

## Biodiversidad en ambientes acuáticos

Sistemas Fluviales y Represas: biodiversidad, conservación e impactos ambientales  
18 de marzo de 2010

WWF  
Universidad del Sur  
Universidad Ricardo Palma,  
Kawsay Pacha Asociación Biodiversidad



Angelo Antonio Agostinho

UNIVERSIDADE ESTADUAL DE MARINGÁ  
Núcleo de Pesquisas em Limnologia, Ictiologia e Aquicultura



### DEFINICIÓN

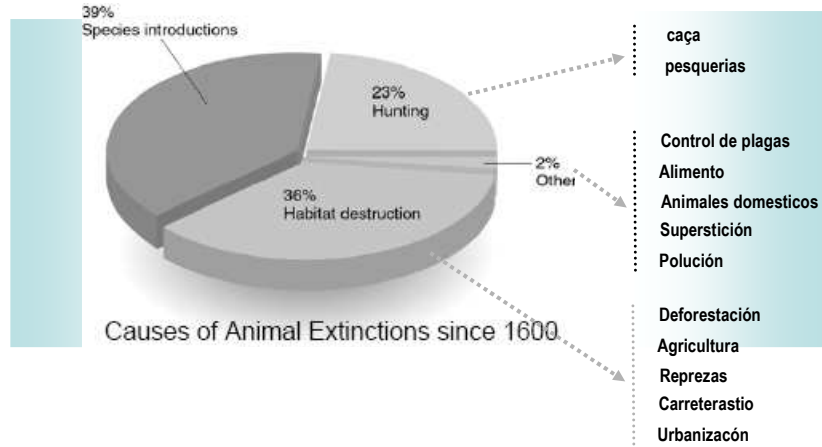
"La biodiversidad es la variabilidad entre los organismos vivos de todas las fuentes, incluidos, entre otros, terrestres, marinos y otros ecosistemas acuáticos y los complejos ecológicos de que son una parte; esto incluye la diversidad dentro de las especies, entre las especies y ecosistemas"

Convention on Biological Diversity, Rio 1992



## GLOBAL BIODIVERSITY

### Amenaza

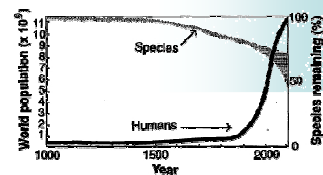
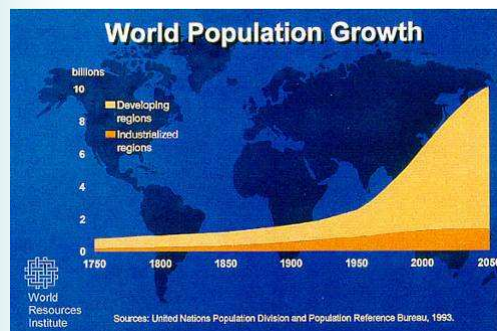


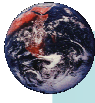
Fonte: World Conservation Monitoring Centre (1992)



## GLOBAL BIODIVERSITY

### Human population increasing





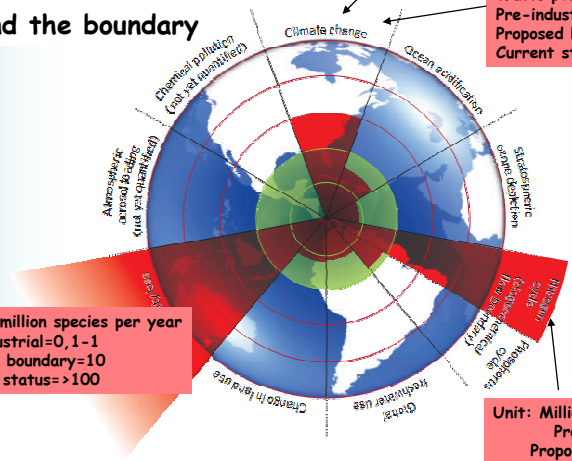
# GLOBAL BIODIVERSITY

**{CO<sub>2</sub>}**  
Unit: part per million by volume  
Pre-industrial=280  
Proposed boundary=350  
Current status=387

Change on radiative forcing  
Watts per m<sup>2</sup>  
Pre-industrial=0  
Proposed boundary=1  
Current status=1,5

## Beyond the boundary

Unit: Species per million species per year  
Pre-industrial=0,1-1  
Proposed boundary=10  
Current status=>100



Unit: Millions of tones per year  
Pre-industrial=0  
Proposed boundary=35  
Current status=>121

Rockstrom et al., 2009 - Nature

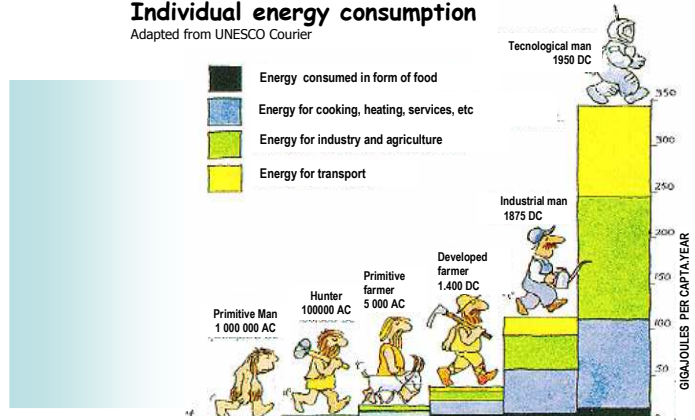


# GLOBAL BIODIVERSITY

## Individual energy consumption

Adapted from UNESCO Courier

- Energy consumed in form of food
- Energy for cooking, heating, services, etc
- Energy for industry and agriculture
- Energy for transport





