

Jun 26th, 3:30 PM - 3:50 PM

## Concurrent Sessions B: Fish Passage in South America - Reservoirs as an Ecological Barrier to Neotropical Fish Migration

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International Conference on  
Engineering and Ecohydrology for Fish Passage

June 25-27, 2013 - Oregon State University



# Reservoirs as an ecological barrier to Neotropical fish migration

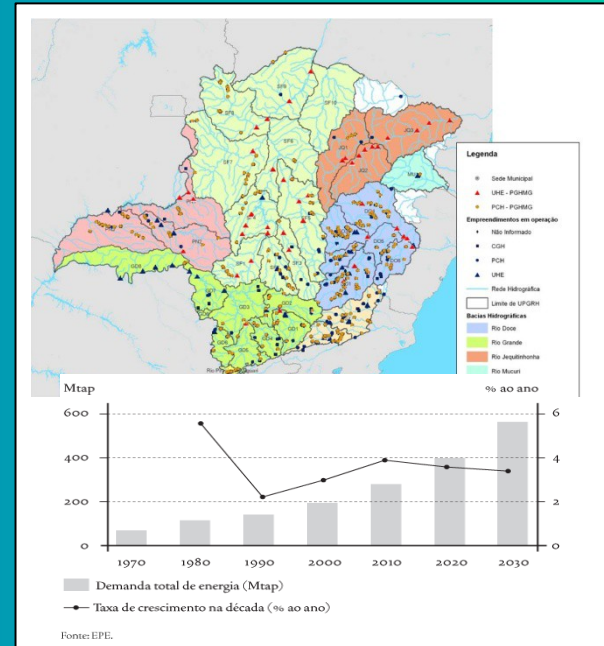
**Why in many situations, fish passes will not be able to preserve the migratory fish species in South America?**

Paulo Santos Pompeu, Fernando M. Pelicice and  
Ângelo A. Agostinho



Great diversity;

Energy demand;



**Fish passes have been one of the adopted strategies**



# *Igarapava Fish Ladder*



Starting of operation = 1999

Length = 282 m; Height = 17,5; Slope = 6%

Type = vertical slot (first built in Brazil); 87 pools (3x3x3 m each)

Couting window (\*)

TR = tail race; R = Igarapava reservoir

# *Itaipu Piracema Channel*





# The Funil Fish Lift



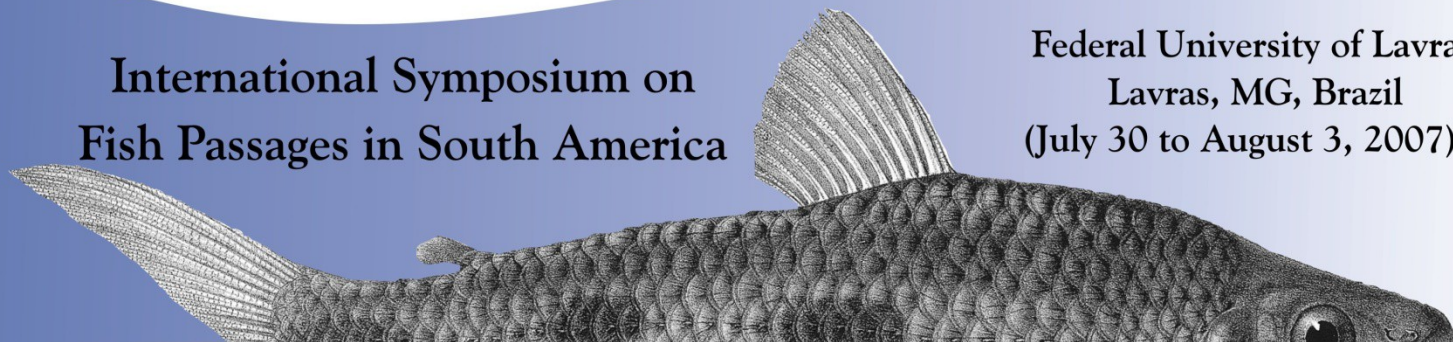
Lift height: 45 m

Hopper volume: 8 m<sup>3</sup>

Exit channel: 120 m

# International Symposium on Fish Passages in South America

Federal University of Lavras  
Lavras, MG, Brazil  
(July 30 to August 3, 2007)



RIVER RESEARCH AND APPLICATIONS

*River Res. Applic.* (2011)

