"We belong to the first generation to learn that a mass extinction event is impending, and to the last generation with the opportunity to inventory much of our planet's biodiversity before it disappears forever."

2003 NSF Announcement of New Program: Planetary Biodiversity Inventories

ALL CATFISH SPECIES INVENTORY

2008 CNSF Poster Presentation by

Mark Sabaj Pérez & John Sullivan

Academy of Natural Sciences
1900 Benjamin Franklin Parkway, Philadelphia, PA 19103

Planetary Biological Inventories (PBIs) are large-scale projects to discover and document all species of a "major clade" (i.e., large group of descendent species from a common ancestor, including fossils). PBIs empower international teams of scientists and institutions to assemble a comprehensive framework for understanding Earth's biodiversity, history and ecosystems. No projects of such magnitude have ever been attempted. Given the accelerated rate of change of our planet – ***the time is now.***

A Global Effort

ACSI began in 2003

• International research network of **422 participants** (including 133 students) in **53 countries.**

• **221 ACSI grants and fellowships** awarded to participants at home and abroad created new opportunities for fieldwork, museum research, specimen imaging projects and communication of results via print and web-based publications.

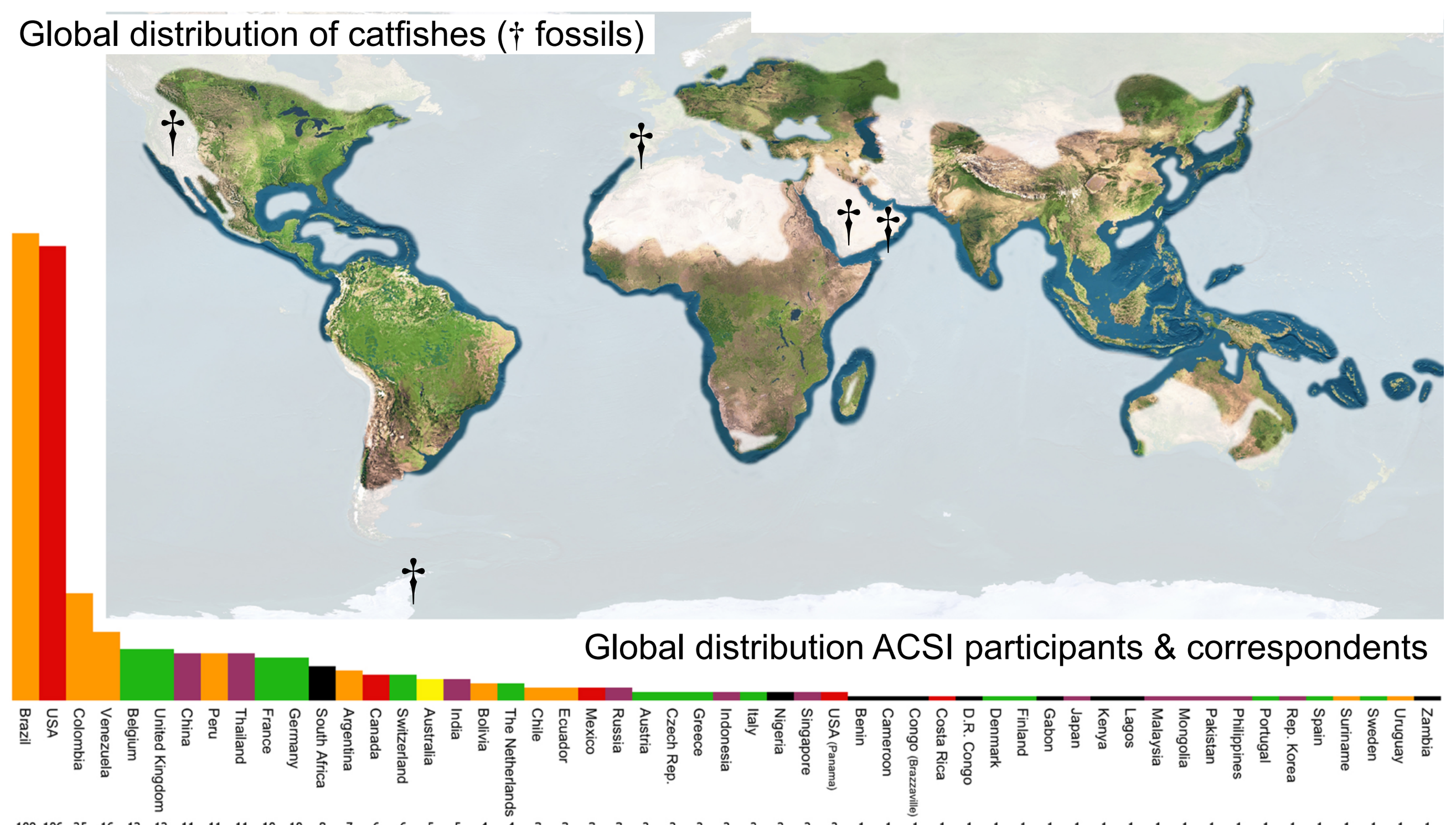
Exploration & Collections

Catfishes found on all continents including fossils on Antarctica

• Wide variety of fresh, brackish and marine habitats.

• Most diverse in the large equatorial watersheds of Africa, Southeast Asia and South America. In the USA.

• 45 species in one family native to North America, 40 catfish families (including one extinct, known only from fossils) known worldwide.



ACSI's Principal Investigators are Drs.