## GLOBAL BIODIVERSITY

Today:  
28% of the world's population  
consumes 77% of the world's  
energy production

or

$\frac{3}{4}$  of the world's population  
Uses less than  $\frac{1}{4}$  of the  
energy produced



## REGIONAL BIODIVERSITY

### Threats

deforestation,  
waterway,  
intensive cattle  
raising



Water scarcity

Urban center,  
industry and  
agriculture

Industry,  
agriculture,  
irrigation,  
aquiculture

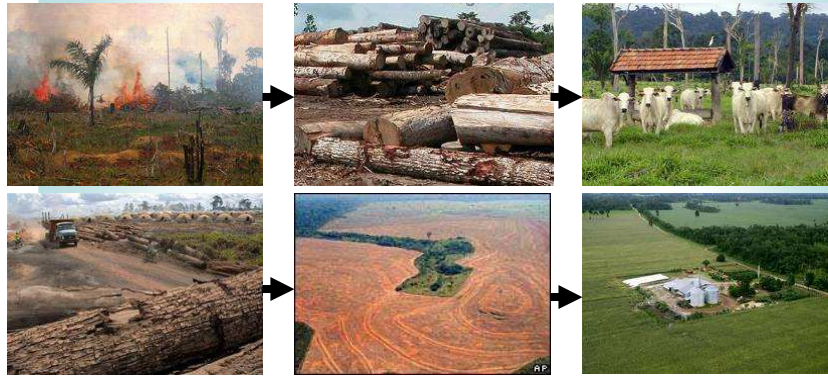
Inadequate treatment of sewage and  
impoundments

Tundisi, 2003; Agostinho et al., 2005



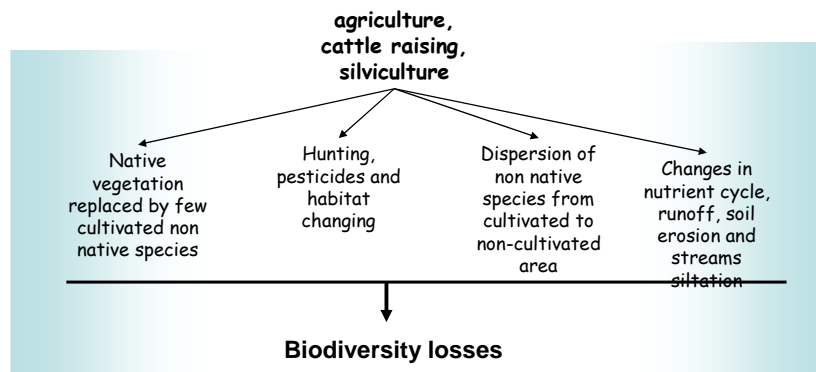
## REGIONAL BIODIVERSITY

### Environmental changes and biodiversity losses



## REGIONAL BIODIVERSITY

### Environmental changes and biodiversity losses

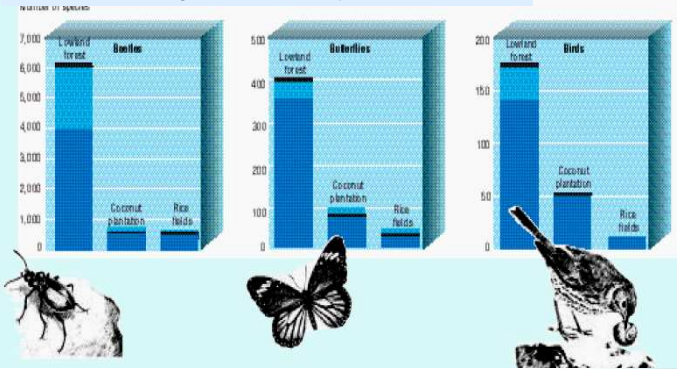


Agostinho et al. (2005). Conservation Biology, 19(3): 646-651



## GLOBAL BIODIVERSITY

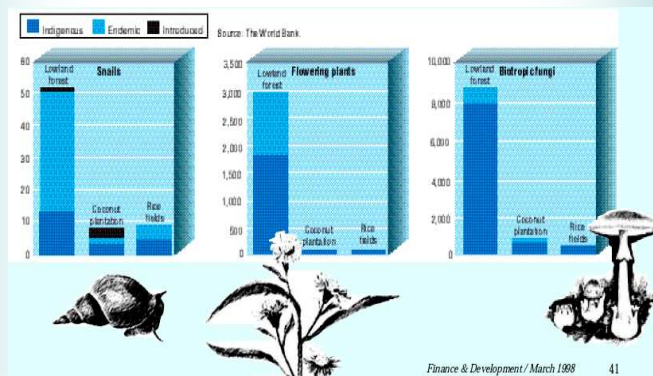
### Forest versus agricultural ecosystems in Borneo



Fonte: Pagiola et al. (1989)

