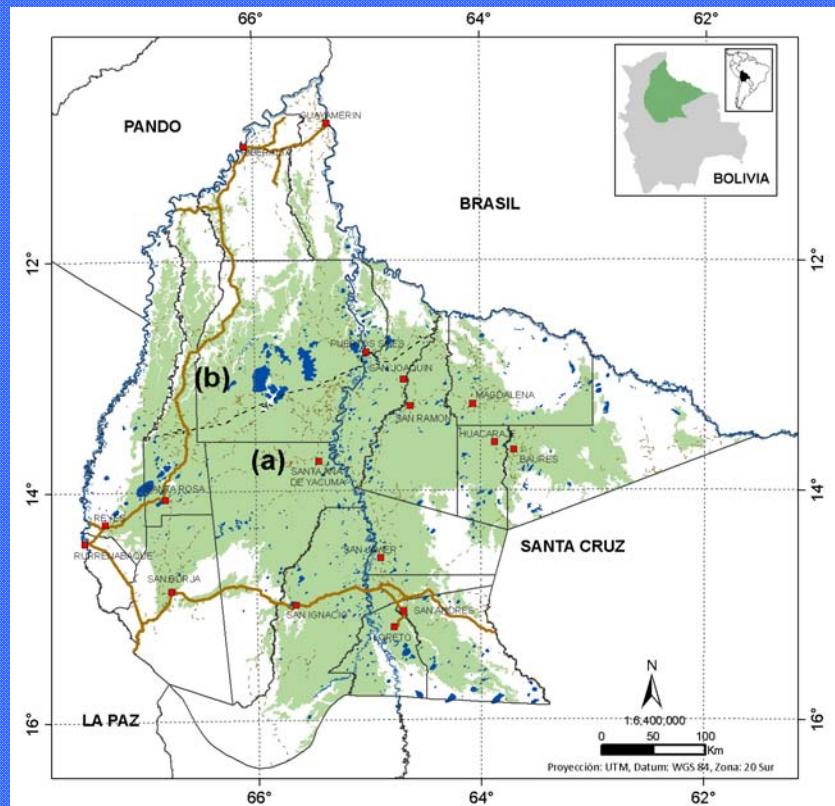


Identification of priority areas for conservation in the Llanos de Moxos, Bolivia

Hydrological and fish distribution modelling



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IRD, UMR GET – Toulouse, France
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**MacArthur
Foundation**
Grant 08-91570-000-GSS,



Llanura del Beni – Moxos floodplain

Ecosystems ecotone
wet tropical forest

62°



BOLIVIA

12°

Beni

(b)

savannah

14°

Mamoré

(a)

RURRENABAQUE

sub-Andean

SAN BORJA

SANTA CRUZ

16°

LA PAZ

Major rivers

N

0 50 100 Km

16°

Proyección: UTM, Datum: WGS 84, Zona: 20 Sur

62°



Tropical Andes

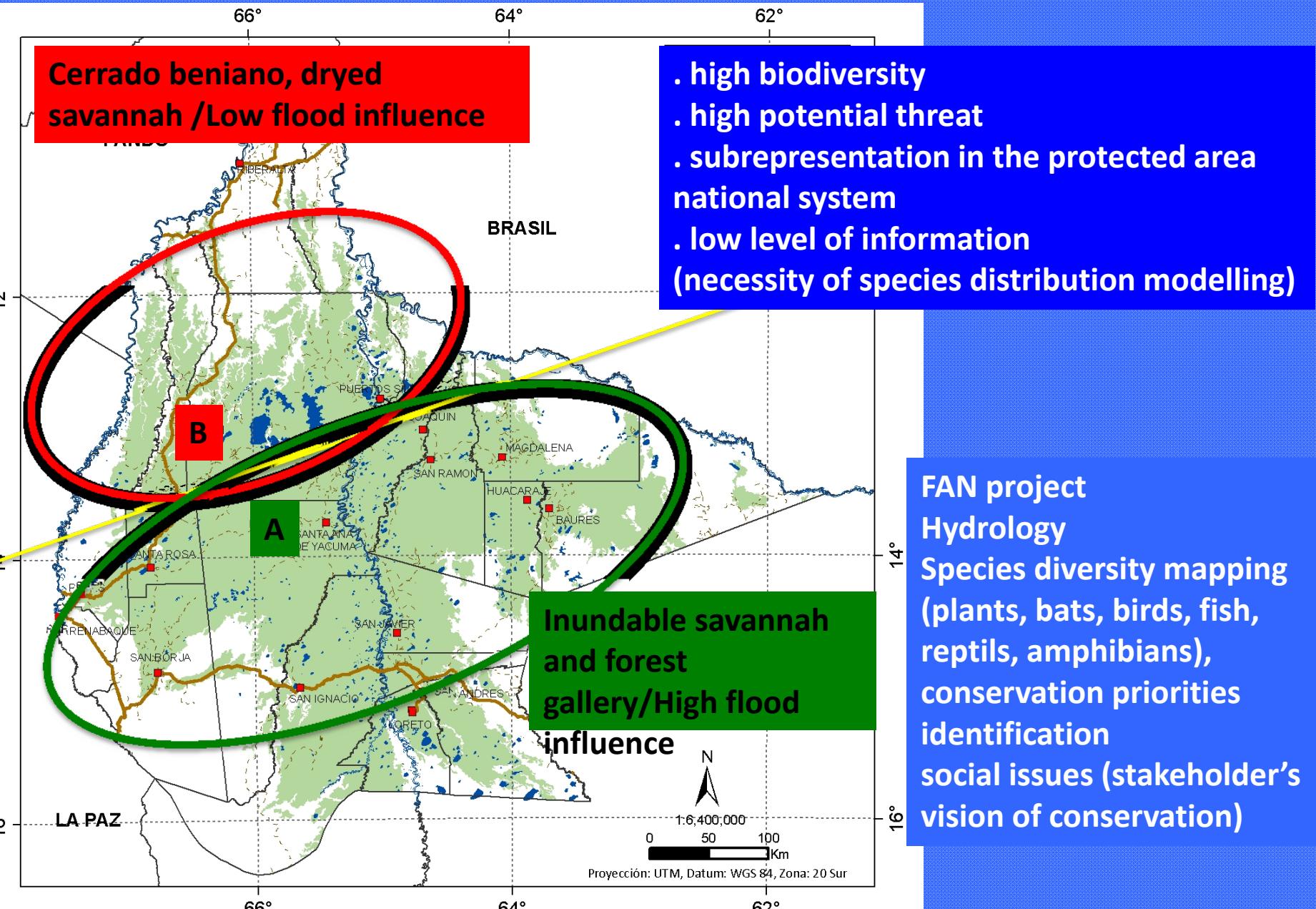
-> biodiversity hotspots for
conservation priorities
(Myers et al. 2000)

Bolivia

-> megadiverse country
(Mittermeier et al. 1997, PNUD 2008)

Convention of Biological Diversity
identification of priority sites for
biodiversity (gap spatial analysis)

Llanura del Beni – Moxos floodplain



Objectives

In the floodplain ecosystems, the hydrological dynamic of the river is a major factor controlling the habitat diversity and the species distribution

