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Long-term study of reservoir cascade in Southeastern Brazil reveals spatio-temporal gradient in fish assemblages

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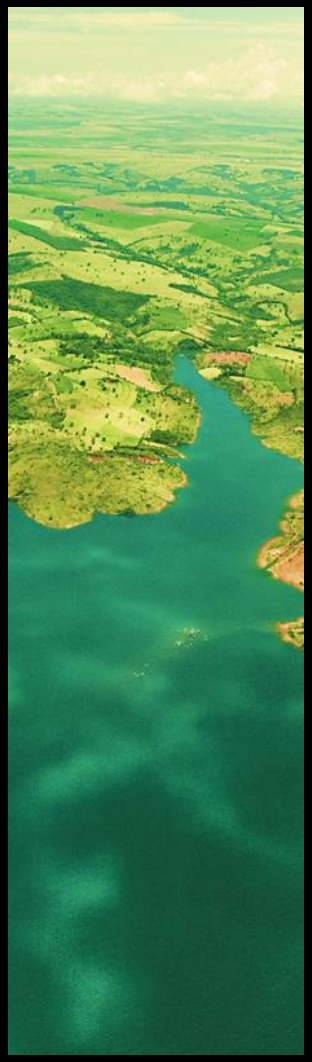
Long-term study of reservoir cascade in Southeastern Brazil reveals spatio-temporal gradient in fish assemblages



Raquel Coelho Loures
Paulo dos Santos Pompeu

Marine and Freshwater Research
69(12) 1983 - 1994

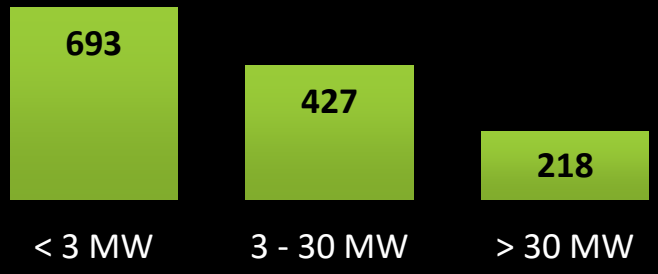
Fish Passage 2018
Hydropower and Fish Symposium
Albury, Australia

UNIVERSIDADE FEDERAL DE LAVRAS

PROGRAMA PeixeVivo CEMIG
A natureza em boa companhia.

INTRODUCTION

1338 hydropower dams in Brazil:
(BIG/ANEEL, 30/10/2018)



