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

Item Type	event;event
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Download date	2024-07-26 00:17:14
Link to Item	<a href="https://hdl.handle.net/20.500.14394/24642">https://hdl.handle.net/20.500.14394/24642</a>



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

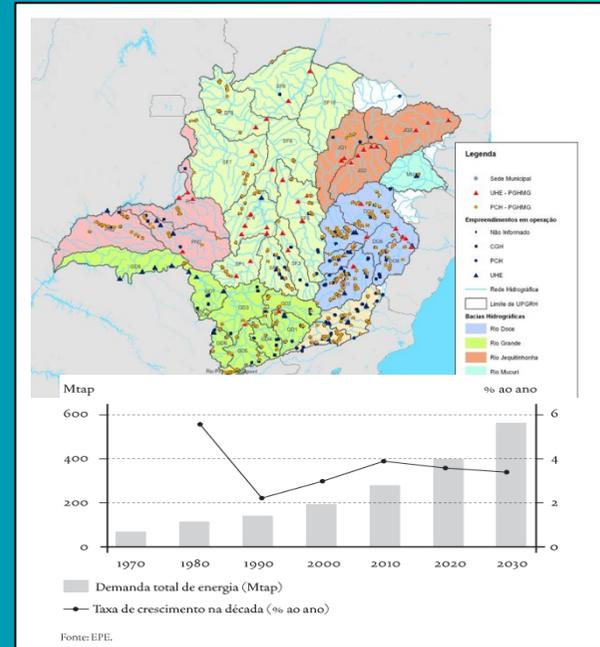
**Why in many situations, fish passes will not be able to preserve the migratory fish species in South America?**

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



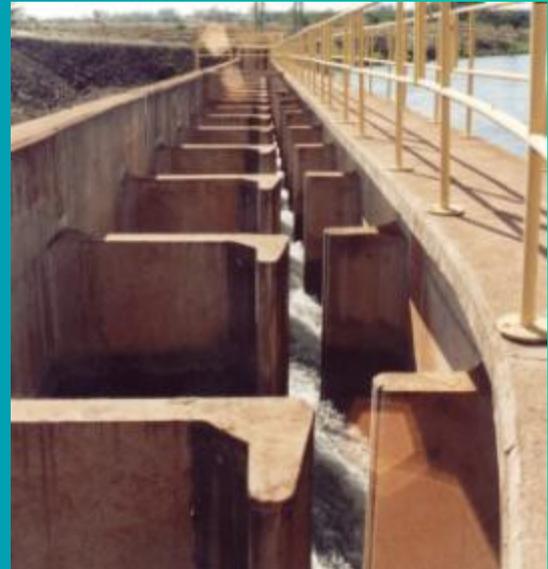
Great diversity;

Energy demand;



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

# *Igarapava Fish Ladder*



Starting of operation = 1999

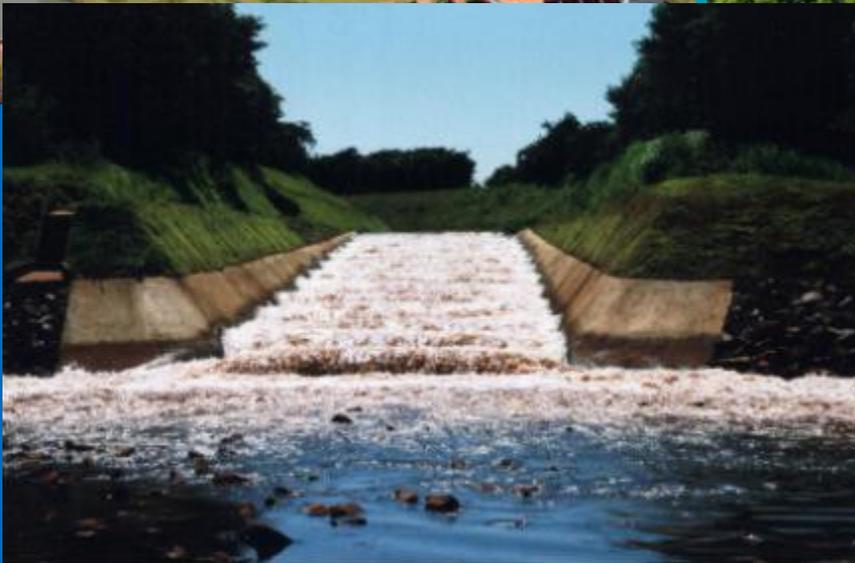
Length = 282 m; Height = 17,5; Slope = 6%