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## EXISTING AND FUTURE CHALLENGES: THE CONCEPT OF SUCCESSFUL FISH PASSAGE IN SOUTH AMERICA

P. S. POMPEU,<sup>a\*</sup> A. A. AGOSTINHO<sup>b</sup> and F. M. PELICICE<sup>c</sup>

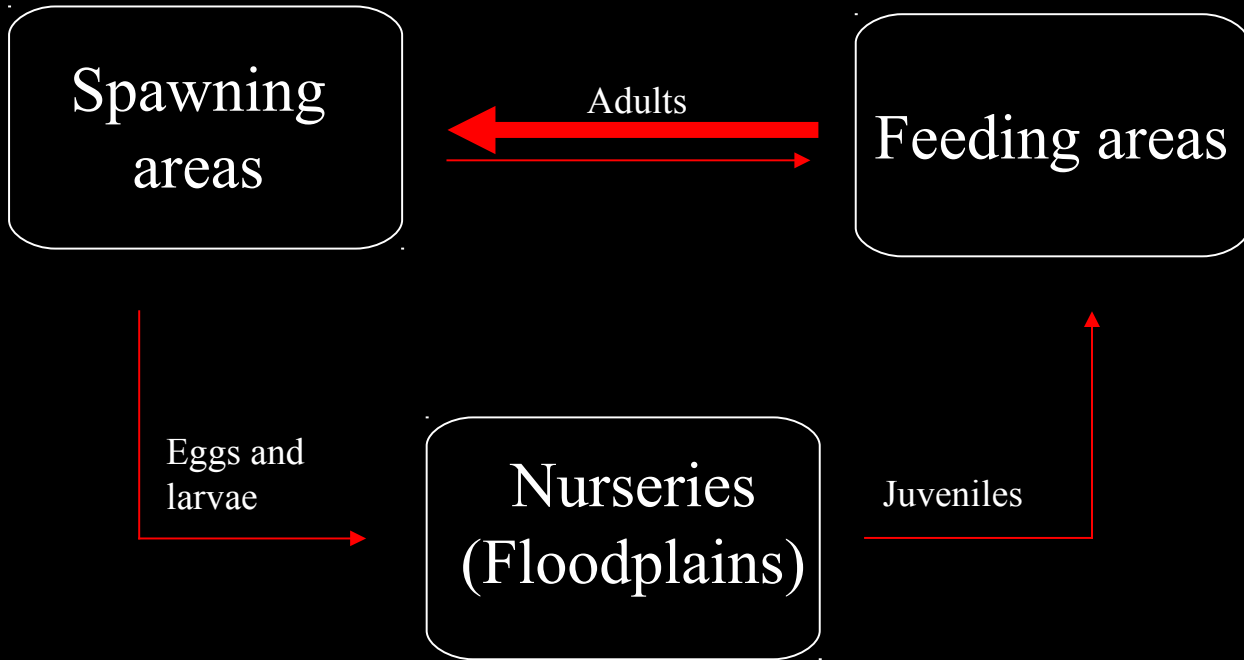
<sup>a</sup> *Department of Biology, Federal University of Lavras, Lavras, Minas Gerais, Brazil*

<sup>b</sup> *Department of Biology/NUPELIA, Maringá State University, Maringá, Paraná, Brazil*

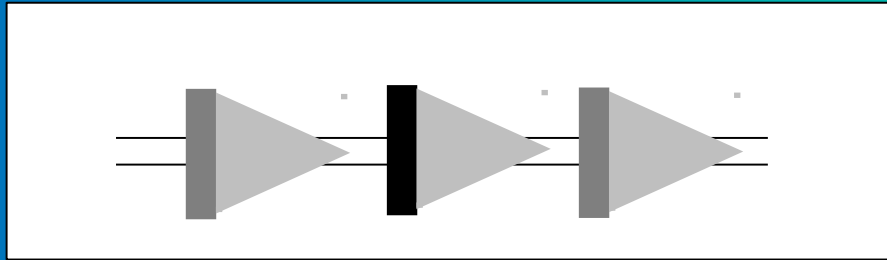
<sup>c</sup> *NEAMB, Federal University of Tocantins, Porto Nacional, Tocantins, Brazil*

**The need for a fish passage depends on the distribution of critical habitats upstream and downstream of the dam.**





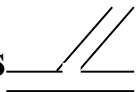
General movements of the migratory fishes of Paraná and São Francisco River basins (Adapted from Godinho & Pompeu, 2003).