Installed Power per district (kW)	Power (KW)
0 a 1.000.000	Até 100.000
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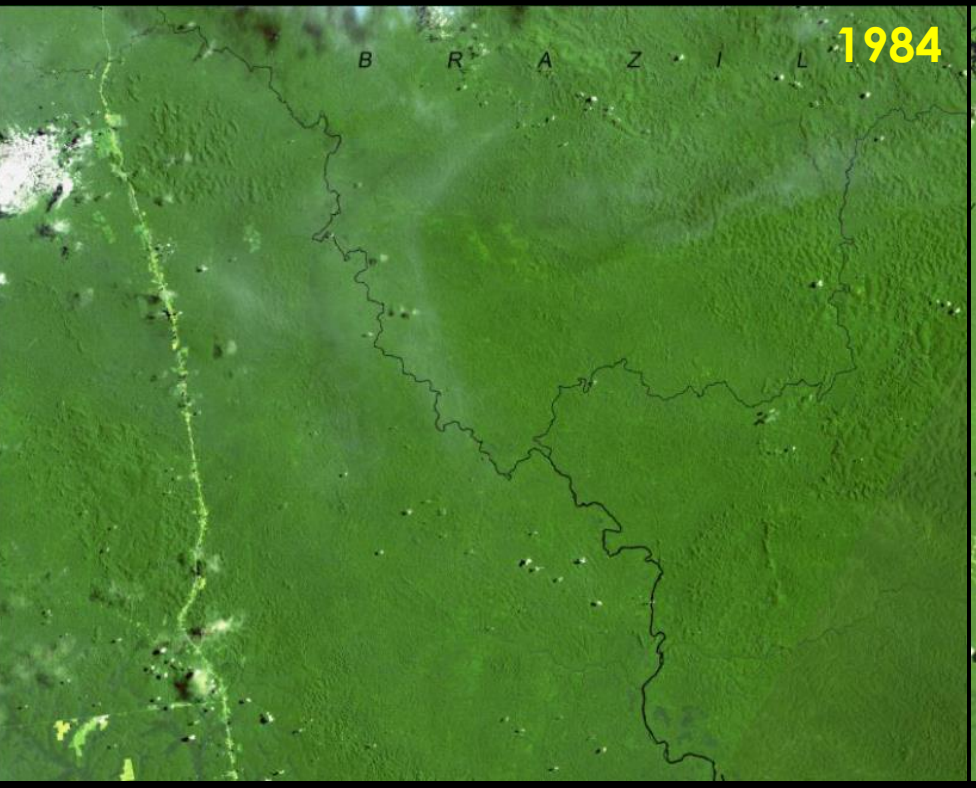
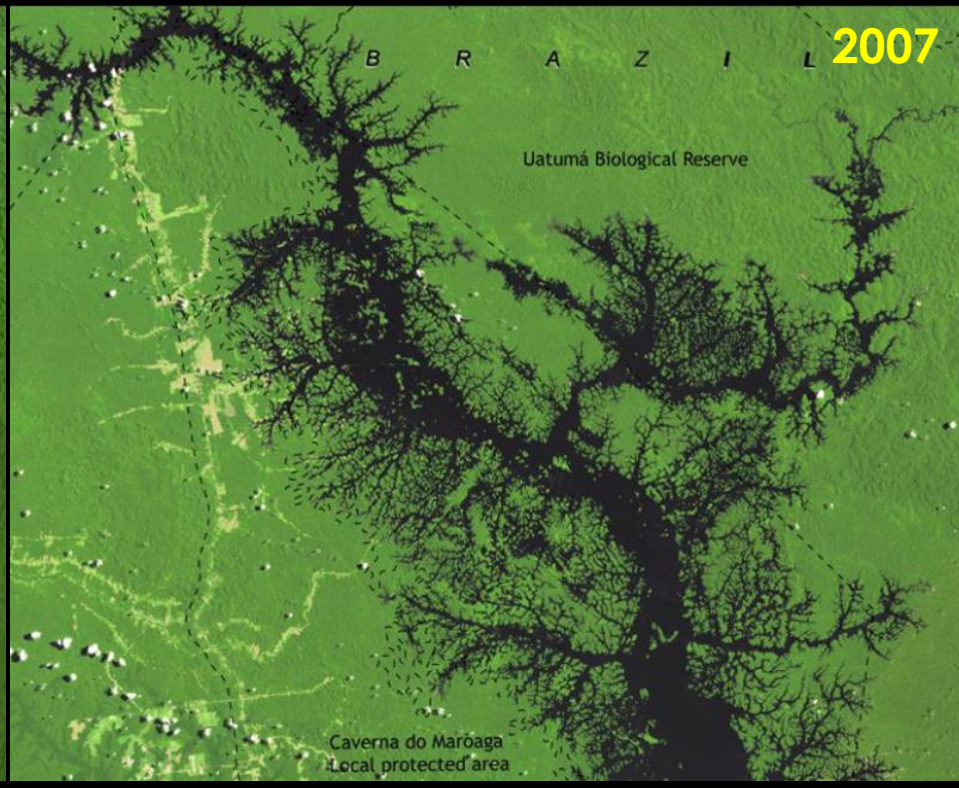
INTRODUCTION