Hydrology

Map the flooded areas in the Beni department

Map the extreme events of 2007 & 2008

Assess the inter-annual variability

Ichthyology

Model the actual fish distribution

Map fish diversity

Optical MODIS

Provide global and daily coverage
Low spatial resolution : 500 meters
Poor ability to detect flood beneath vegetation cover

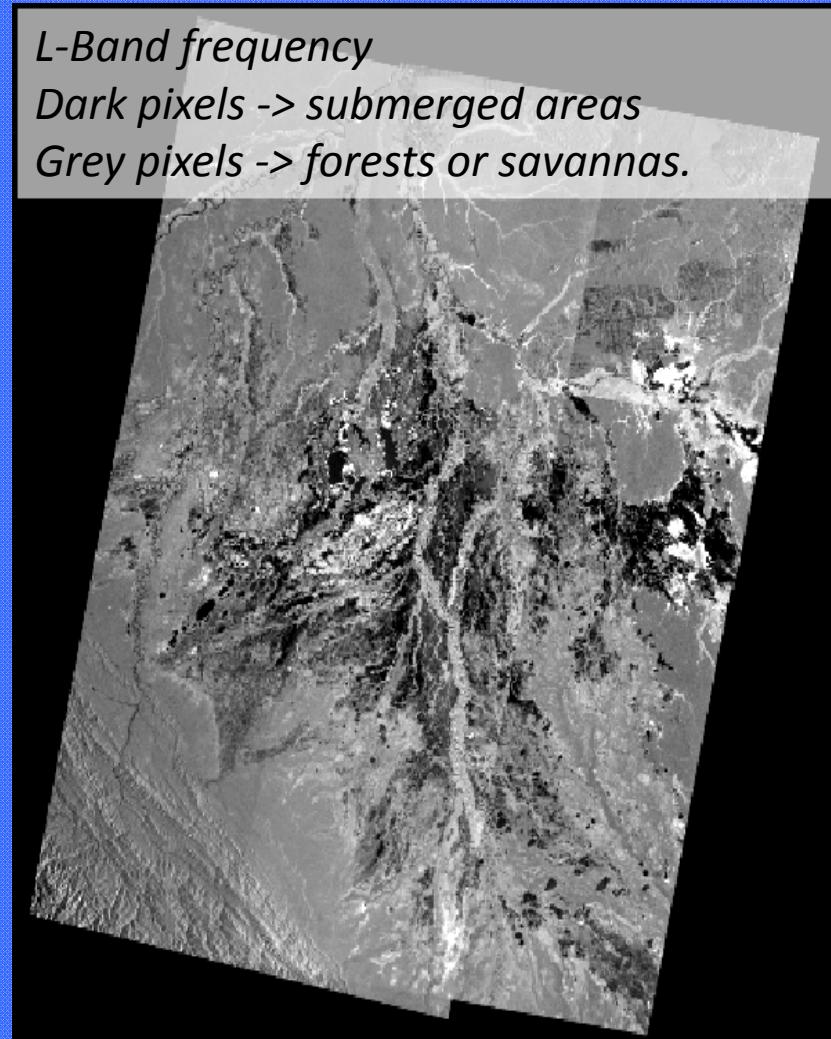


Dark pixels -> submerged areas

Green pixels -> forests or savannas.

Radar PALSAR

Not affected by cloud coverage
image archive restricted
image in relation to satellite orbit



L-Band frequency

Dark pixels -> submerged areas

Grey pixels -> forests or savannas.

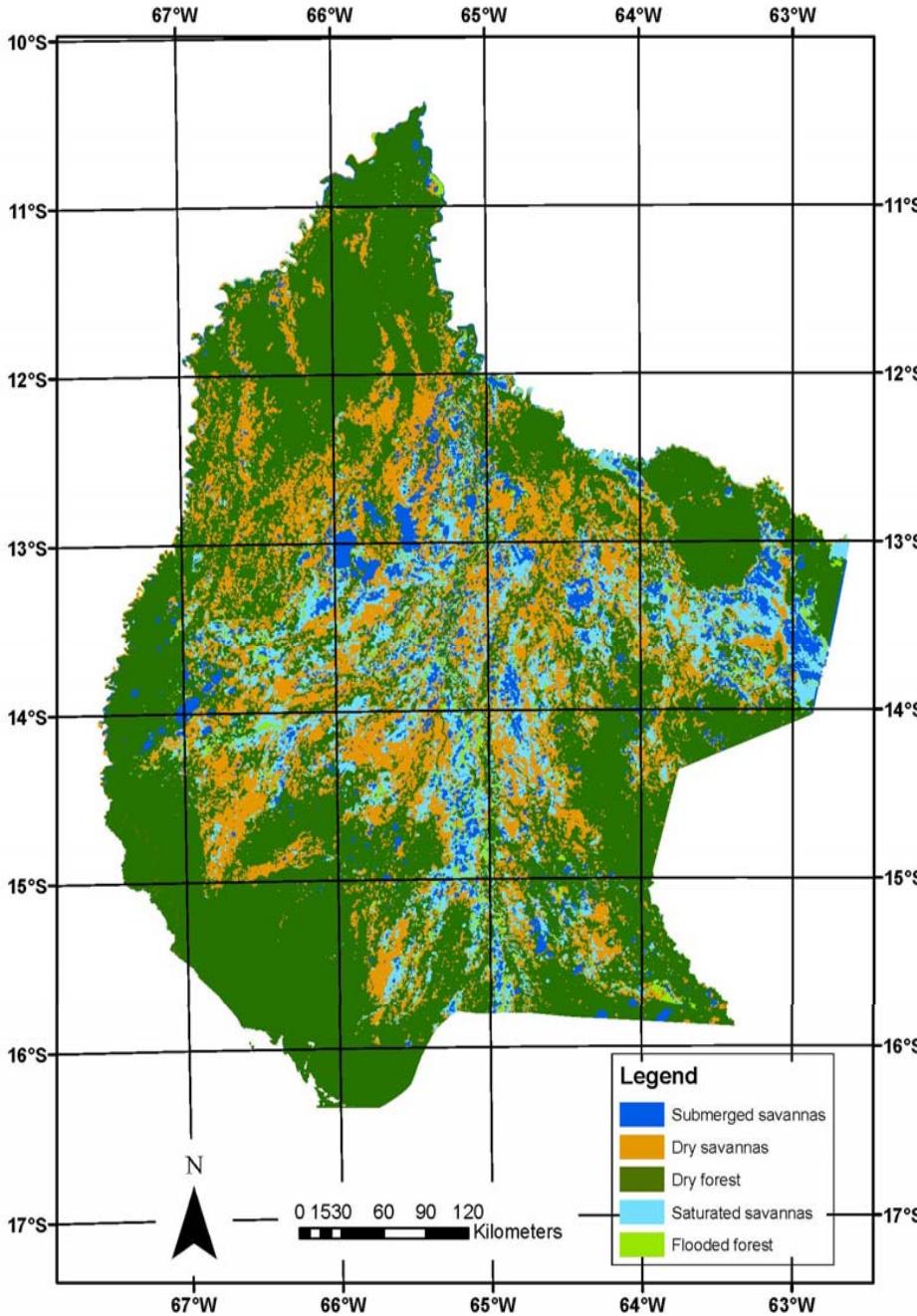
Automatic Classification Mapping

- . 3 flood class: dry/saturated/submerged
- . 3 land cover types : savanna, forest, open water
- . 5-class : open water, flooded forest, dry forest, saturated savanna