## REGIONAL BIODIVERSITY

### Forest versus agricultural ecosystems in Borneo



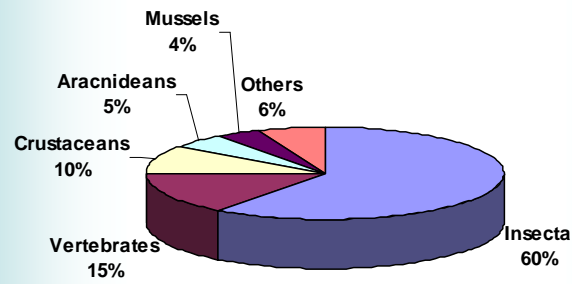
Finance & Development / March 1998 41

Fonte: Pagiola et al. (1989)



## FRESHWATER BIODIVERSITY

Animals composition ( $\pm 126.000$  species)

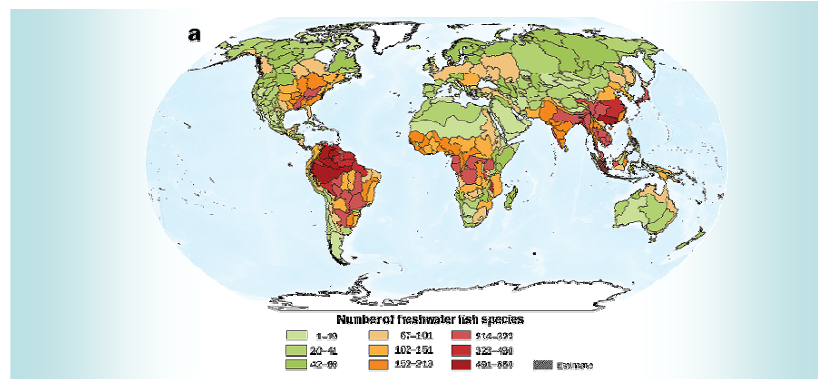


\* Sala et al. 2000 – Global diversity scenarios for the year 2100. *Science*, 287  
Dudgeon et al. 2006 – *Biol.Rev.*



## GLOBAL FRESHWATER BIODIVERSITY

Freshwater ecoregions of the world and fish diversity

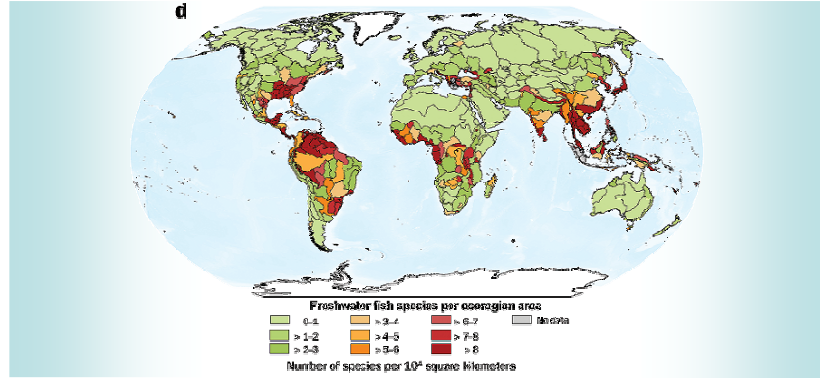


Abell et al. (2008). *BioScience*, 58(5): pg 403



## GLOBAL FRESHWATER BIODIVERSITY

### Freshwater ecoregions of the world and fish diversity

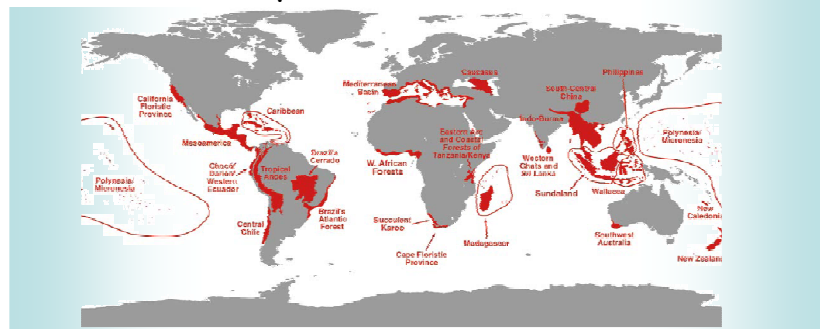


Abell et al. (2008). *BioScience*, 58(5): pg 403

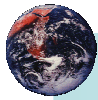


## GLOBAL BIODIVERSITY

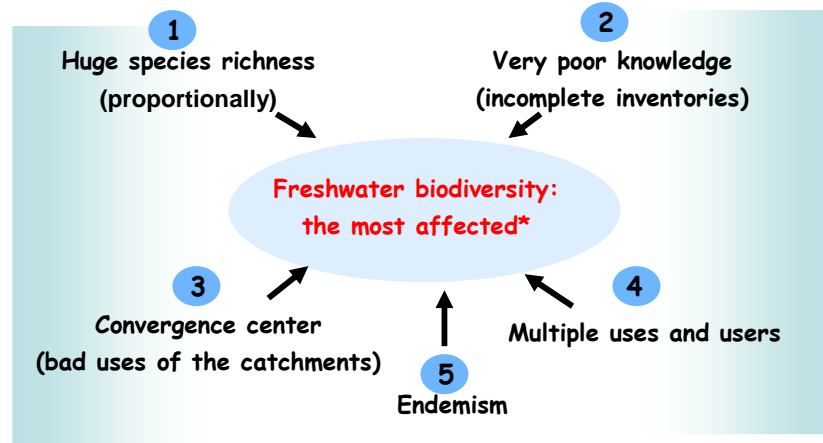
### Identification of hotspots



Reid (1998). *TREE*, 13(7)  
Myers et al. (2000). *Nature*, 403



## FRESHWATER BIODIVERSITY



\* Sala et al. 2000 – Global diversity scenarios for the year 2100. *Science*, 287  
Dudgeon et al. 2006 – *Biol.Rev.*