Uatumâ River in Amazon State



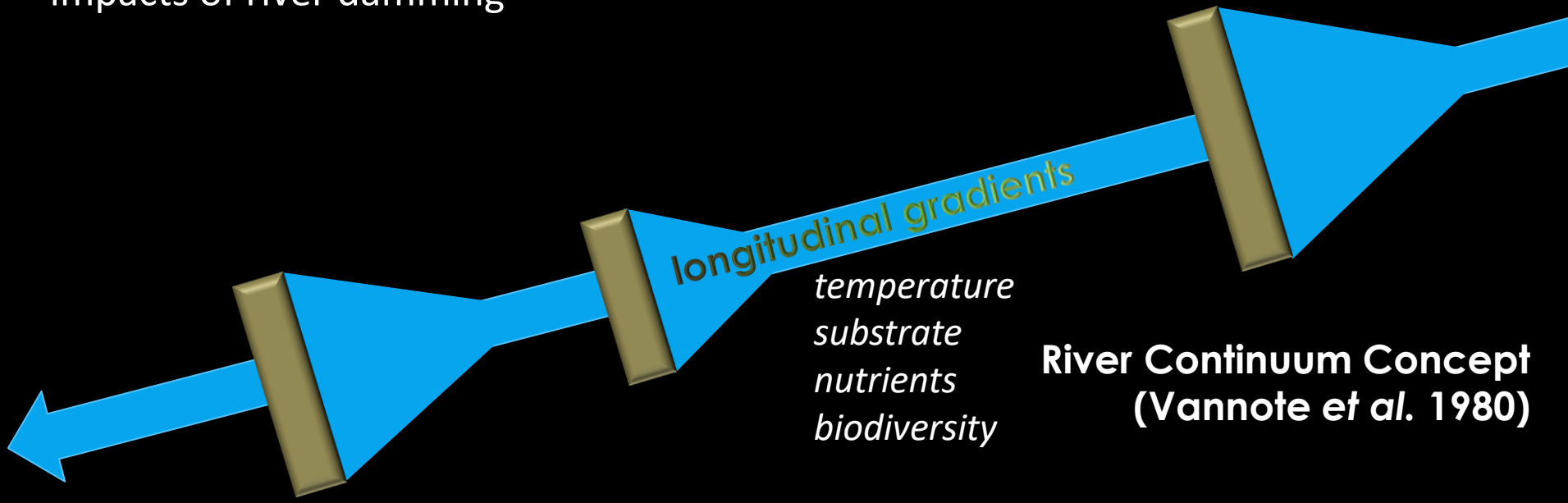
Balbina Reservoir, Brazil (NASA, Images of Change)

INTRODUCTION

Reservoir cascade:

the loss of connectivity by impoundments leads to longitudinal shifts of gradients in different variables (*e.g.* temperature, substrate, nutrients and biodiversity)