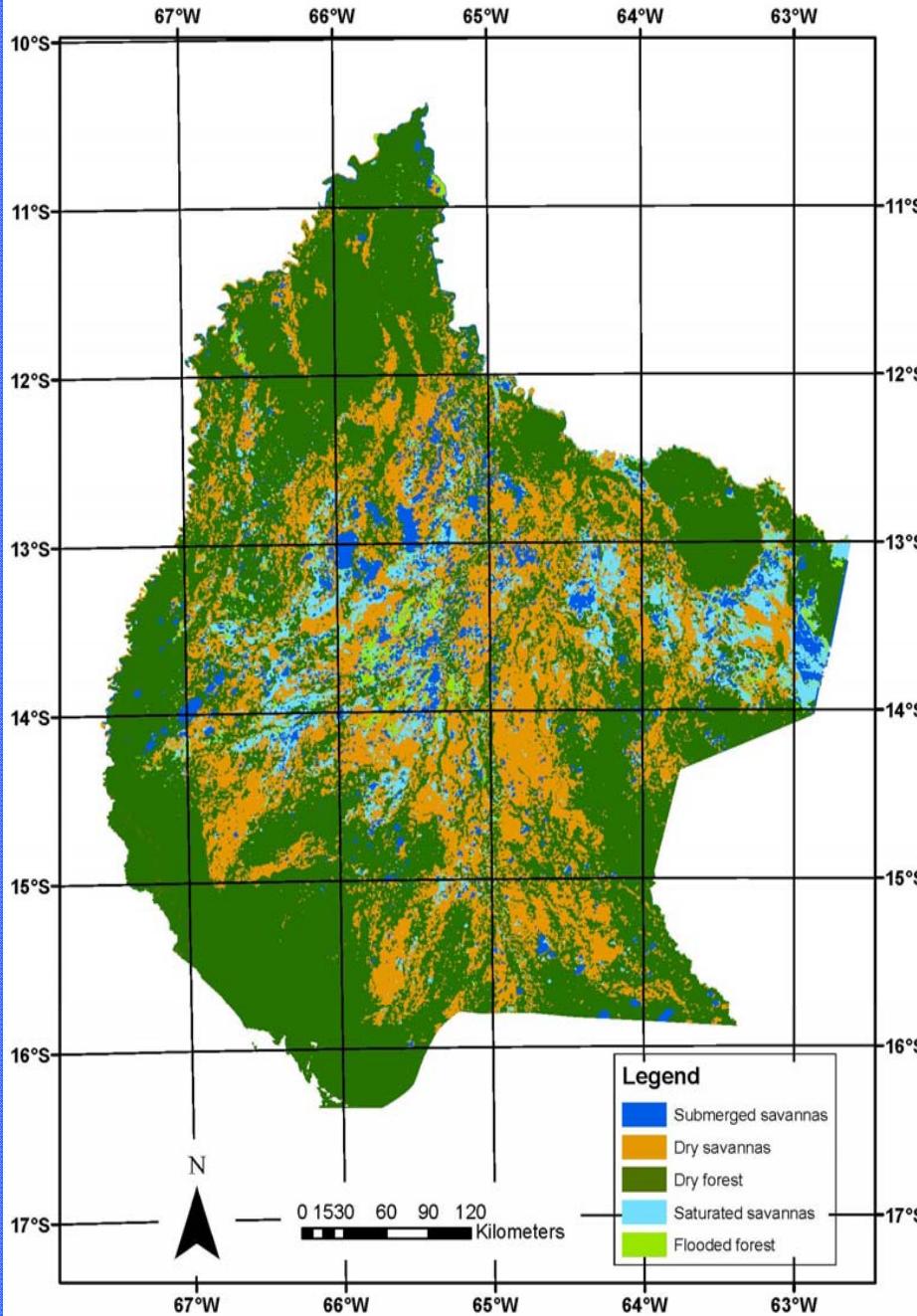
Remote sensing ability for flood mapping

Themes	Radar	Optical
Flooded forest	Excellent	Poor
Flooded savannas (submersion)	Excellent	Excellent
Flooded savannas (saturated zones)	Excellent	Variable
Open lakes	Fine	Excellent

