

BARCODING NEOTROPICAL FISHES

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Neotropical Region



Fishes

> 50% of vertebrates are fishes = 28,000 species



From these 13,000 are freshwater species



**About 6,000 species are Neotropical
4,475 are valid species + 1,550 are undescribed**

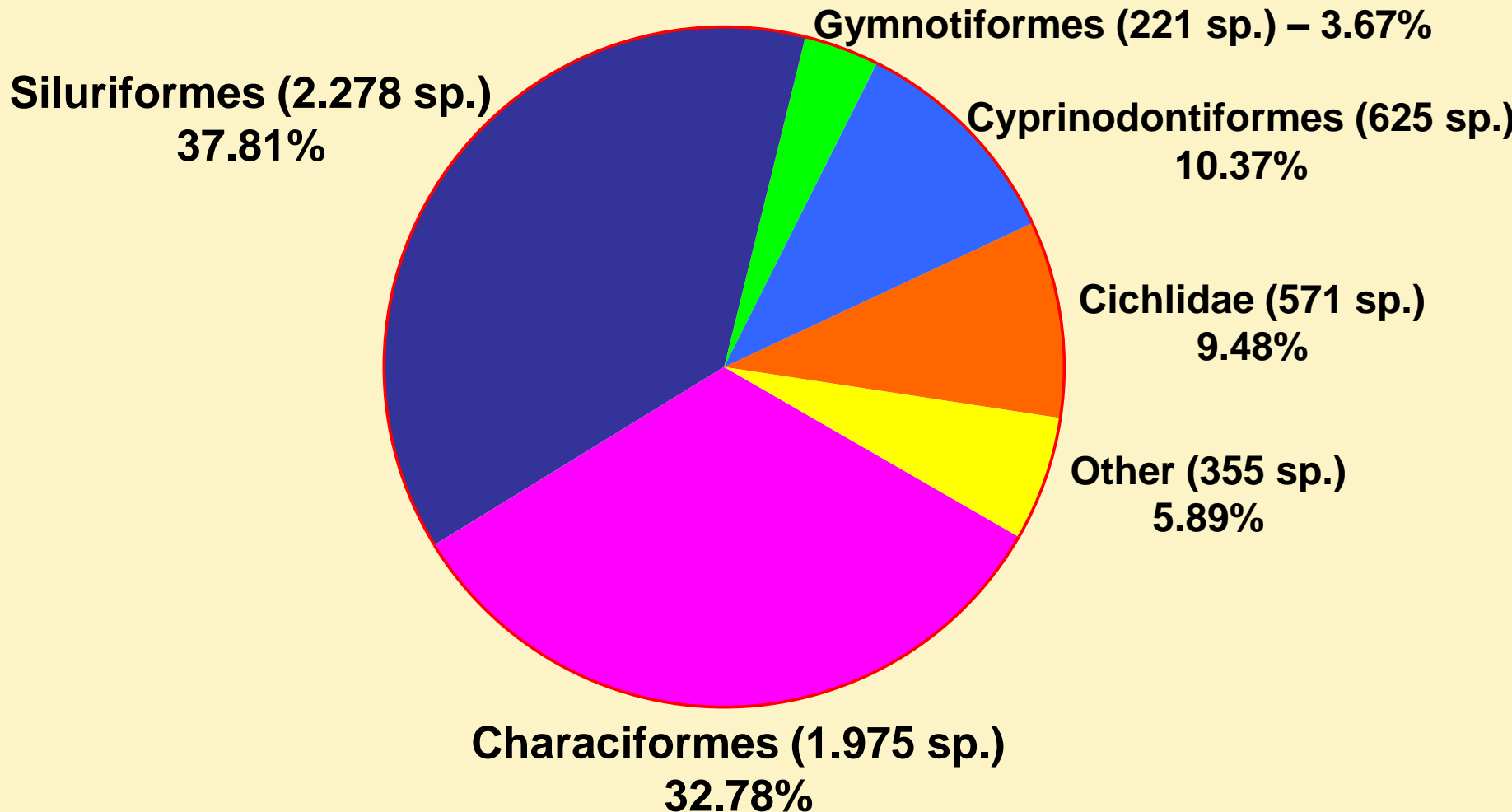


The richest freshwater fish fauna of the world

Neotropical freshwater fishes

4.475 named species (6.025 estimated)

(Reis et al., 2003)



Brazilian saltwater fishes

	N
<hr/>	
Classe Myxini	
Myxiniformes	4
<hr/>	
Classe Condrichthyes	
Chimaeriformes	3
Orectoboliformes	2
Carcharhiniformes	41
Lamniformes	13
Hexanchiformes	3
Squaliformes	18
Squatiformes	4
Rajiformes	55
<hr/>	
Classe Actinopterygii	
Elopiformes	2
Albuniformes	4
Anguilliformes	94
Saccopharhyngiformes	1
Clupeiformes	47
Siluriformes	21

Osmeriformes	19
Stomiiformes	58
Aulopiformes	51
Myctophiformes	80
Lampridiformes	8
Polymixiiformes	2
Ophidiiformes	28
Gadiformes	33
Batrachoidiformes	13
Lophiiformes	17
Mugiliformes	7
Atheriniformes	14
Beloniformes	34
Stephanoberyciformes	1
Beryciformes	14
Zeiformes	5
Gasterosteiformes	18
Scorpaeniformes	32
Perciformes	456
Pleuronectiformes	56
Tetraodontiformes	40
<hr/>	
Total	1297

Fish phylogeny



Available online at www.sciencedirect.com



Molecular Phylogenetics and Evolution 32 (2004) 152–163

www.elsevier.com/locate/ympev

MOLECULAR
PHYLOGENETICS
AND
EVOLUTION

Molecular phylogeny of the armored catfish family Callichthyidae (Ostariophysi, Siluriformes)

Cristiane Kioko Shimabukuro-Dias,^a Claudio Oliveira,^{a,*} Roberto E. Reis,^b
and Fausto Foresti^a



Genetics and Molecular Biology, 31, 1 (suppl), 284–292 (2008)
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www.sbg.org.br

Research Article

Phylogenetic analysis of the order Pleuronectiformes (Teleostei) based on sequences of 12S and 16S mitochondrial genes

Marisa F.C. Azevedo^{1*}, Claudio Oliveira¹, Belén G. Pardo², Paulino Martínez² and Fausto Foresti¹

Copeia, 2004(3), pp. 496–506

Phylogenetic Analysis and Redescription of the Genus *Hemochilus* (Characiformes: Characidae)