• Passes aiming to maintain recruitment are irrational in this situation if they do not reconnect critical fish habitats in the river by incorporating passes at all the dams.



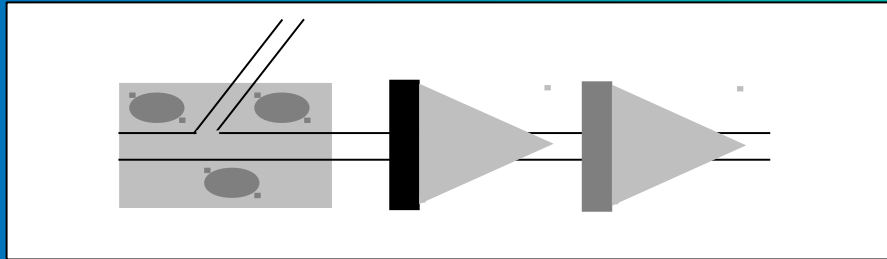
Nursery areas



Reproduction sites



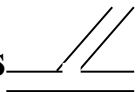
Dam of interest



• Passes operating in these conditions may function as ecologic traps (Pelicice and Agostinho, 2008), because they remove the fish from healthy environments and transport them to sites with no critic habitats.



Nursery areas

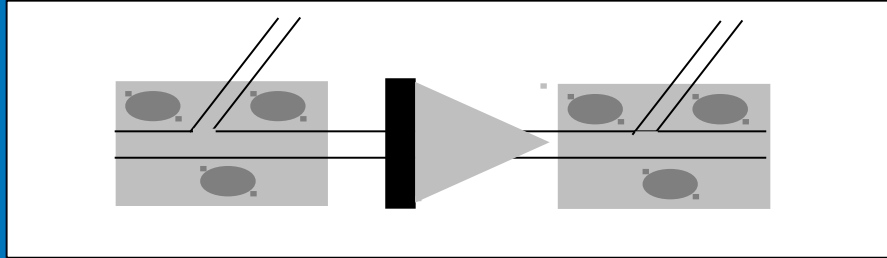


Reproduction sites



Dam of interest

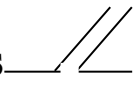




•Because the populations may become self sustainable in the long-term in both regions, these passes would become questionable or justified only for the maintenance of the genetic flow between the populations.



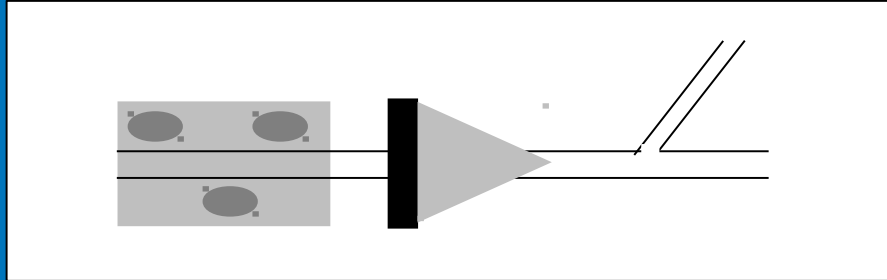
Nursery areas



Reproduction sites



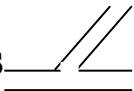
Dam of interest



•This is the only case study where maintenance of connectivity between areas upstream and downstream is crucial for maintaining migratory species populations.