Lawrence Page
Carl Ferraris, Jr.
University of Florida

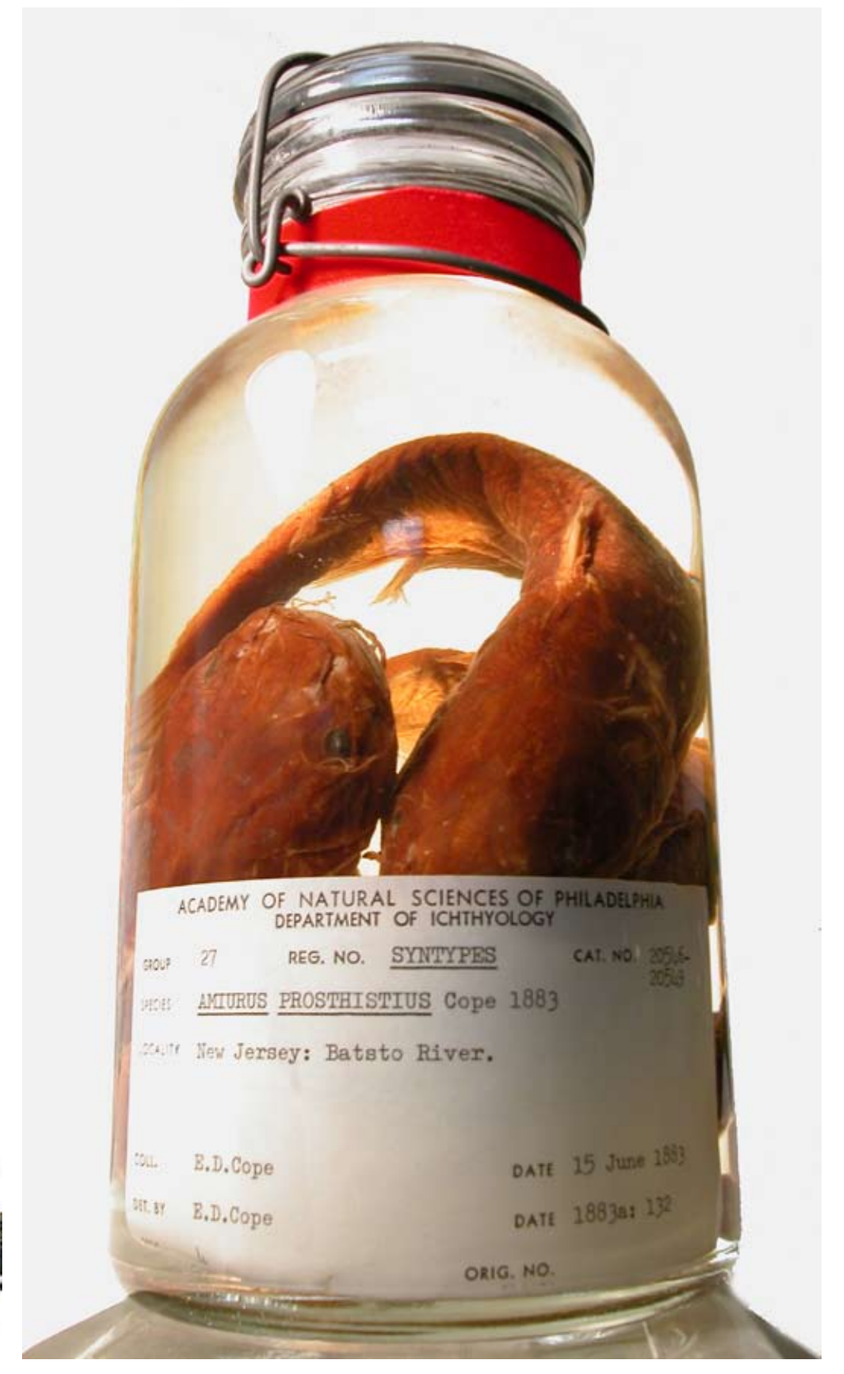
Jonathan Armbruster
Auburn University

John Friel
Cornell University

Mark Sabaj Pérez
John Lundberg
Academy of Natural Sciences of Philadelphia

• 4.68 million dollars over 5 years .

• $835,000 budgeted for graduate students and postdocs in the USA and $674,212 awarded to American and foreign participants (student and professional).



ACSI explores new waters

• **51 field projects in 22 countries** including major ACSI expeditions to Argentina, Brazil, Cameroon, Central African Republic, Guyana, Indonesia, Mexico, Mongolia, Papua New Guinea, Republic of Congo, Suriname, Tanzania, Thailand, Venezuela and Zambia.

• hundreds of thousands of specimens & thousands of genetic samples deposited in museums in the USA and around the world.

Not all species discoveries are made in the field.

Many new catfishes are discovered in the world's collections

• To diagnose new species, specimens old and new must be compared to those of already described species, particularly "types" used for their original descriptions. ACSI facilitates such work by funding museum visits, type-imaging projects, and rare literature scanning, and by making images and literature globally available via the Internet.