RICARDO M. C. CASTRO, RICHARD P. VARI, FÁBIO VIEIRA, AND CLAUDIO OLIVEIRA

Molecular Phylogenetics and Evolution 49 (2008) 606–617



ELSEVIER

Contents lists available at ScienceDirect

Molecular Phylogenetics and Evolution

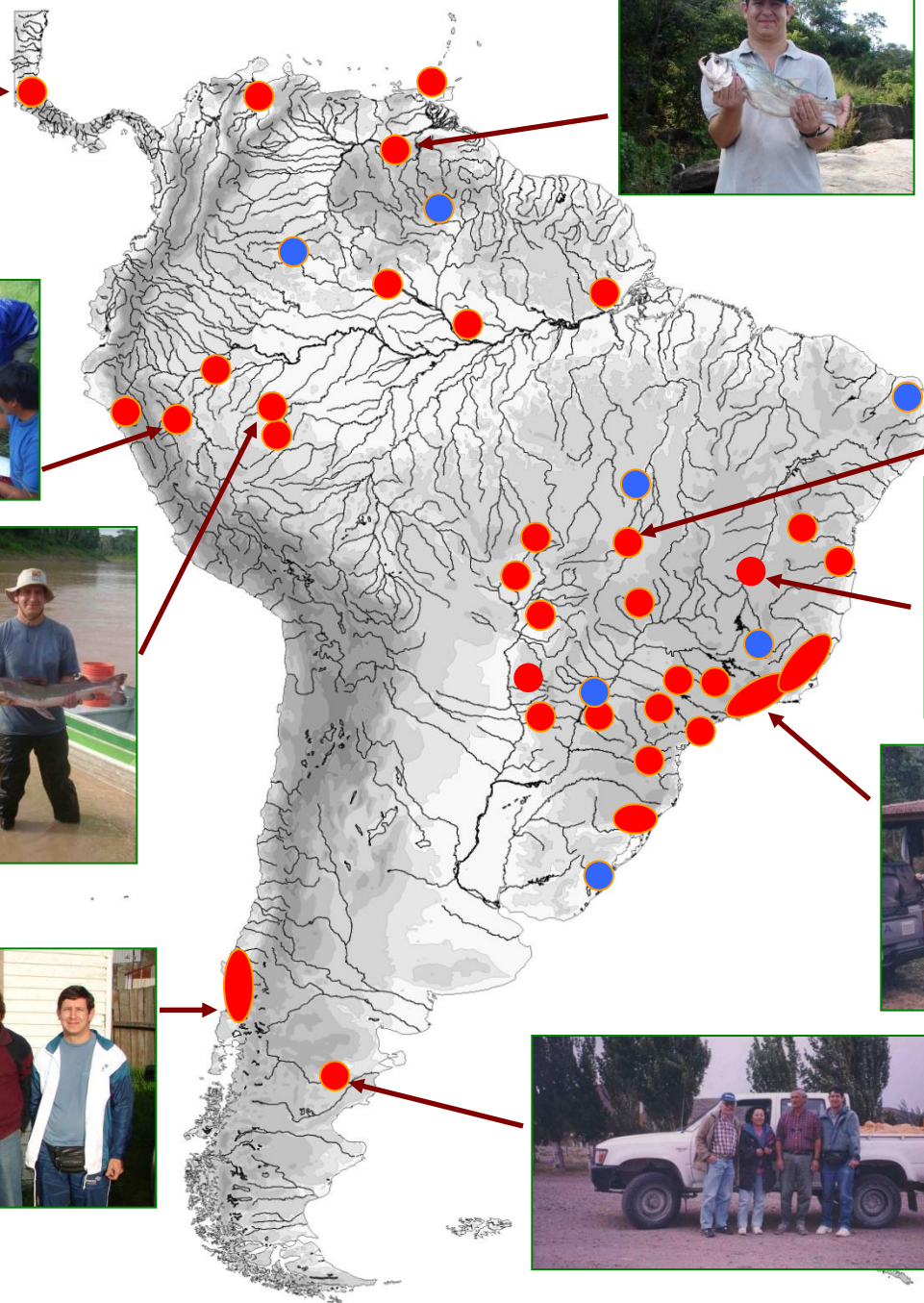
journal homepage: www.elsevier.com/locate/ympev



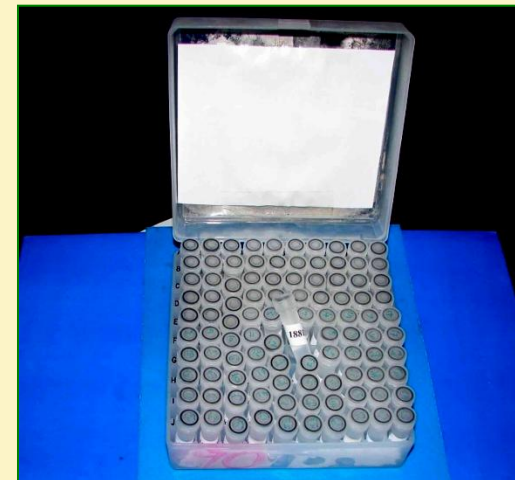
Molecular systematic and historical biogeography of the armored Neotropical catfishes Hypoptopomatinae and Neoplecostominae (Siluriformes: Loricariidae)

Márcio Cesar Chiachio^a, Claudio Oliveira^a, Juan I. Montoya-Burgos^{b,*}

Collection of fishes and tissues



Fish and tissue collections



Fishes from Upper rio Paraná – a case study

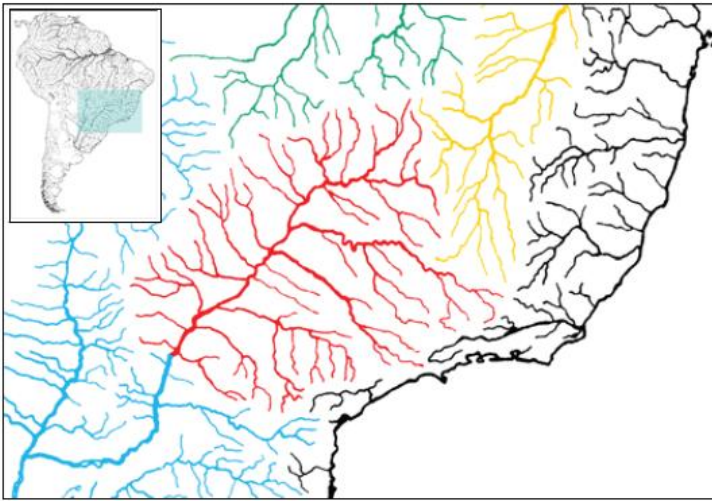
Diversidade da ictiofauna do Alto Rio Paraná: composição atual e perspectivas futuras

Francisco Langeani^{1,6}, Ricardo Macedo Corrêa e Castro², Osvaldo Takeshi Oyakawa³,

Oscar Akio Shibatta⁴, Carla Simone Pavanelli⁵ & Lilian Casatti¹

Biota Neotropica v7 (n3) – <http://www.biotaneotropica.org.br/v7n3/pt/abstract?article+bn03407032007>

Langeani, F., Castro, R.M.C., Oyakawa, O.T., Shibatta, O.A., Pavanelli, C.S. & Casatti, L. **Ichthyofauna diversity of the upper rio Paraná: present composition and future perspectives.** *Biota Neotrop.* Sep/Dez 2007 vol. 7, no. 3 <http://www.biotaneotropica.org.br/v7n3/pt/abstract?article+bn03407032007>. ISSN 1676-0603.



310 species/11 orders/38 families

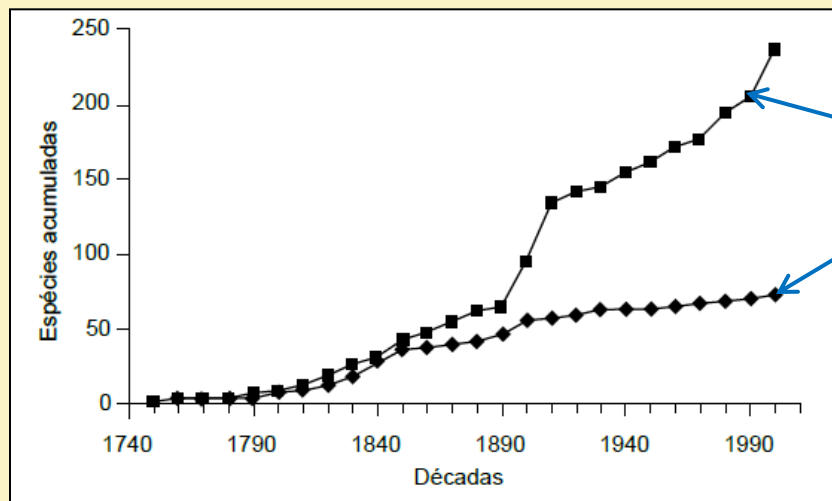
236 (76.1%) autochthonous

67 (21.6%) allochthonous

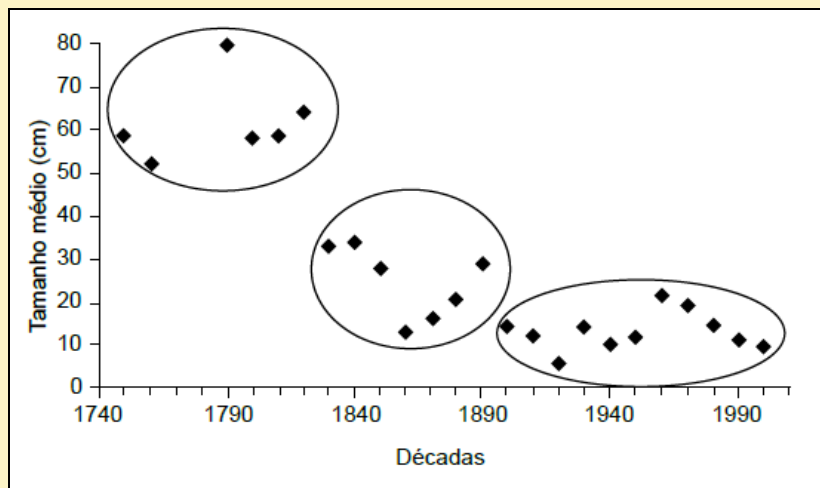
7 (2.3%) exotic

50 possible new species (~15%)

Fishes from Upper rio Paraná – a case study



Accumulated numbers of
autochthonous (squares) and
allochthonous plus exotic
(lozenges) by decade



