DNA Barcodes 2015
Guelph, Canada, August 21st, 2015

The Brazilian Barcode of Life (BrBOL) initiative and its potential to aid in biodiversity conservation

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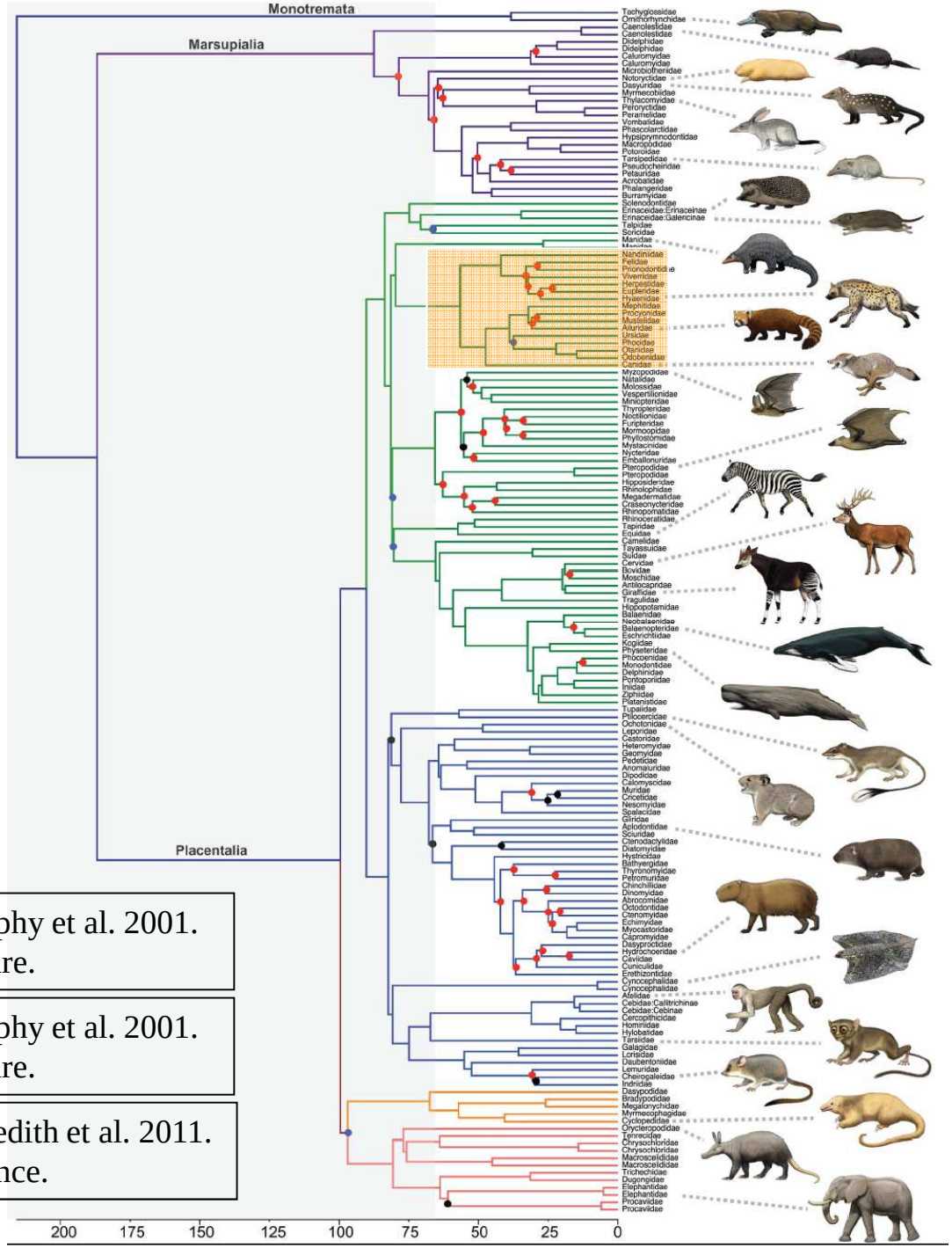


Murphy et al. 2001. Nature.

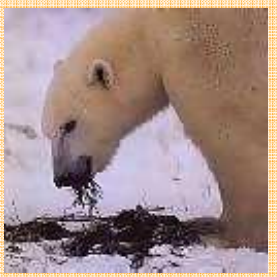
Murphy et al. 2001. Nature.

Meredith et al. 2011. Science.

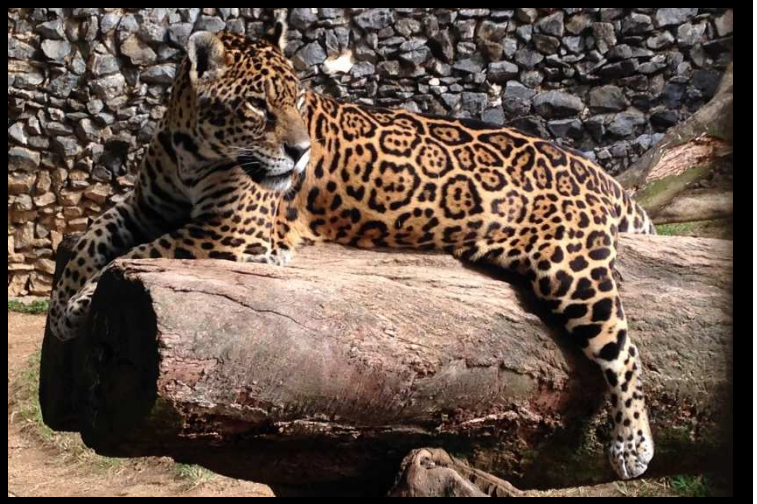
order Carnivora

Phylogeny, phylogeography, population genetics, molecular ecology, genomics

order Carnivora



THE JAGUAR GENOME PROJECT



- Brazilian-led initiative
(PUCRS, FIOCRUZ-MG, ESALQ/USP)
+ Sorocaba zoo and several collaborators
(USA, Russia, Spain, Portugal, Ireland)

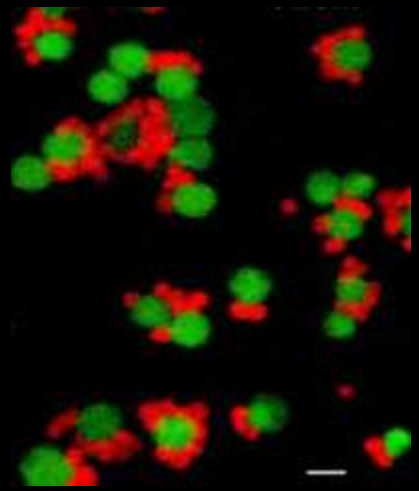
- Full sequence of the jaguar genome (84x).

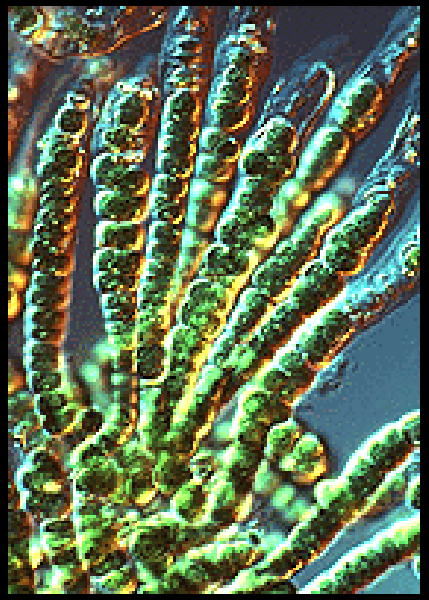
- De novo assembly, de novo annotation, comparative analyses.

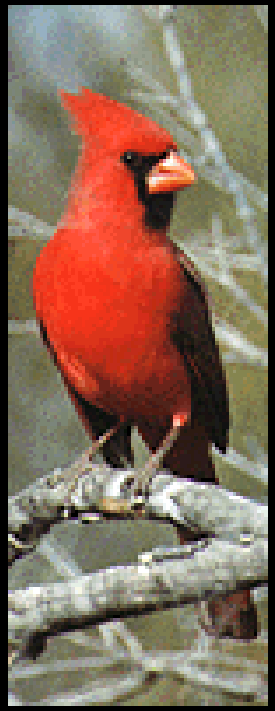
- Transcriptomes from multiple tissues.

- Population genomics
    - Exome sequencing for >100 wild jaguars from different regions.
    - Population structure and history, scans for selection.

BIODIVERSITY







Applications of DNA Barcoding in Biodiversity Conservation

1. Gathering data on components of native biodiversity;
   1.1. Baseline data (*e.g.* community composition and dynamics, geographic distribution, trophic interactions).
   1.2. Monitoring of biodiversity in impacted áreas.