long-term monitoring to determine impacts of river damming

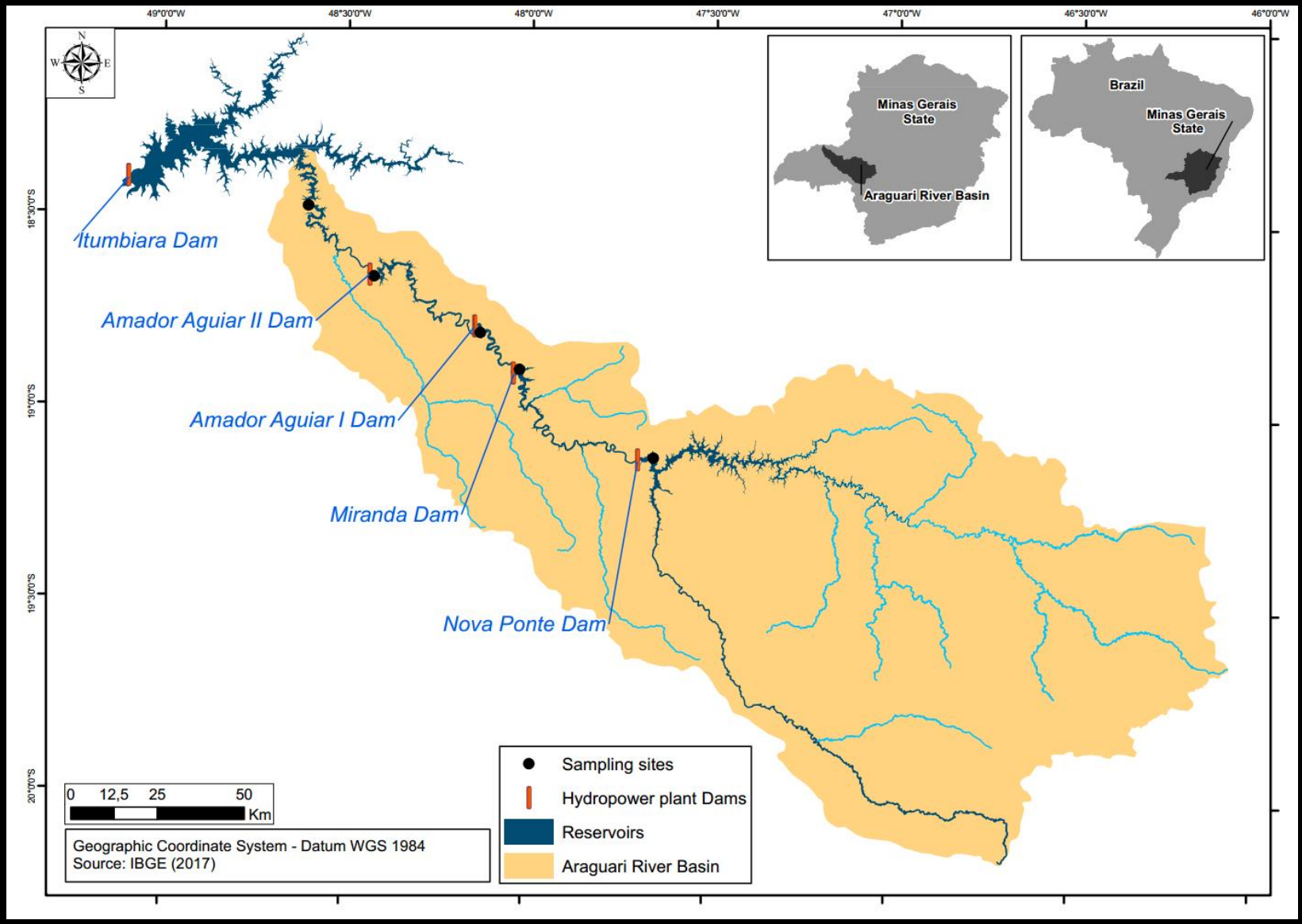


River Continuum Concept (Vannote *et al.* 1980)

OBJECTIVE

Evaluate spatio-temporal changes in fish assemblages in Araguari reservoir cascade system

STUDY AREA



Sampling sites in the Araguari reservoir cascade system (475 km).

STUDY AREA

- Year of reservoir filling
- Capacity installed (MW)
- Reservoir area (km²)

Nova Ponte Dam

1993
510 MW
450 km²

Miranda Dam

1997
408 MW
52 km²

Amador Aguiar I Dam

2005
240 MW
19 km²

Amador Aguiar II Dam

2006
210 MW
45 km²

Itumbiara Dam

1980
2082 MW
778 km²

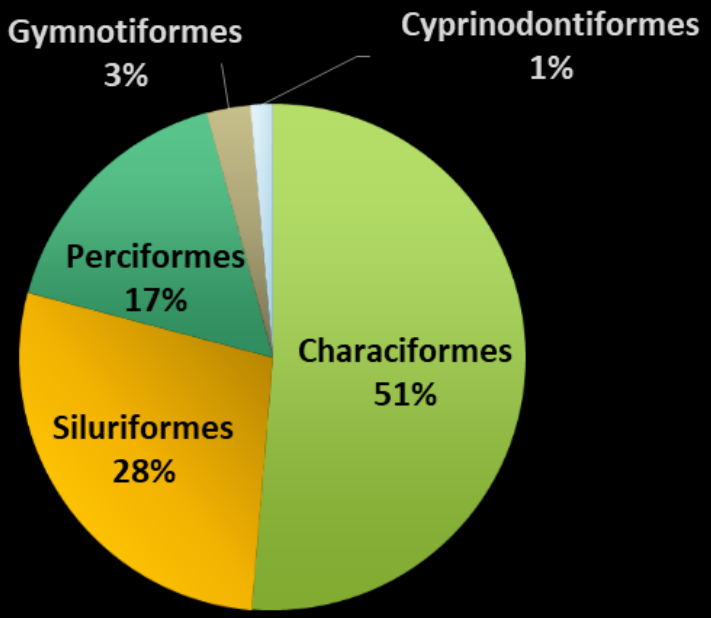
Araguari reservoir cascade, Upper Paraná River basin, Brazil

DATASET

- From 1993 to 2015, 23 years of monitoring
- Fish were caught using gillnets with mesh sizes from 3, 4, 5, 6, 7, 8, 10, 12, 14 and 16 cm (opposite knot length)
- We only considered sampling events that clearly indicated sample effort = 111 samples

RESULTS AND DISCUSSION

- 72 fish species sampled, representing five orders and 19 families.



