

<p>ISEI 7</p> <p>7th International Conference on Ecological Informatics</p> <p>13 – 16 December 2010</p> <p>Ghent University Ghent, Belgium</p>	<p>Qualitative models to investigate the influence of human activities on the biotopes of Pirá-Brasília - <i>Simpsonichthys boitonei</i> - in Brasília, Brazil.</p> <p>Henrique Anatole Ramos and Paulo Salles</p>
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Session: Qualitative reasoning (Chair: B. Bredeweg (The Netherlands))

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Abstract

Pirá-Brasília (*Simpsonichthys boitonei*) is an endemic annual fish found in the Brazilian Federal District area. Annual fishes complete their entire life cycle in temporary aquatic environments, being found in adult stage only in brief annual periods. The Pirá-Brasília distribution is restricted to temporary ponds in the lowland southern part of the Paranoá river basin.

The annual fishes typical biotopes – temporary ponds on floodable areas, lowlands, “veredas” and marshes of different types – have high environmental importance, and are one of the target areas of the Ramsar Convention on wetlands. Despite the importance of these areas, temporary marshes or lagoons have been drastically destroyed by deforestation, drainage and landfill, both by the expansion of farming and urbanization areas. For this reason, 52 species of annual fishes, including the Pirá-Brasília, represent the most threatened group of the Brazilian ichthyofauna.

The work described in this paper shows the results of a modeling effort aiming to represent the annual fish Pirá-Brasília life cycle and environmental factors that contribute to increase the vulnerability of this species, in order to justify measures that should be taken to support conservation proposals. Qualitative reasoning modeling allows to confront different views and to harmonize existing knowledge about the Pirá-Brasília and other annual fish species, usually scattered in studies carried on in different areas of biology, and empirical knowledge stored in the common sense of fish breeders. The models were implemented in Garp3 workbench (www.garp3.org), following a compositional modeling approach, in which simulation models are created by the combination of model fragments among those available in a library created by the modelers.

Two models were built in order to answer the following research questions:

- (a) How knowledge about the interactions of the Pirá-Brasília and the environment where it is regularly found would contribute to the understanding of relevant aspects of these fish survival?
- (b) What would be the main effects of the changes caused by human communities on biotopes occupied by Pirá-Brasília populations?

The first question was answered by the Life Cycle model, which explores the most relevant biotic and abiotic factors acting on the Pirá-Brasília life cycle. The second one, by the model Biotope, that captures aspects related to the water quality, forests and human actions.

The Life Cycle model represents the effects of the precipitation/evaporation balance during alternance of a rainy and a dry seasons. The amount of water on the soil and the oxygen

concentration have strong influence on the development of the embryos left in the previous year (in diapauses III). Some of these embryos develop into fingerlings and then into adults, which in turn put a negative feedback on the development of new embryos.

If the habitat does not become dry before the fishes reach sexual maturity, the spawning process is active and generates embryos in diapause I. With the beginning of the dry season and the gradual loss of water by the habitat, oxygen in the substrate increases again, inducing the development of the embryos into diapause II. The development stops until the photoperiod increases again. Increased photoperiod combined with the presence of oxygen in the substrate, lead the development of embryos into diapause III.

Relevant environmental problems addressed by the Biotope model include the transportation of garbage by floods, the deforestation of riparian forests (treated in Brazil as Permanent Preservation Areas – APP) and soil erosion. Among human interventions that completely destroy habitats, the model includes damming of streams and rivers to water supply and electricity generation, the occupation of APP by unregulated urban expansion and suppression of wetlands to farming purposes.

With the qualitative models support and aiming at the biotope conservation and the protection of the Pirá-Brasília populations, the following measures were proposed:

1. search, in a systematic way, new species populations, mainly outside the conservation areas of strictly protection;
2. carry out conservation actions with the human population in direct contact with the biotopes, as well as the periodic monitoring of the environmental conditions of the occurrence areas to the species;
3. improve the control by the environmental policies on maintaining the integrity of Permanent Preservation Areas (specific areas protected by Brazilian legislation), with potential use by the species as a guidance to periodic inspections and samples;
4. use the Pirá-Brasília's image as a flag-species, as a way to attract the media attention to the environment and to rise the knowledge and public awareness on benefit of regional biodiversity of aquatic organisms;
5. stimulate the development and implantation of new practices and technologies, capable of supply the water demands to human provision and irrigations, reducing the needed of new dams on the species distribution area;
6. invest on environmental education and public awareness, mainly on the rural areas, about the importance of the temporary water environments, and the potential problems generated by the construction of successive dams, even small ones, on small creeks.

Model validation was realized by four environmental analysts of the Brazilian Institute of Environmental and Sustainable Use of Natural Resources (IBAMA) that work with fishery resources management and answered to more general questions; and with a biologist of the University of Brasília that, as a specialist with previously knowledge about the Pirá-Brasília, answer to more specific questions about the model. All the participants manifested a very positive impression about the approach of Qualitative Reasoning, the software Garp3 and the models presented. In the words of one of them: the qualitative model showed the knowledge in a fairly visual and intuitive way, allowing a quick understanding. The evaluators consider valid the proposal to use the models to plain and define conservation measures to Pirá-Brasília and other annual fish species, with some adaptations to regional realities.

Qualitative modeling of ecosystems showed to be a promising tool for use in the process of governmental management and decision making, as they allow for the insertion of a wide range of qualitative data, integrating socio-economic and cultural factors with the environment. Their use becomes particularly interesting when it is considered the huge number of situations in which decision makers have to do their job without the support of numerical data.

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