2. Gathering data on threats to native biotas.
   - *e.g.* invasive species, pathogens, wildlife trafficking.

3. Helping to enforce actions aimed at curbing threats to biodiversity.
   - *e.g.* wildlife forensic analyses.

Brazil

Area: 8,515,767 km2
Population: 190,732,694

Megadiverse country

- Estimated to harbor ~1.8 mi spp. (10-17% of the world's total)
  [Lewinsohn & Prado 2005]

- Known fauna:
~9k vertebrates (711 mammals, 1,900 birds, 732 non-avian reptiles, 973 amphibians, 3,133 continental fish, 1,376 marine fish)

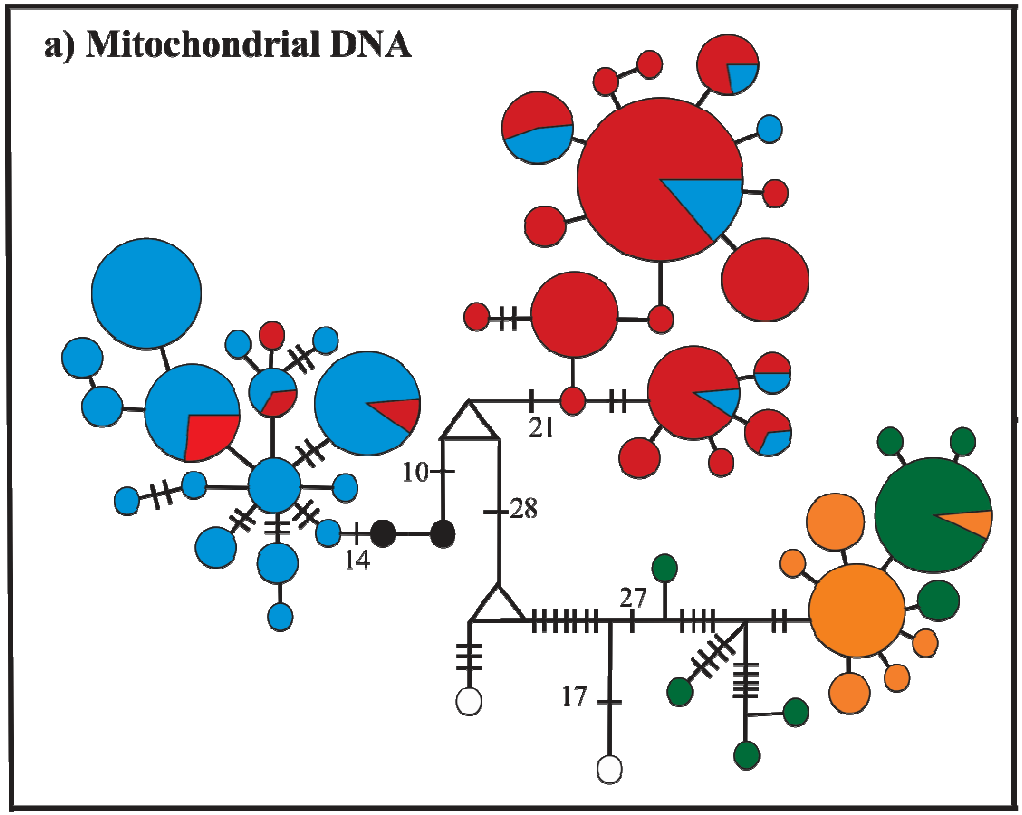
Map: wikipedia.org

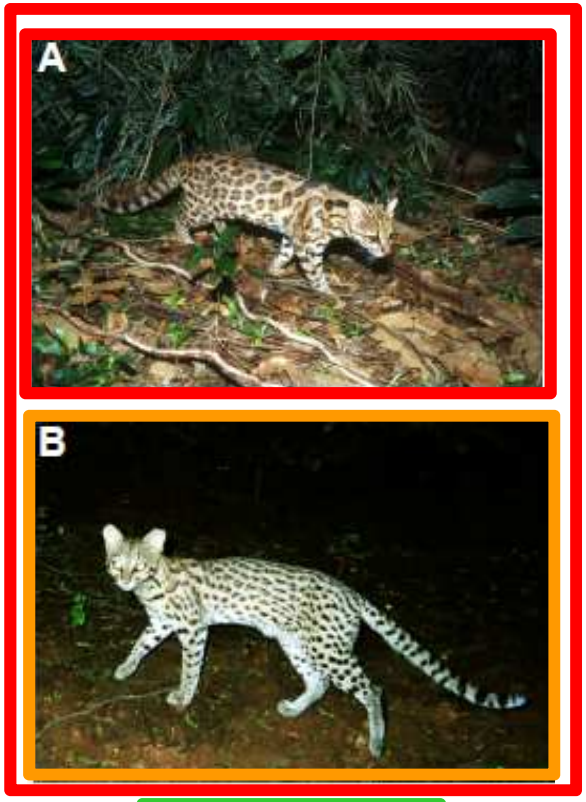
Brazil: newly recognized mammal species [2013-2014]

Tapirus kabomani

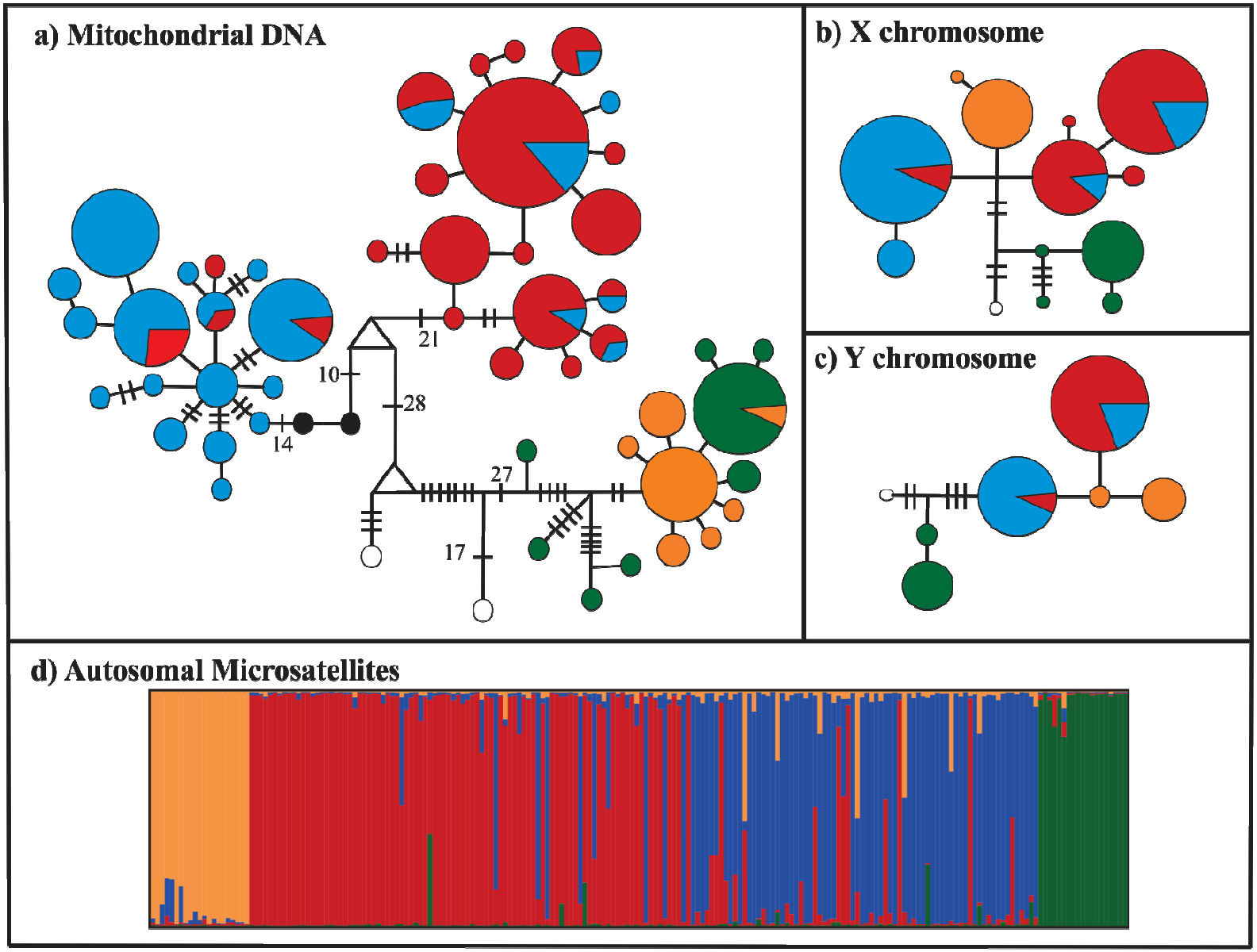
Inia araguaiensis

Leopardus guttulus





Trigo *et al.* 2013. Curr. Biol.



Trigo *et al.* 2013. Curr. Biol.

Implications for DNA barcoding

Going back to a broader perspective...

Brazilian Biomes

- High biodiversity.