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



RIVER RESEARCH AND APPLICATIONS

*River Res. Applic.* (2011)

Published online in Wiley Online Library  
(wileyonlinelibrary.com) DOI: 10.1002/tra.1557

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

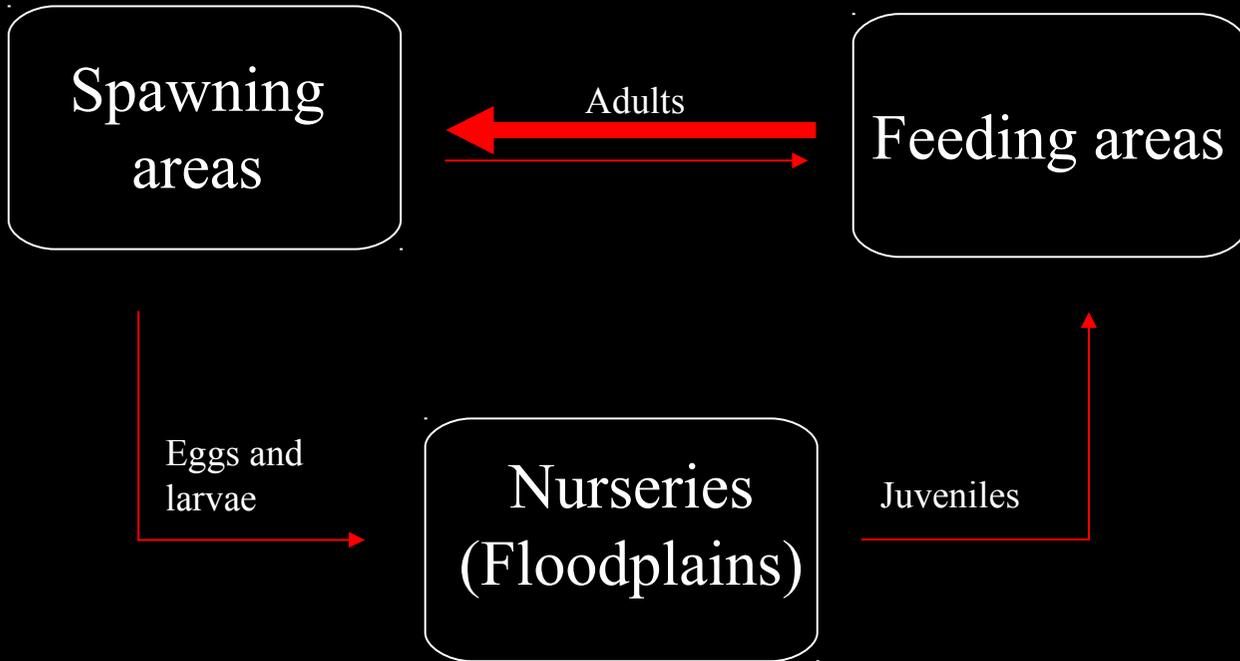
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<sup>a</sup> *Department of Biology, Federal University of Lavras, Lavras, Minas Gerais, Brazil*

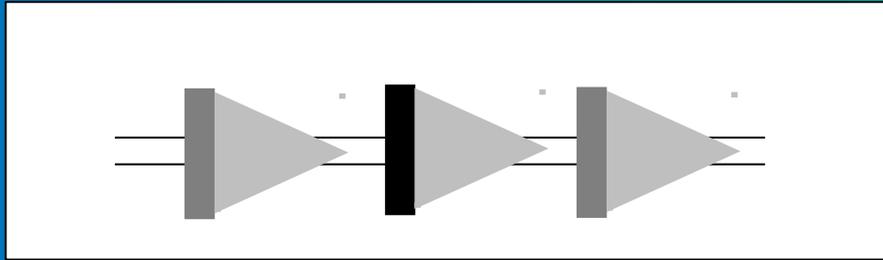
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**The need for a fish passage depends on the distribution of critical habitats upstream and downstream of the dam.**