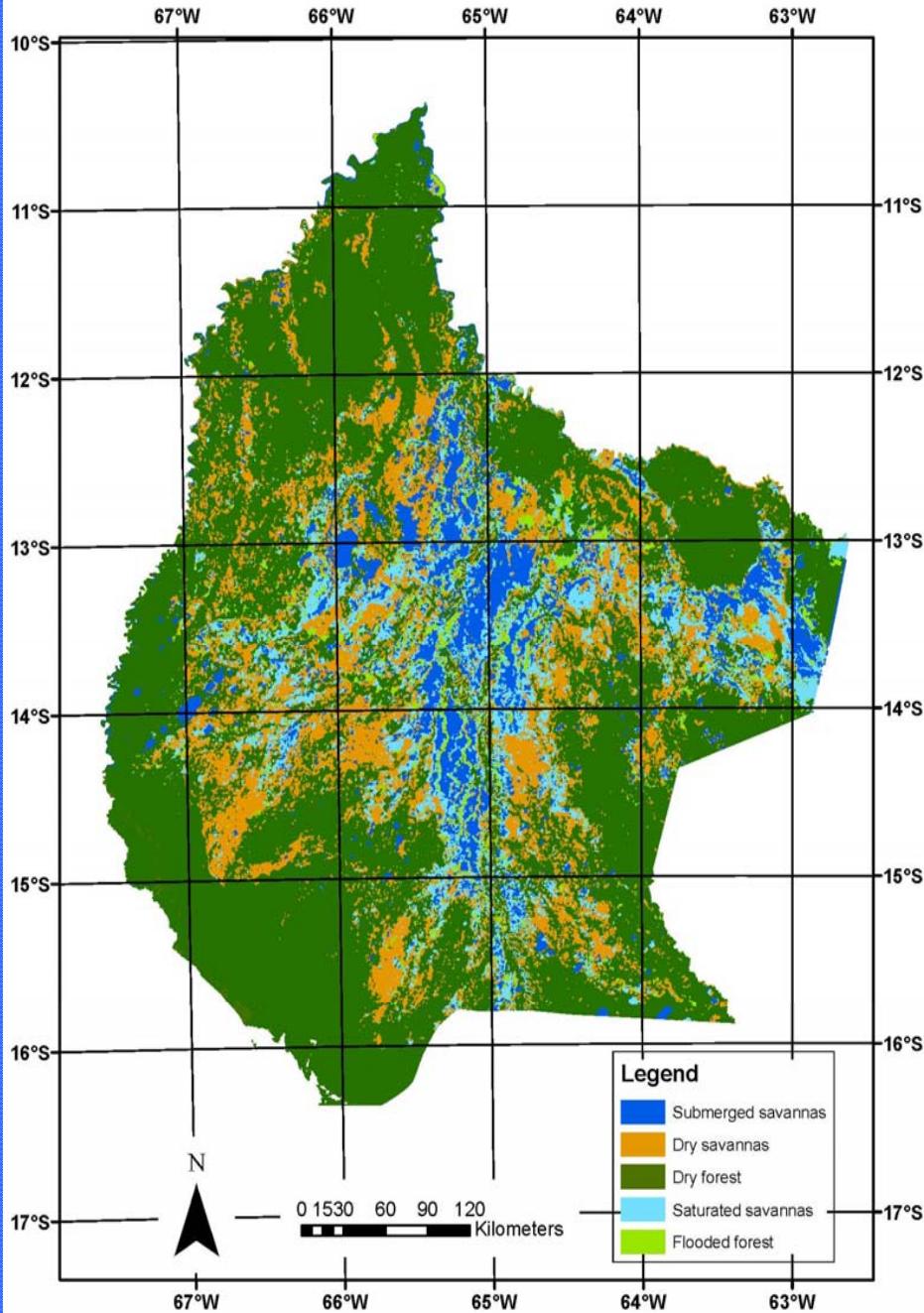
2003



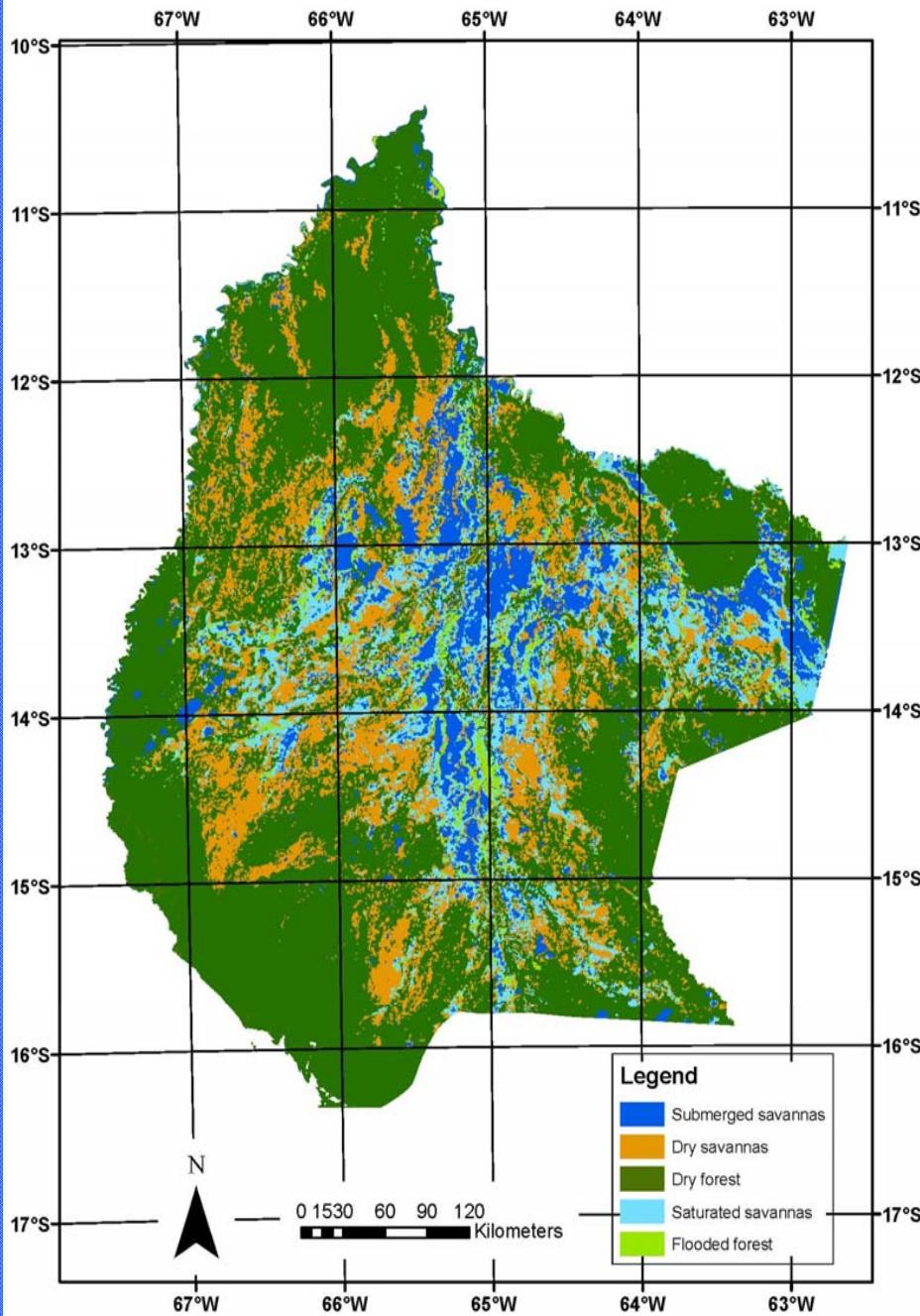
2006



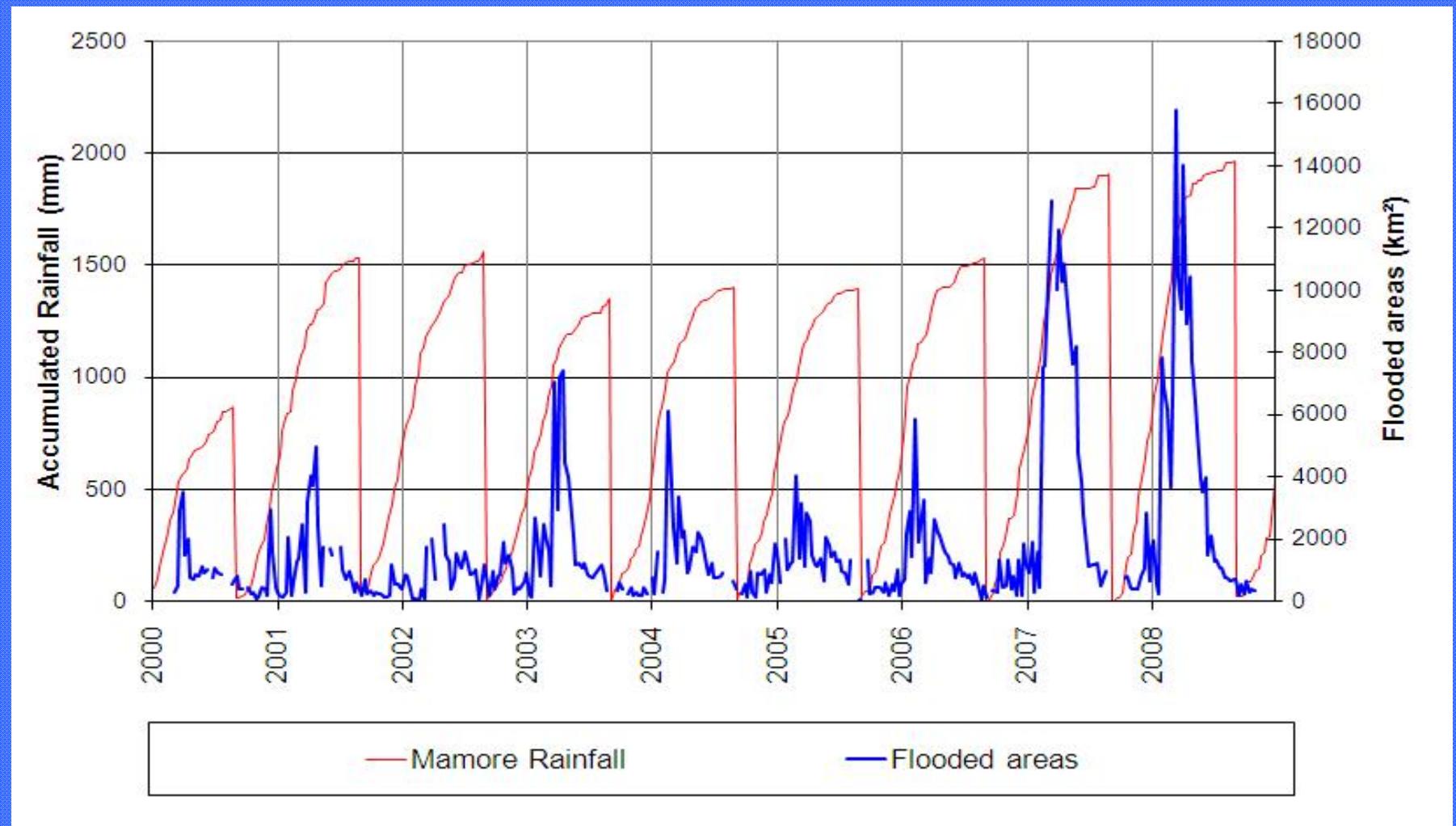
2007



2008

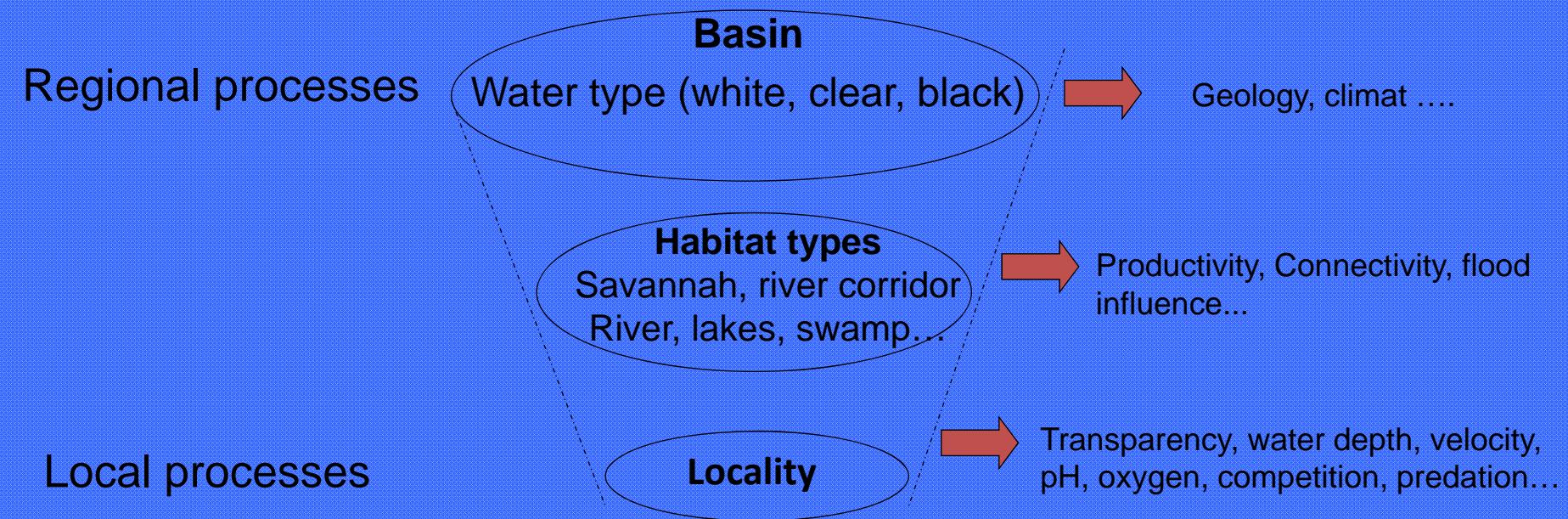


River discharge - Flooded areas relationships and Flooded areas vs Cumulated Rainfall



Fish distribution