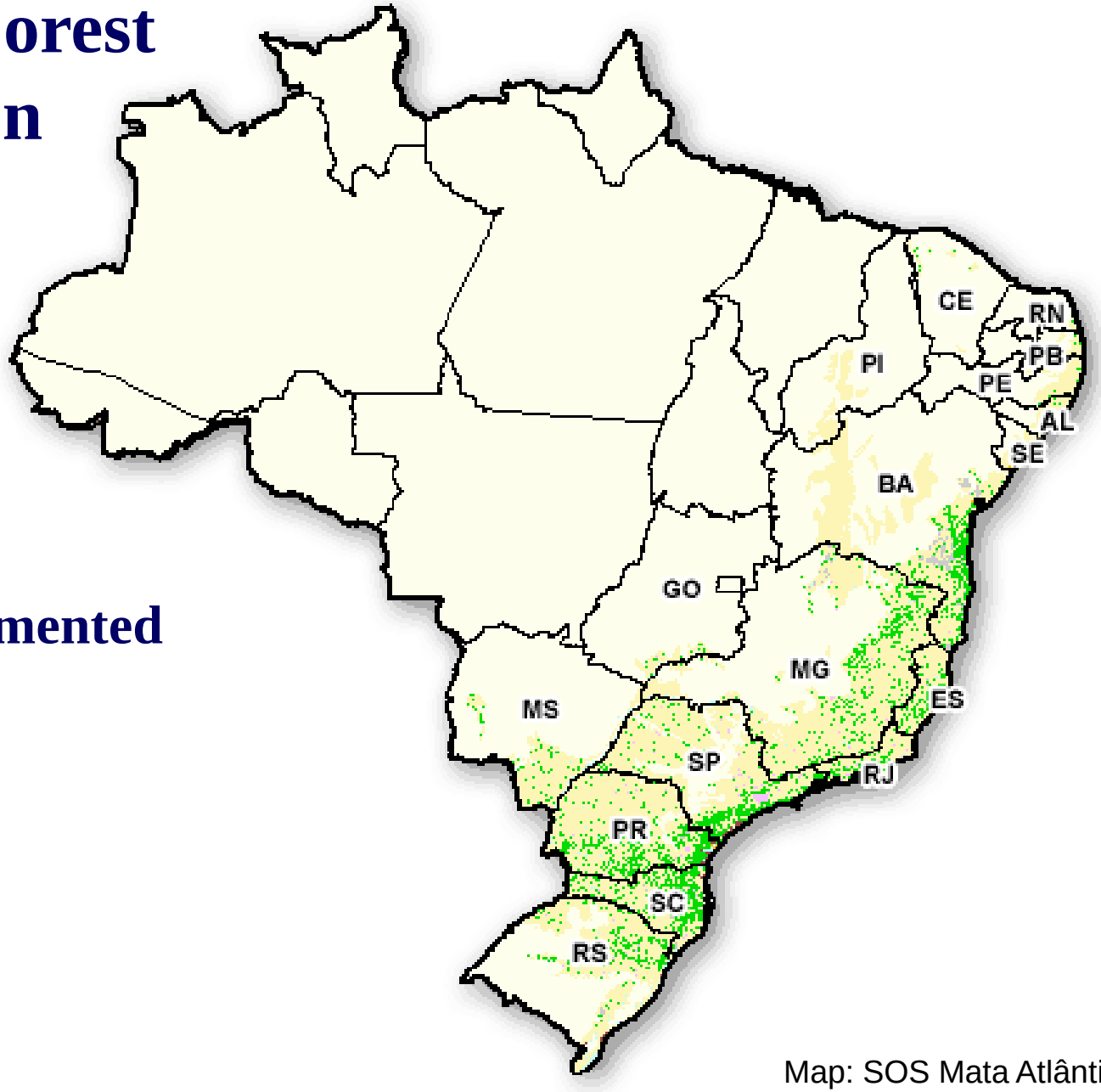
- High endemism.

(*e.g.* 50% of Atlantic forest amphibians are endemic)

- High rate of habitat destruction.

Map: http://meioambiente.culturamix.com/

Atlantic Forest destruction



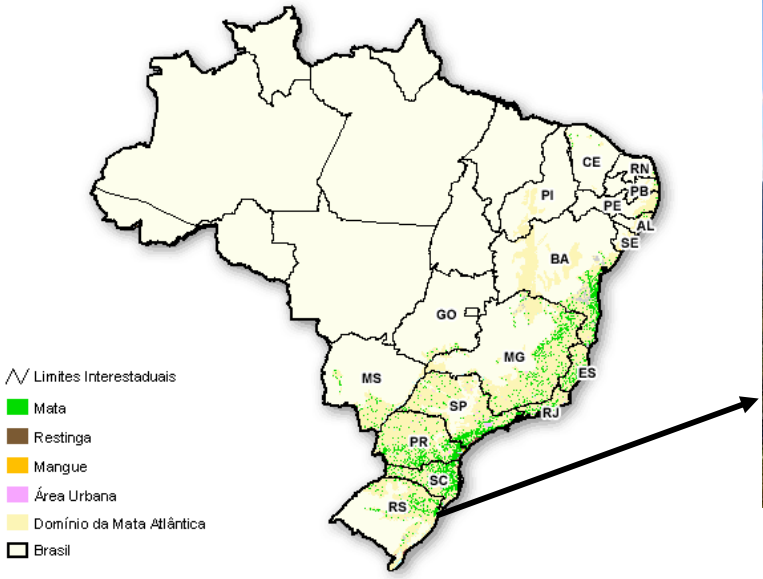
~10% left
- Highly fragmented

Map: SOS Mata Atlântica

Meta-barcoding of Atlantic Forest bromeliad tank waters

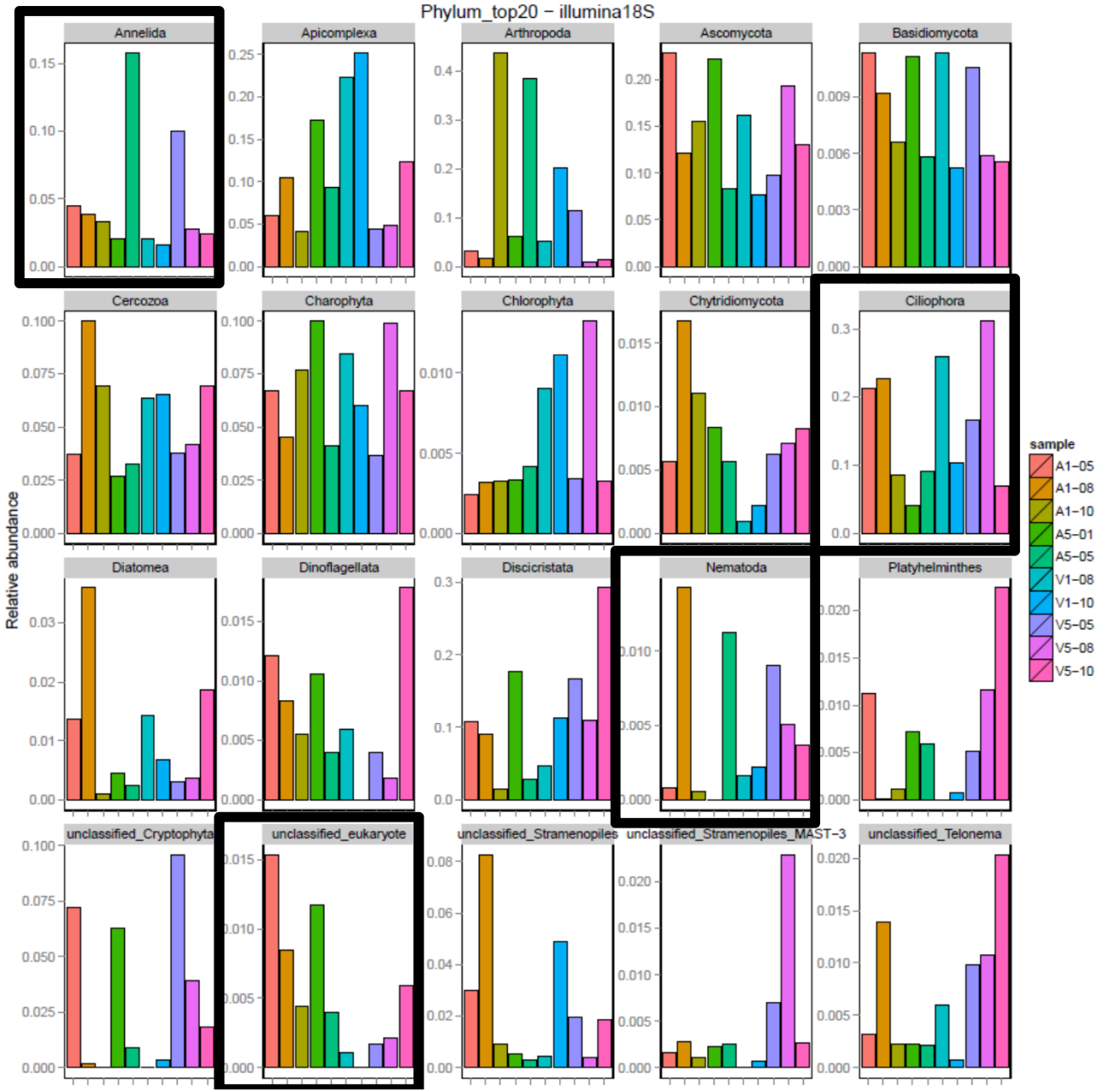
Aechmea gamosepala

Vriesea platynema



CPCN Pró-Mata, PUCRS, Brazil

Meta-barcoding of Atlantic Forest bromeliad tank waters



The effort towards Large-scale DNA barcoding of Brazilian biodiversity

Initial Proposal (2005):

Beginning of the Brazilian DNA barcoding network

- Large-scale inventory of Brazilian biodiversity

- Multi-center project designed in 2005 to boost taxonomic research in Brazil using the DNA barcode concept as a catalyst to integrate field collections, museum-based biodiversity research, genome center networks and bioinformatics advances.