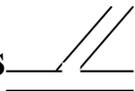
General movements of the migratory fishes of Paraná and São Francisco River basins (Adapted from Godinho & Pompeu, 2003).



• 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.



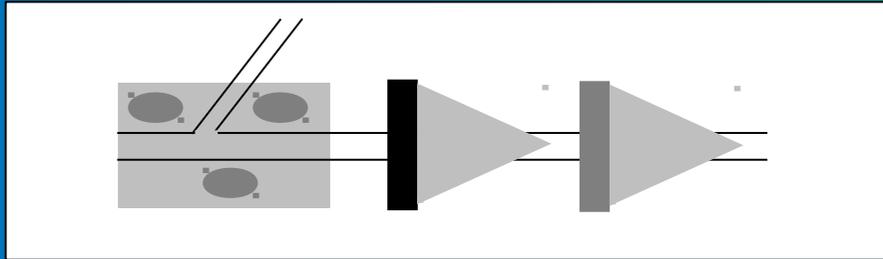
Nursery areas



Reproduction sites



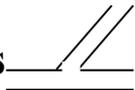
Dam of interest



• 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.



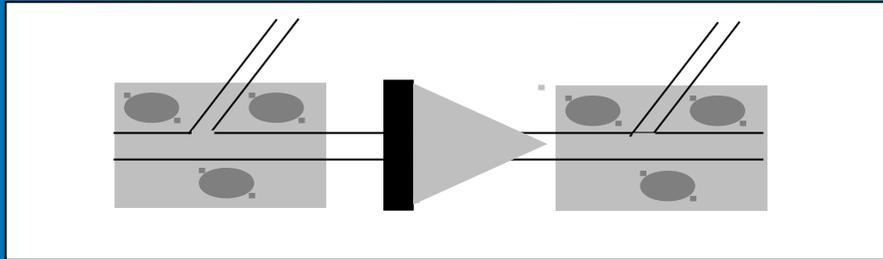
Nursery areas



Reproduction sites



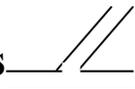
Dam of interest



•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.