- 58 species were native to the basin
- 14 non-native
  - 10 from other Brazilian basins and
  - 4 from other countries

RESULTS AND DISCUSSION

12 migratory species were recorded

Brycon orbignyanus

Salminus brasiliensis

Piaractus mesopotamicus

Leporinus friderici

Salminus hilarii

Prochilodus lineatus

Megaleporinus macrocephalus

Megaleporinus obtusidens

Pimelodus maculatus

Pinirampus pirinampu

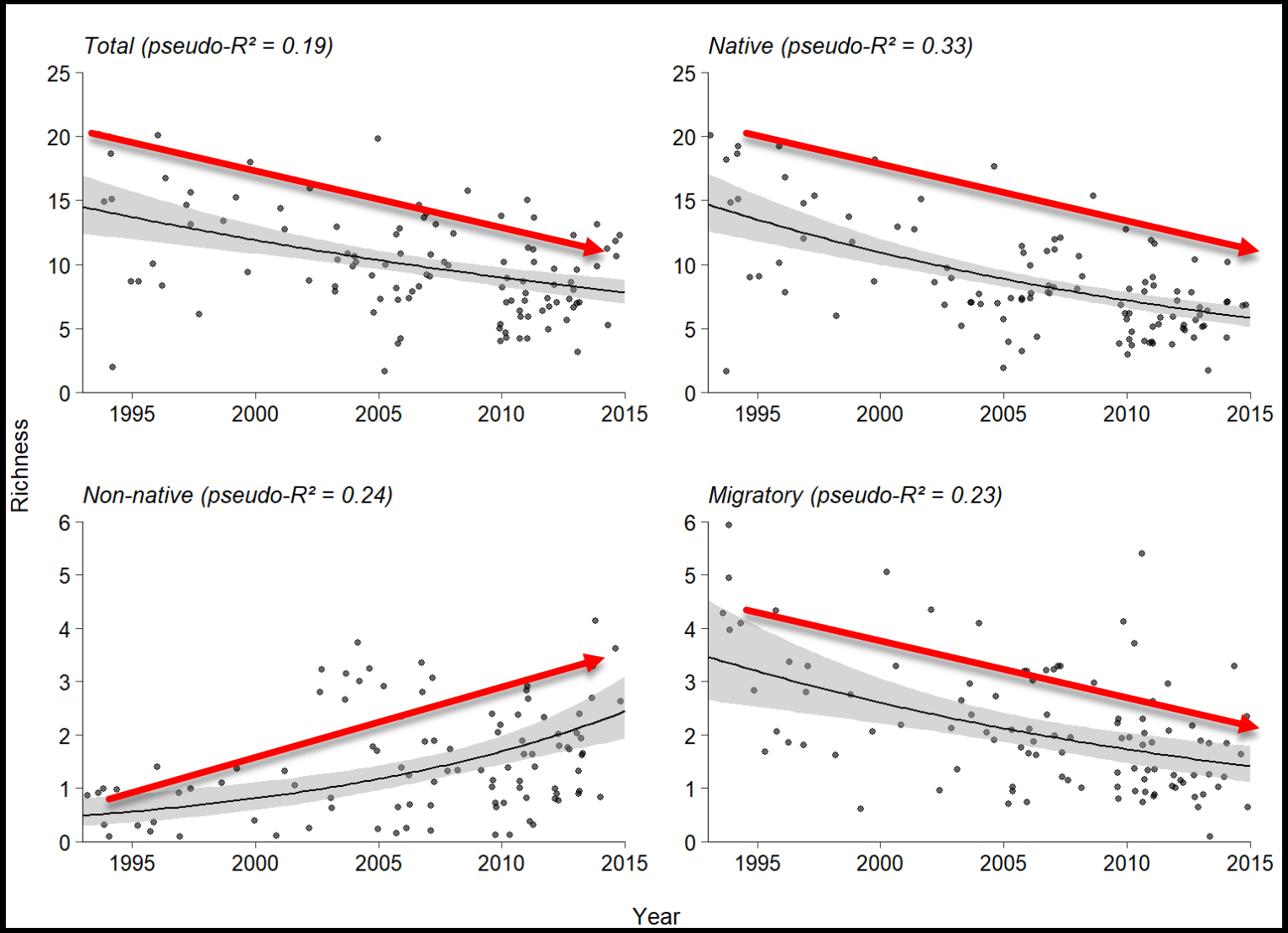
Pseudoplatystoma corruscans

Zungaro jahu