- 6 museums, 14 Centers of Molecular Biodiversity, ~300 people

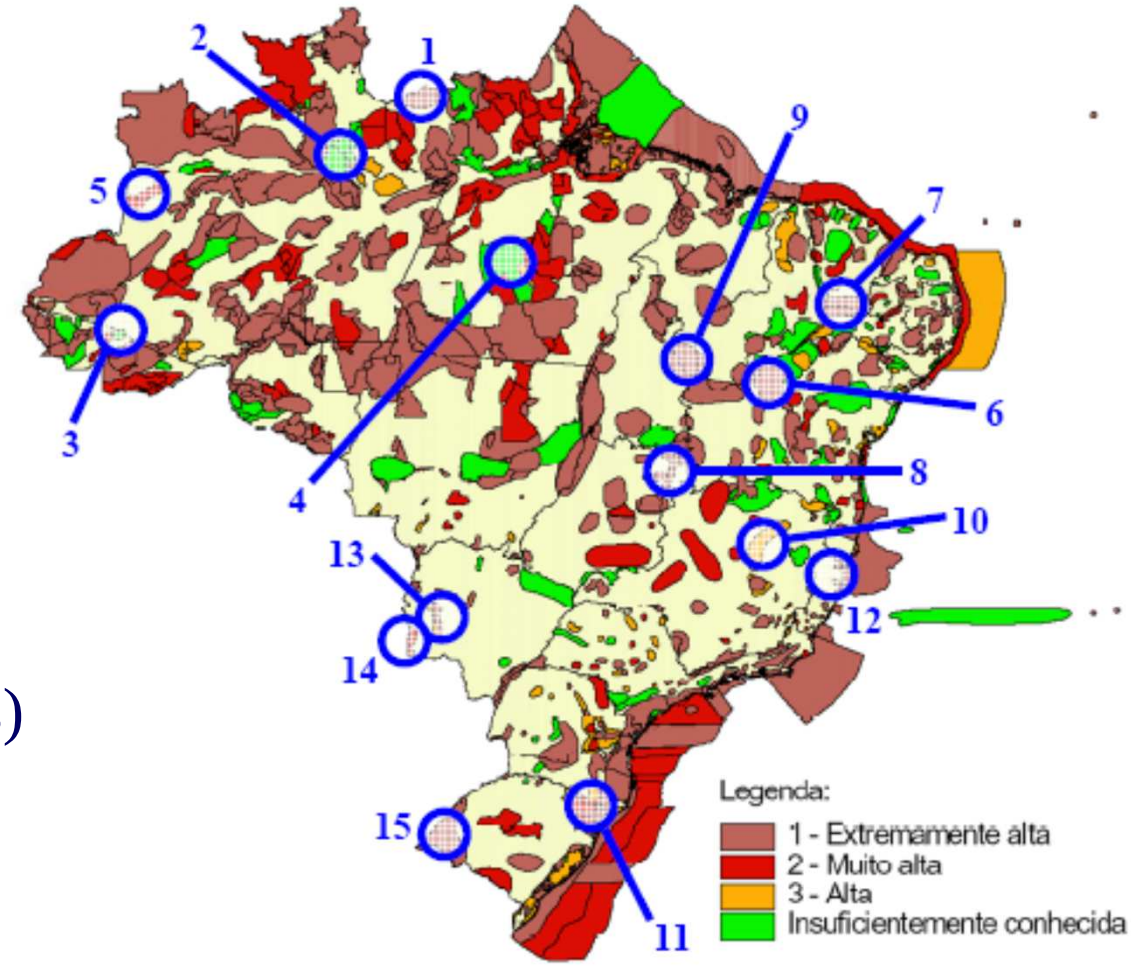
Large-scale inventorying of Brazilian biodiversity (2005)

Sampling strategy

15 sites:

-10,000 samples/site:

- fish
- amphibians
- reptiles (incl. birds)
- mammals
- spiders
- Leguminosae



2010 – BrBOL launched

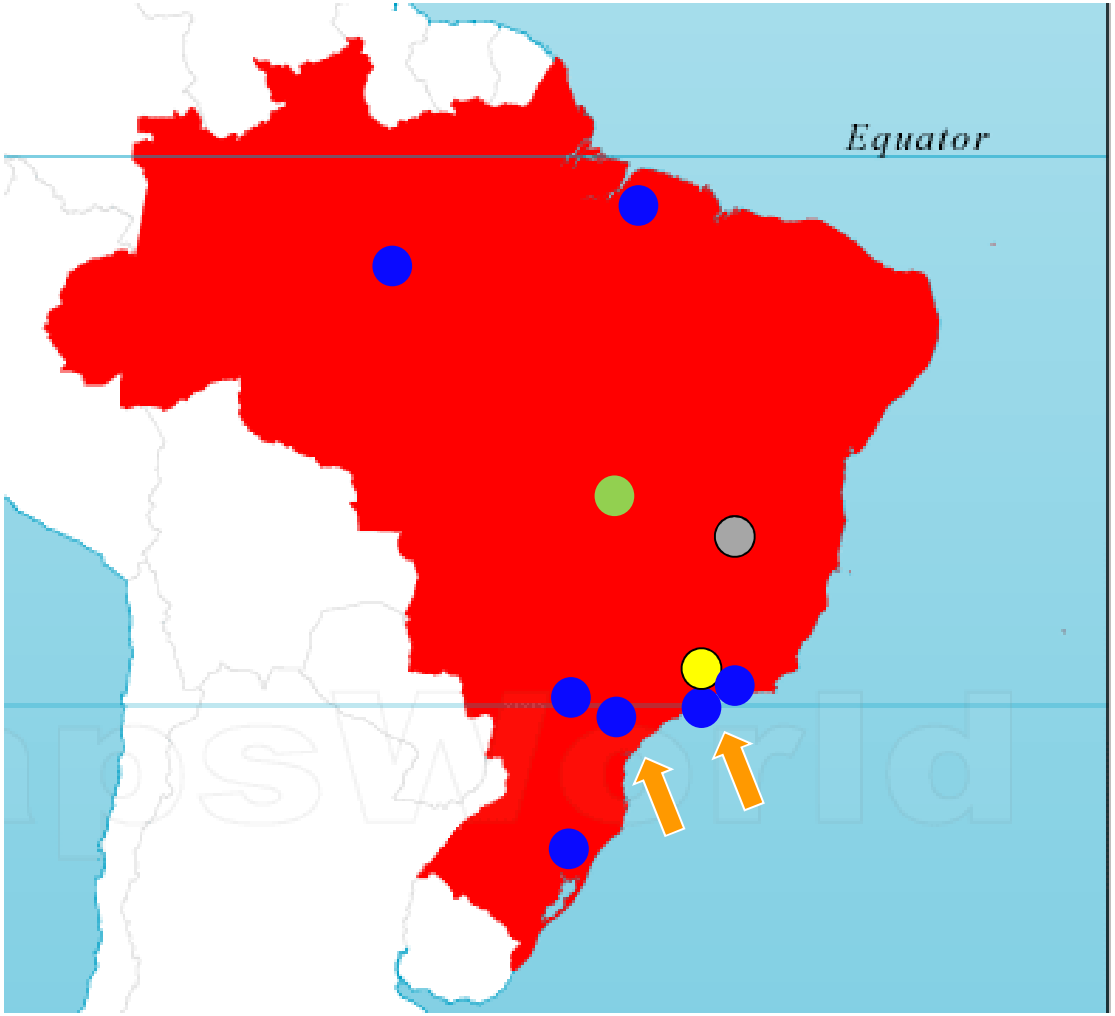
www.brbol.org

Phase 1:
~US$ 3,000,000
2010-2014

>100 participating groups

~500 people involved

- All major Brazilian museums and natural history collections.
- Bioinformatics center
- Biomedical institution
- Agricutural research agency



The two largest museums did not have molecular biology laboratories.
- Implemented in both via funding from the BrBOL network.