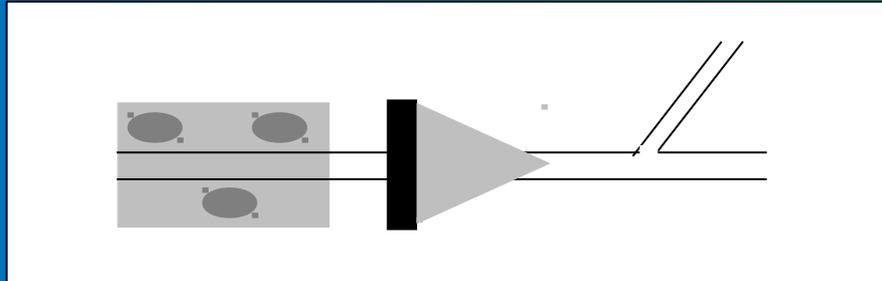
Nursery areas



Reproduction sites



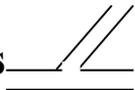
Dam of interest



•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



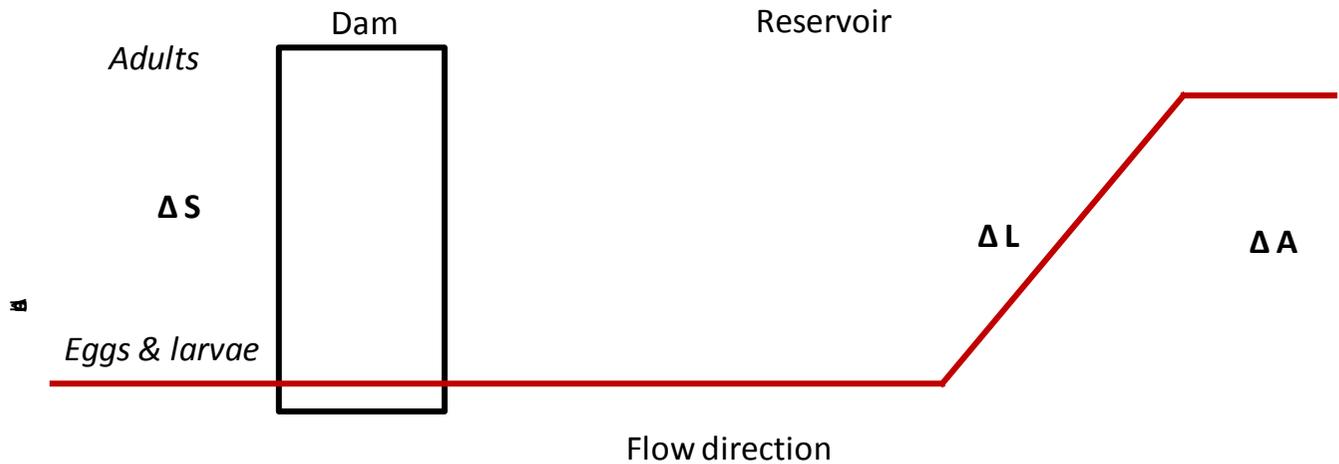
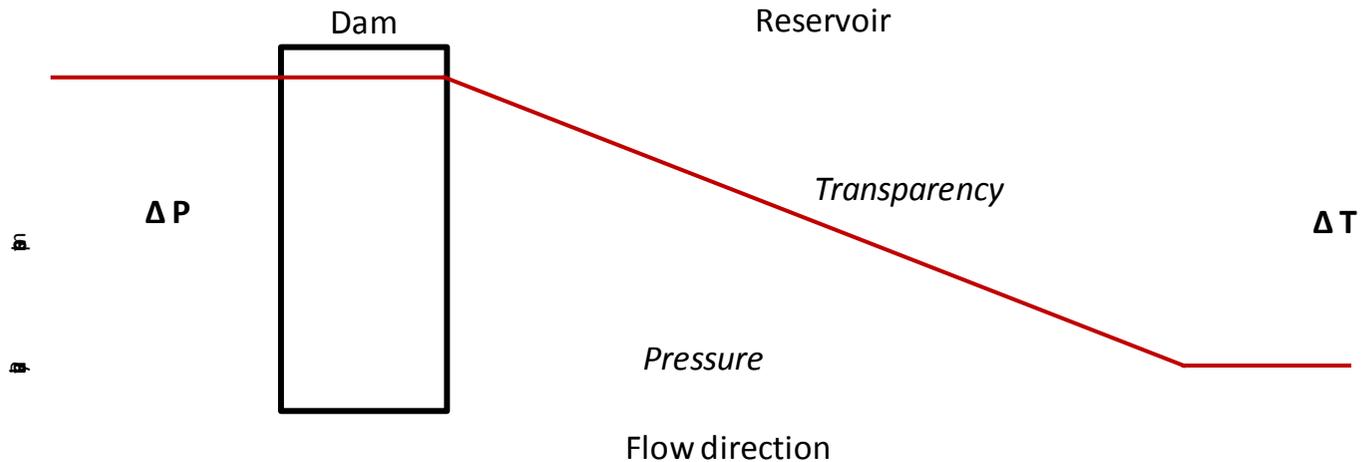
Dam of interest