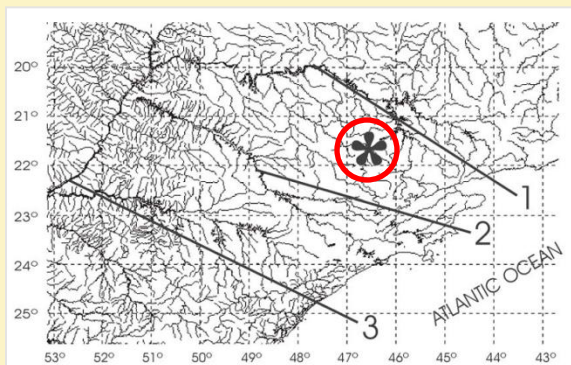
Medium species size (cm) by decade

Fishes from Upper rio Paraná – a case study

Distribution patterns

Endemism

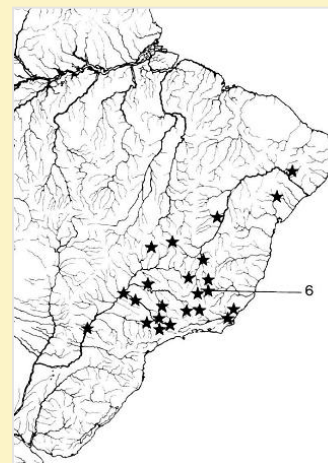
Tricomyscterus maracaya



Bockmann & Sazima, 2004

Wide distribution

Piabina argentea



Vari & Harldi, 2001

Characteristics of Neotropical Fishes

- **High diversity**
- **High description rates**
- **Distribution – endemism or wide distribution**
- **Many complexes and cryptic species**
- **Probably recent radiation**

These particular characteristics make it very difficult to correct identify many Neotropical fish species

How many species we have here?



***M. oligolepis* Amazonas**



***M. oligolepis* Araguaia**



***M. oligolepis* Paraguai**



***M. sanctaefilomenae* Paraná**



***M. sanctaefilomenae* Parnaíba**



***M. forestii* La Plata Basin**

DNA Barcode

 THE ROYAL
SOCIETY

Received 29 July 2002
Accepted 30 September 2002
Published online 8 January 2003

Biological identifications through DNA barcodes

Paul D. N. Hebert*, Alina Cywinska, Shelley L. Ball
and Jeremy R. deWaard

Department of Zoology, University of Guelph, Guelph, Ontario N1G 2W1, Canada

**Barcoding Animal Life: Cytochrome c Oxidase Subunit 1 Divergences among
Closely Related Species**

Paul D. N. Hebert; Sujeevan Ratnasingham; Jeremy R. deWaard

Proceedings: Biological Sciences, Vol. 270, Supplement: Biology Letters. (Aug. 7, 2003), pp.
S96-S99.

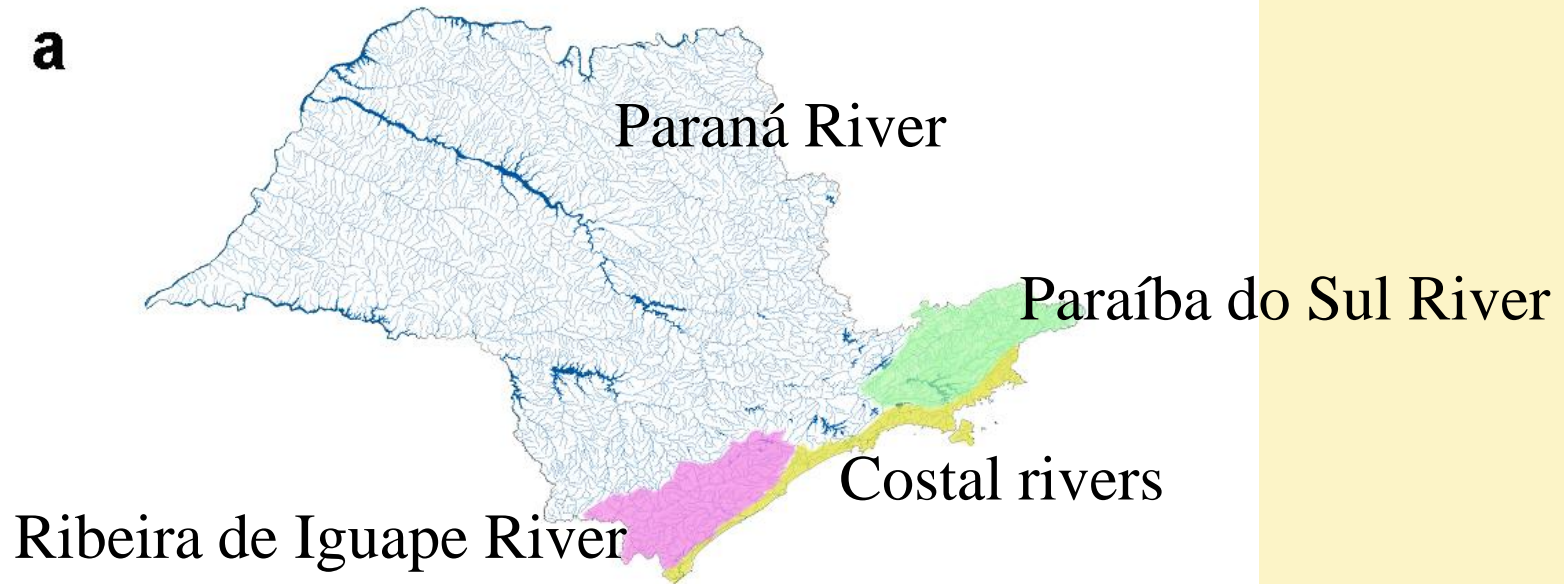


How the DNA barcode can help us?

- ➔ **Helping in the creation/expansion of new collections of fishes and tissues**
- ➔ **Testing hypotheses about species**
- ➔ **Generating information for rapid and precise species identification**
- ➔ **Allowing the comparison of faunas from different river basins**

How the DNA barcode can help us?

a



b



Fishes from Upper Parana river

896 specimens/ 196 species/ 108 genera/ 31 families

BOLDSYSTEMS v2.5


Management & Analysis

Home | Taxonomy Browser | Identify Specimen | Introductory Tutorial | Documentation

Fishes from Upper Parana River, Brazil [FUPR]

PROJECT DATA VIEWS

 View All Records

 Search/Filter

PROJECT OPTIONS

List All Projects
 Modify Project Properties
 Register Primers
 View All Primers

PUBLICATION

Submit to GenBank
 Bibliography Submission
 Project Summary- Specimens,
 Localities, and GenBank

UPLOADS

Specimen Data
 Specimen Images
 Sequences
 Trace Files

Summary Stats

	Specimens (% complete)	Species (% complete)
COI-5P	896 / 1027 (87.2%)	196 / 200 (98%)

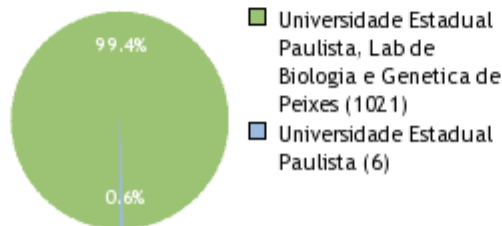
Sequence Data Report

Lacking Traces :	0
Seqs with stop codons :	0
Contaminated Seqs :	0

Specimen Data Report

Specimen records:	1027
Lacking geo reference:	116
Lacking photographs :	1027

Specimen Depositories:



Marker(s)

Primary Marker : COI-5P

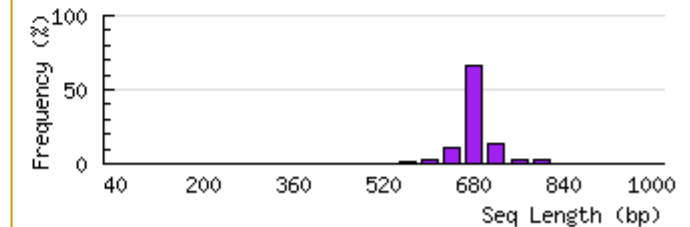
Sequence Quality Stats

	High (<1% Ns)	Medium (<2% Ns)	Low (<4% Ns)	Unreliable (>4% Ns)
COI-5P	100	0	0	0

Trace Quality Stats

	High(%)	Medium(%)	Low(%)	Failed(%)	Total
COI-5P	78.49	8.57	3.48	9.46	2041

Sequence Length Distribution - COI-5P



Project Growth : Specimen

Fishes from Brazilian Ribeira de Iguape River

311 specimens/ 53 species/ 39 genera/ 16 families

BOLDSYSTEMS v2.5 | Management & Analysis

Home | Taxonomy Browser | Identify Specimen | Introductory Tutorial | Documentation