Nursery areas



Reproduction sites



Dam of interest

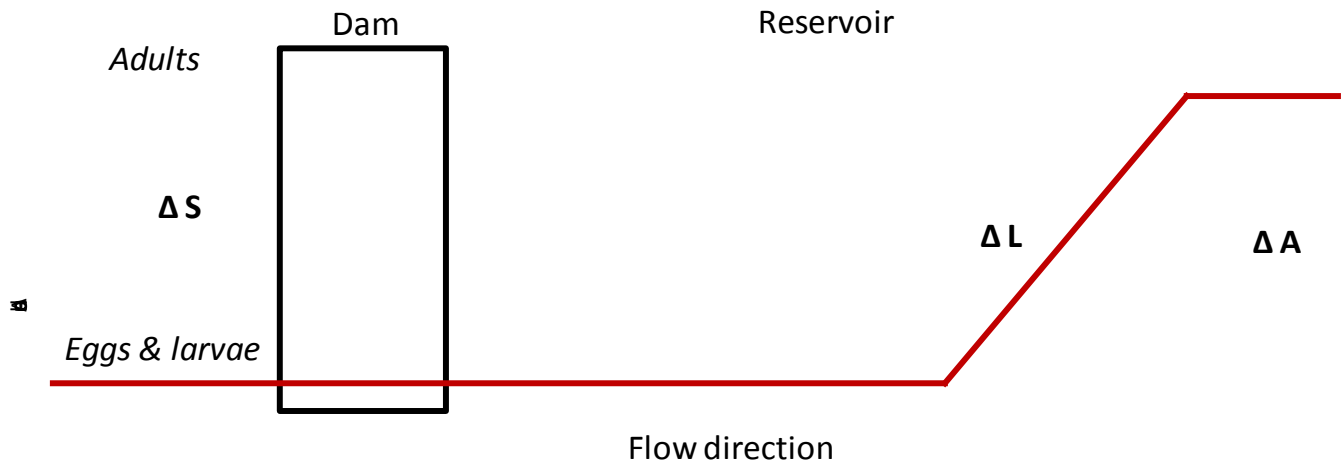
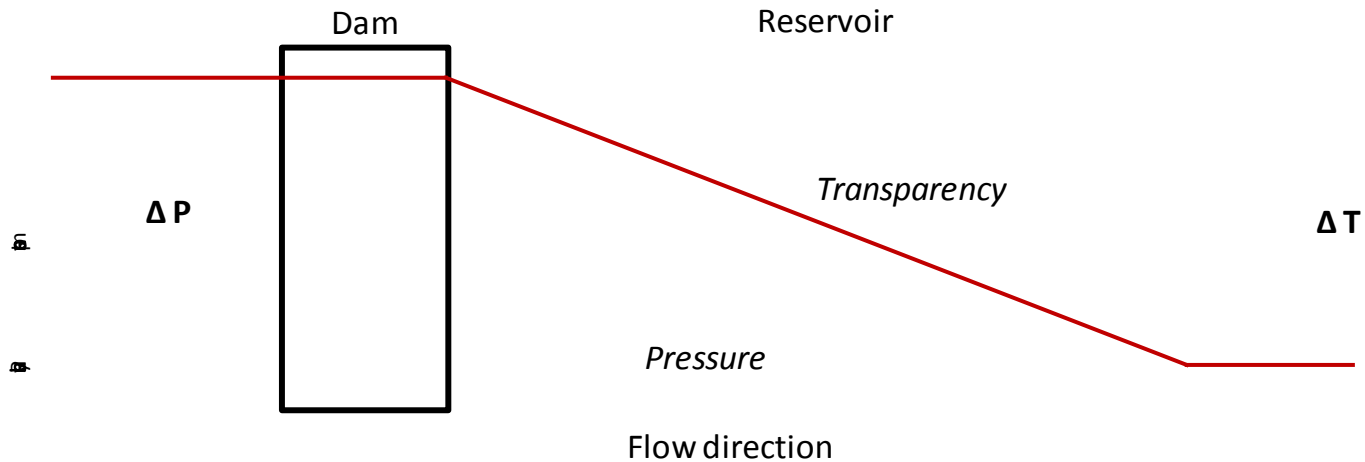
# Reservoirs as an ecological barrier