Community composition and species distribution are under influence of a set of physical and biological factors that actuate hierarchically at different temporal and spatial scales



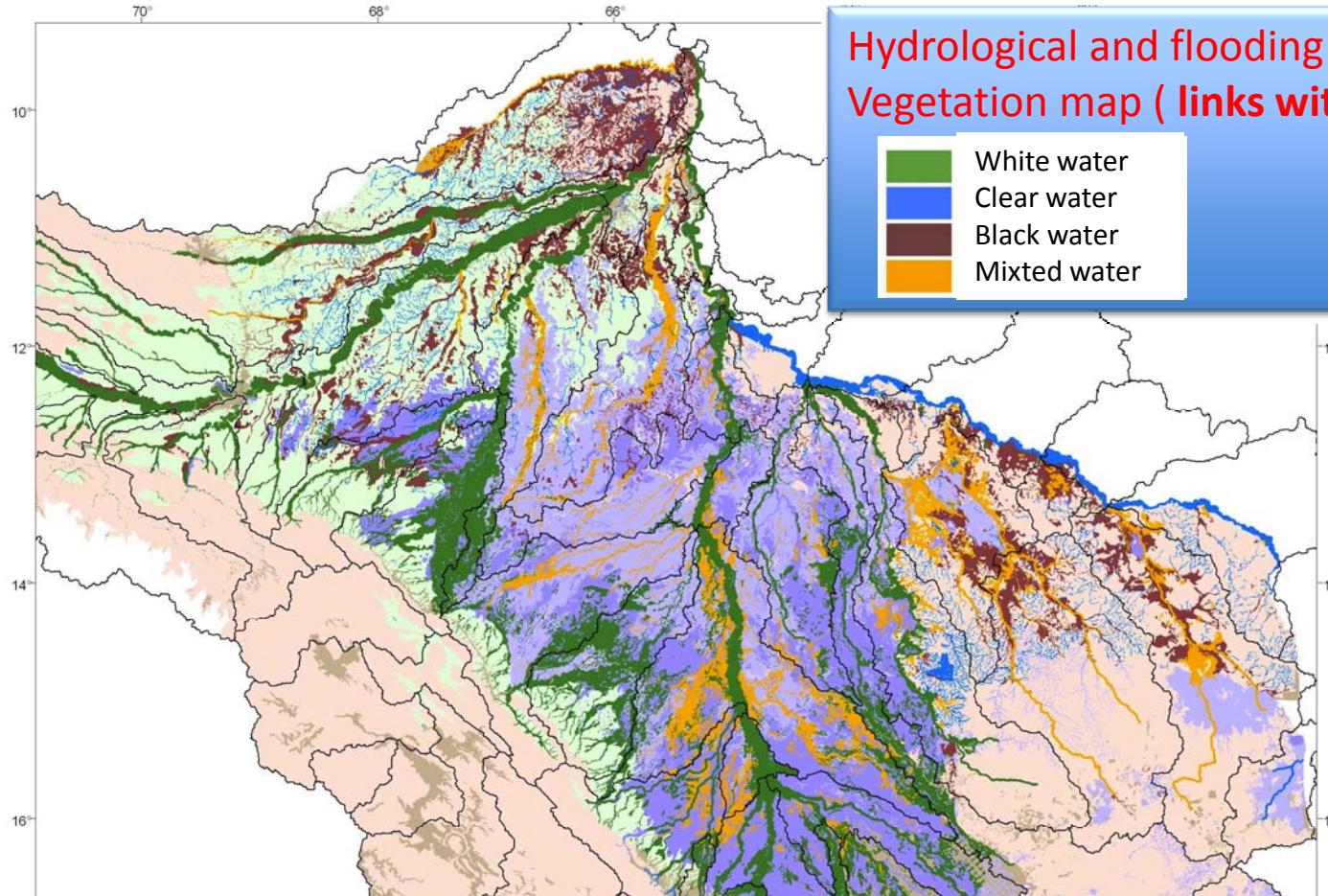
Factors to primary introduce for fish modelling at regional scale