Fishes from Brazilian Coastal Rivers part II [FBCRB]

PROJECT DATA VIEWS

View All Records

Search/Filter

PROJECT OPTIONS

List All Projects

Register Primers

View All Primers

PUBLICATION

Bibliography Submission

Project Summary- Specimens, Localities, and GenBank

UPLOADS

Specimen Data

Specimen Images

Sequences

Trace Files

DOWNLOADS

Sequences

Summary Stats

	Specimens (% complete)	Species (% complete)
COI-5P	311 / 383 (81.2%)	53 / 57 (93%)

Sequence Data Report

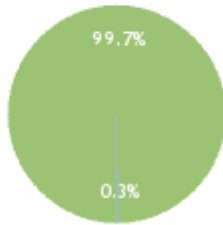
Lacking Traces :	0
Seqs with stop codons :	0
Contaminated Seqs :	0

Specimen Data Report

Specimen records:	383
Lacking geo reference:	47
Lacking photographs :	383

Specimen Depositories:

Universidade Estadual Paulista, Lab de Biologia e Genetica de Peixes (382)	99.7%
Universidade Federal Do Rio Grande Do Norte, Departamento de Biologia Celular e Genetica (1)	0.3%



Marker(s)

Primary Marker : COI-5P

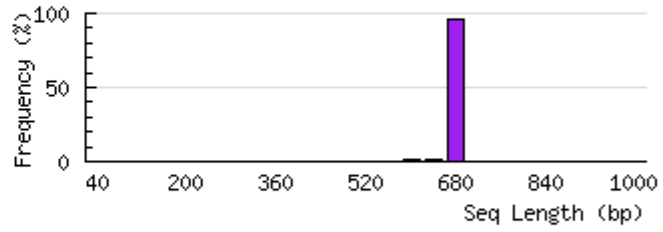
Sequence Quality Stats

	High (<1% Ns)	Medium (<2% Ns)	Low (<4% Ns)	Unreliable (>4% Ns)
COI-5P	100	0	0	0

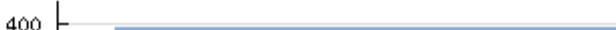
Trace Quality Stats

	High(%)	Medium(%)	Low(%)	Failed(%)	Total
COI-5P	81.09	7.42	2.38	9.11	714

Sequence Length Distribution - COI-5P



Project Growth : Specimen



Fishes from Brazilian Coastal Rivers

376 specimens/ 66 species/ 46 genera/ 19 families

BOLDSYSTEMS v2.5 | Management & Analysis

Home | Taxonomy Browser | Identify Specimen | Introductory Tutorial | Documentation

Fishes from Brazilian coastal rivers [FBCR]

PROJECT DATA VIEWS

View All Records

Search/Filter

PROJECT OPTIONS

List All Projects

Modify Project Properties

Register Primers

View All Primers

PUBLICATION

Submit to GenBank

Bibliography Submission

Project Summary- Specimens, Localities, and GenBank

UPLOADS

Specimen Data

Specimen Images

Sequences

Trace Files

Summary Stats

	Specimens (% complete)	Species (% complete)
COI-5P	376 / 539 (69.8%)	68 / 91 (74.7%)

Sequence Data Report

Lacking Traces :	0
Seqs with stop codons :	0
Contaminated Seqs :	0

Specimen Data Report

Specimen records:	539
Lacking geo reference:	508
Lacking photographs :	539

Specimen Depositories:

	<ul style="list-style-type: none"> Universidade Estadual Paulista, Lab de Biologia e Genetica de Peixes (539)
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Marker(s)

Primary Marker : COI-5P

Sequence Quality Stats

	High (<1% Ns)	Medium (<2% Ns)	Low (<4% Ns)	Unreliable (>4% Ns)
COI-5P	100	0	0	0

Trace Quality Stats

	High(%)	Medium(%)	Low(%)	Failed(%)	Total
COI-5P	91.14	3.52	0.97	4.37	824

Sequence Length Distribution - COI-5P

Project Growth : Specimen

Fishes from Paraíba do Sul River

251 specimens/ 54 species/ 40 genera/ 17 families

BOLDSYSTEMS v2.5 | Management & Analysis

Home | Taxonomy Browser | Identify Specimen | Introductory Tutorial | Documentation

Fishes from Paraíba do Sul River, Brazil [FPSR]

PROJECT DATA VIEWS

- View All Records
- Search/Filter

PROJECT OPTIONS

- List All Projects
- Register Primers
- View All Primers

PUBLICATION

- Bibliography Submission
- Project Summary- Specimens, Localities, and GenBank

UPLOADS

- Specimen Data
- Specimen Images
- Sequences
- Trace Files

Summary Stats

	Specimens (% complete)	Species (% complete)
COI-5P	251 / 292 (86%)	54 / 59 (91.5%)

Sequence Data Report

Lacking Traces :	0
Seqs with stop codons :	0
Contaminated Seqs :	0

Specimen Data Report

Specimen records:	292
Lacking geo reference:	12
Lacking photographs :	292

Specimen Depositories:

100.0%	Universidade Estadual Paulista, Lab de Biologia e Genetica de Peixes (292)
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Marker(s)

Primary Marker : COI-5P

Sequence Quality Stats

	High (<1% Ns)	Medium (<2% Ns)	Low (<4% Ns)	Unreliable (>4% Ns)
COI-5P	100	0	0	0

Trace Quality Stats

	High(%)	Medium(%)	Low(%)	Failed(%)	Total
COI-5P	84.68	4.6	2.41	8.31	914

Sequence Length Distribution - COI-5P

Project Growth : Specimen

Marine Fishes from São Paulo

234 specimens / 55 species / 51 genera / 36 families

BOLDSYSTEMS v2.5 | Management & Analysis

Home | Taxonomy Browser | Identify Specimen | Introductory Tutorial | Documentation

Marine Fishes from São Paulo, Brazil [MFSP]

PROJECT DATA VIEWS

- View All Records
- Search/Filter

PROJECT OPTIONS

- List All Projects
- Register Primers
- View All Primers

PUBLICATION

- Bibliography Submission
- Project Summary- Specimens, Localities, and GenBank

UPLOADS

- Specimen Data
- Specimen Images
- Sequences
- Trace Files

Summary Stats

	Specimens (% complete)	Species (% complete)
COI-5P	234 / 342 (68.4%)	55 / 71 (77.5%)

Sequence Data Report

Lacking Traces :	0
Seqs with stop codons :	0
Contaminated Seqs :	0

Specimen Data Report

Specimen records:	342
Lacking geo reference:	50
Lacking photographs :	342

Specimen Depositories:

Universidade Estadual Paulista, Lab de Biologia e Genetica de Peixes (342)	100.0%
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Marker(s)

Primary Marker : COI-5P

Sequence Quality Stats

	High (<1% Ns)	Medium (<2% Ns)	Low (<4% Ns)	Unreliable (>4% Ns)
COI-5P	100	0	0	0

Trace Quality Stats

	High(%)	Medium(%)	Low(%)	Failed(%)	Total
COI-5P	65.64	7.6	5.41	21.35	684

Sequence Length Distribution - COI-5P

Project Growth : Specimen

Records page

BOLD Systems - Record List - Windows Internet Explorer

http://www.boldsystems.org/views/recordlist.php?&

Home | Taxonomy Browser | Identify Specimen | Introductory Tutorial | Documentation

Fishes from Upper Parana River, Brazil [FUPR]