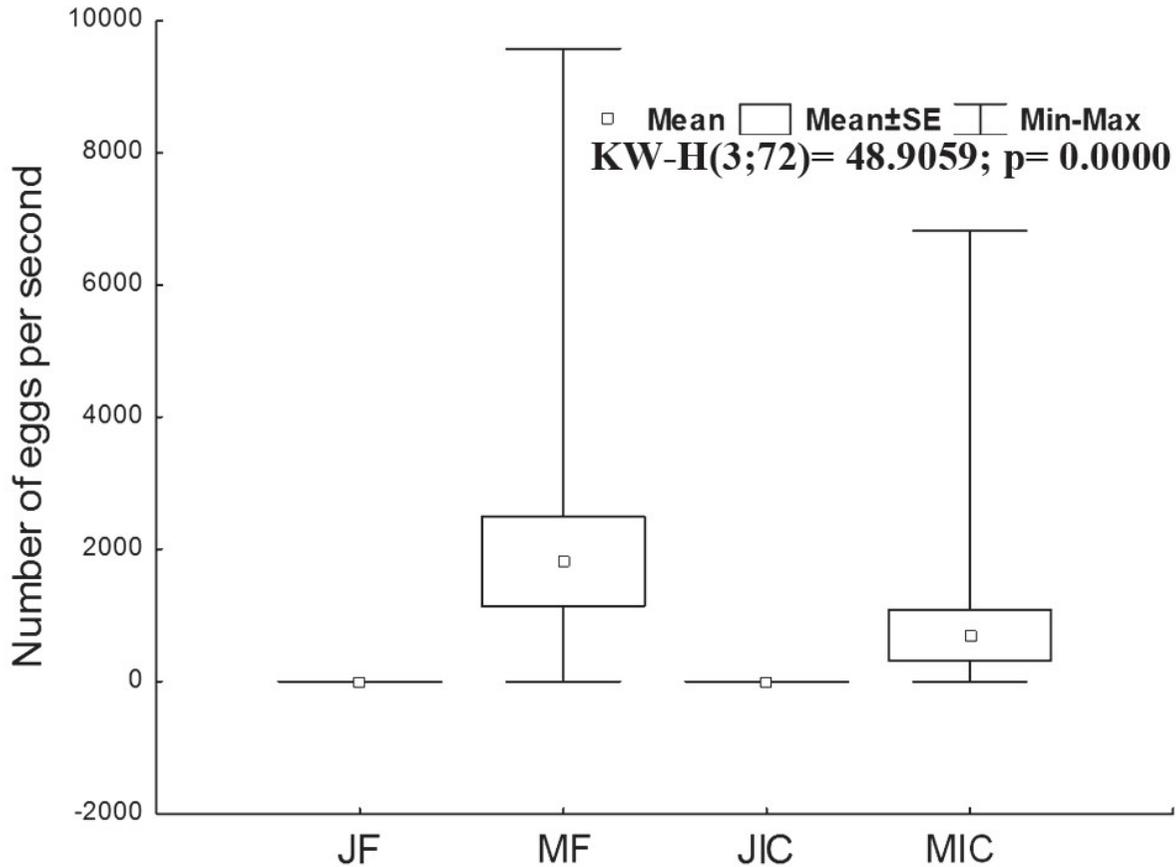
# Reservoirs as an ecological barrier

- 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.

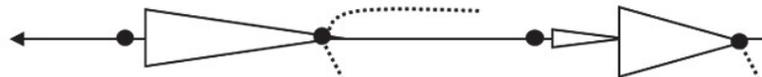
# Characteristics of the barrier represent by dams and reservoirs on the migratory movements of the Neotropical fish fauna.