1- Water type : white vs. clear and black or mixed water

2- Habitat-types: : savannah vs. fluvial corridor ; lentic (lakes) vs. lotic (river)

3- Landscape position: connectivity, flood influence

Aquatic habitat classification



Hydrological and flooding studies
Vegetation map (links with hydrology)

White water
Clear water
Black water
Mixed water

Low frequency flooding
High frequency flooding
Regular drainage
Good drainage

Used factors for the MaxEnt modelling:

Habitat classification

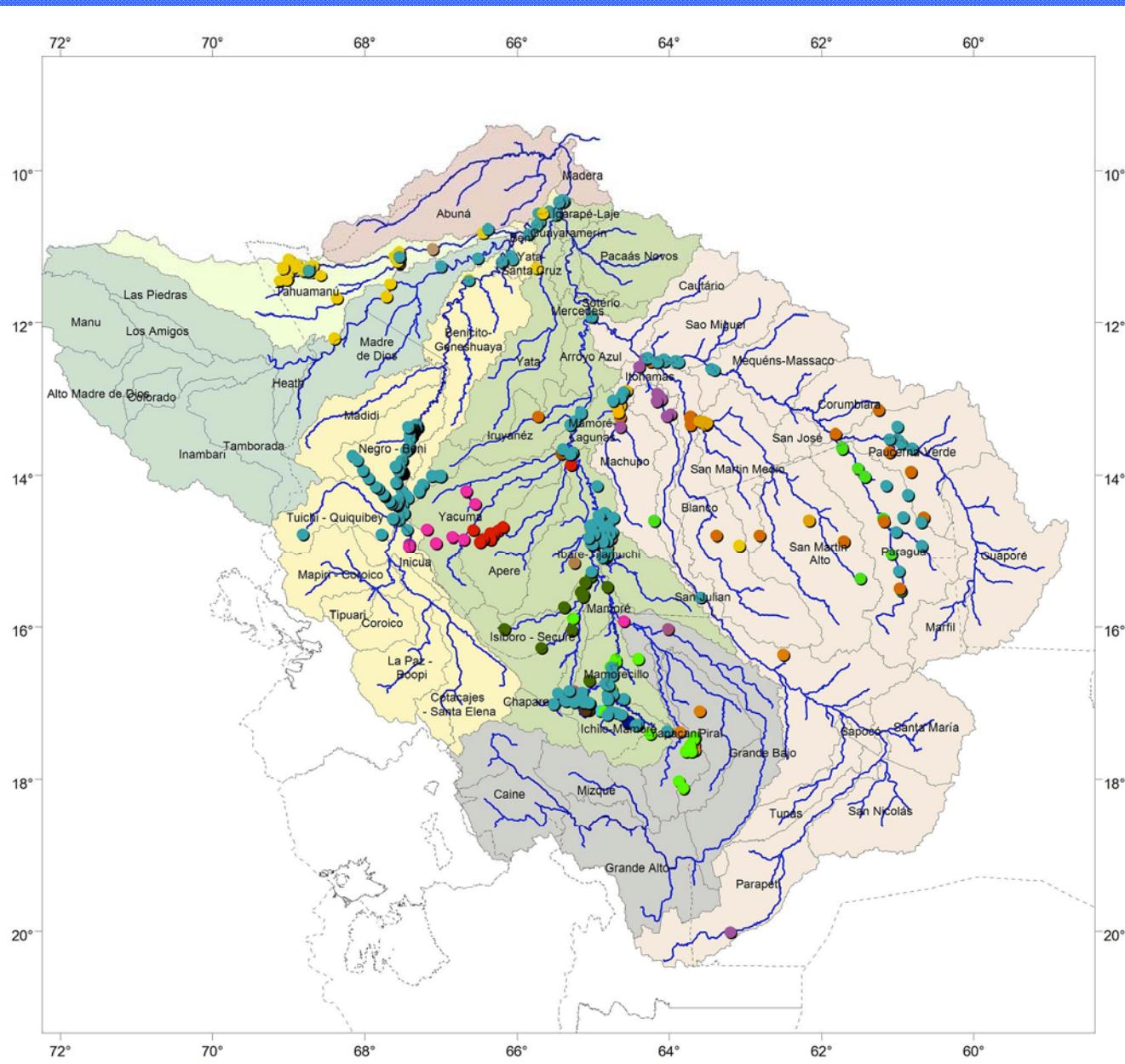
1- water type, 2- savannah vs. fluvial corridor, 3- Flood influence/ drainage quality
+

19 climatic and landscape factors: T°, precipitation, altitude, eco-region

Georeferenced database of fish observations

		Publication	Project db		
Scientific publications					
BIOCAB	Proyecto IRD/UMSA-IE/UAB-CIRA			public	671
CIRA	Proyecto IRD/UMSA-IE/UAB-CIRA			restricted	728
EMAA	Proyecto IRD/UMSS-ULRA			restricted	1207
WCS	Proyecto CIPTA / WCS Bolivia			restricted	2325
RAP	Rapid Assessment Program Biodiversity Survey Database (Conservation International)		restricted	998	
AMNH	The American Museum of Natural History of New York, USA		public		728
ANSP	Philadelphia Academy of Natural Sciences, USA		public		699
AUM	Auburn University, Department of Zoology-Entomology, Museum, USA		public		63
BMNH	British Museum of Natural History, London, Inglaterra		public		130
CAS	California Academy of Sciences, San Francisco, USA		public		19
CBF	Colección Boliviana de Fauna, Museo Nacional de Historia Natural, La Paz, Bolivia		restricted		202
CU	Cornell's University Museum of Vertebrates, Ithaca, USA		public		2982
FLMNH	Florida Museum of Natural History, Gainesville, USA		public		10
FMNH	The Field Museum of Natural History, Chicago, USA		public		569
INPA	Instituto Nacional de Pesquisas da Amazonia, Manaus, Brazil		public		1145
KU	University of Kansas, Natural History Museum, Lawrence, USA		public		28
MCNC	Museo de Ciencias Natural de Caracas, Venezuela		public		1
MCP	Museu de Ciencias, Porto Alegre, Brazil		public		35
MNHN	Museum National d'Histoire Naturelle, Paris, France		public		5
MNRJ	Museu Nacional, Universidade Federal do Rio de Janeiro, Brazil		public		333
MZUSP	Museo de zoologia da Universidade de Sao Paulo, Brazil		public		1
NRM	Naturhistoriska Riksmuseet (Swedish Museum of Natural History), Stockholm, Suecia		public		13
ROM	Royal Ontario Museum, Ontario, Canada		public		73
SMF	Forschungsinstitut und Naturmuseum Frankfurt am Main, Frankfurt, Alemania		public		6
UMMZ	University of Michigan Museum of Zoology, USA		public		2
UMSS	Universidad de San Simón Cochabamba, Bolivia		restricted		890
USNM	Smithsonian Institution, National Museum of Natural History, Washington, USA		public		1530
ZMA	Universiteit van Amsterdam, Zoologisch Museum, Amsterdam, Holland		public		407
NEODAT	Neotropical Biodiversity Database		public		6
GBIF	Global Biodiversity Information Facility		public		