COI-5P: 899 Specimens : 1027

Identification	Specimen Page	Sequence Page	Length [Ambig]	COI-5P	Contains	Extra Info	Set
<input type="checkbox"/> <i>Acestrorhynchus lacustris</i>	LBP-15206	FUPR027-09	644 [0n]			FAO-03	
<input type="checkbox"/> <i>Acestrorhynchus lacustris</i>	LBP-17213	FUPR026-09	636 [0n]			FAO-03	
<input type="checkbox"/> <i>Acestrorhynchus lacustris</i>	LBP-17212	FUPR025-09	698 [0n]			FAO-03	
<input type="checkbox"/> <i>Acestrorhynchus lacustris</i>	LBP-15174	FUPR024-09	637 [0n]			FAO-03	
<input type="checkbox"/> <i>Acestrorhynchus lacustris</i>	LBP-15173	FUPR023-09	686 [0n]			FAO-03	
<input type="checkbox"/> <i>Ancistrus cirrhosus</i>	LBP-34759	FUPR787-09	0				
<input type="checkbox"/> <i>Ancistrus cirrhosus</i>	LBP-34755	FUPR786-09	652 [0n]				
<input type="checkbox"/> <i>Ancistrus cirrhosus</i>	LBP-34754	FUPR785-09	652 [0n]				
<input type="checkbox"/> <i>Ancistrus cirrhosus</i>	LBP-34753	FUPR784-09	652 [0n]				
<input type="checkbox"/> <i>Ancistrus cirrhosus</i>	LBP-34752	FUPR783-09	643 [0n]				
<input type="checkbox"/> <i>Ancistrus cirrhosus</i>	LBP-35987	FUPR782-09	652 [0n]				
<input type="checkbox"/> <i>Ancistrus cirrhosus</i>	LBP-35979	FUPR781-09	652 [0n]				
<input type="checkbox"/> <i>Ancistrus cirrhosus</i>	LBP-35959	FUPR780-09	652 [0n]				
<input type="checkbox"/> <i>Apareiodon affinis</i>	LBP-25976	FUPR402-09	0				
<input type="checkbox"/> <i>Apareiodon affinis</i>	LBP-26377	FUPR401-09	0				
<input type="checkbox"/> <i>Apareiodon affinis</i>	LBP-26376	FUPR400-09	[0n]				
<input type="checkbox"/> <i>Apareiodon affinis</i>	LBP-26375	FUPR399-09	0				
<input type="checkbox"/> <i>Apareiodon affinis</i>	LBP-34671	FUPR398-09	617 [0n]				
<input type="checkbox"/> <i>Apareiodon ibitiensis</i>	LBP-18635	FUPR433-09	652 [0n]				

Done

Internet | Protected Mode: Off

Caixa de Entrada - ... Microsoft PowerPoi... Coleção de Peixes Senhas [Modo de C... BOLD Systems - Rec... Desktop 21:16

Specimen page

BOLD Systems - Specimen Record - Windows Internet Explorer
http://www.boldsystems.org/views/specimenrecord.php?&

BOLDSYSTEMS v2.5 | Management & Analysis

Fishes from Upper Parana River, Brazil [FUPR]

[Edit Specimen](#)

Specimen Identifiers

Sample ID :	LBP-25838	Museum ID :	25838
Isolate / Field Num:	LBP2008030000	Collection Code :	LBP 4849
Donated By :		Deposited In :	Universidade Estadual Paulista, Lab de Biologia e Genetica de Peixes

Taxonomy


Identifier :	Claudio Oliveira
phylum :	Chordata
class :	Actinopterygii
order :	Siluriformes
family :	Pimelodidae
genus :	Steindachneridion
species :	<i>Steindachneridion scriptum</i>
Taxonomy Note :	

Specimen Details


Voucher Type :	
Tissue Type :	
Extra Info :	
Sex :	
Reproduction :	S
Life Stage :	
Note :	

Collection Data

Collectors :	H Brandao
Date Collected :	01-Mar-2008
Country :	Brazil
State/Province:	Sao Paulo
Region/County :	Upper Parana Basin
Sector :	
Exact Site :	
Latitude :	-22.9037
Longitude :	-49.9834
Coord. Source :	
Coord. Accuracy :	
Elevation :	
Elevation Accuracy:	
Depth:	
Depth Accuracy:	



Photographs



Sequence page

BOLD Systems - Sequence Record - Windows Internet Explorer
http://www.boldsystems.org/views/sequencerecord.php?&

Barcode Identifiers

Barcode ID : FUPR888-09 Sample ID : LBP-25638
Identified As : Steindachneridion scriptum

COI-5P

Marker : COI-5P GenBank Accession :
Last Updated : 2009-10-05 Translation Matrix : Vertebrate Mitochondrial

Sequencing Runs

Run Date	Run Site	Direction	Trace File	PCR primers	Seq Primer	Status
<input type="checkbox"/> 2009-09-22 18:22:03	Biodiversity Institute of Ontario	Forward	FUPR888-09[C_FishF1t1,C_FishR1t1]_F.ab1	C_FishF1t1/C_FishR1t1	M13F	high qual
<input type="checkbox"/> 2009-09-22 19:48:09	Biodiversity Institute of Ontario	Reverse	FUPR888-09[C_FishF1t1,C_FishR1t1]_R.ab1	C_FishF1t1/C_FishR1t1	M13R	med qual

[View Trace Files](#) [Download](#)

Nucleotide Sequence

Residues :	617	TTGGTACAGCTCTTAGCCTGTTAAATCGGGCAGAGCTAGCCCAACCTGGCACTCTCCTAGGTGATGACCAAACTCT
Comp. A :	168	ATAATGTCAATGTCACCTGCTCATGCTTCGTAATAATTTTCTTTATAGTAATACCTATTATGATCGGAGGCTTTG
Comp. G :	107	GAAACTGATTAGTCCCACTAATAATCGGGCCGAGATATAGCATTTCACGAATGAACAACATAAGCTTCTGAT
Comp. C :	158	TACTCCCCCATCTTTTCTACTACTTGCCTCATCTGGGTAGAAAGCAGGAGCAGGGACGGGTTGAACCGTAT
Comp. T :	184	ATCCGCTCTTCCCGGAAATCTGCACACGACGGGGCTCCGTAGACTTAATAATTTCTCCCTCCATTGGCAG
Ambiguous :	0	GGGTCTCATCTATTCTAGGGCTAATACTTTAATACAACTAATAATGAAACCTCCAGCTAATTCACAAT
		ACCAAAACCACTAATTTATTTGAGCCATTTAATACGCCGTAATACTCTCTACTGTCACTCCAGTATTAGCTG
		CAGGCATTACAATAATTAACAGACCGAAATCTAATACTACTCTTTGACCAGCAGGAGGAGAGACCCAA
		TTCTTTATCAACACTT

[Clear Sequence](#)

Identify Sequence Using : [Full Database](#) [Species Database](#) [Ref. Database](#)

Amino Acid Sequence

Residues :	217	GTALSLIRAEALQPGTLGGDQIYNVIVTAHAFVMIFFMMPIMIGGPGNVLVPLMIGAPDMAFFRMDMSFWL
		LPPSFLLLASGVVAGAGTGWTVYPLAGNLAHAGASVLDLTFSLHLAGVSSILGAINFITTIINMKPPAISQY
		QTPLFIWAILITAVLLLLSLFVLAAGITMLLDRNLNTPFDPAAGGDPILYQHL