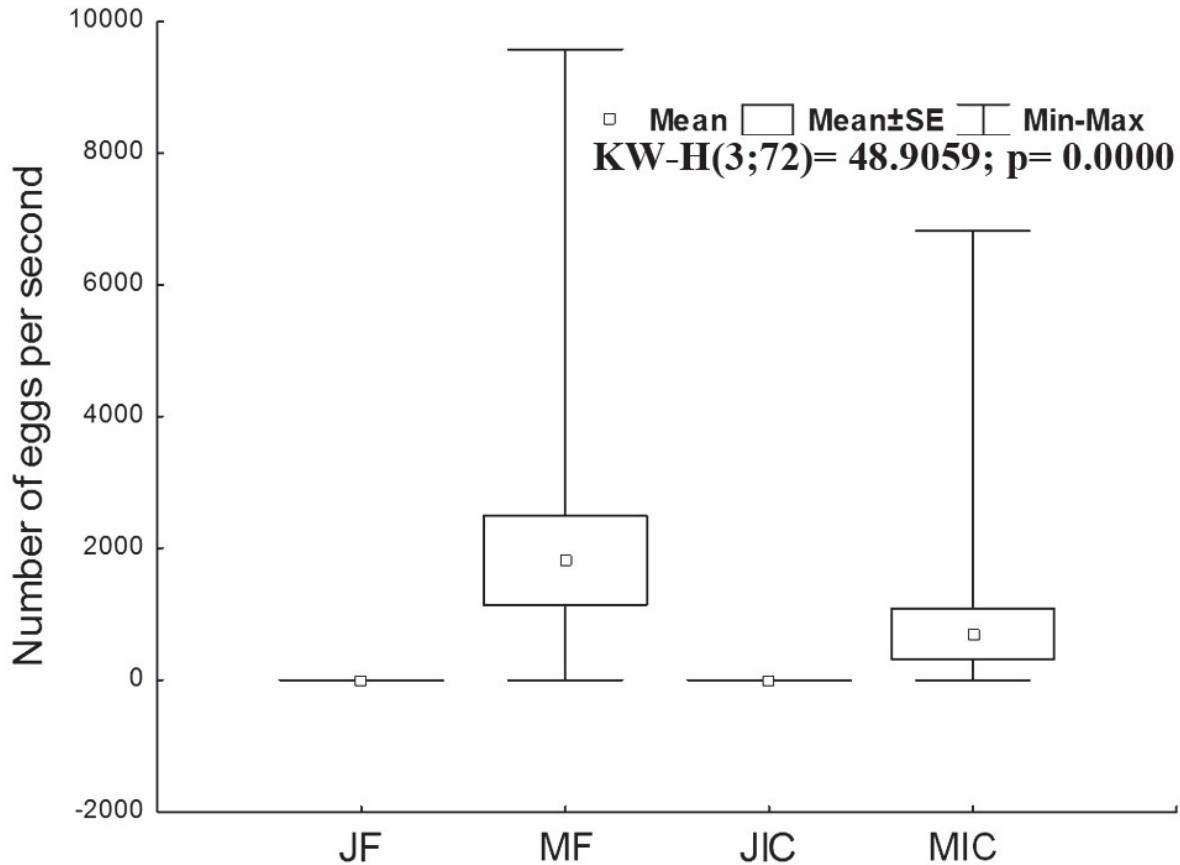
- Despite the high investments and efforts involved, most facilities have been considered ineffective in preserving the populations of target species.
- We believe this failure can be related to inappropriate management strategies that have only focused on the barrier imposed by the dam.
- We propose that the reservoirs themselves should be considered as an independent barrier to Neotropical fish migration as well, especially to downstream movements.



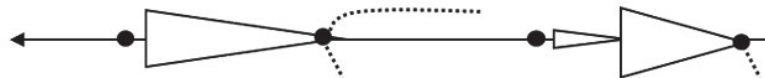
# Characteristics of the barrier represent by dams and reservoirs on the migratory movements of the Neotropical fish fauna.

|                                | Dam  | Reservoir  |
|--------------------------------|--|--|
| Characteristics of the barrier | Vertical<br>Abrupt<br>Structural   | Horizontal<br>Gradient<br>Hydraulic/Limnological                       |
| Relation to fish biology       | Physical   | Behavioral   |
| Main movements prevented       | Upstream reproductive migration of adults<br>Upstream dispersion of juveniles and adults | Downstream migration of adults, eggs and larvae                        |
| Selectivity                    | High to upstream movements<br><br>Unknown to downstream movements                        | High to downstream movements<br><br>Probably low to upstream movements |
| Technical solution             | Available<br>Ladders, lifts, canals  | Unavailable  |
| Effectiveness of solution      | Medium to low  | Unavailable  |