## FRESHWATER BIODIVERSITY

### 1 Huge species richness

Freshwater: 0,01% of the World's water  
8% of the Earth's surface

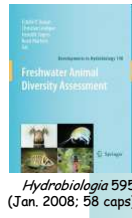
Animal species in freshwater: ±126.000 species  
(9,5% of the total)

Fish species in freshwater: +10.000 species  
40% of the global fish diversity  
25% of the global vertebrates

Dudgeon et al. (2006)  
Balian et al. (2008)

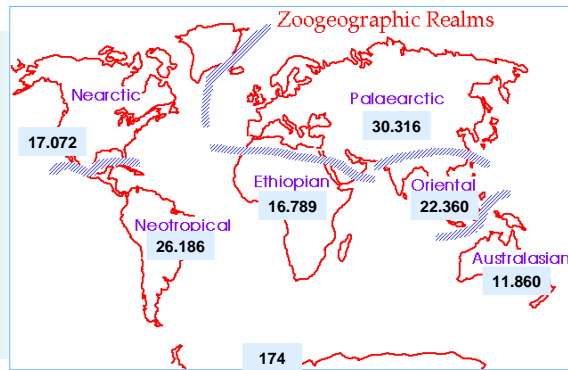


# FRESHWATER BIODIVERSITY

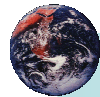


*Hydrobiologia* 595  
(Jan. 2008; 58 caps)

## Species richness per Zoogeographic Region

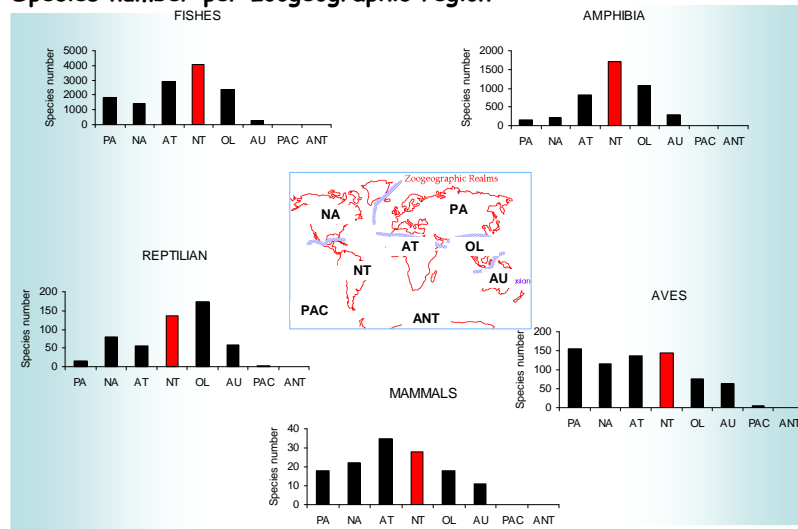


Dudgeon *et al.* (2006) e  
Balian *et al.* (2008)



# FRESHWATER BIODIVERSITY

## Species number per zoogeographic region



Balian *et al.* (2008)



## FRESHWATER BIODIVERSITY

14% of the global biodiversity

TABLE 1. Estimated number of species in freshwater environments in Brazil and the world.

Taxa	Brazil <sup>a</sup>	World	Reference
Mollusca	509-600 <sup>b</sup>	?	Agostinho & Castello 1996, Poul & Hart 2003
Algae	10-800	37,700	Dickie 2002, Huxemond 1992
Protozoa	180 <sup>c</sup>	?	Lakso-Eklöf et al. 2004
Porifera (Demospongiae)	41	149	Valentin-Bricelj 1999
Cnidaria (Hydrozoa)	7	17	Silva & Schmitt 1999
Phytoplankton			
Bacillariophyta	92	4,500	Forman 1999
Diatomea	253	?	Robit & Riba 2000
Dinophyta	00	6000	Thalheimer 1993
Coccolithophora	96	> 1000	Paço 2000
Alveolates	128	800	Ames 2000
Nannoplankton	95	?	Menezes 1976
Nannofloras	?	15	Forman 1993
Gastropoda	63	250	Forman 1999
Nematoda	10	240	Forman 1993
Rotifera	10	98	Forman 1999
Tardigrada	61	700	Assmann 1999
Amphibia			
Oligoneura	78	600	Schnee & Amund 1999
Plecoptera	4	40	Ribe 1998
Mollusca			
Bivalvia	115	?	Agostinho 1999
Gastropoda	102	5000	Silva et al. 1999
Rudista	497	2000	Oliveira-Silva & Mouton 1999
Arthropoda			
Alumina	352	14000	Forman 1999
Crustacea			
Copepoda	760-850 <sup>d</sup>	1,550	Mesquita-Ferreira & Siba 1999
Cladocera	112	692	Forman 1999
Siphonophora	10	168	Forman 1993
Insecta	110	1000	Magalhães 1995
Hemiptera			
Ephemeroptera	166	2000	Silva et al. 2004
Chironomidae	208	2000	Mendes 2004
Odonata	661	9,200	Forman 2004
Trichoptera	110	2000	Forman 1999
Diptera	378	?	Exposito et al. 2004
Neuroptera	16	300	Forman 1999
Plecoptera	2,112	10,000	Dudgeon & Matthews 2004
Amphibia	722	8,742	Forman et al. 2004