Spatial repartition of records



574 locality

Mamoré	246
Iténez	140
Madre de Dios	92
Beni	71
Grande	23
Abuna	2

Fish Diversity in the Bolivian Amazon

	Madre de Dios	Beni	Mamoré	Iténez	Total
Lauzanne et al. 1991	101	-	327	163	389
Sarmiento & Barrera 2004					650
Jégu et al. 2010				619	
Carvajal & Zeballos 2010	303	323			714
IRD-FAN project	352	398	691	600	993

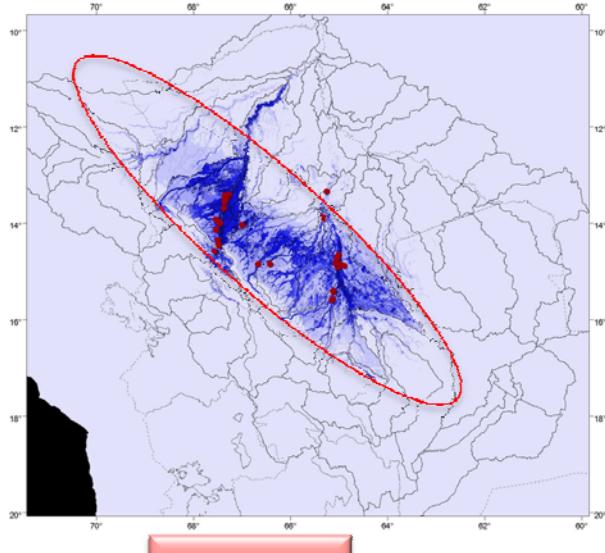
319 genus, 45 families y 11 order.