Publication

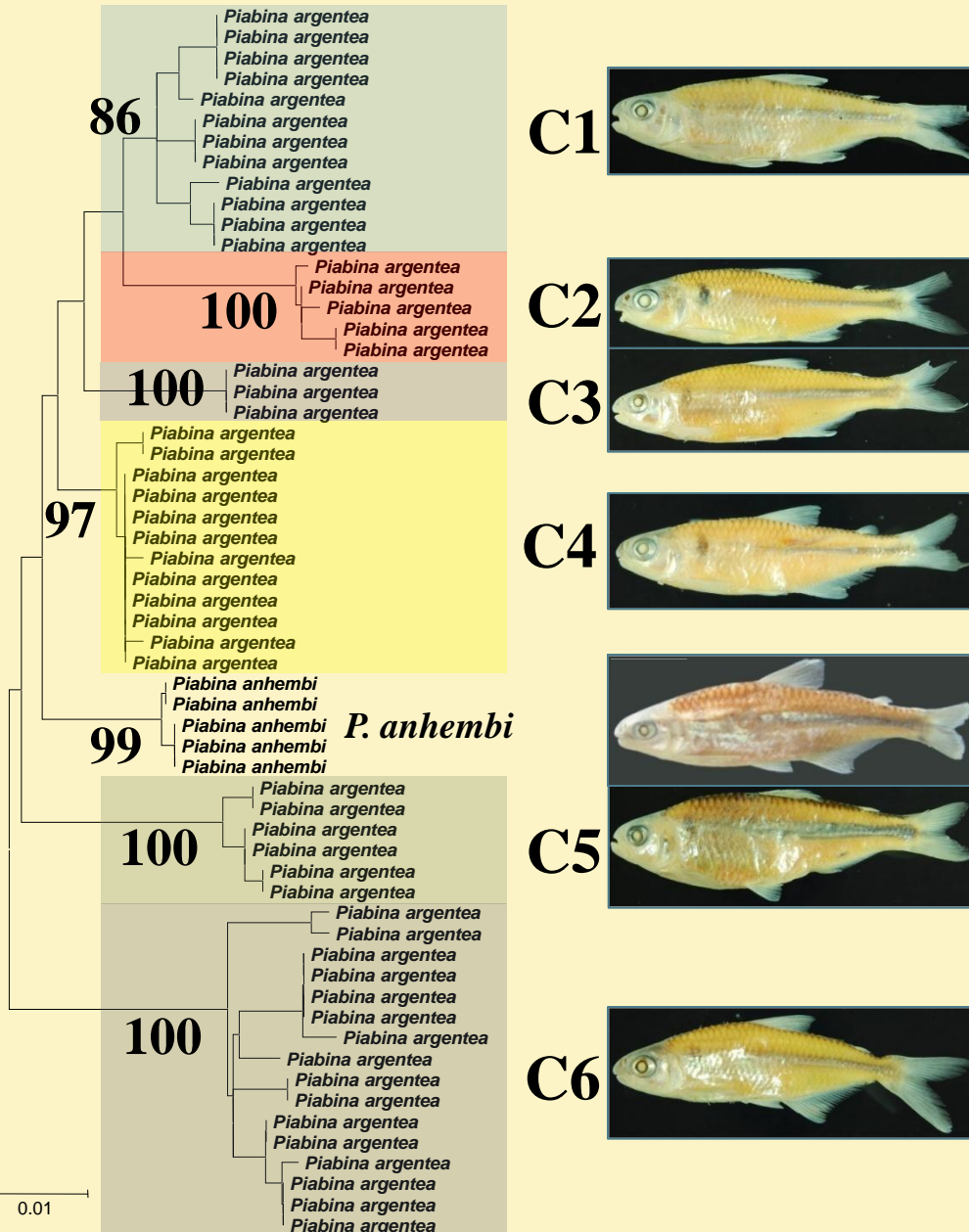
Illustrative Barcode

Sample Report From LIMS

Done

Internet | Protected Mode: Off 75%

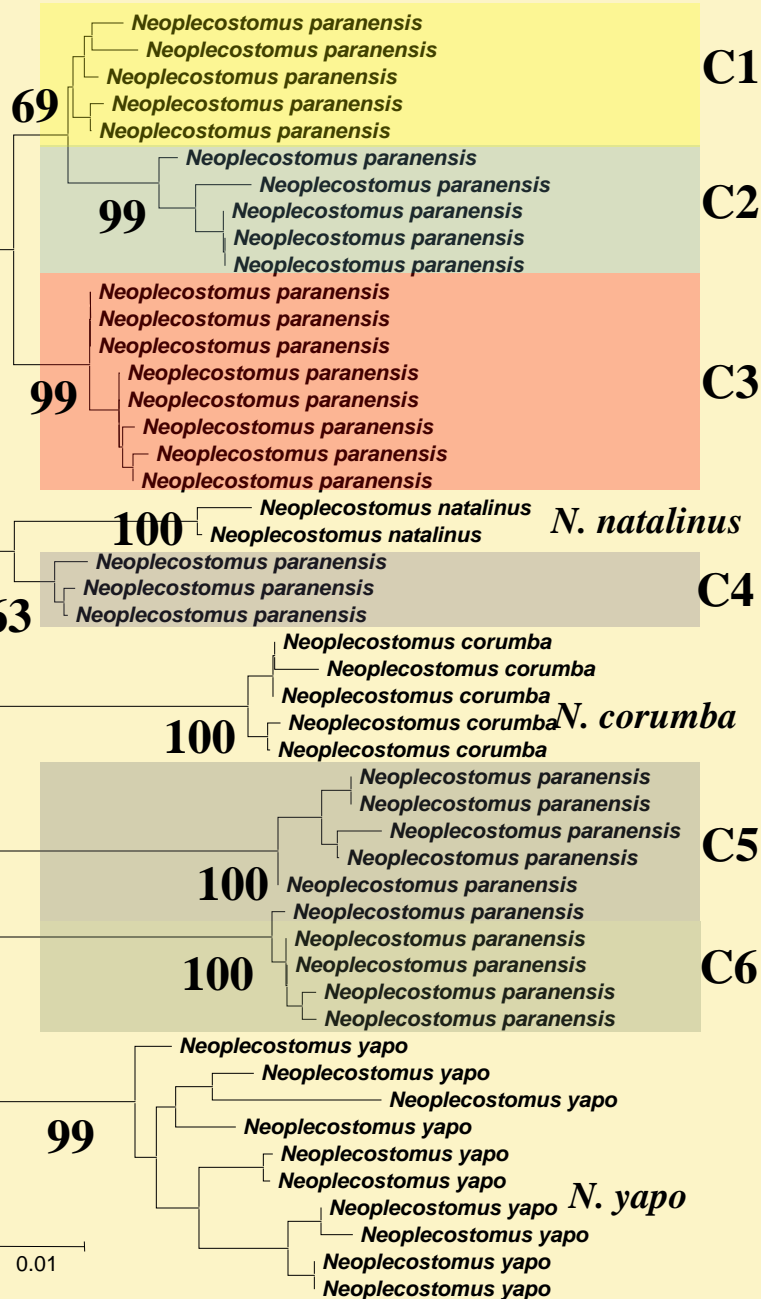
Case study – *Piabina argentea*



6 clusters (C)

	K2P Divergence		
	Min	Ave	Max
Intracluster	0%	0.4%	0.9%
Intercluster	2%	3.5%	5.6%
Congeneric species	2.2%	3.1%	4%
Intra vs. Inter	8.8 X		

Case study - *Neoplecostomus*



Neoplecostomus paranensis

6 clusters (C)

K2P Divergence			
	Min	Ave	Max
Intracluster	0.3%	0.5%	0.7%
Intercluster	1.7%	4.9%	8.4%
Congeneric species	2.2%	5.5%	7.4%
Intra vs. Inter	8.9 X		



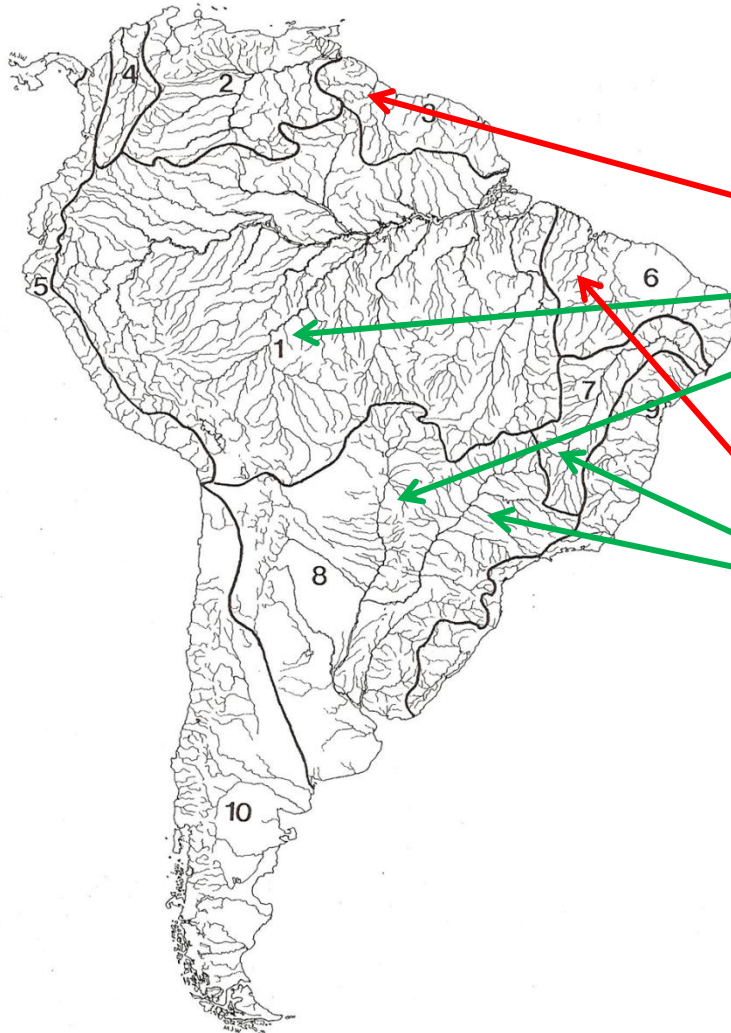
We are describing 3 new species!