<sup>a</sup>Based on data of species in the scientific literature.  
<sup>b</sup>Estimated number of species.  
<sup>c</sup>Estimated number of species.  
<sup>d</sup>Estimated number of species.

Agostinho et al. (2005). Conservation Biology, 19(3)

## FRESHWATER BIODIVERSITY

### 2 Very poor knowledge

- Several basins were not sampled yet
- Few researchers and infrastructure
- Few aquatic inventories
- Information is scattered
- Several groups need major taxonomic revisions

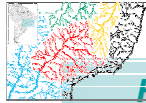
Even vertebrate:

Fish: 1% of the total is described yearly

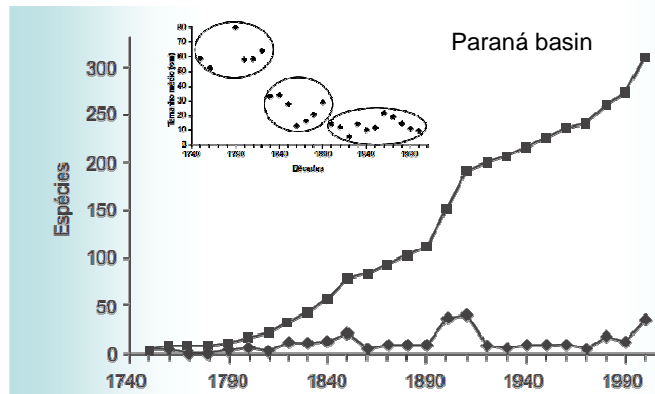
Amphibians: 35% was described during last decade

Dudgeon et al. (2006) - Biol.Rev.

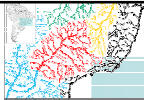
Agostinho et al. (2005). Conservation Biology



## FRESHWATER BIODIVERSITY



Langeani et al. (2007) - *Biot. Neot.*



## FRESHWATER BIODIVERSITY

### Species description



### Monogenea (8 spp.)

- *Kritskyia annakohnae* Boeger, Tanaka & Pavanelli, 2001
- *Kritskyia boegeri* Takemoto, Lizama & Pavanelli, 2002
- *Kritskyia eirasi* Guidelli, Takemoto & Pavanelli, 2003
- *Unibarra* sp. n. Lizama, Takemoto & Pavanelli, em prep.
- *Sciadicleithrum* sp. n. Yamada, Takemoto, Bellay & Pavanelli, em prep.
- *Sciadicleithrum* sp. n. Yamada, Takemoto, Bellay & Pavanelli, em prep.
- *Gussevia* sp. n., Moreira, Takemoto & Pavanelli, em prep.
- *Sciadicleithrum* sp. n. Bellay, Takemoto, Yamada & Pavanelli, em prep.

### Digenea (3 spp.)

- *Sanguinicola platyrhynchi* Guidelli, Isaac & Pavanelli, 2002
- *Dadayius pacupeva* Lacerda, Takemoto & Pavanelli, 2003
- *Magnitellinum corvitellinum* Lacerda, Takemoto & Pavanelli, 2009

### Cestoda (19 spp.)

- *Jauella glandicephalus* Rego e Pavanelli, 1985
- *Megatylacus brooksi* Rego & Pavanelli, 1985
- *Travassielia avitellina* Rego & Pavanelli, 1987
- *Spatulifer maringaensis* Pavanelli & Rego, 1989
- *Goezeella nupeliensis* Pavanelli & Rego, 1989
- *Chambriella paranaensis* (Pavanelli & Rego, 1989)
- *Nomimoscolex matogrossensis* Rego & Pavanelli, 1990
- *Proteocephalus serrasalmus* Rego & Pavanelli, 1990
- *Cangatiella arandasi* Pavanelli & Machado dos Santos, 1991
- *Paramonticella itaipuensis* Pavanelli & Rego, 1991
- *Nupela Portoriquensis*, Pavanelli & Rego, 1991
- *Chambriella agostinhoi* Pavanelli & Machado dos Santos, 1992
- *Monticella loyolai* Pavanelli & Machado dos Santos, 1992
- *Proteocephalus gibsoni* Rego & Pavanelli, 1992
- *Megathylacus travassosi* Pavanelli & Rego, 1992
- *Monticella belavistensis* Pavanelli, Machado, Takemoto & Santos, 1994
- *Proteocephalus chubbi* Pavanelli & Takemoto, 1995
- *Proteocephalus vazzolerai* Pavanelli & Takemoto, 1995
- *Spasskyellina mandi* Pavanelli & Takemoto, 1996