Images: Ota et al., 2018

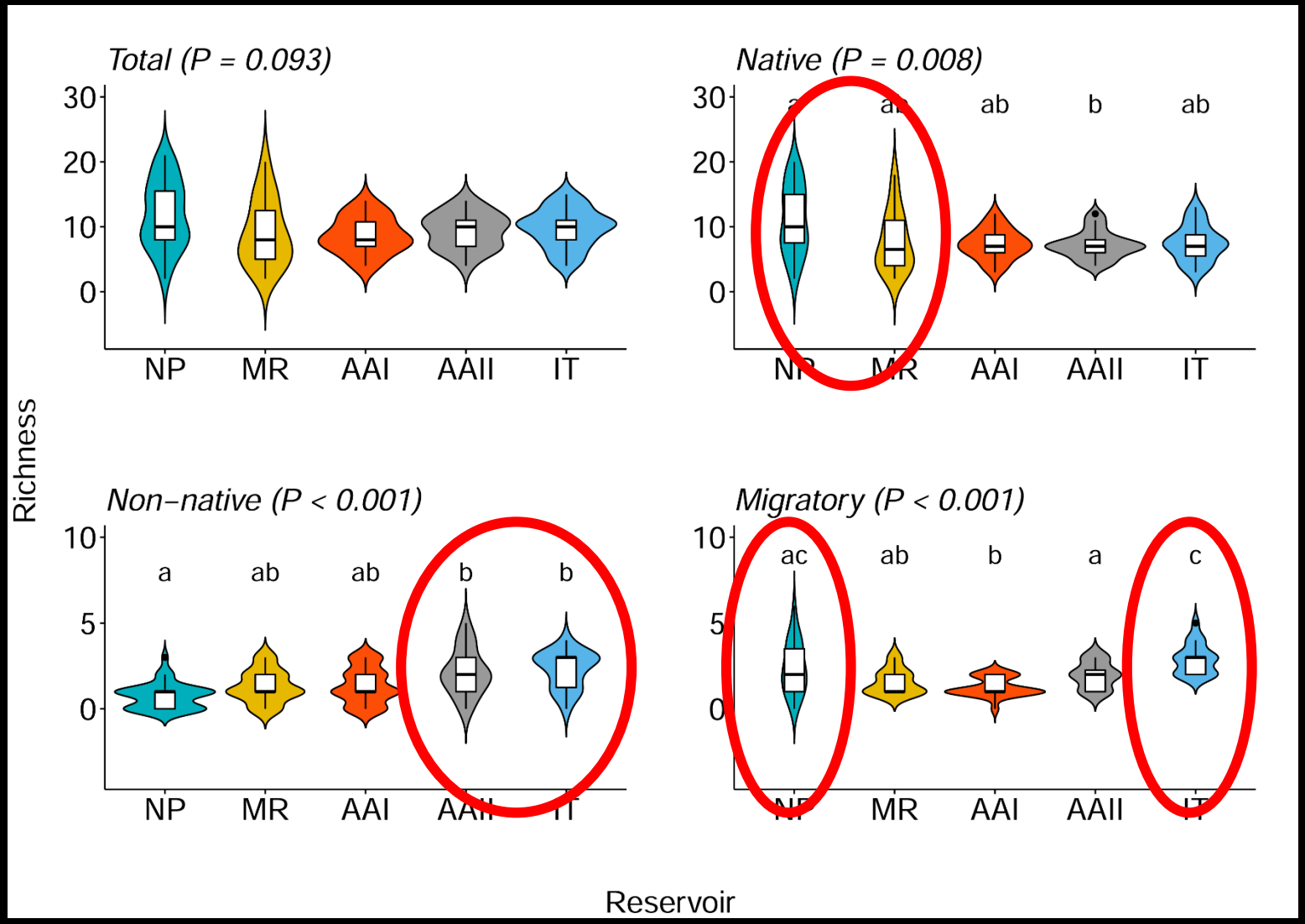
RESULTS AND DISCUSSION

How does fish species richness vary over time?



RESULTS AND DISCUSSION

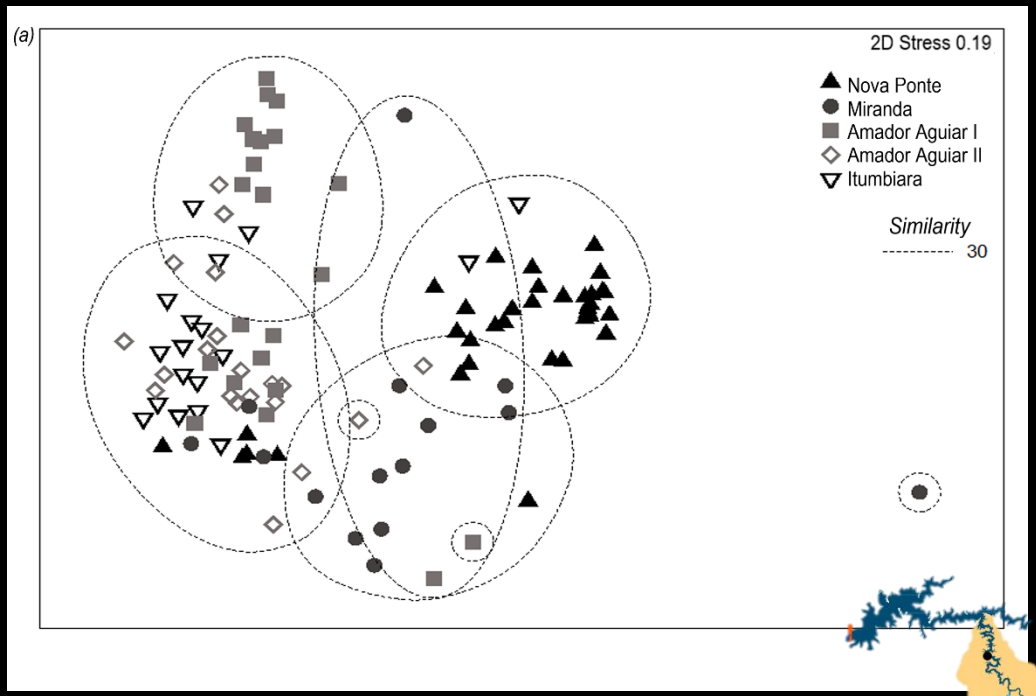
How does fish species richness vary among the reservoirs?