BrBOL
Brazilian Barcode of Life

Projects

The Brazilian Barcode of Life Consortium has 11 projects:

PROJECT ID	PROJECT NAME	GROUP LEADER	DESCRIPTION
PJ 01	Bioinformatics Platform	Guilherme Corrêa de Oliveira	Read more
PJ 02	Brazilian Initiative for Molecular Identification of Marine Organisms	Mariana Cabral de Oliveira	Read more
PJ 03	Brazilian DNA Barcoding Initiative for Aquatic Arthropod	Fabio de Oliveira Roque	Read more
PJ 04	Vouchers Management and Institutional Capacity to Generate DNA Barcodes	Paulo Andreas Buckup	Read more
PJ 05	Molecular Identification of Biodiversity of Terrestrial Invertebrates	Ana Maria Lima de Azeredo Espin	Read more
PJ 06	Molecular Identification of Brazilian Plants	Vânia Cristina Rennó Azevedo	Read more
PJ 07	Molecular Identification of Brazilian Fungi	Aristóteles Góes Neto	Read more
PJ 08	Molecular Identification of Brazilian Parasites and Vectors	Fernando Araujo Monteiro	Read more
PJ 09	DNA Barcoding of Brazilian Ichthyofauna	Jorge Ivan Rebelo Porto	Read more
PJ 10	DNA Barcoding of Tetrapoda: Amphibians, Reptiles, Birds and Mammals	Eduardo Eizirik	Read more
PJ 11	BrBOL - Brazilian Network for Molecular Identification of Biodiversity	Claudio de Oliveira	Read more

Barcoding Tetrapoda:
4 sub-groups
Amphibians (C. Haddad)
Reptiles (H. Zaher)
Birds (C. Miyaki)
Mammals (E. Eizirik)

DNA barcoding of Brazilian tetrapods (2010-2014)

25 participating institutions

> 100 people involved

Participating labs

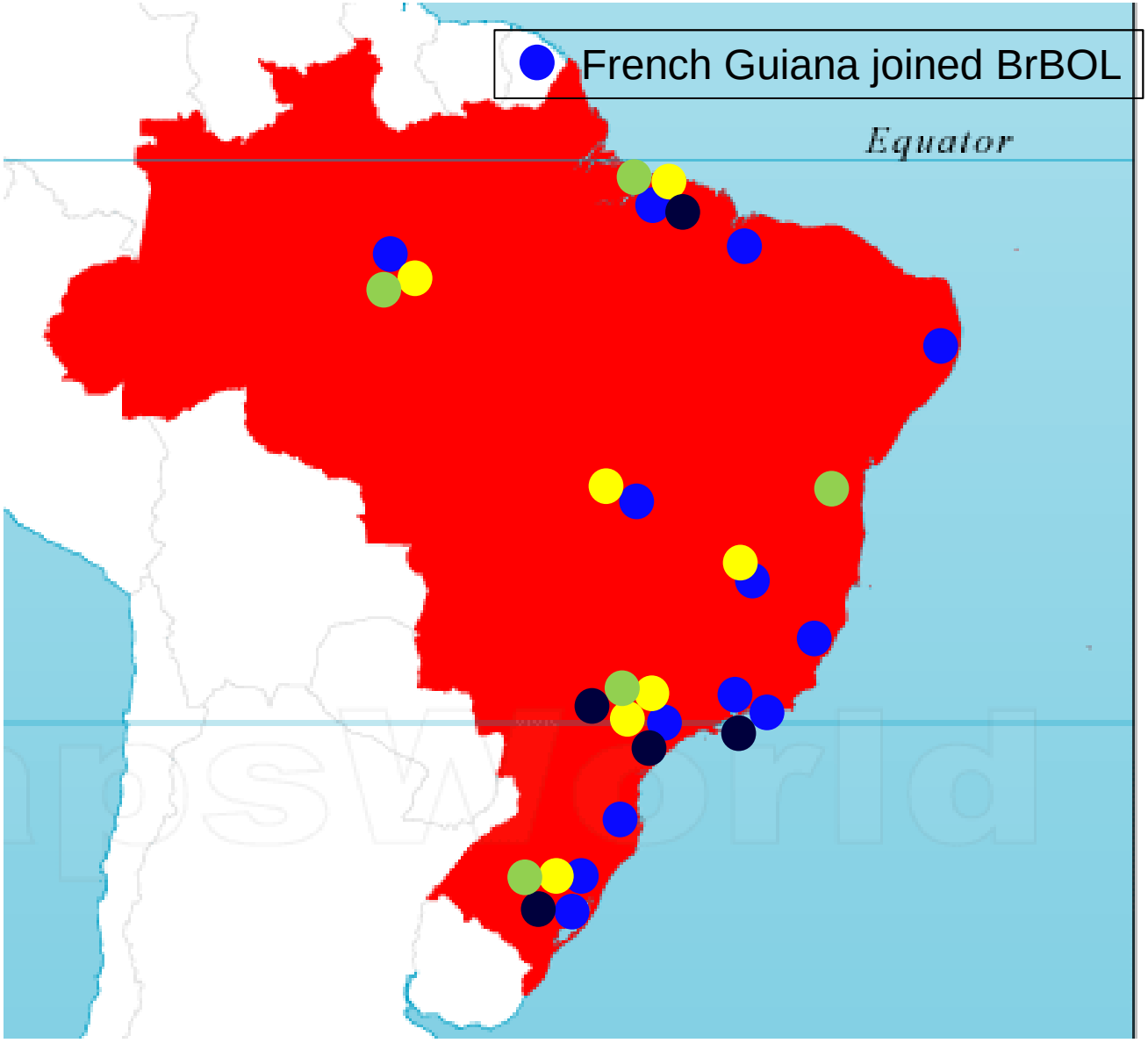
Mammals

Birds

Non-avian reptiles

Amphibians

4 Major Natural history collections in Brazil



DNA barcoding of Brazilian tetrapods

Brazilian Barcode of Life

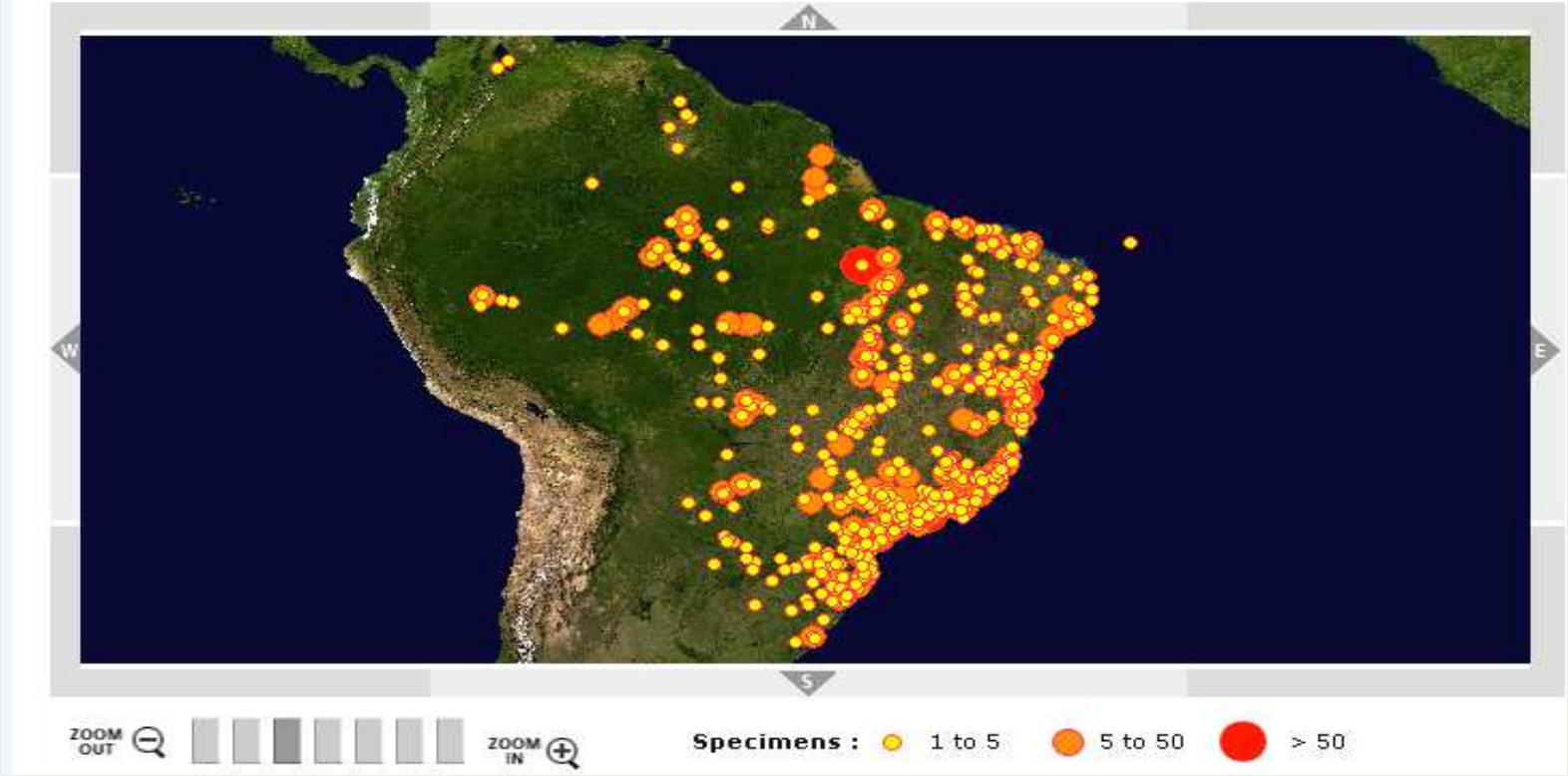
Results: DNA Barcode (*COI*) library construction (2010-2015)