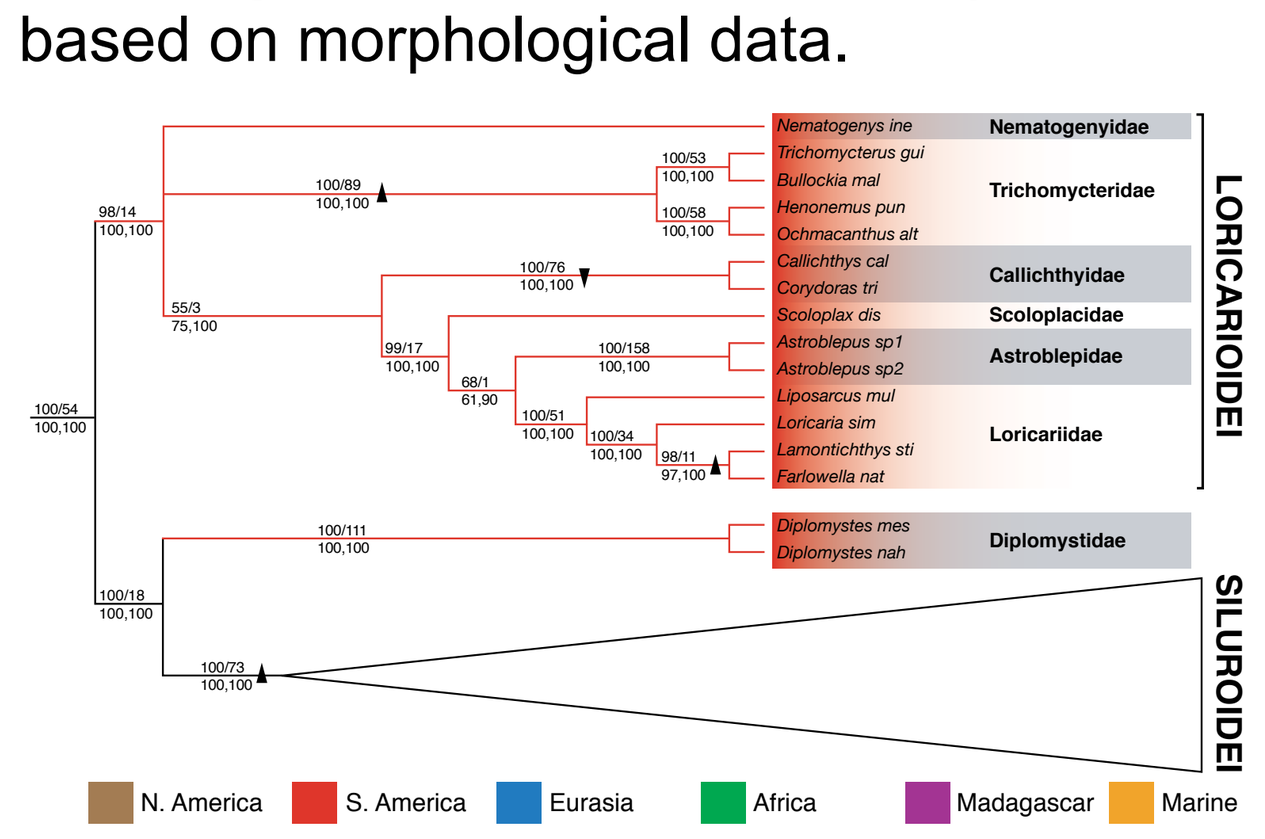
Discovering new species & more

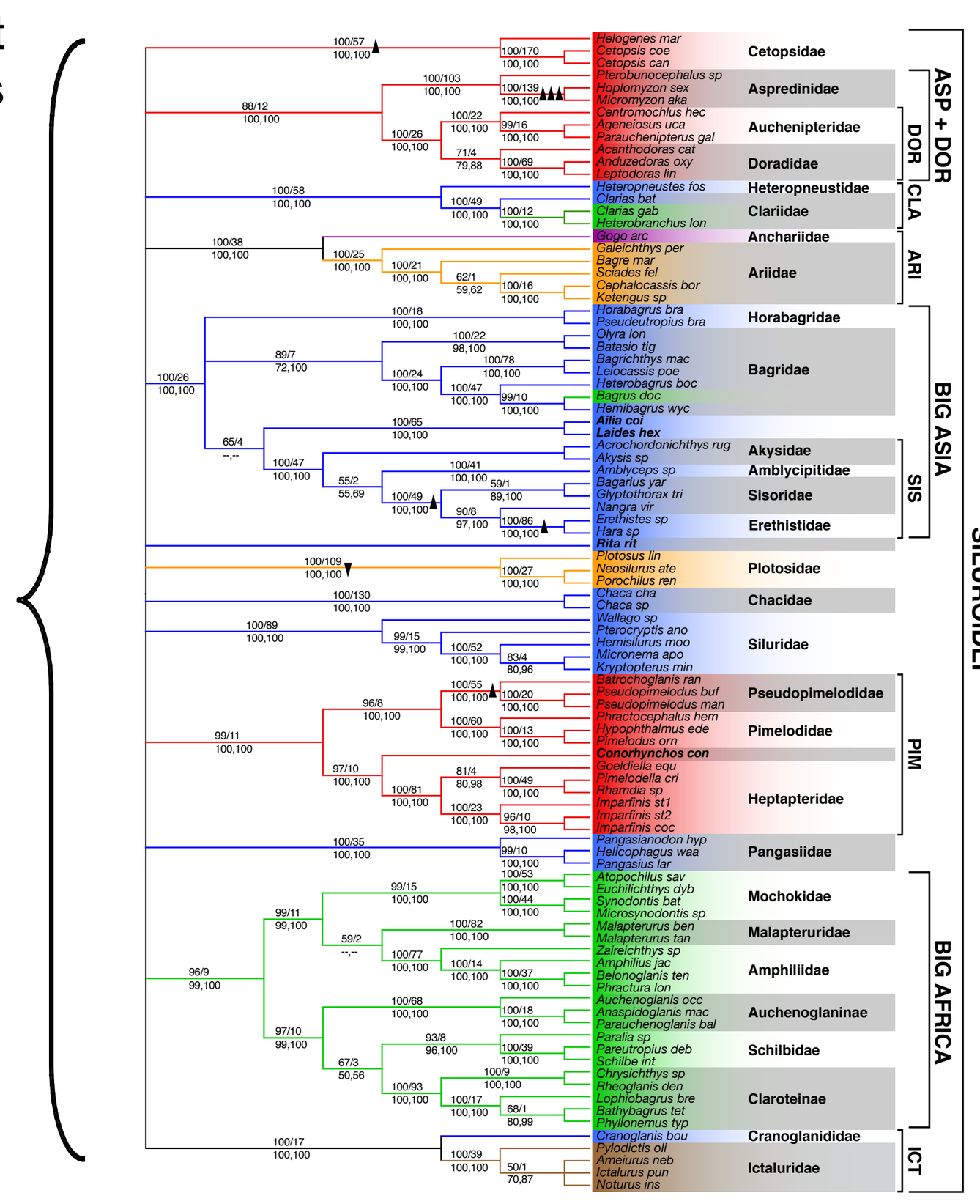
ACSI's primary goal: the complete classification of all catfish species

Step 1: compilation of all previously named and described species. Published in **"**Checklist of catfishes, recent and fossil…**"** by ACSI co-PI Carl J. Ferraris, Jr.: summarizes important taxonomic information for all 4,624 species of catfishes ever described.

Step 2: discovery, naming and description of new species: ongoing with **over 350 new species described** since the start of the project.

Step 3: organization of all species into hierarchical groups (i.e., genera, families) based on evolutionary relationships: DNA sequences compiled and analyzed for over 130 species representative of all major catfish lineages. The relationships proposed by this new and comprehensive molecular data set provide new insights on the evolution of catfishes that are being compared to traditional hypotheses based on morphological data.

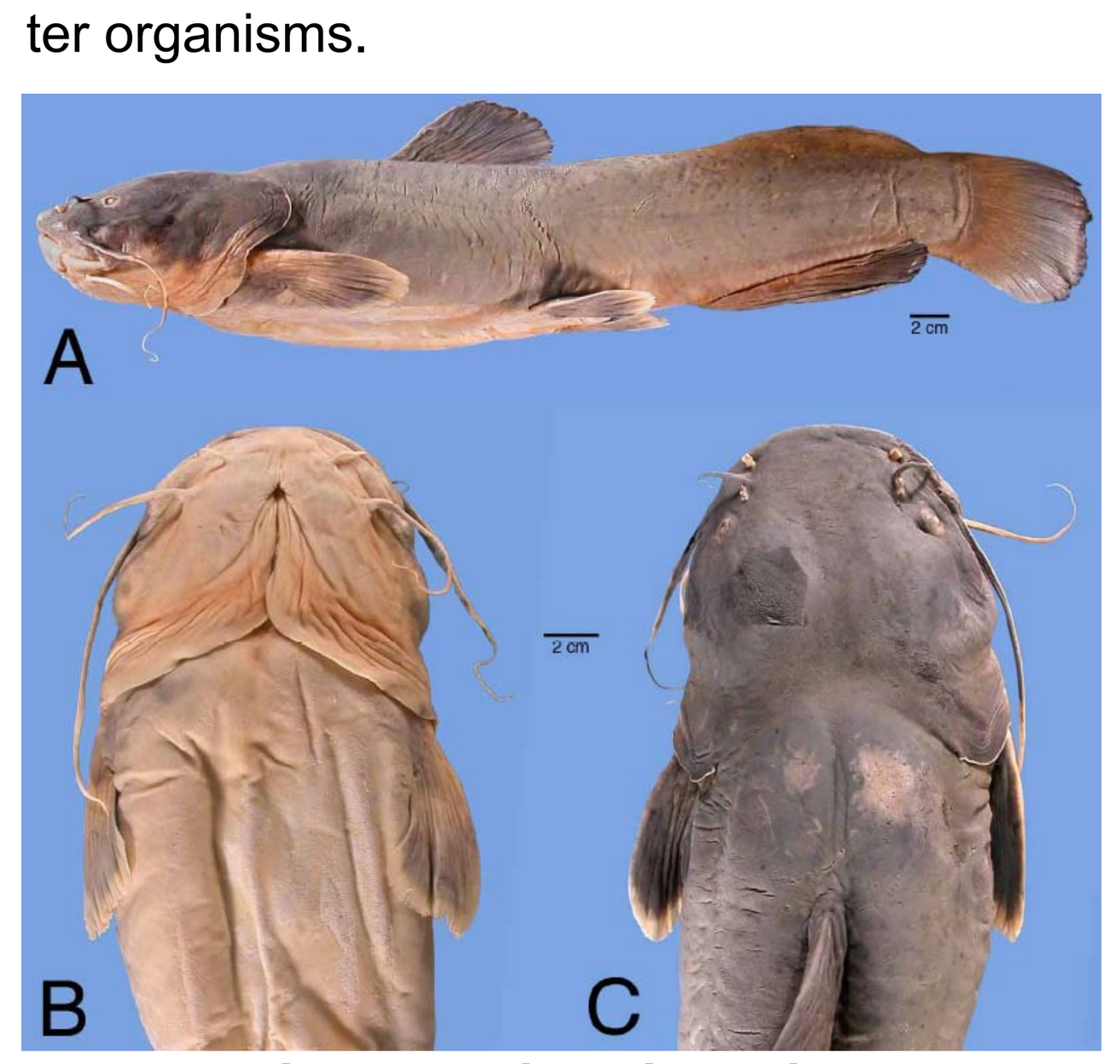




Phylogeny or "tree" of catfishes based on DNA sequence data compiled by ACSI postdoc John Sullivan and collaborators.

