, with a power of 920 Megawatts. This dam is located in the lower area of the Balsas River Basin, generating a 400 square kilometers for the reservoir, with a saving capacity of 12,000 million cubic meters.

Operational politics for The Infiernillo dam reservoir includes energy generation and flows control, but it does not consider ecological conservation discharges (i.e. environmental flows). This is why this work proposes a discharges regime modification to include an environmental flows regime, through a methodology based on historical flows (Mexican Norm NMX-AA-159-SCFI-2012), where the system operation is optimized through a reservoir zoning therefore its operation curve, penalizing deviations. The optimization problem consists in minimizing penalties during the water accumulation phase and using the genetic algorithm NSGA II (Non-dominated Sorting Genetic Algorithm II) to find the optimal proposal.

SS1.5

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ENVIRONMENTAL FORCING OF CRUSTACEAN ZOOPLANKTON IN A MEDITERRANEAN RESERVOIR (RIVER DOURO WATERSHED, NORTH-WESTERN IBERIA): EFFECTS ON SPECIES ABUNDANCE AND VARIABILITY

A 8-yr record of monthly observations (2000-2002 and 2007-2011) in Azibo Reservoir were used (1) to describe crustacean zooplankton interannual and seasonal variability; (2) to understand the environmental forcing underlying zooplankton dynamics. This reservoir was chosen because unlike the majority of existing reservoirs, water level fluctuations are not very pronounced, never exceeding 3m. Furthermore, the introduction of pike (*Esox lucius* L.) in the 1990's led to a marked reduction of cyprinid fish abundance. Consequently, fish predatory pressure is regarded to be too low to drive zooplankton community. Without the interference of internal disturbances generated by extreme anthropogenic water level fluctuations and by fish predation on the zooplankton, this reservoir provides a good environment for studying the reservoir general limnology, filling the lack of long term data on this kind of aquatic ecosystems. ANCOVA and Pearson correlation analyses indicated that total phosphorus, Secchi depth, conductivity and pH, as well as, cyanobacteria and diatoms abundance were significantly related to precipitation. A seasonal cycle in zooplankton composition common to all the years sampled was identified. This pattern consisted of a marked separation between a winter and a summer assemblage (ANOSIM: R=0.841; p=0.01). The winter zooplankton assemblage was characterized by a higher abundance of *Daphnia longispina/pulex*. By contrast, in summer and autumn *Ceriodaphnia pulchella*, *Diaphanosoma brachyurum* and the copepod *C. numidicus* were dominant. BIOENV analysis identified temperature, conductivity, Secchi depth, diatoms and cyanobacteria abundance as the environmental variables most highly forcing seasonal zooplankton composition and species abundance. Results also provided evidence of interannual variability in the timing of zooplankton succession. In fact, the timing of appearance and/or annual peak densities varied among years. These data on crustacean zooplankton assemblage will certainly provide a baseline against which future changes on this reservoir can be measured, allowing the evaluation and the prediction of the impacts of land use modifications and of climate change on ecosystem integrity. Furthermore, the obtained information can also be extrapolated to other Mediterranean reservoirs.



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CERTIFICATE OF ATTENDANCE

We confirm that

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has presented the Oral Communication entitled:

ENVIRONMENTAL FORCING OF CRUSTACEAN ZOOPLANKTON IN A MEDITERRANEAN RESERVOIR (RIVER DOURO WATERSHED, NORTH-WESTERN IBERIA): EFFECTS ON SPECIES ABUNDANCE AND VARIABILITY

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