Group	Barcoded Individuals	Barcoded Species
Amphibians	5,100	450
Non-avian reptiles	2,608	816
Birds	3,508	1,253
Mammals	2,122	344
Total	**13,338**	**2,863**

Geographic distribution of amphibian barcodes – BrBOL (M. Lyra, C. Haddad)

BOLD SYSTEMS

Total 5100 ind – 4750 in BOLD (~450 species)



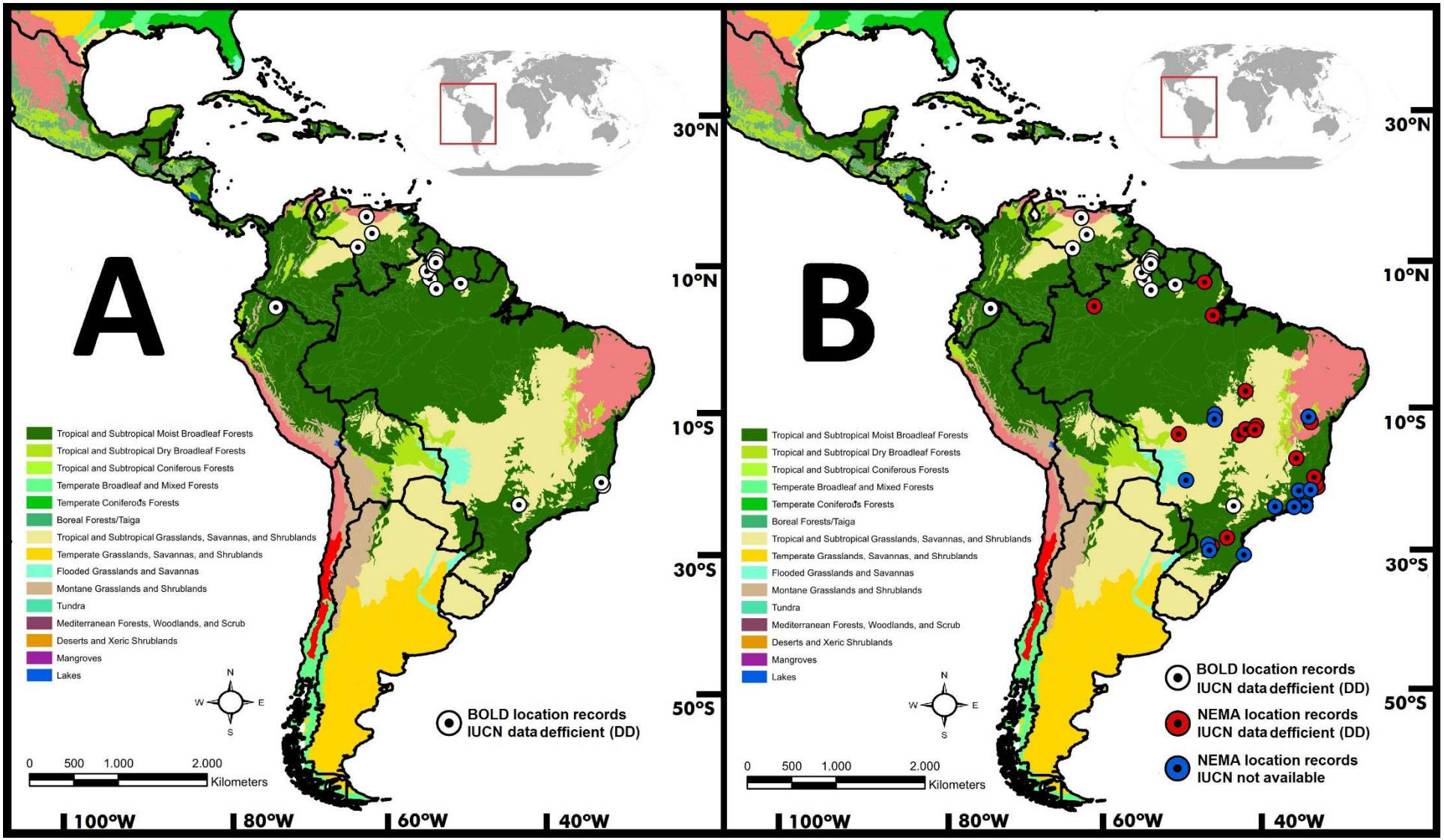
DNA barcoding of Atlantic Forest amphibians
(M. Lyra, C. Haddad)

~3800 inds/vouchers

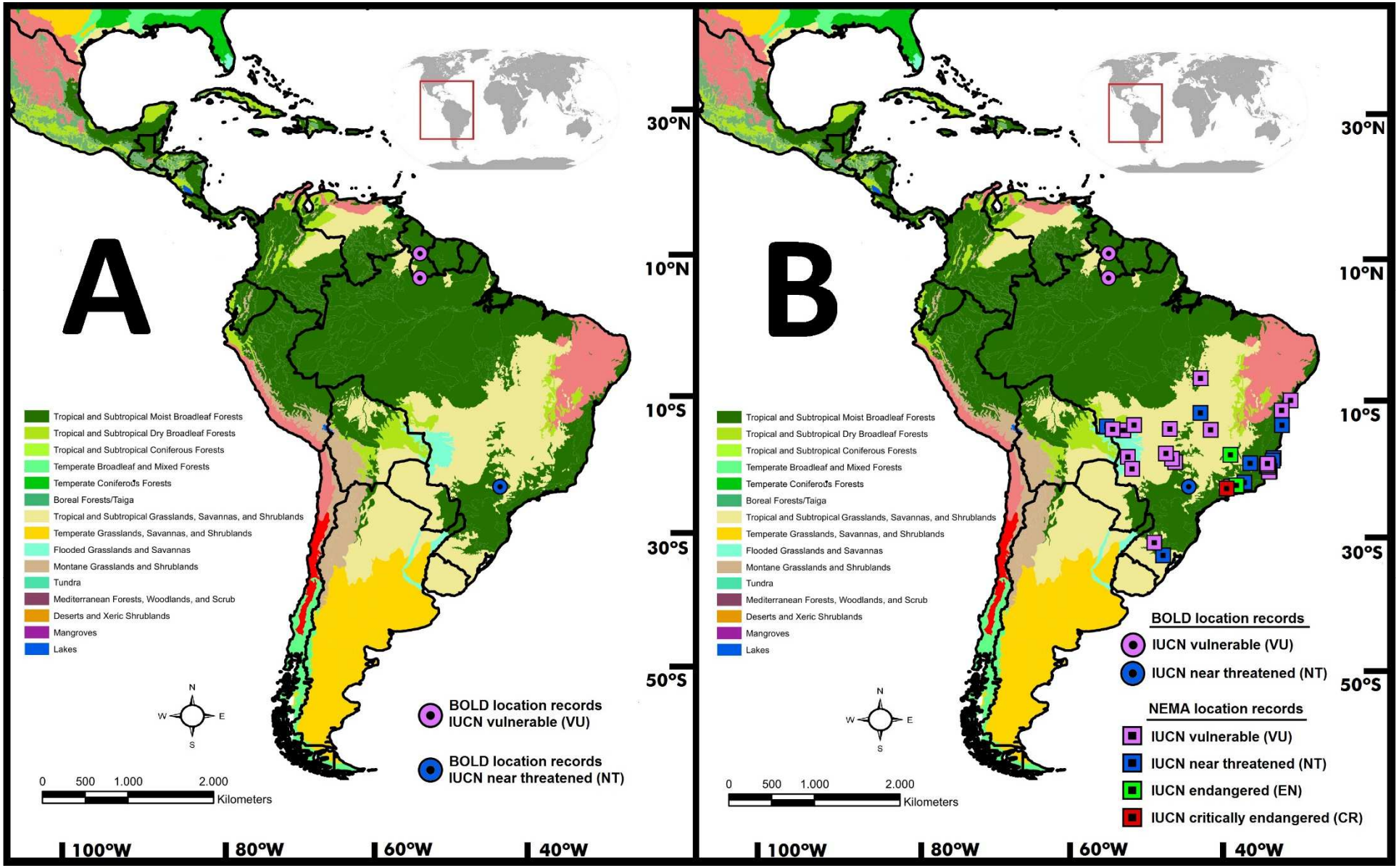
- 386 species (71% of the known species).