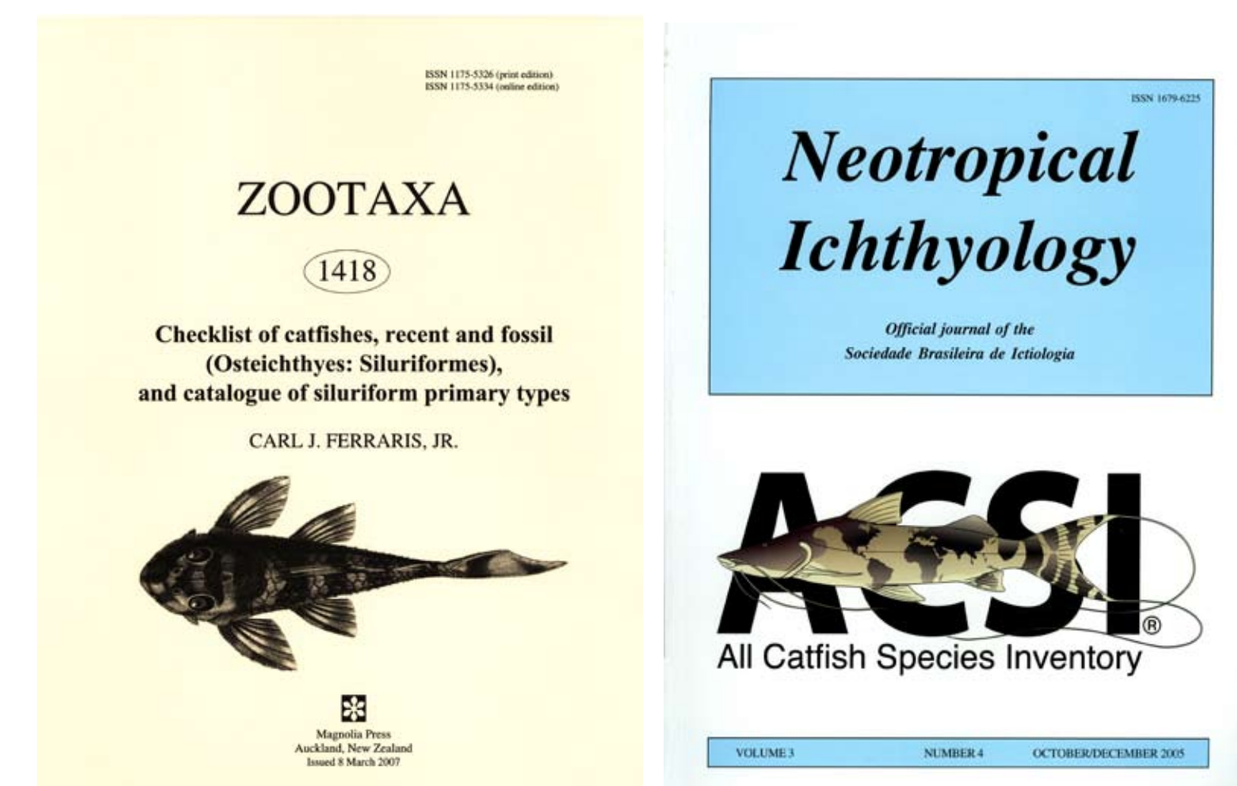
A surprising discovery...

• *Lacantunia enigmatica* (below), representative of a **new catfish Family Lacantuniidae**, in Chiapas, Mexico. Morphological and molecular data indicate that this species' closest relatives are in Africa. The Chiapas catfish is the only New World catfish with intimate ties to Africa, and suggests new biogeographic scenarios for today's distribution of freshwater organisms.



Lacantunia enigmatica
Rodiles-Hernández, Hendrickson & Lundberg 2005

Publication & Digital Archives


ZOOTAXA
1418
Checklist of catfishes, recent and fossil (Osteichthyes: Siluriformes), and catalogue of siluriform primary types
CARL J. FERRARIS, JR.
Magnolia Press
Auckland, New Zealand

Neotropical Ichthyology
Official journal of the Sociedade Brasileira de Ictiologia

ACSI
All Catfish Species Inventory
VOLUME 3 NUMBER 4 OCTOBER/DECEMBER 2005

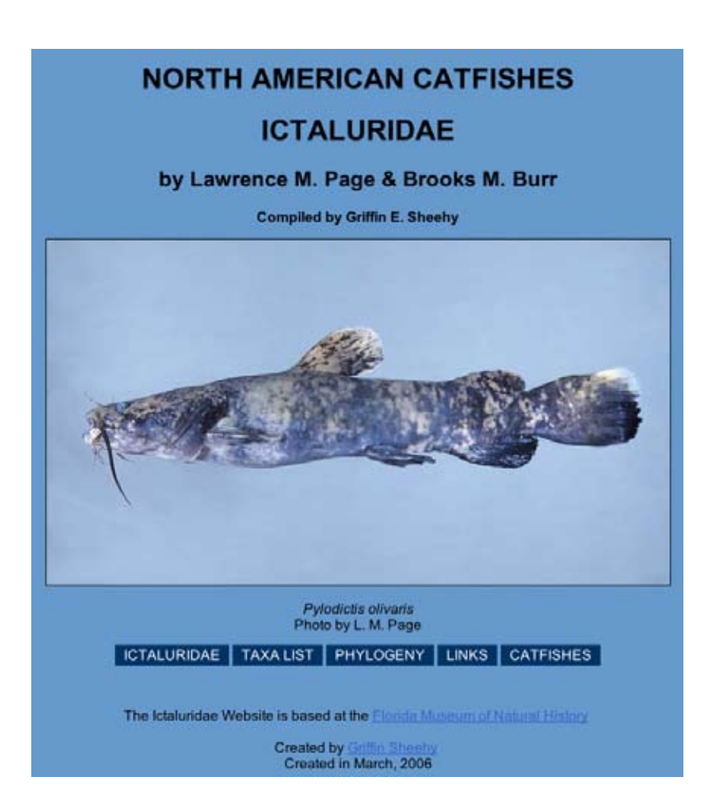
ACSI has funded publication of numerous papers on catfish species and classification

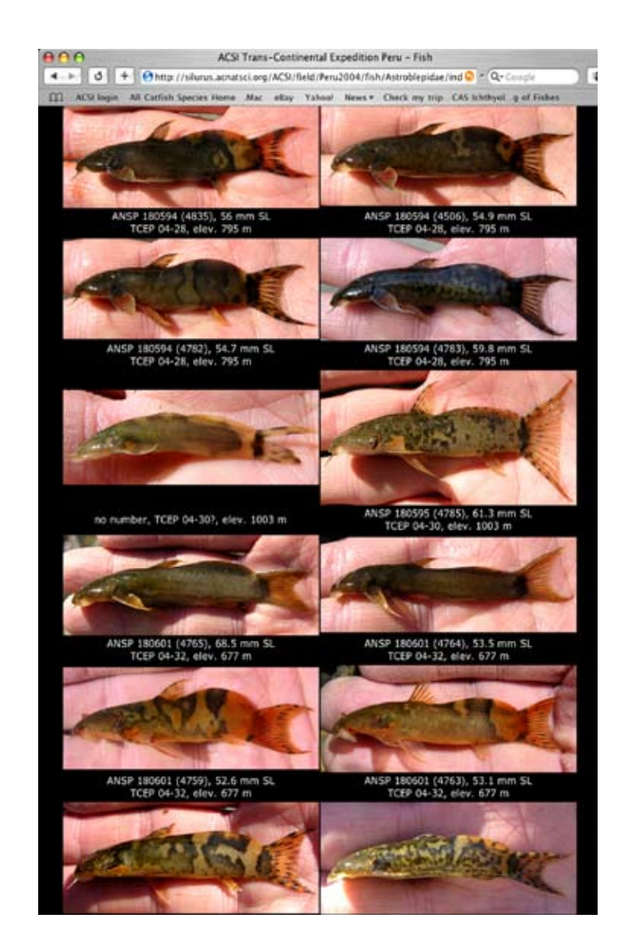
• Special issues in two scientific journals: Neotropical Ichthyology (in 2005 & 2008, published by the Sociedade Brasileira de Ictiologia) and the Proceedings of the Academy of Natural Sciences of Philadelphia (2008). Creating such outlets regularly stimulates the completion of ongoing studies.