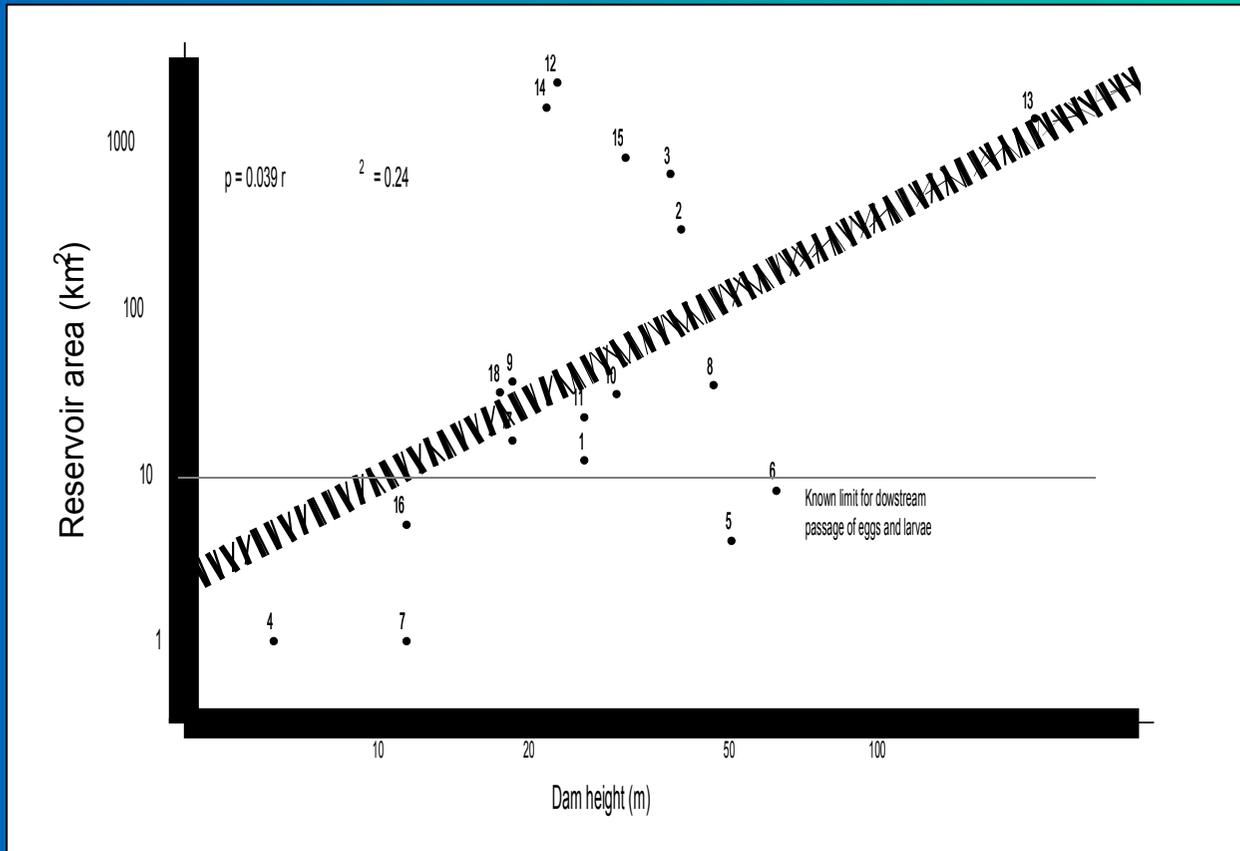
	Dam	Reservoir
Characteristics of the barrier	Vertical Abrupt Structural	Horizontal Gradient Hydraulic/Limnological
Relation to fish biology	Physical	Behavioral
Main movements prevented	Upstream reproductive migration of adults Upstream dispersion of juveniles and adults	Downstream migration of adults,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