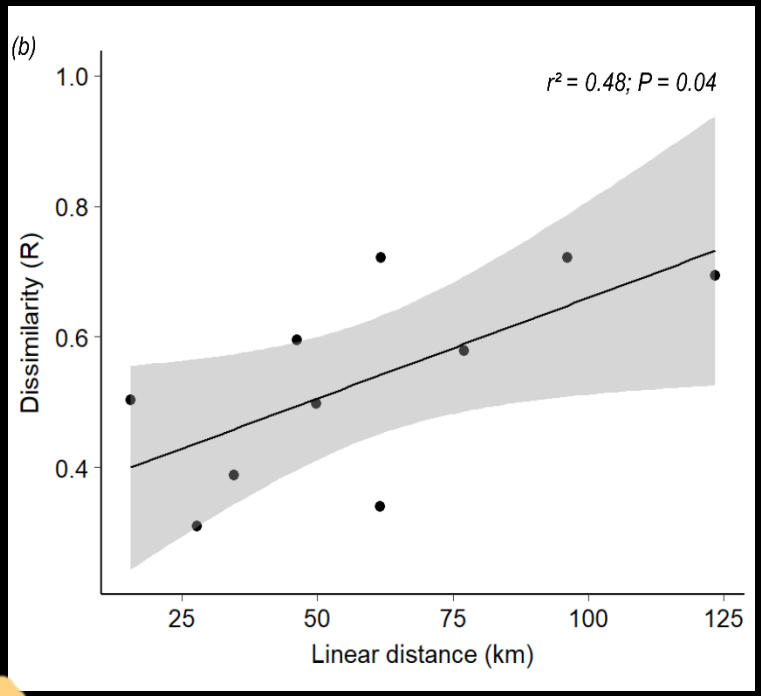


Violin plot comparing the distribution pattern of richness among reservoirs

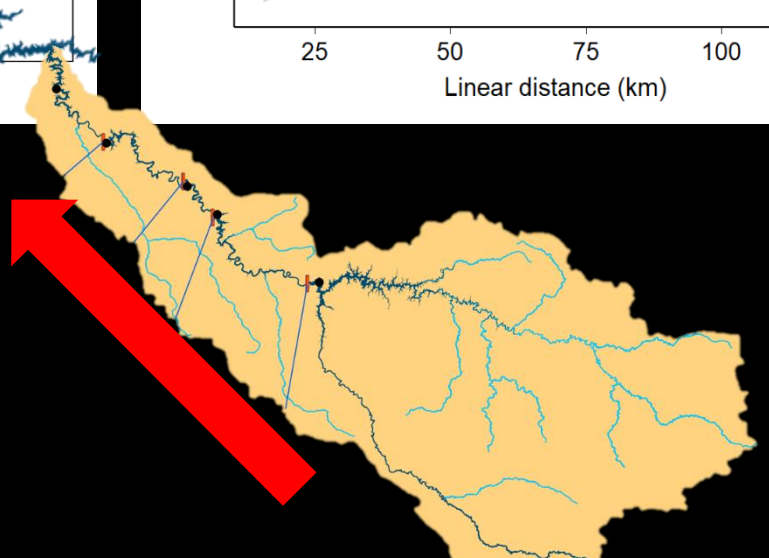
RESULTS AND DISCUSSION

Is there a longitudinal gradient in fish assemblages along the cascade?





nMDS using Bray–Curtis dissimilarity index
(ANOSIM: P < 0.01; R = 0.585)



RESULTS AND DISCUSSION

What are the factors structuring native fish assemblage in the reservoir cascade?

Marginal and sequential test results from distance-based linear models (DistLM).

	Group	SS(trace)	Pseudo-F	P	Explained variation (%)	AIC	Cumulative explained variation (%)
	Marginal test						
	Age	22535	7.39	0.001	6.35		
	Area	25301	8.36	0.001	7.13		
	Position	68645	26.12	0.001	19.33		
Non-native species	**Piscivorous**	34964	1.89	0.001	9.85		
Non-native species	**Herbivorous**	31120	3.43	0.001	8.76		
Non-native species	**Omnivorous**	15746	1.66	0.007	4.43		
Non-native species	**Invertivorous**	14965	2.38	0.003	4.21		
	Sequential test						
1	**+Position**	68645	26.12	0.001	19.33	875.99	19.33
3	**+Area**	27821	11.62	0.001	7.83	866.65	27.17
4	**+Age**	19879	8.91	0.001	5.60	859.77	32.76
2	**+ Herbivorous**	28696	4.74	0.001	8.08	851.56	40.84

Metynnis maculatus

FINAL REMARKS

- The observed longitudinal gradient **suggested an additive effect** of nearby reservoirs in fish assemblage structure.

- Possible cumulative effects in reservoir cascade must be **carefully considered in the first stage of hydropower development plans, in river basin inventories**, when alternatives for dam construction are being studied.

- The influence of longitudinal position of the reservoir along the cascade demonstrates the **importance of larger spatial scales analysis**.

- Finally, the **monitoring of non-native fish species** populations is also crucial to inform any program that aims to prevent, control or eradicate such species.

Thanks for your attention!

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