ACSI's digital archives @ http://silurus.ansp.org

• Nearly 9,000 images of important specimens (e.g., "types") housed in 54 museums distributed on every continent, and PDFs of over 1,000 catfish publications, most of rare or out-of-print works.

• Participants can upload, download & view images of catfishes and their habitats as well as pertinent literature. Images are combined with ongoing taxonomic and evolutionary studies to create on-line taxa lists and descriptions, identification keys and distribution maps.





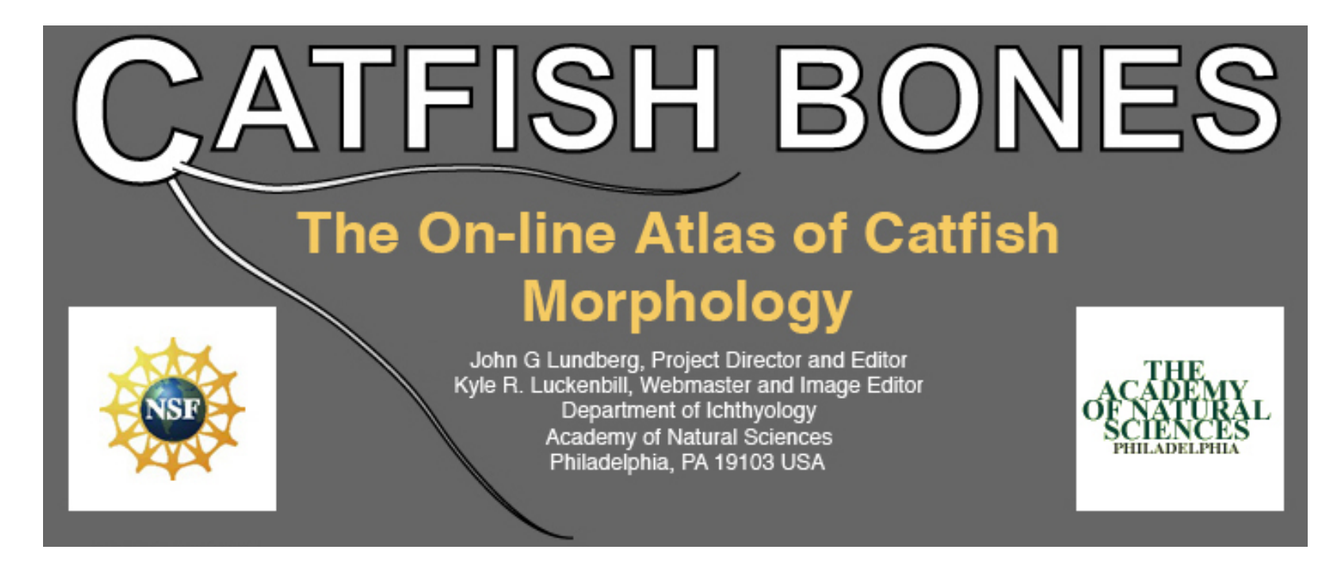
Sample webpages