Case study - *Moenkhausia*



M. oligolepis

M. sanctaefilomenae



Different forms of *Moenkhausia*



***M. oligolepis* Amazonas**



***M. oligolepis* Araguaia**



***M. oligolepis* Paraguai**

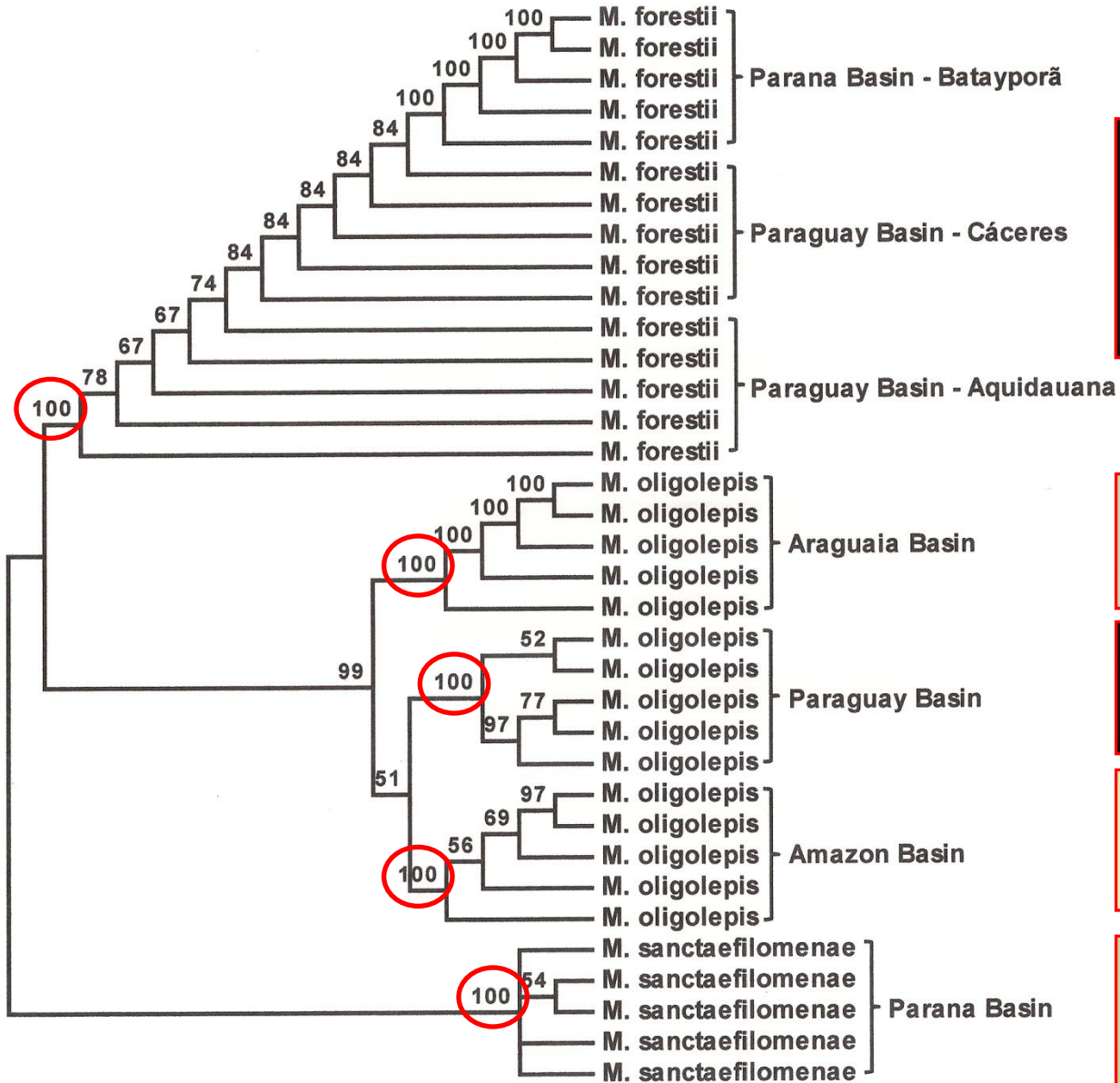


***M. sanctaefilomenae* Paran**



***M. sp.* La Plata Basin**

Barcoding *Moenkhausia*



**New species of *Moenkhausia* Eigenmann, 1903 (Characiformes: Characidae)
 with comments on the *Moenkhausia oligolepis* species complex**

Ricardo C. Benine, Tatiane C. Mariguela and Claudio Oliveira



Moenkhausia forestii

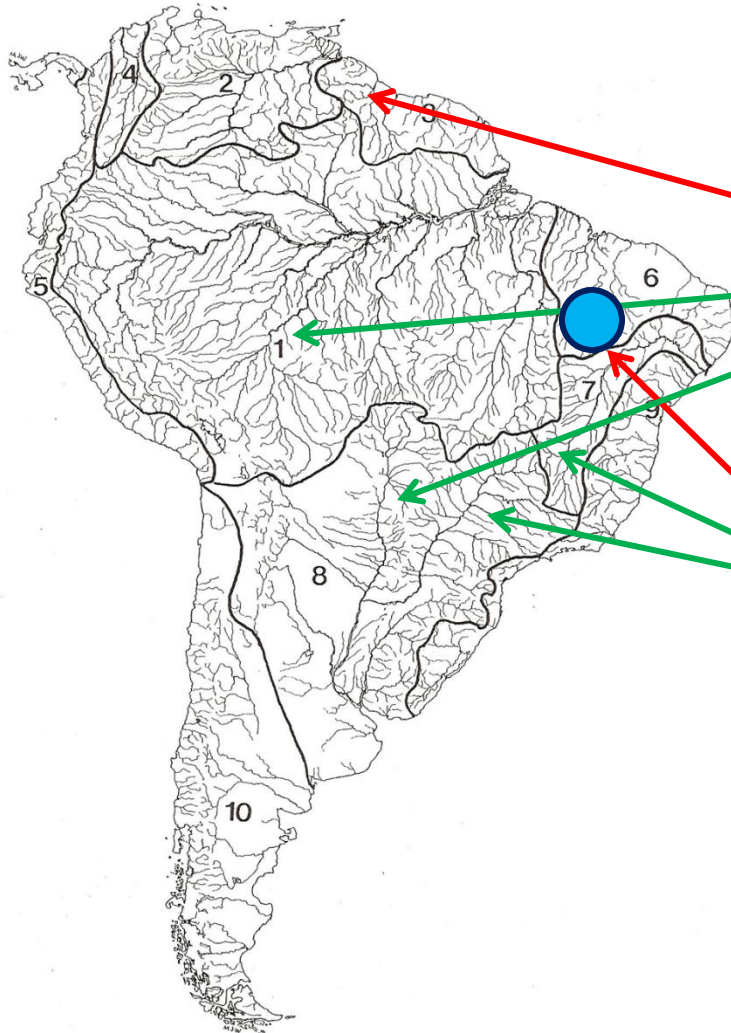
	1	2	3	4	5	
1 <i>Moenkhausia sanctaefilomenae</i> Paraná Basin EU177008 to EU177012	0.003±0.002					
2 <i>Moenkhausia oligolepis</i> Amazon Basin EU177038 to EU177042	0.190±0.019	0.010±0.003				
3 <i>Moenkhausia oligolepis</i> Araguaia Basin EU177013 to EU177017	0.200±0.021	0.128±0.015	0.010±0.003			
4 <i>Moenkhausia oligolepis</i> Paraguay Basin EU177033 to EU177037	0.184±0.018	0.109±0.013	0.139±0.016	0.014±0.003		
5 <i>Moenkhausia forestii</i> Paraguay Basin -Aquidauana EU177023 to EU177027	0.183±0.019	0.174±0.019	0.180±0.019	0.197±0.019	0.005±0.002	
6 <i>Moenkhausia forestii</i> Paraná Basin EU177018 to EU177022	0.182±0.019	0.172±0.019	0.180±0.019	0.197±0.019	0.006±0.002	0.000±0.000
7 <i>Moenkhausia forestii</i> Paraguay Basin - Cáceres EU177028 to EU177032	0.183±0.019	0.173±0.019	0.178±0.019	0.198±0.020	0.007±0.003	0.001±0.000