### Acanthocephala (1 spp.)

- *Neoechinorhynchus pimelodi* Brasil & Pavanelli, 1998

## FRESHWATER BIODIVERSITY

### 3 Convergence center

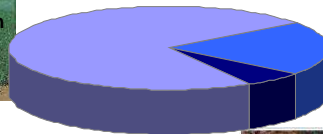
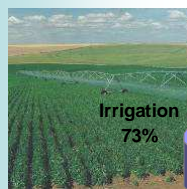
- Erosion
- Pollution (ex.: organic, pesticides, fertilizer, sewage)
- Siltation
- runoff pattern
- upstream activities (ex: impoundments, drainage)
- downstream migration

Agostinho et al. (2005). Conservation Biology



## FRESHWATER BIODIVERSITY

### 4 Multiple uses and users



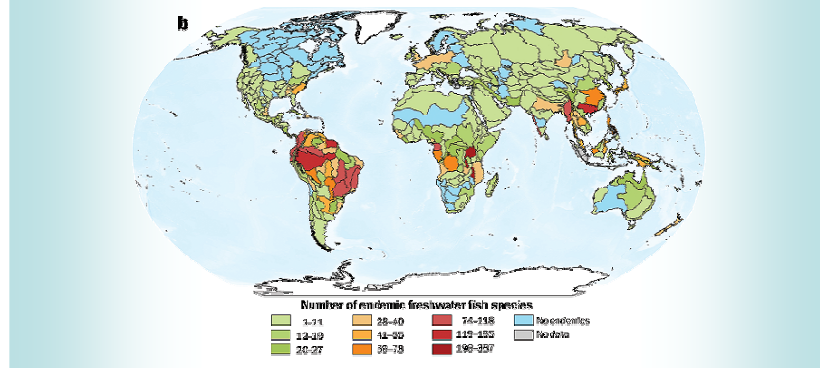
Others  
Navigation  
Recreation  
Fisheries  
Hydropower  
Sewage  
etc





## GLOBAL FRESHWATER BIODIVERSITY

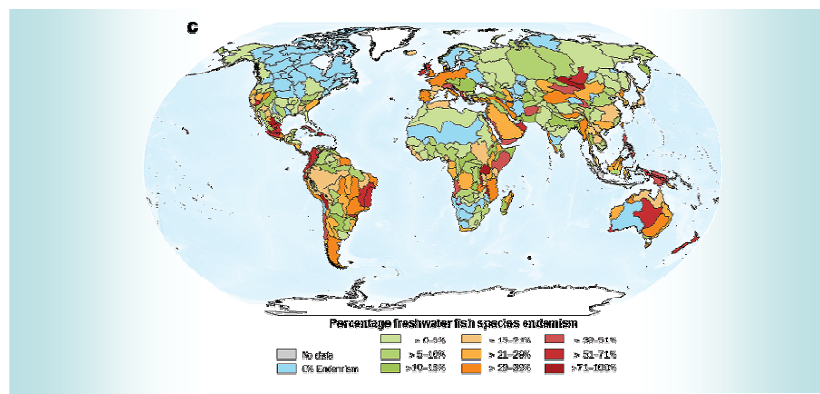
### 5 Endemism



Abell et al. (2008). *BioScience*, 58(5): pg 403



## GLOBAL FRESHWATER BIODIVERSITY



Abell et al. (2008). *BioScience*, 58(5): pg 403

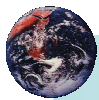


## FRESHWATER BIODIVERSITY

Iguaçu basin:  
±80 species => 70% endemic

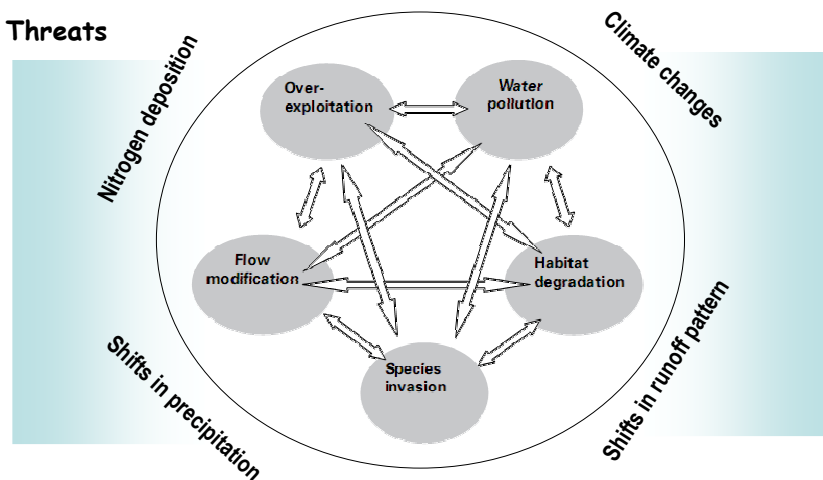


Agostinho et al (2005)