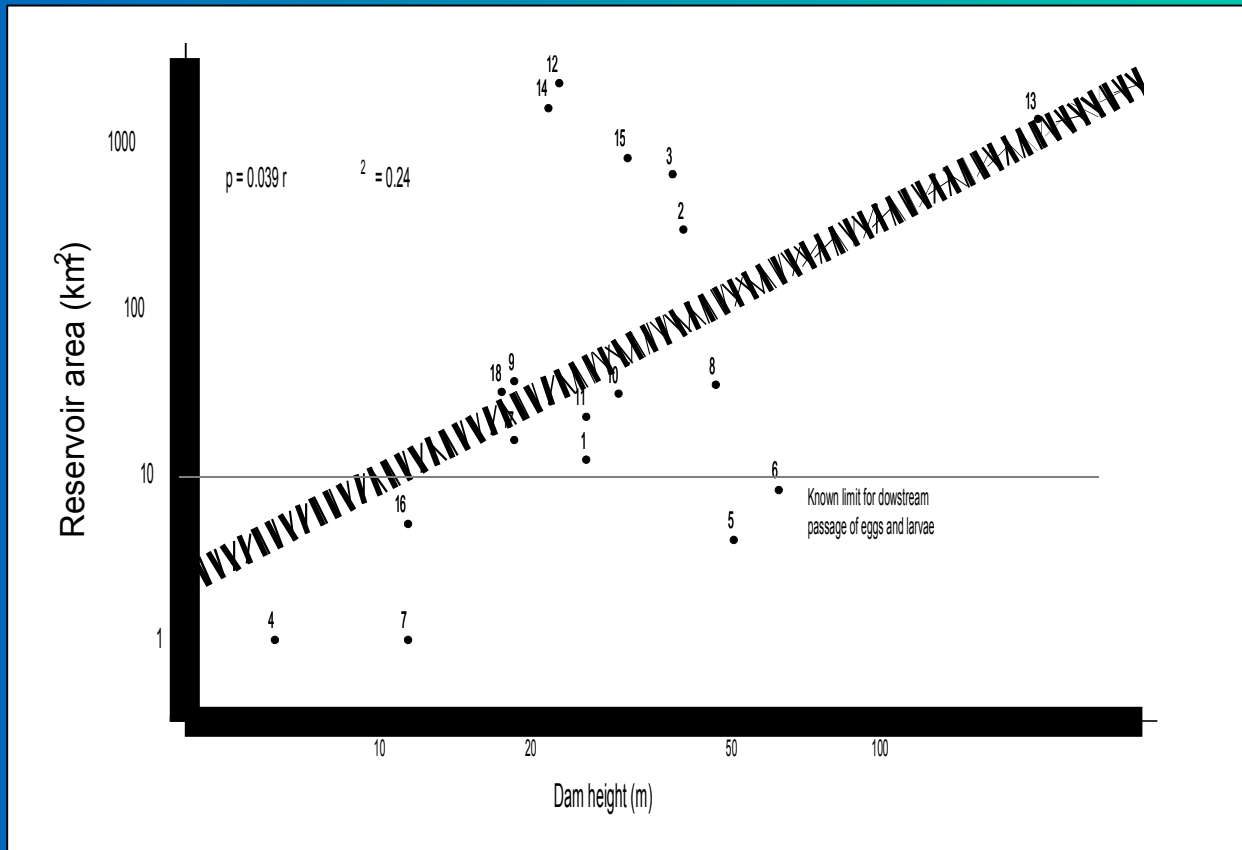




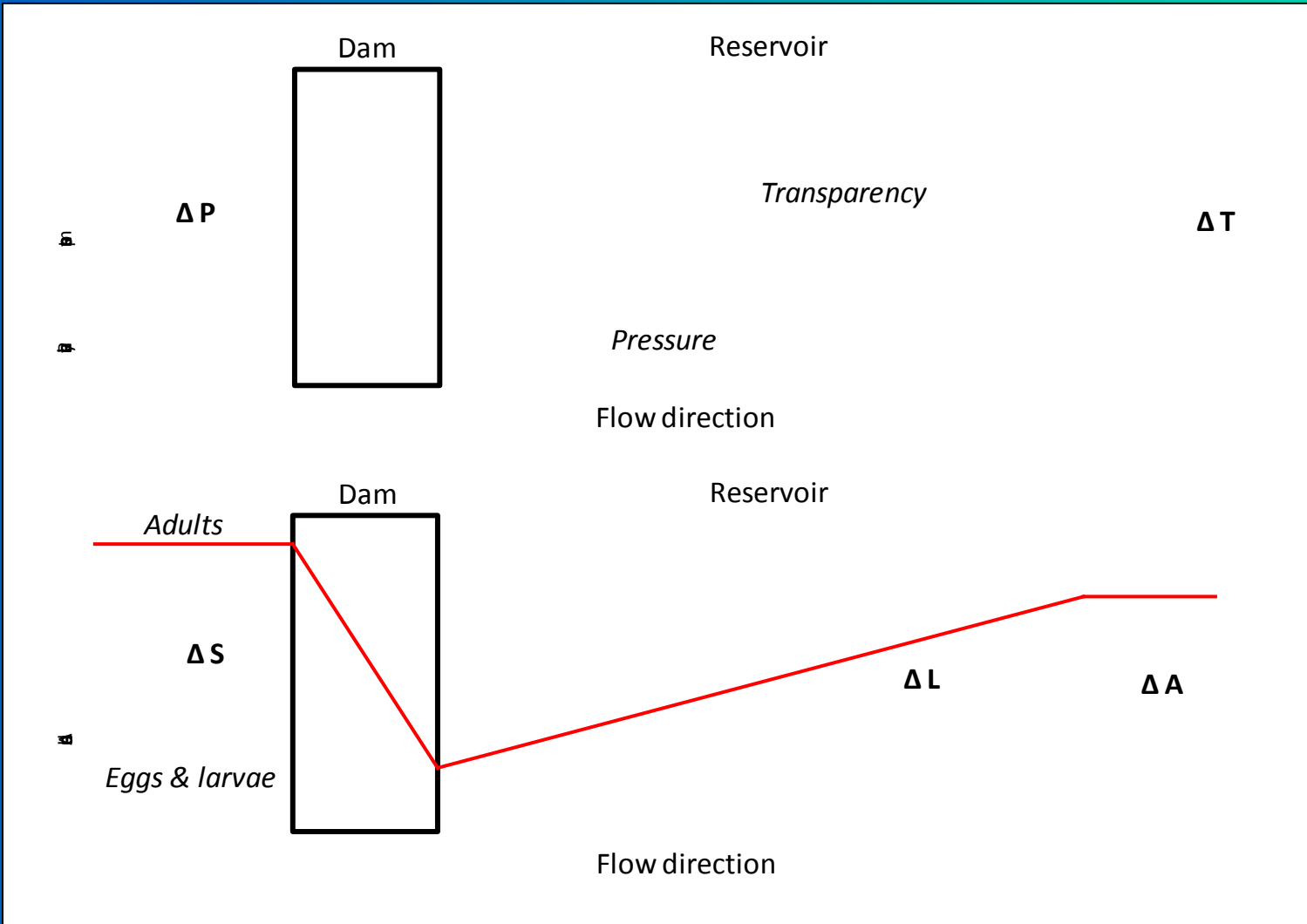
**a**



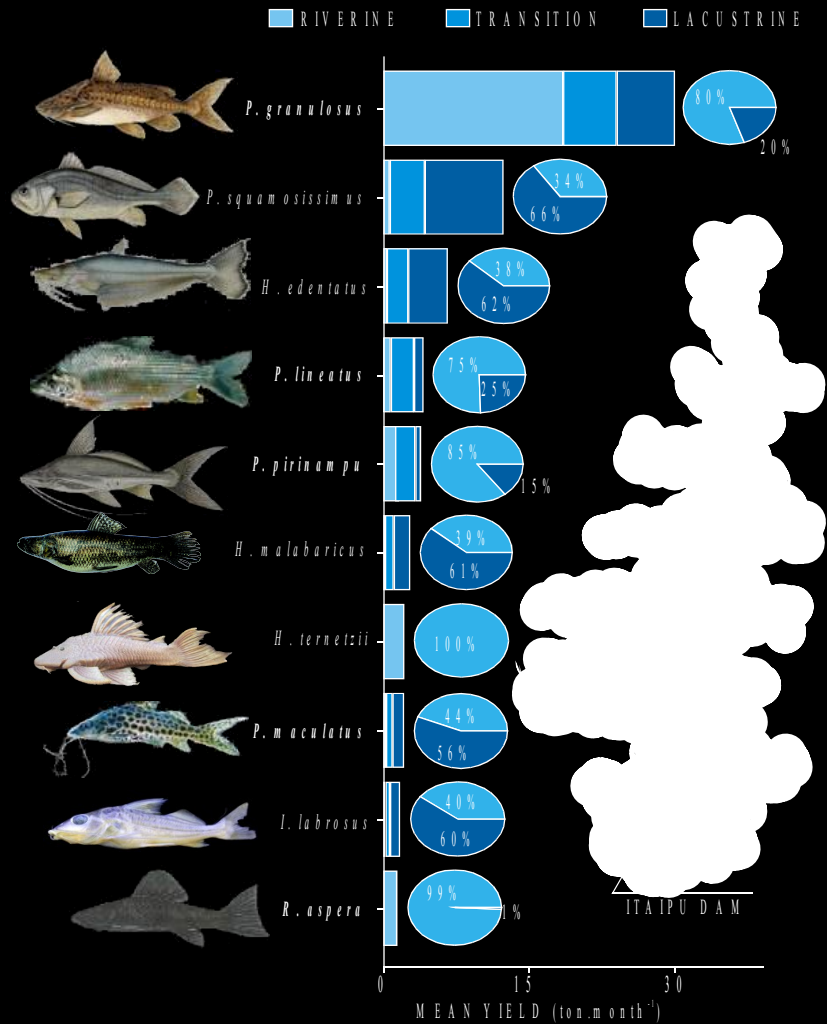




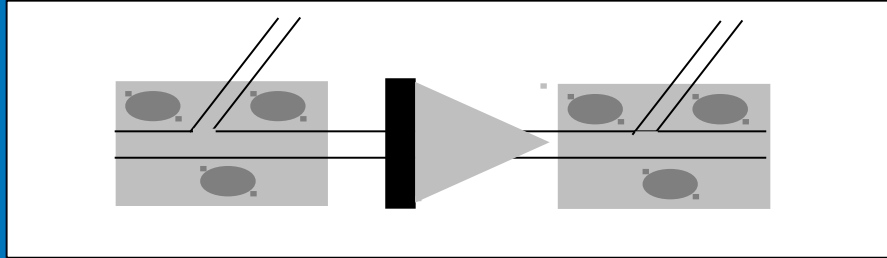
**Relationship between Reservoir area and dam height for South American hydropower plains where a fish passage device was installed (1 = Canoa Quebrada; 2 = Peixe Angical; 3 = Lageado; 4 = Igarapé; 5 = Risoleta Neves; 6 = Santa Clara; 7 = Salto Moraes; 8 = Funil; 9 = Igarapava; 10 = Canoas I; 11 = Canoas II; 12 = Porto Primavera; 13 = Itaipú; 14 = Yaceretá; 15 = Salto Grande; 16 = Ourinhos; 17 = Baguari; 18 = Aimorés).**



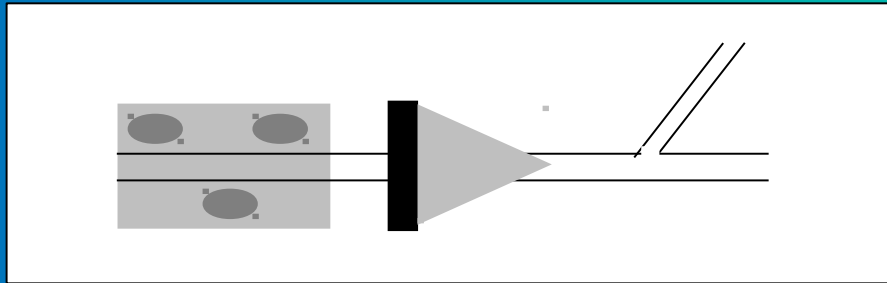
# Preference of migratory fishes for the upper part of the reservoir (Itaipu)







•Reduced success of downstream movements of fish could result in decreased downstream fish stocks.



•If the descendent migration does not happen, the pass loses its value to recruitment conservation.

•To avoid this situation, the distribution of critical habitats should be thoroughly evaluated during the inventory of the hydroelectric potential of the reach, specially if a big reservoir will be created.

# Conclusions

- Because their ecological nature (e.g. absence of flow), instead of physical, reservoirs may represent a major obstacle to migratory movements, since management strategies to deal with this behavioral barrier are not available.
- As a consequence, alternative actions to conserve migratory fish must necessarily consider the location and environmental context of new Hydropower plants, basically because current management actions (e.g. fish passes) have been ineffective.
- In this perspective, only the maintenance of long stretches of river without dams, where migratory fish complete their life cycles, could assure self sustaining populations in the long term.



**THANK YOU !**



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