777 species with a completed identification

216 (22%) reported at the genus level in the museum

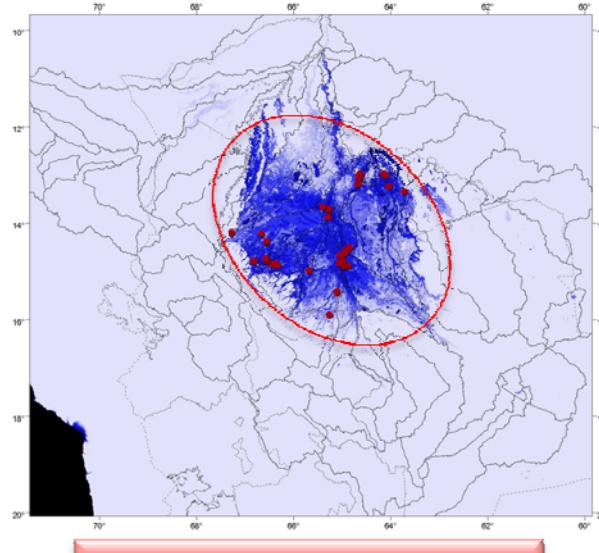
MaxEnt modeling results

Pterodoras granulosus



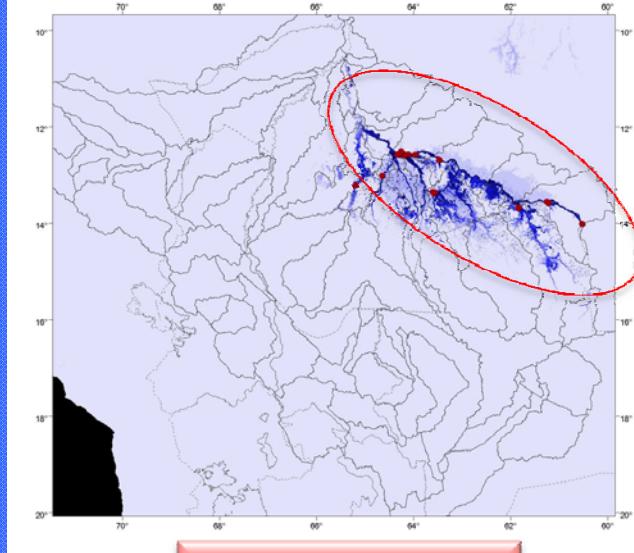
Foot hill

Markiana nigripinnis



Central lowland plain

Laemolyta taeniata



Brazilian shield

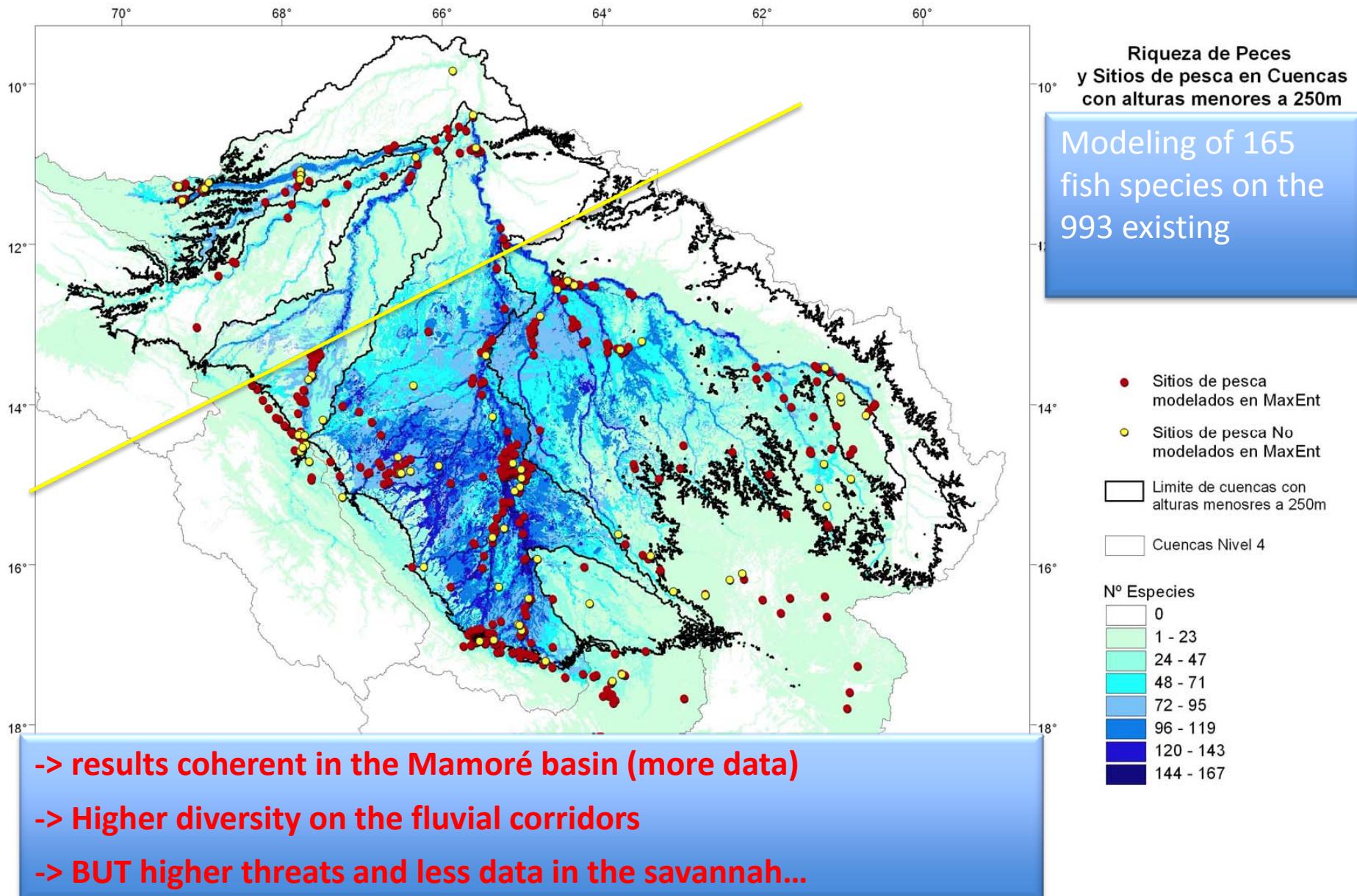
Model valid at the regional scale

Modeled distribution respected observed distribution clearly influenced by regional contrast and basin limits

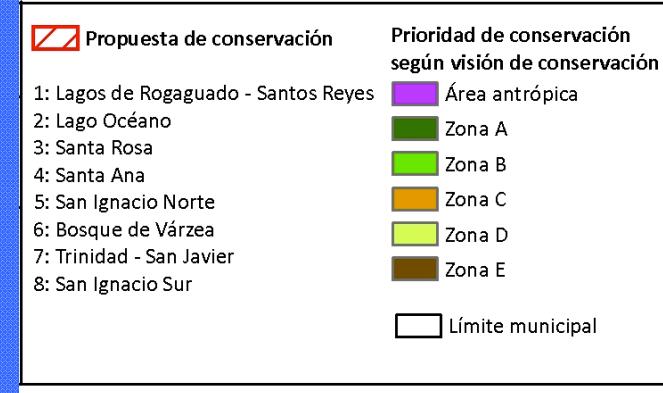
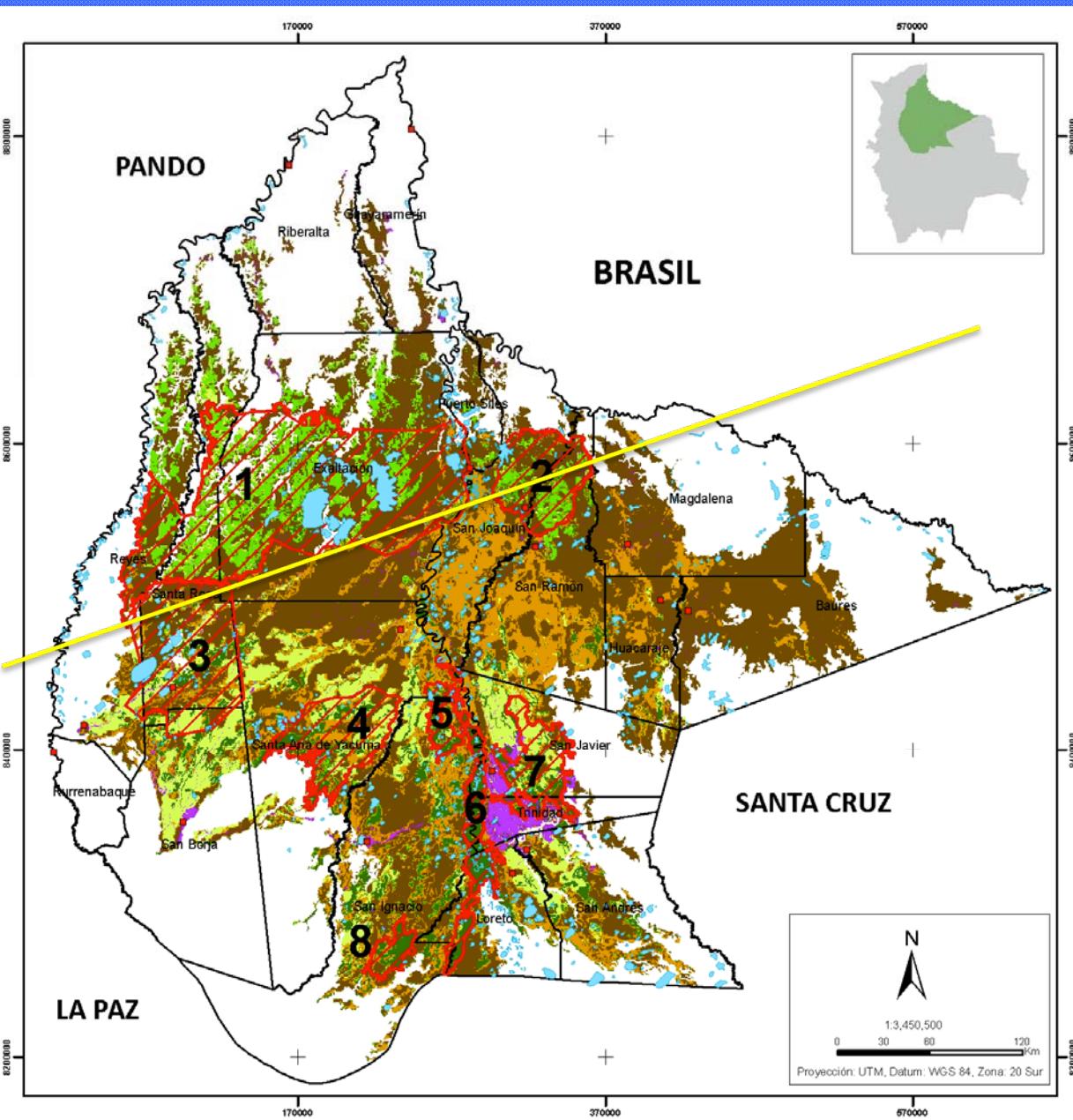
Model not valid at the local scale

- > Over-estimation on the savannah
- > Under-estimation on the river

Fish diversity map



Proposed conservation sites



Elaborado por:

Financiado por:

MacArthur Foundation

Reino de los Paises Bajos

Impact of climate changes on flooding, biodiversity and anthropogenic activities in a large Amazonian floodplain system.