- 59/63 genera

Geographic distribution of mammal DNA barcodes

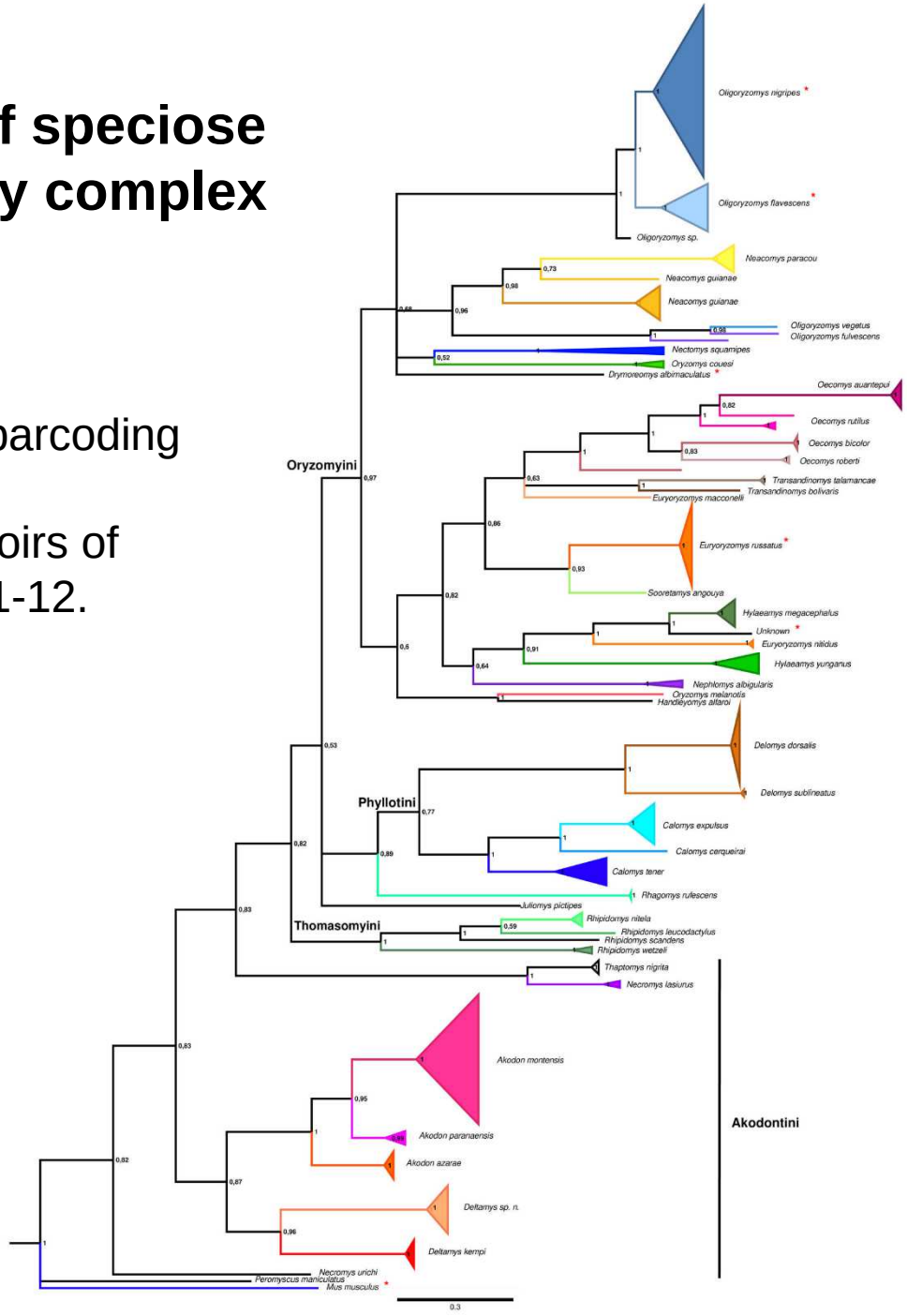


Geographic distribution of mammal DNA barcodes

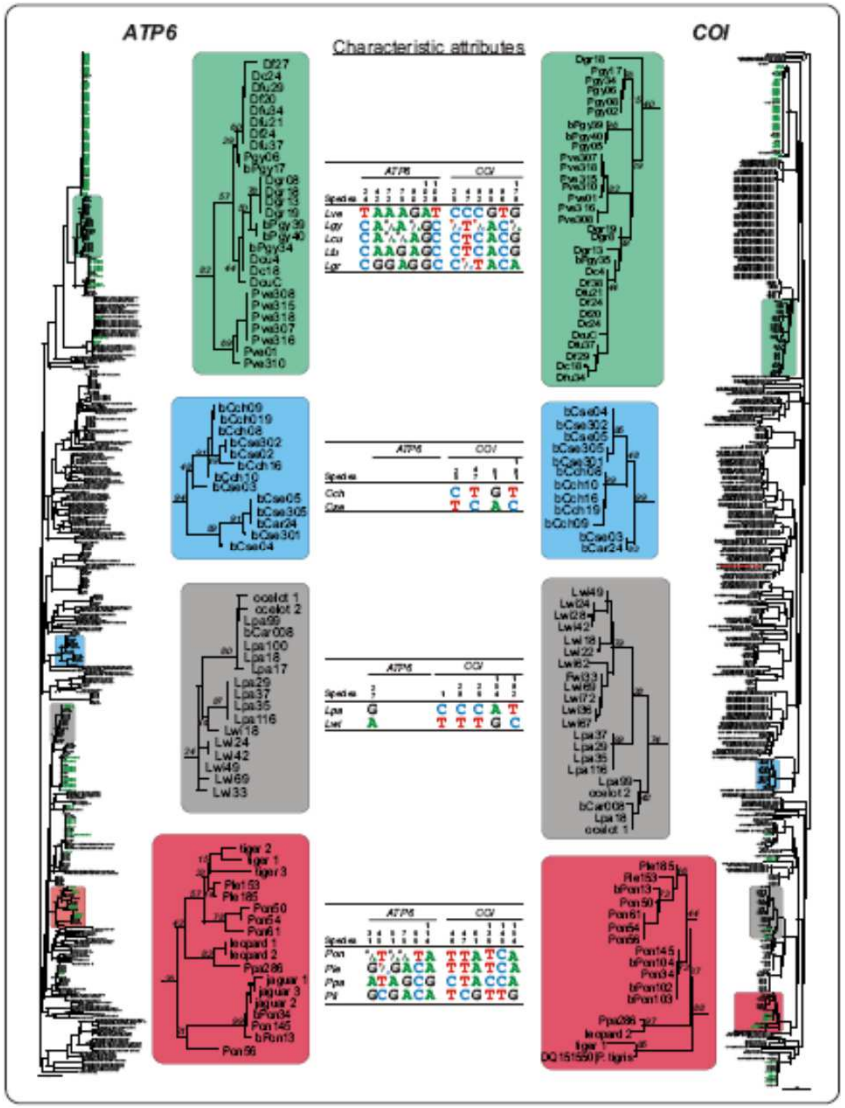


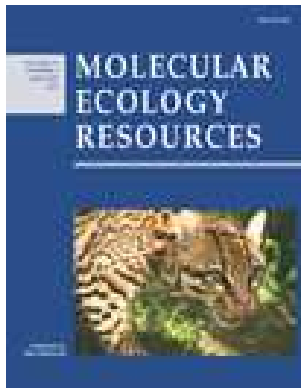
DNA barcoding of speciose and taxonomically complex groups

Müller et al. 2013. DNA barcoding of sigmodontine rodents: identifying wildlife reservoirs of zoonoses. Plos One, 8: 1-12.



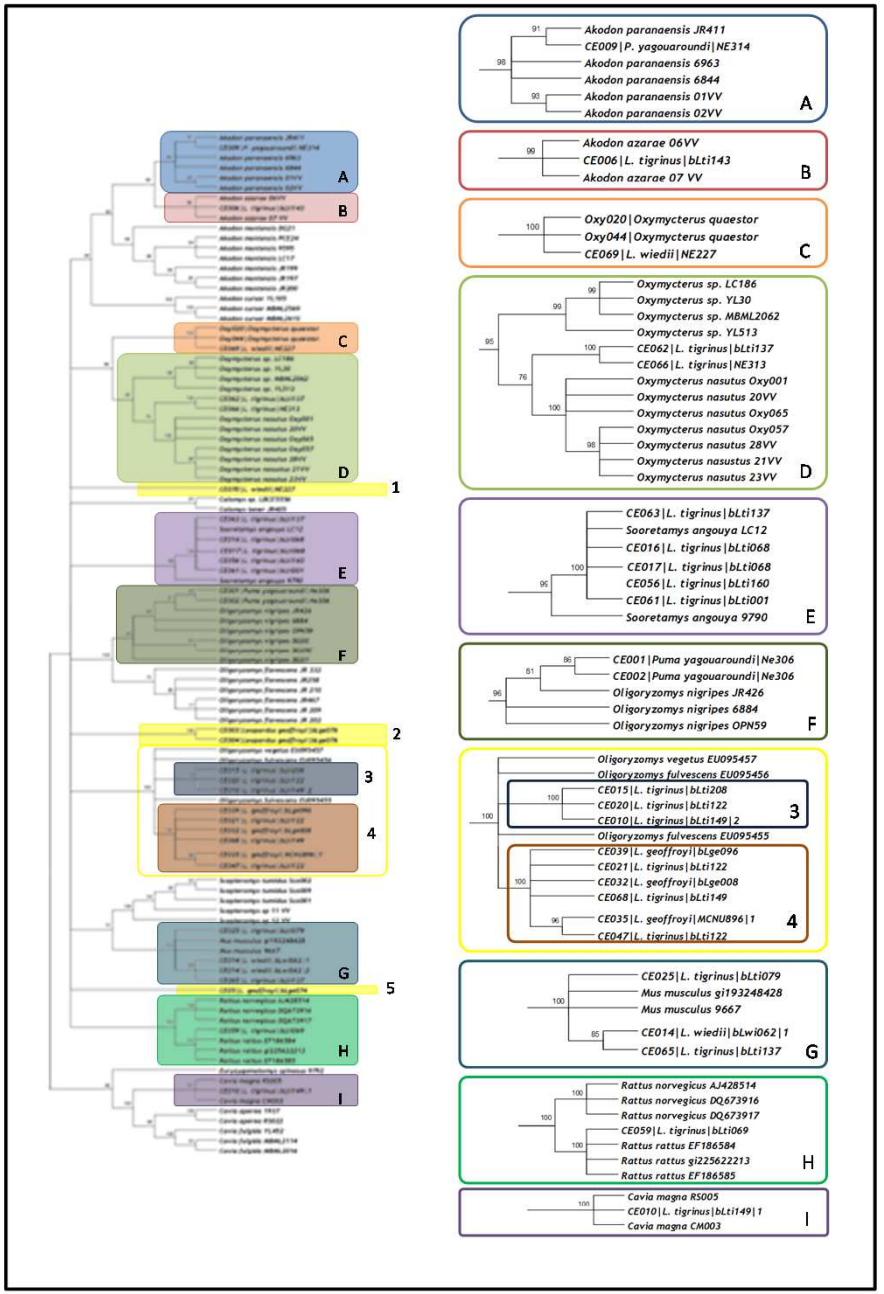
Development of mini-barcodes for the identification of carnivores from fecal samples