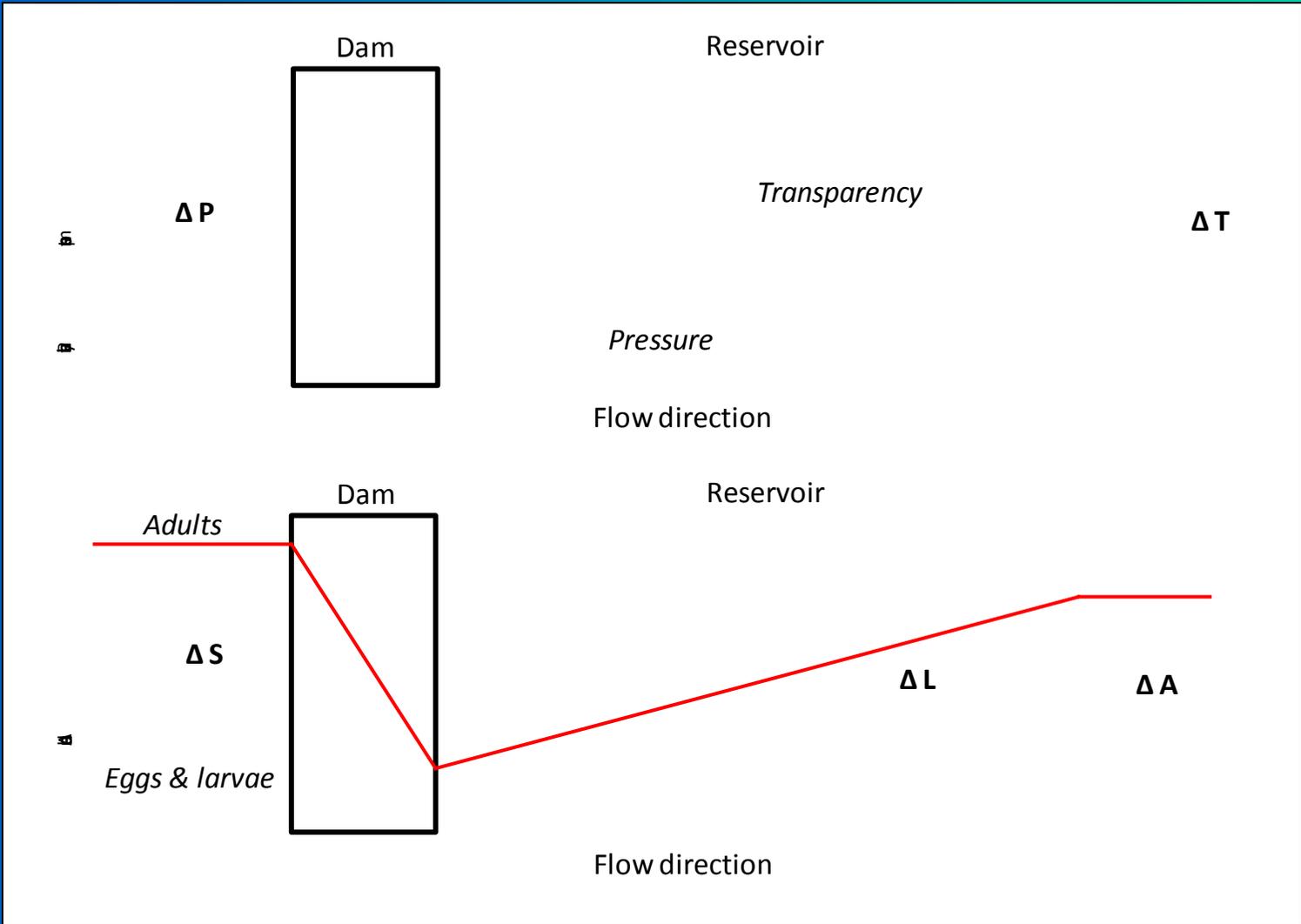


**a**

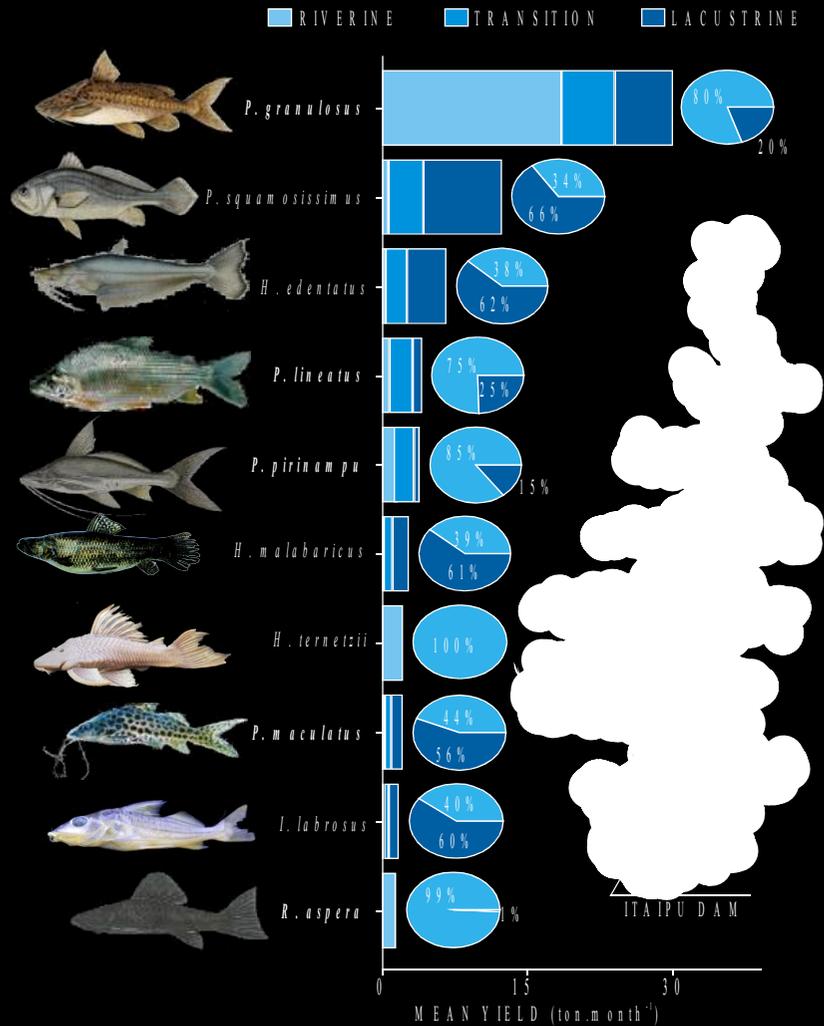


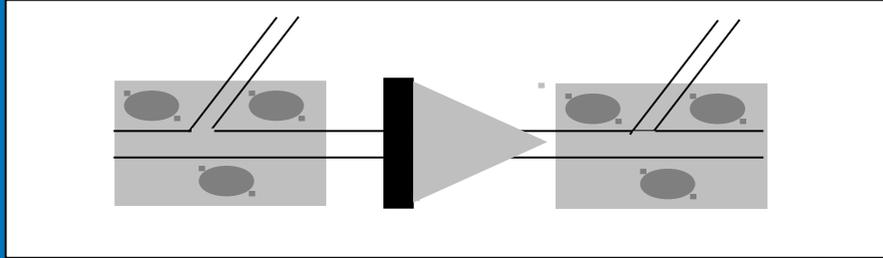


**Relationship between Reservoir area and dam height for South American hydropower plains where a fish passage device was installed (1 = Canoa Quebrada; 2 = Peixe Angical; 3 = Lageado; 4 = Igarapé; 5 = Risoleta Neves; 6 = Santa Clara; 7 = Salto Moraes; 8 = Funil; 9 = Igarapava; 10 = Canoas I; 11 = Canoas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

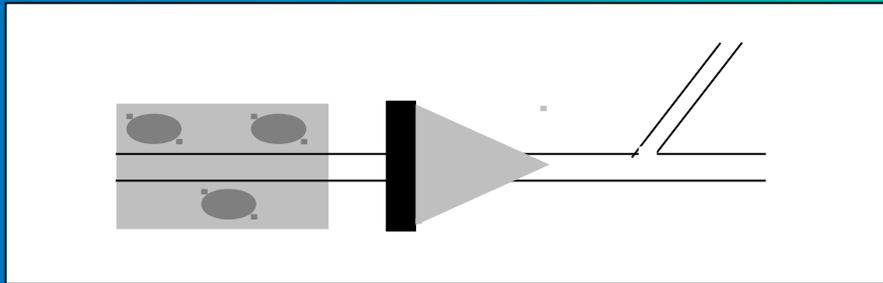


# Preference of migratory fishes for the upper part of the reservoir (Itaipu)





- 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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