Case study - *Moenkhausia*

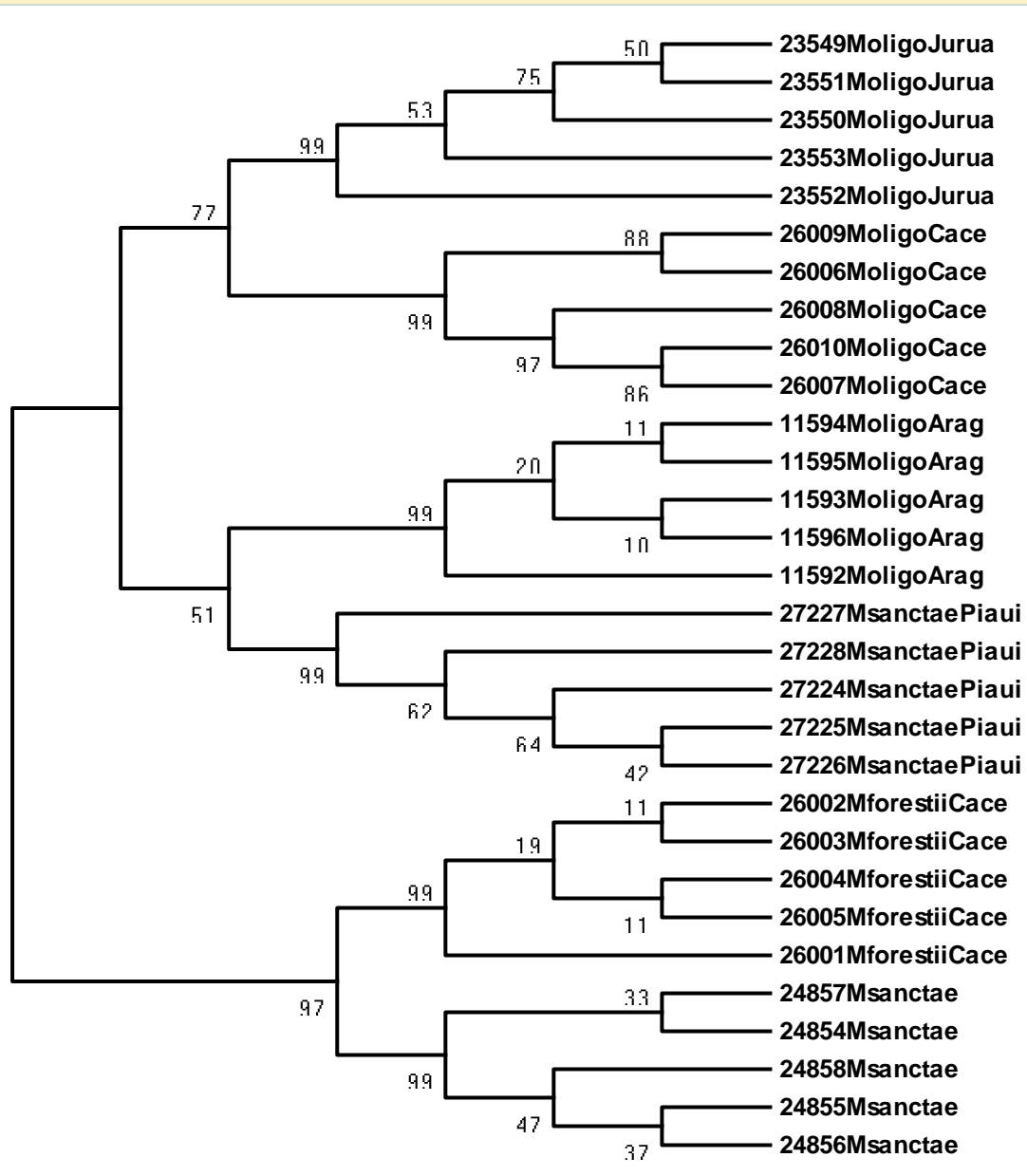


M. oligolepis

M. sanctaefilomenae



Three new species of *Moenkhausia*



M. oligolepis



M. sp. Paraguay River



M. sp. Araguaia River



M. sanctaefilomenae



M. forestii



M. sp. Paraná River

Case study - *Mugil*



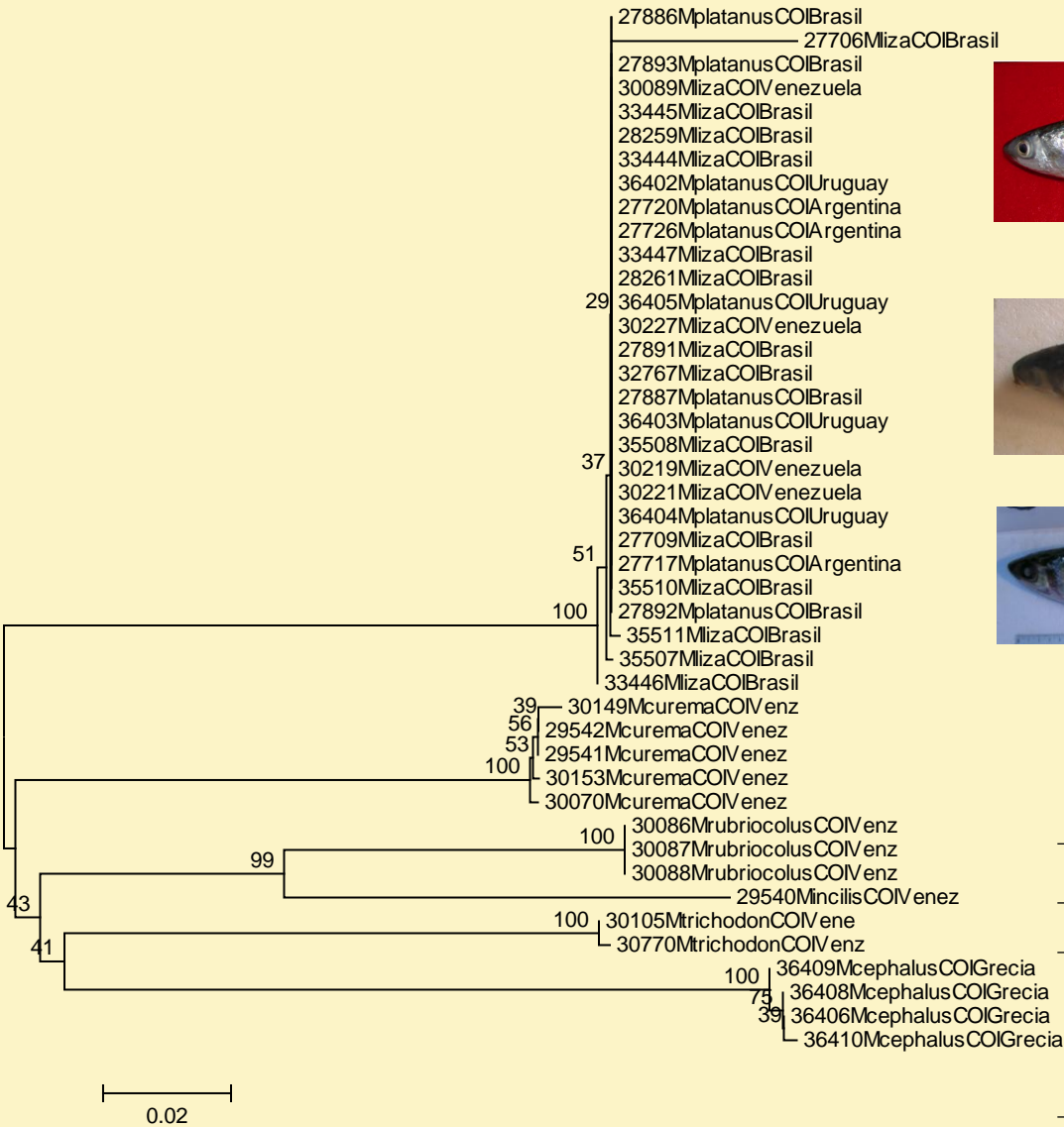
Mugil liza Valenciennes, 1836



Mugil platanus Günther, 1880



Case study - *Mugil*



Venezuela



Brazil



Argentina

Mugil liza

K2P Divergence - Groups

	Min	Ave	Max
Intragroups	0.1%	0.2%	0.3%
Intergroups	16.8%	19.4%	21.8%
Intra vs. Inter	97X		

Conclusion

➔ Results have showed possible cryptic species in three widely distributed fish groups

- *Piabina argentea* Reinhardt, 1867 (6 species)

- *Neoplecostomus paranensis* Langeani, 1990 (6 species)

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→ Results have permitted the description of new species

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- *Moenkhausia* sp. – three new species under description

- *Neoplecostomus* sp. – three new species under description

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→ Results have showed possible synonym species names used for wide distributed species

- *Mugil platanus* = *Mugil liza*

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➔ Results have showed possible synonym species names used for wide distributed species

- *Mugil platanus* = *Mugil liza*

➔ **Barcode really can improve our knowledge about species!**

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