P. B. Chaves et al. 2012. Mol. Ecol. Res.

Dietary analyses of wild cats using DNA barcodes of prey items

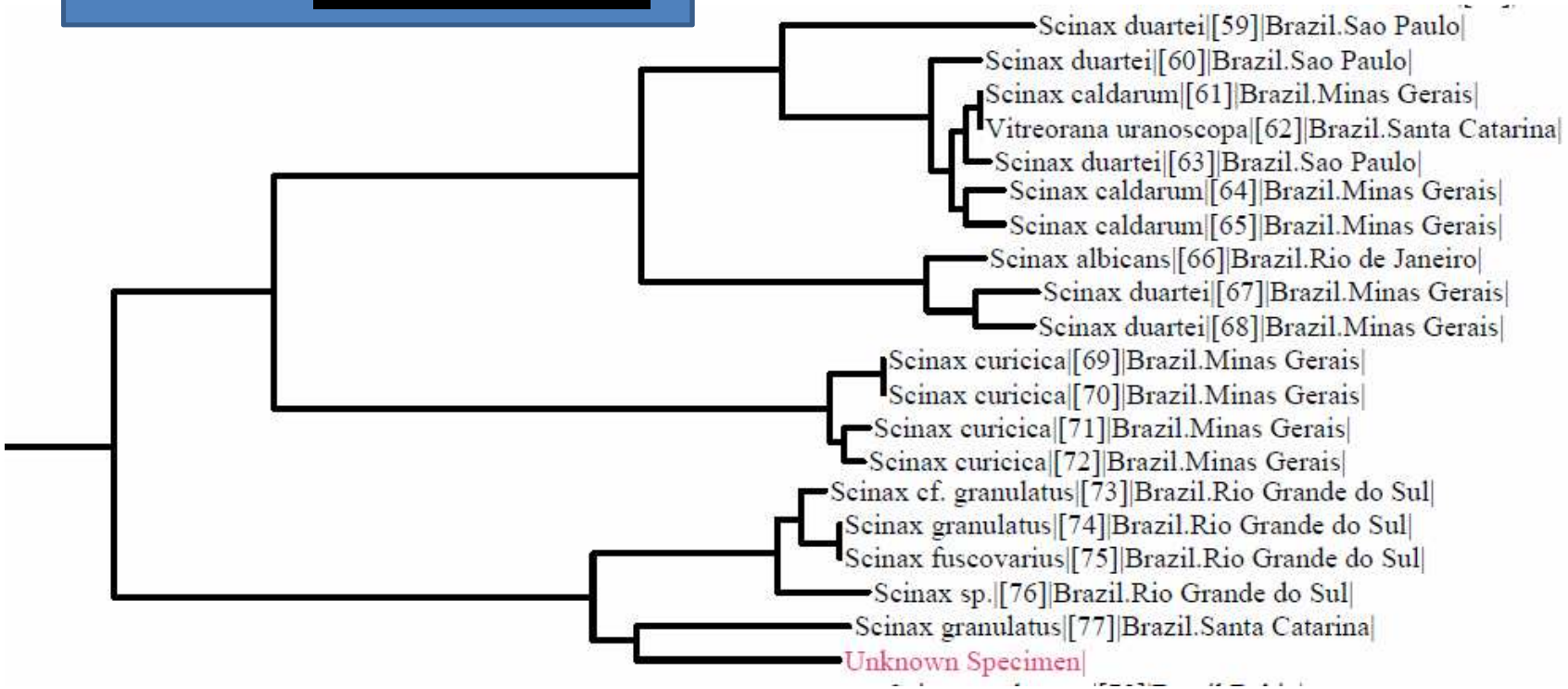


F. Tirelli, H. Figueiró, T. Trigo, M. Appel

Dietary analyses of wild cats using DNA barcodes of prey items

Leopardus geoffroyi

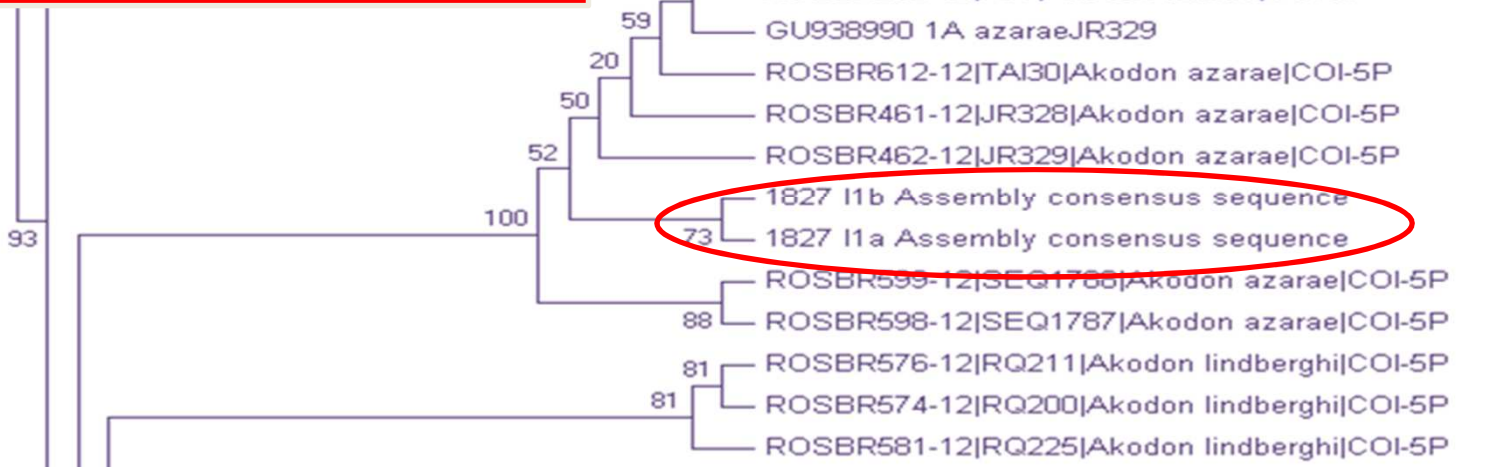
Scinax granulatus



Dietary analyses of wild cats using DNA barcodes of prey items

Leopardus guttulus

Akodon azarae



Wildlife Forensics

- Proof of concept studies by various university laboratories.

- DNA barcoding now routinely used by the Brazilian Federal Police.

Well-publicized case: Man arrested in 2003 with 58 eggs packed around his body. DNA barcoding used to identify the source species.

Wildlife Forensics

DNA Barcoding Identifies Illegal Parrot Trade

Priscila F. M. Gonçalves, Adriana R. Oliveira-Marques,
Tania E. Matsumoto, and Cristina Y. Miyaki

Journal of Heredity, 2015, 560–564

DNA barcoding in Brazil - Perspectives

Good news:

1. We got started and scratched the surface
2. An unprecedented community of biodiversity scientists has been assembled and integrated in Brazil.
3. There is capacity in the country to move forward.

Challenges ahead:

1. Securing continuous, large-scale funding.
2. Improving governance and organizational structure.
3. Scaling up and speeding up to tackle the magnitude of the task and the pace of habitat loss in the country.

Acknowledgments

BrBOL

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Maria Eduarda Appel

Bromeliad meta-barcoding

Taiz Simão
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Renata Medina