## FRESHWATER BIODIVERSITY

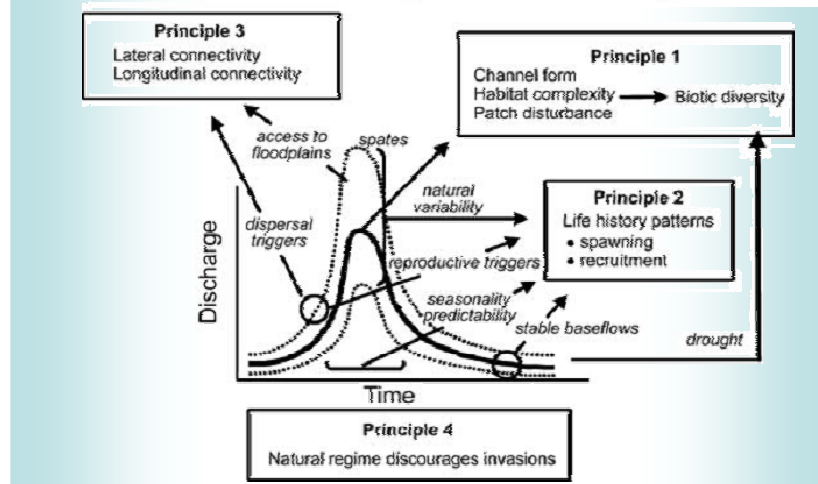
Threats



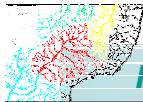
Dudgeon et al. (2006). Biol. Rev.,



## FRESHWATER BIODIVERSITY

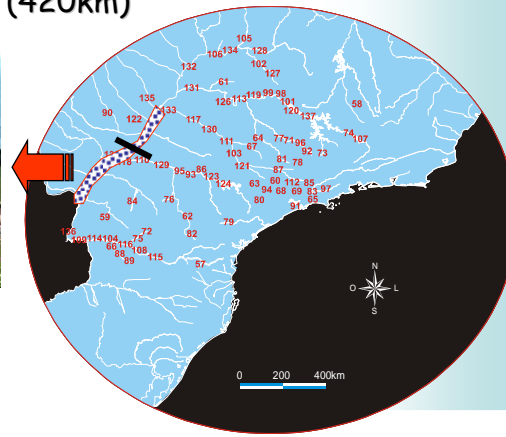


Dudgeon et al. (2006). Biol. Rev., 81



## REGIONAL BIODIVERSITY

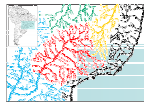
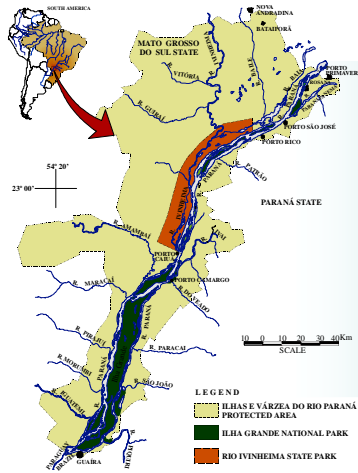
### Upper Paraná River Floodplain and impoundments (420km)





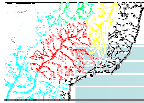
## LOCAL AQUATIC BIODIVERSITY

### Conservation Units



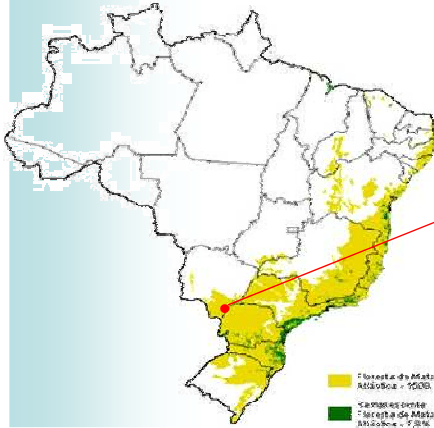
## REGIONAL BIODIVERSITY

• Plants	951	
• Aquatic macrophytes	118	
• Phytoplankton	585	
• Periphyton	474	
• Zooplankton (+ciliados+rotíferos)	1011	
• Benthic invertebrates (+Ostracoda)	315	
• Ictioparasites	284	
• Fishes	137	
• Amphibian	22	
• Reptiles	37	
• Birds	295	
• Mammals	60	
• TOTAL	4289	



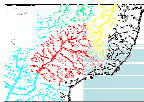
## REGIONAL BIODIVERSITY

### Atlantic Forest Biome: Sítio 6 - PELD



#### Species Proportion

Fish :	50%
Amphibians :	6%
Annelidas:	58%
Rotifers:	50%
Cladocerans:	60%
Algae:	9%

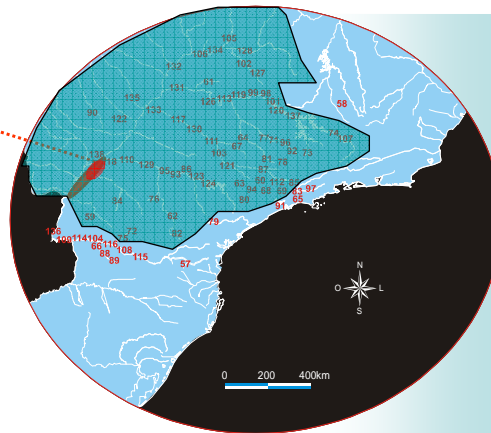


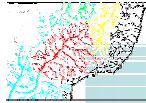
## REGIONAL BIODIVERSITY

### Ex.: fish fauna

45% out of 310 species  
(0,7 % of the drainage area)