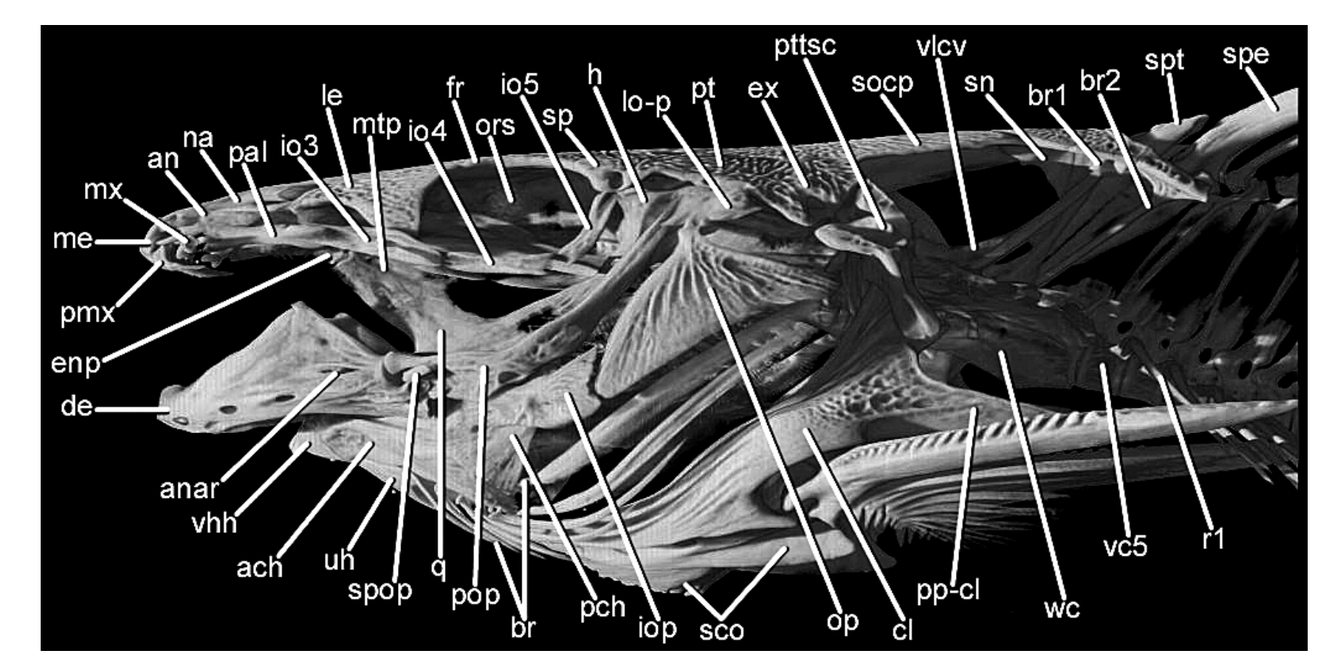
Applications of New Technology

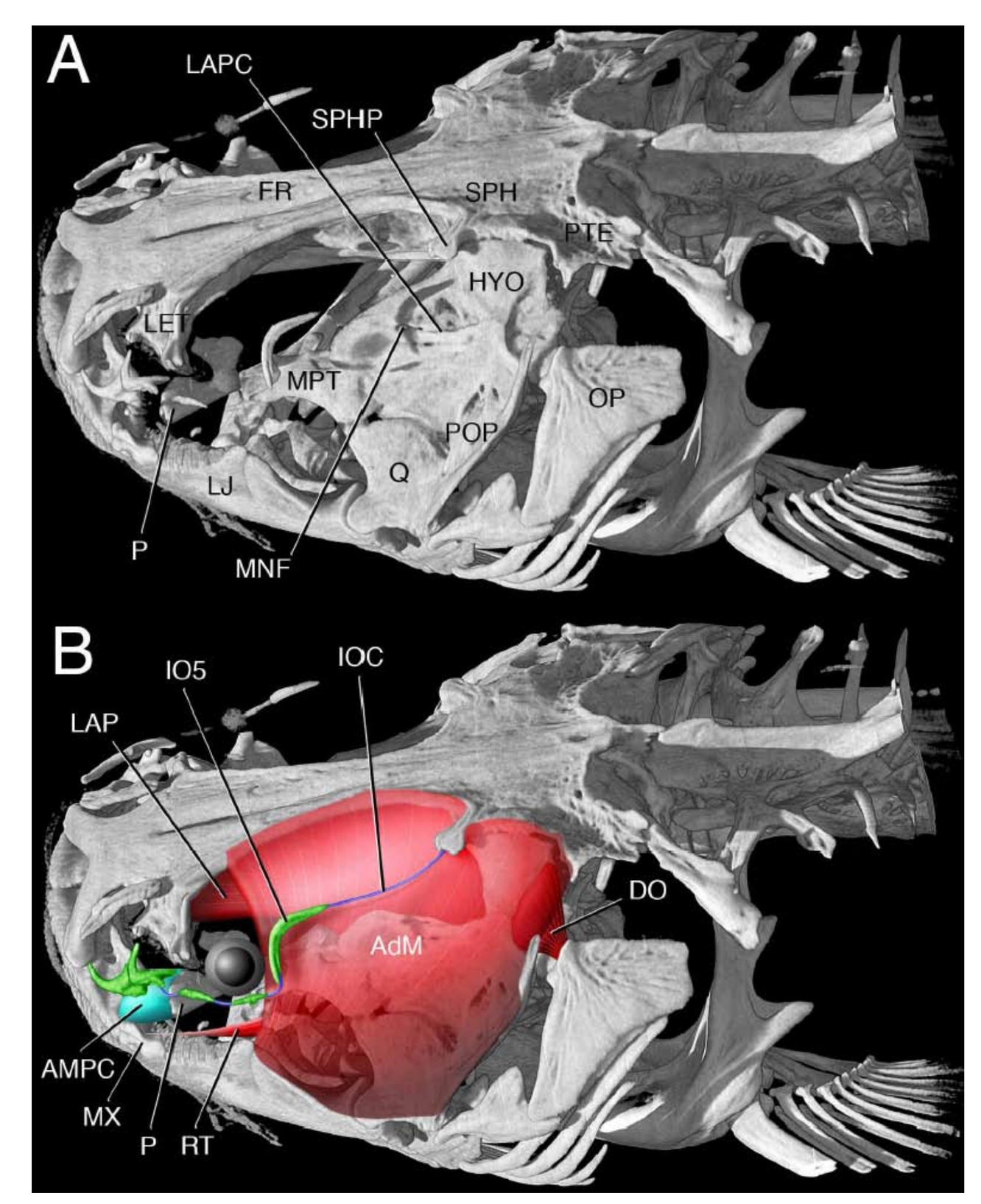
Transforming the study of anatomy for the 21st Century

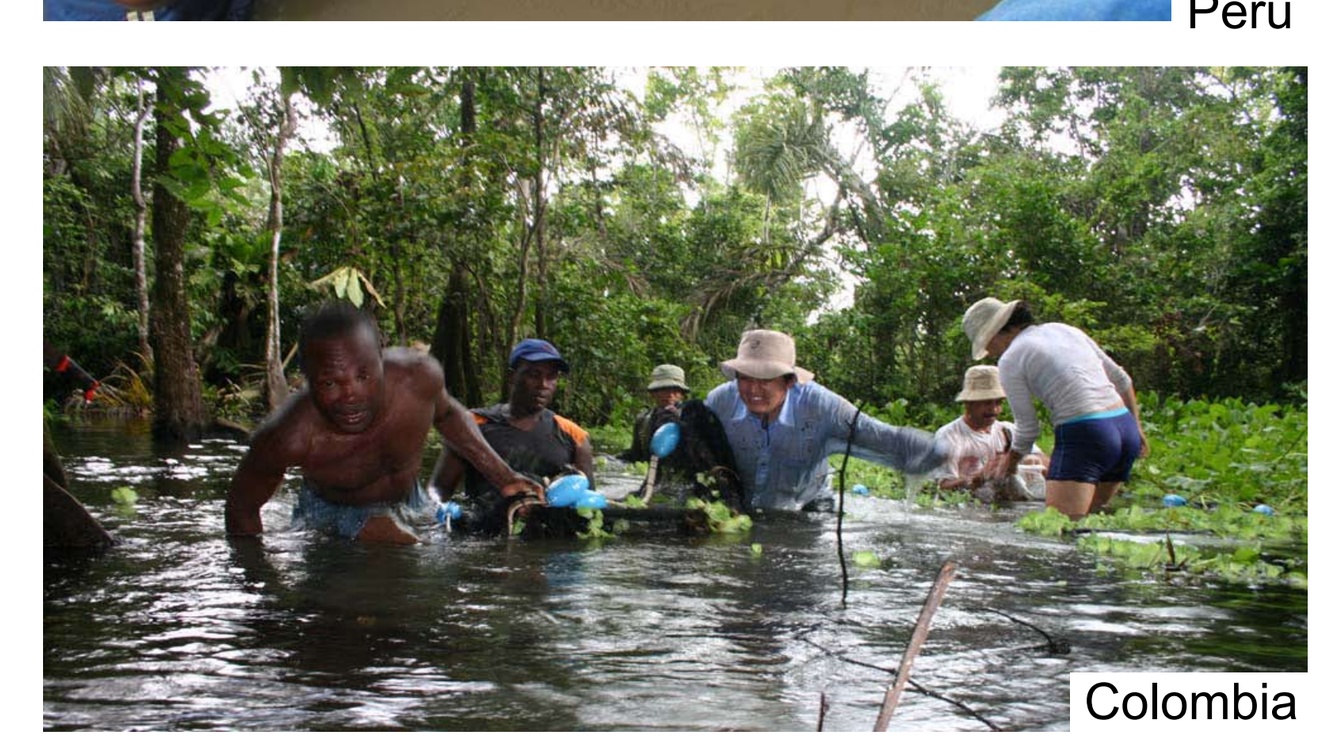
• Catscan or x-ray computed tomography (HRXCT) developed by the DigiMorph team at the University of Texas, Austin generates detailed 3D images of entire specimens that ACSI digitally dissects to study and document complex internal anatomy.

• Skeletal atlases for representative catfishes and is made available via the Catfish Bones website: http://catfishbone.acnatsci.org/.









