Balancing hydropower and biodiversity in the Amazon, Congo, and Mekong

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HYDROPOWER DEVELOPMENT IN THE AMAZON, CONGO AND MEKONG BASINS

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In their important paper published in Science, vol. 351, issue 6269 pp. 128-129, Winemiller F.O. *et al* gave a very good summary of the impact of dam construction in the three basins on fish biodiversity However, the construction of dams in the Amazon, Congo and Mekong basins affects not only fish biodiversity but also the hydrosocial cycle, that is the hydrological dynamics, the human activities in connection with the biodiversity of terrestrial and aquatic ecosystems. This was demonstrated by the Amazon Basin (1) but is most probable valid for the Mekong and Congo basins.

Deforestation that occurs with reservoir construction also affects fish biodiversity and the ecological dynamics of the aquatic ecosystems such as creeks, lakes and wetlands. (2)

The present plans to develop the Amazon, Congo and Mekong Rivers with the construction of several reservoirs, as shown by the authors will introduce a large scale change in the hydrological cycle in the hydrosocial cycle and ecosystem services that are key to the maintenance of evolutive and biodiversity processes (3).

Besides the overall impact in the aquatic and terrestrial ecosystems construction of Amazonian reservoirs results in the emissions of greenhouse gases affecting aquatic biodiversity and fish biodiversity downstream the reservoirs.(4,5) Greenhouse gases may also be produced in the Congo and Mekong basin reservoirs.

For the Amazonian reservoirs there are another threats not described by the authors: there are 150 new dams planned for the six major tributaries of the Amazon in the Andes. Peru, Ecuador, Bolivia and Colombia are building up already 55 dams for hydroelectricity in the Andean Amazon (6). Besides the river fragmentation caused by these dams there is strong interference of the connectivity that links the Andean headwaters with the lowland Amazon, also affecting fish migration, fish biodiversity and sediment transportation. This will affect aquatic biodiversity, habitat integrity, food chains and biogeochemical cycles downstream.

Some further recommendations for planning and conservations of the basins: several rivers are active centers of evolution (7). They should be fully protected of reservoir construction and maintained as **permanent evolutive hotspots** (8); the interaction of engineering techniques with ecohydrological principles are also fundamental: less inundated areas with smaller reservoirs and low retention times; avoiding large reservoir cascades maintaining stretches of rivers free of reservoirs enhancing the recovery of the biodiversity and the fluvial ecological dynamics.

An optimization of dam construction should include planning for protecting fish diversity, maintaining habitat integrity as pointed out by the authors. The management of competing objectives includes a important question: the challenge is where and how hydropower is built up. As pointed out in (9) the fundamentals are the scientific understanding of the relationship between ecosystem services and hydropower benefits. This is strategic in a long term policy. Planning, engineering procedures, ecohydrological principles and limnological/ecological approaches are not incompatible (10).

Reservoir construction around the world has been improved considerably in the last 20 years thanks to the accumulated scientific knowledge of reservoir research. Therefore new technologies for reservoir construction should be included earlier in the planning stage in the three basins, in order to mitigate impacts, optimize operations for hydropower production, maintaining connectivity of streams, lakes with the river downstream the reservoir, and suplying adequate water quality with positive impact on fish biodiversity downstream (11,12).

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