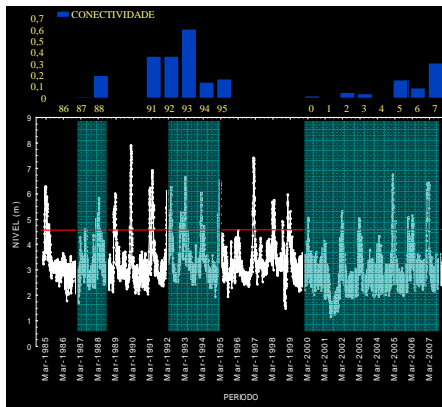
5,5% out of 2500 species  
0,058 % of Brazilian territory



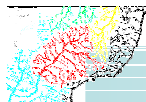
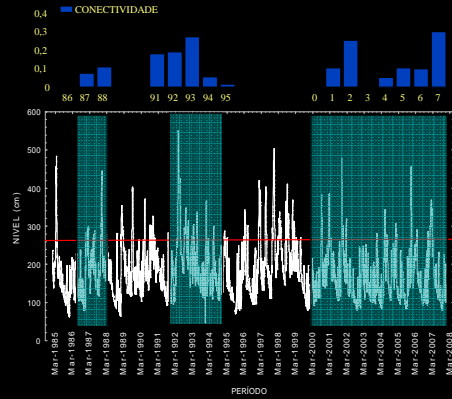


## REGIONAL BIODIVERSITY

### PARANÁ

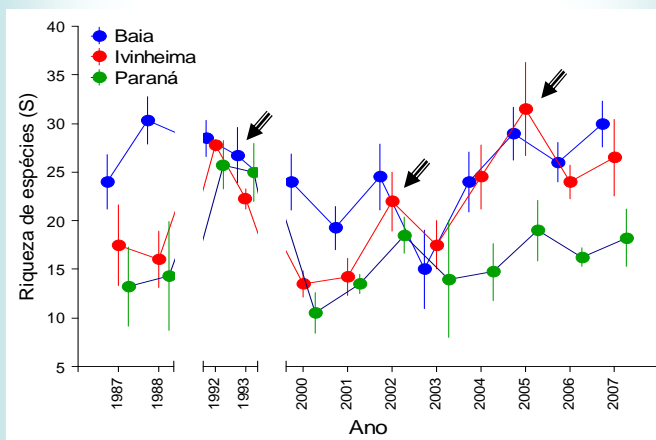


### IVINHEIMA



## REGIONAL BIODIVERSITY

### Riqueza de espécies



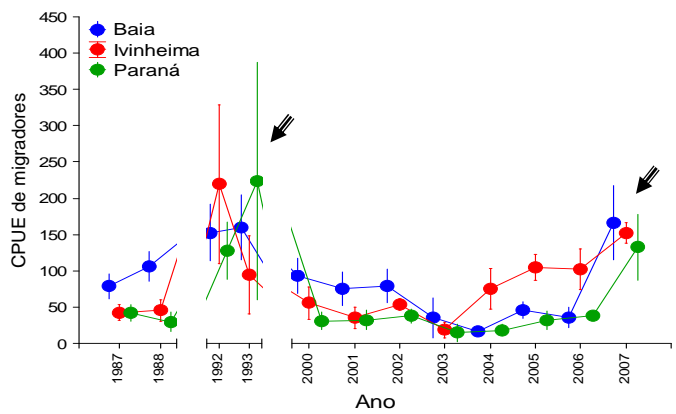
Fernandes et al., 2009

# Abundância

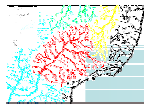


## REGIONAL BIODIVERSITY

### Abundância

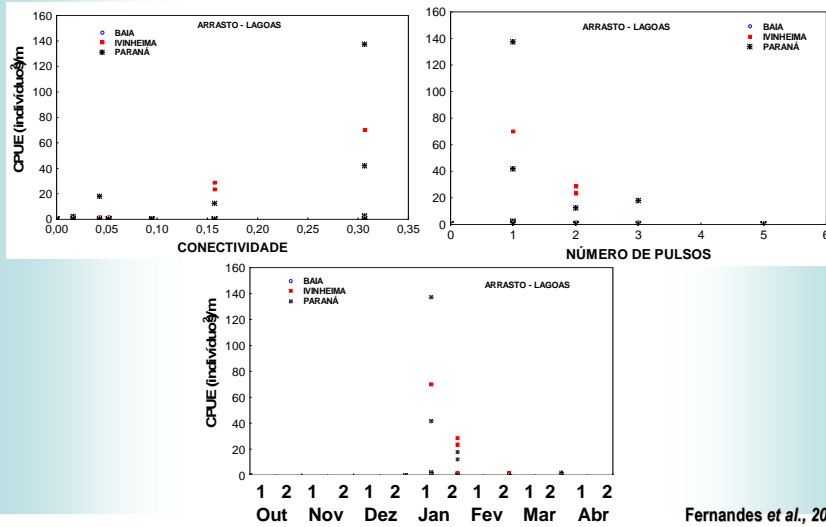


Fernandes et al., 2009



## REGIONAL BIODIVERSITY

### Abundância



Fernandes et al., 2009