Education & Outreach

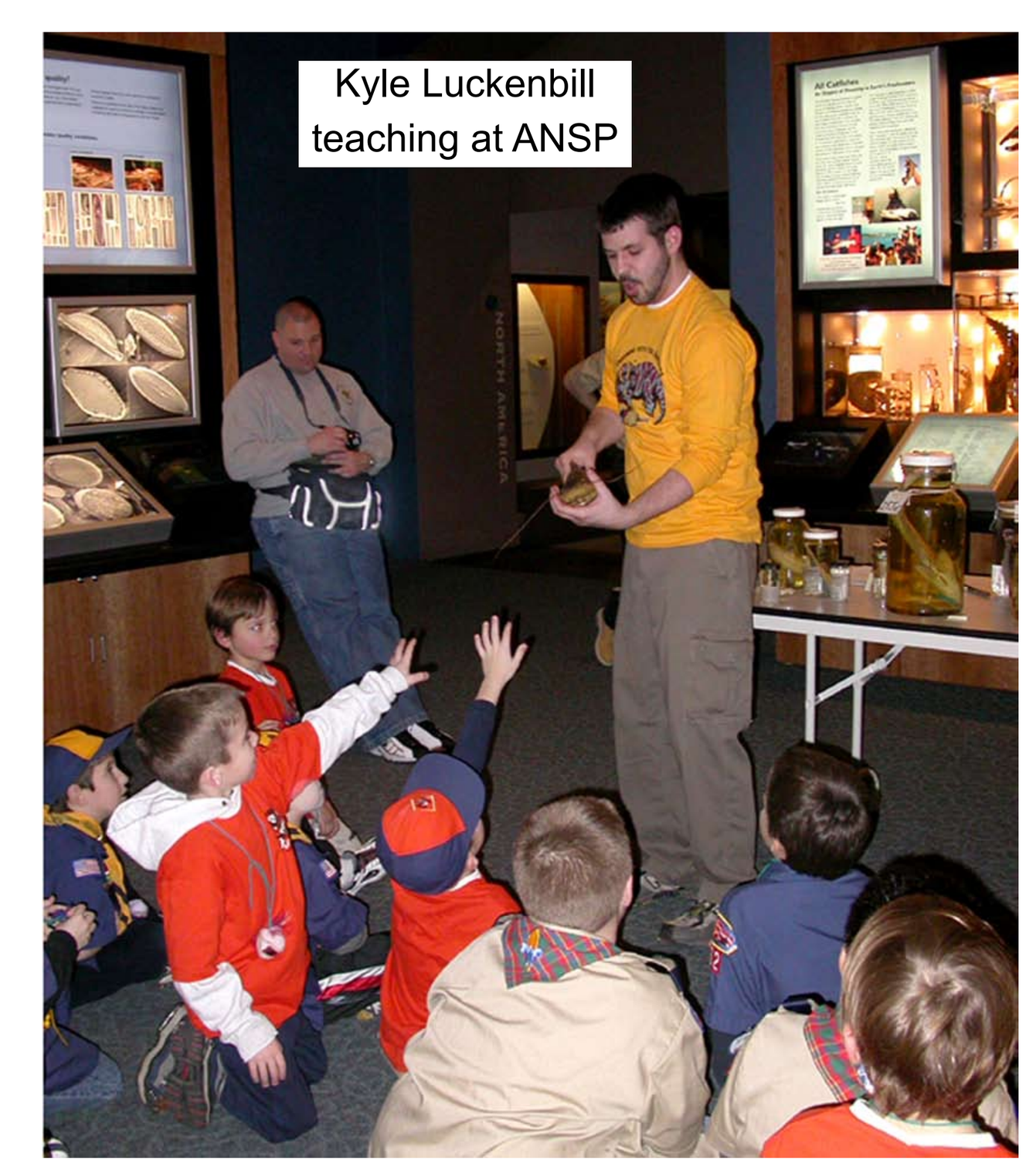
• Support and training for over 20 undergraduates, 12 graduate students and 4 postdocs at US institutions.

• Training in the field and lab to dozens of students abroad.

• Museum exhibits at The Academy of Natural Sciences (ANSP) & National Mississippi River Museum & Aquarium.

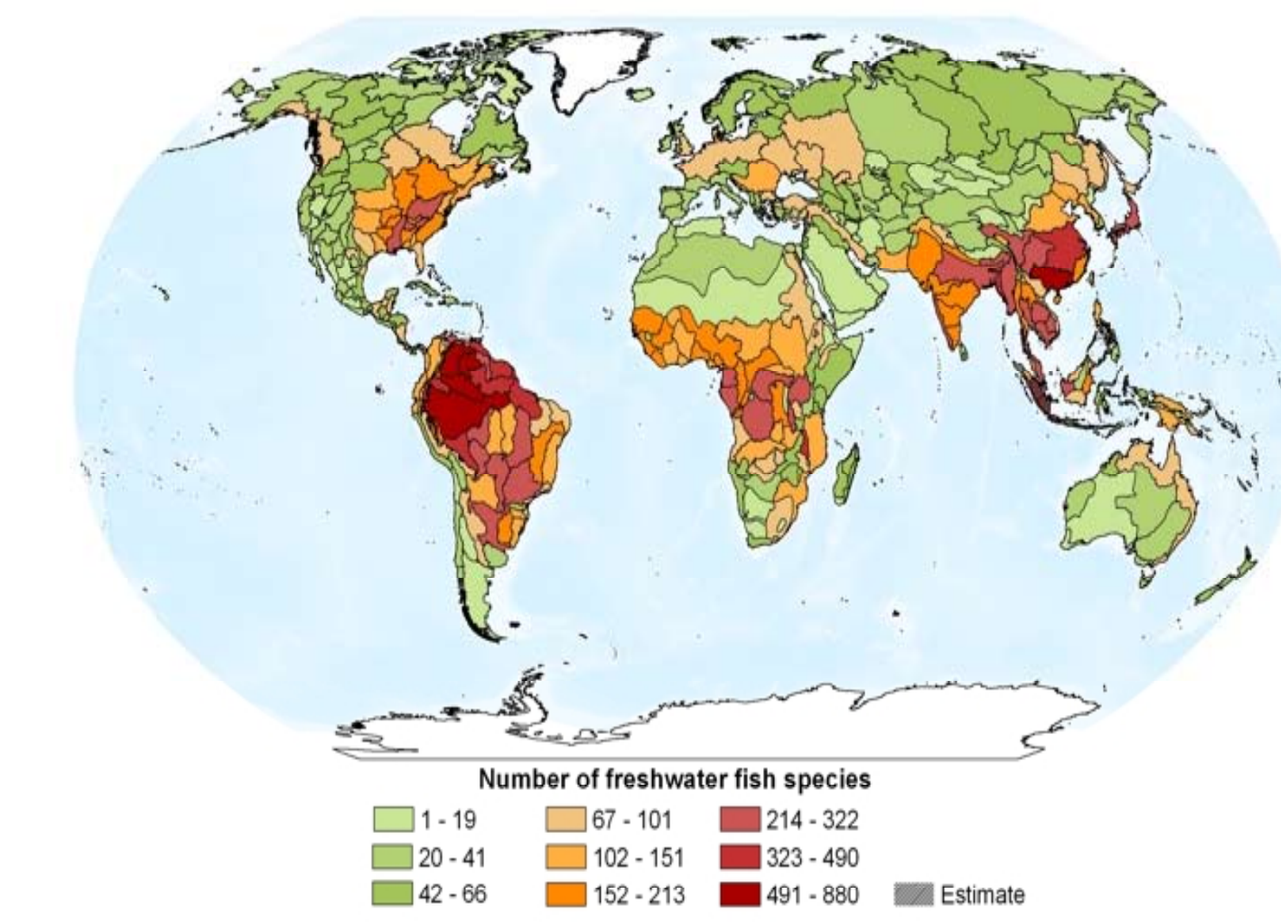
• Workshops in Brazil, Singapore and South Africa.

• Classes, talks, tours, tutorial videos and other public programs in collaboration with the ANSP Education Department



ACSI co-PI Jonathan Armbruster teaches lesson on catfishes to Amerindian schoolchildren of the Karasabi village, Guyana.

Freshwater Conservation



Species inventories are the basis for sound conservation

• **Taxonomy** is the global language for communicating information about biodiversity

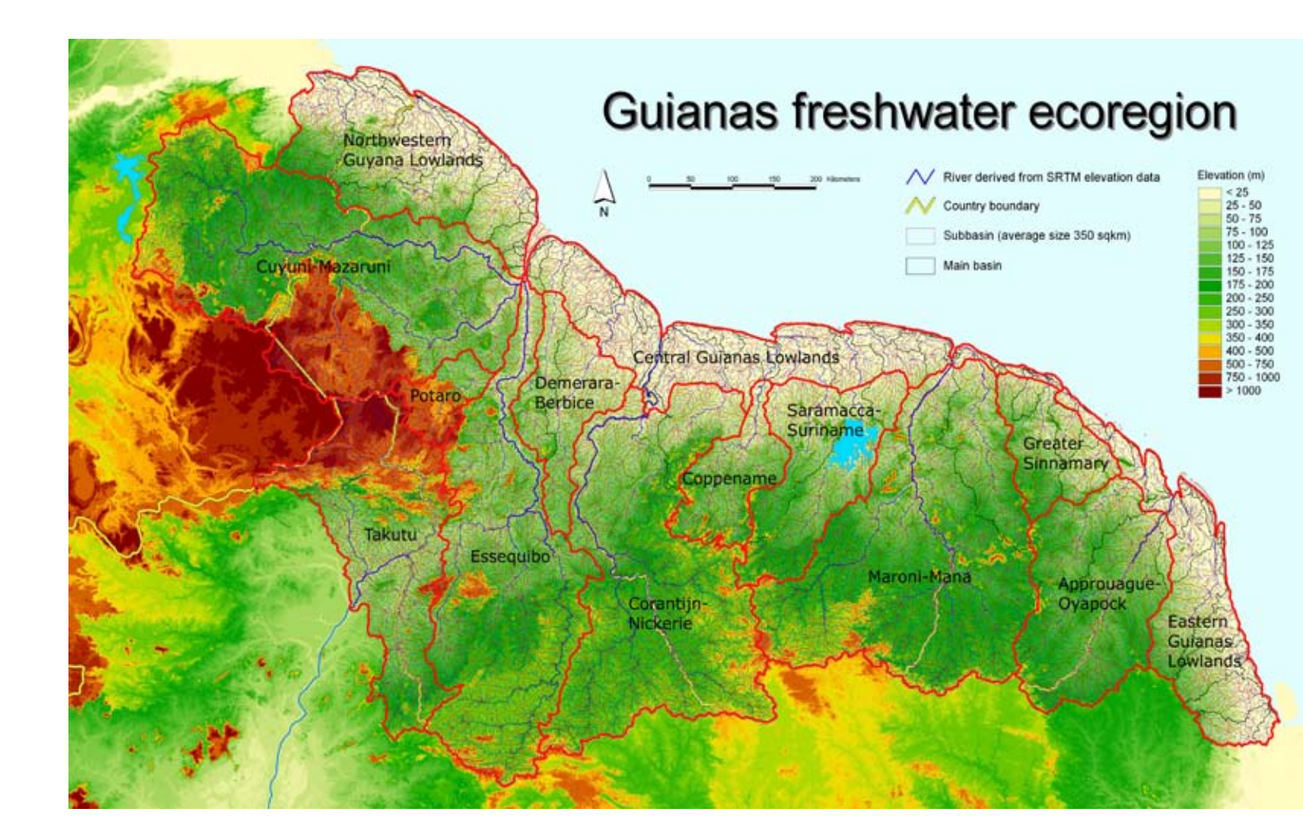
• ACSI has contributed knowledge and expertise to an effort by **World Wildlife Fund** and **The Nature Conservancy** to newly identify and characterize the Earth's freshwater ecosystems.

• Covering virtually all freshwater habitats, the **Ecoregion Map**, together with associated species data, is an invaluable tool for underpinning global and regional conservation planning efforts, for serving as a logical framework for large-scale conservation strategies.

2008 Publication in **BioScience**

Freshwater Ecoregions of the World: A New Map of Biogeographic Units for Freshwater Biodiversity Conservation

ROBIN ABELL, MICHELE L. THIEME, CARMEN REVENGA, MARK BRYER, MAURICE KOTTELAT, NINA BOGUTSKAYA, BRIAN COAD, NICK MANDRAK, SALVADOR CONTRERAS BALDERAS, WILLIAM BUSSING, MELANIE L. J. STIASSNY, PAUL SKELTON, GERALD R. ALLEN, PETER UNMACK, ALEXANDER NASEKA, REBECCA NG, NIKOLAI SINDORF, JAMES ROBERTSON, ERIC ARMIJO, JONATHAN V. HIGGINS, THOMAS J. HEIBEL, ERIC WIKRAMANAYAKE, DAVID OLSON, HUGO L. LÓPEZ, ROBERTO E. REIS, JOHN G. LUNDBERG, MARK H. SABAJ PÉREZ, AND PAULO PETRY



ACSI fieldwork always involves working with local peoples and routinely provides unique opportunities to educate indigenous communities on catfishes and conservation.

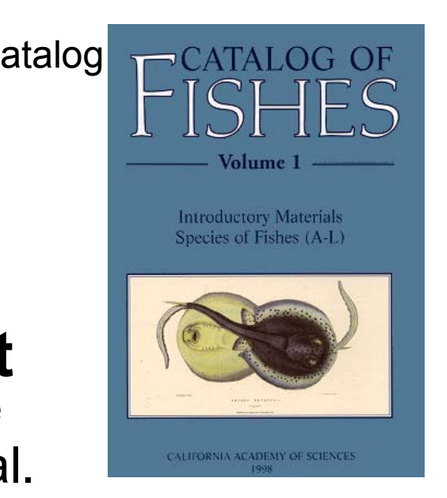
Synergistic Collaborations

Natural ties exist between ACSI & many other NSF supported projects

• ACSI expeditions yield valuable collections of fishes and aquatic organisms shared with the **Cypriniformes Tree of Life** and **Mussel Project.**

• ACSI studies on the phylogenetic history of catfishes create branches for the **Tree of Life Web Project**. ACSI expertise provides accurate information and materials for development of public exhibits such as **Amazon Voyage** developed by the Miami Musuem of Science. Such cooperative work elevates the profiles and productivity of all these NSF projects, some of which are listed below.

Catalog of Fishes
research.calacademy.org/research/ichthyology/Catalog
W. Eschmeyer et al.
California Academy of Sciences



Tree of Life Web Project
www.tolweb.org/tree
D. Maddison et al.
University of Arizona

Cypriniformes Tree of Life
bio.slu.edu/mayden/cypriniformes/home.html
R. Mayden et al.
St. Louis University

DeepFin Project
www.deepfin.org
G. Orti et al.
University of Nebraska

Morphobank Project
www.morphobank.org
M. O'Leary & S. Kaufman
Stony Brook University

Haploporid Monographs
R. Overstreet et al.
University of
Southern Mississippi

DigiMorph
www.digimorph.org
T. Rowe et al.
University of Texas
At Austin

Partnerships for Enhancing Expertise in Taxonomy

Amazon Voyage Exhibit
L. Enriconi et al.
Miami Museum of
Science & Planetarium

The Mussel Project
clade.acnatsci.org/mussel
D. Graf & K. Cummings
Academy of Natural Sciences
& Illinois Natural History Survey

The Congo Project
research.amnh.org/ichthyology/congo/index_02.html
M. Stiassny et al.
American Museum of Natural History

Inaugural PBI projects
funded by the National Science Foundation
are global inventories of
Catfishes, Plant Bugs,
True Slime Molds
& *Solanum*
(plant group including major crop species such as potatoes & tomatoes)

Catfishes were chosen due to their global distribution, high diversity (about 1 in 4 freshwater fishes, 1 in 10 fishes and 1 in 20 vertebrates is a catfish), and widespread familiarity.
As esteemed naturalist Archie Carr noted: *Any damned fool knows a catfish!*
Nevertheless, *we fools are damned far from knowing all catfishes!*