The Value of Imaging Specimens in Ichthyology

John P. Sullivan, Cornell University Museum of Vertebrates
iDigBio Vertebrate Digitization Workshop, Berkeley, CA, April 4-6, 2016

Adam Summers
Brian Sidlauskas
Not talking about: photos of living fishes
What I am talking about...

Visible light photographs of whole fish specimens (alive or dead) already accessioned or soon-to-be accessioned in a natural history collection.

*Pollimyrus* sp. CUMV 97656, male (left), 63 mm SL, JPS-549, female (right) 60 mm SL, JPS-554; UNIKIS-10-83, 16-Sep-2010, Masindula Creek, Kisangani, Province Orientale, D.R. Congo
Other ways of imaging fish specimens...
Radiographs
X-ray CT (Stacey Farina’s sculpins)

CU54050_Rhamphocottus_richardsonii
CU98019_Leptocottus_armatus
CU98035_Arteius_lateralis

CU97981_Liparis_dennyi
CU98033_Arteius_harringtonii
CU97998_Jordania_zonope

CU97975_Dasycottus_setiger
CU97986_Liparis_florae
CU98024_Blepsias_cirrhosus
Phractura fasciata, 118 mm SL, CUMV 96006, UNIKIS-10-059, Wagenia rapids, Kisangani, Province Orientale, D.R. Congo, 13-Aug-2010

- useful
- easy
- boosts self-esteem

whole specimen photographic images
The Value of Imaging in Ichthyology

• We are visual creatures
• Specimen photography has become a necessary skill
• Images communicate & preserve important information about specimens, facilitating discovery & research
• Images reduce wear and tear to specimens
• Images important for teaching & outreach to general public
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21st Century skills for organismal biologists

Size doesn't matter in Big Data, it's what you ask of it that counts

Big Data is changing the way we do science today. Traditionally, data were collected manually by scientists making measurements, using microscopes or surveys...

PHYS.ORG

Using R to mine species data

Many of us generate more data than we know what to do with (speaking of which: keep an eye out for the 2016 NGS Field Guide, coming soon!), so it's easy to forget about the piles of data aike...

MOLECULARECOLOGIST.COM

databases

programming languages
No. 2.—Application of Photography to Illustrations of Natural History. With two figures printed by the Albert and Woodbury Processes.

No attempts have thus far been made to apply the comparatively new processes of carbon printing to general illustrations of Natural History, though excellent figures of microscopic preparations have been printed by carbon processes by Deane, Woodward, and others. The lithographic plates of many memoirs on natural history have been made up with the assistance of photographs, but the want of permanence of the common photographic prints has prevented their use beyond that of auxiliaries to lithography. The rapid progress made in carbon printing by the Woodbury and Albert processes promises to furnish us, within a short time, the means for direct application of photography to illustrations of natural history, and these new methods of printing are likely to replace to a great extent the ordinary lithographic plates.

The accuracy of a photographic illustration is of course far beyond that of an engraving or lithograph, and as soon as a few practical difficulties of printing the separate figures of a plate at one impression are overcome, we shall be able to illustrate our memoirs accurately and economically, and give figures with an amount of detail which the great expense of engraving or lithographing would usually make impossible, even were it mechanically practicable.
When did photographs replace illustrations?

Campylomormyrus mirus holotype

lithograph, P.J. Smits for Boulenger 1898

scanned 35 mm slide, Wilhelm Harder 1984

Campylomormyrus mirus
Holotypus MRAC 131 (203)
### Scorpaeidae - Scorpionfishes, cont.

#### Cowcod - *Sebastes levus* (Eigenmann & Eigenmann, 1889)

**FEATURES:** Color highly variable; capable of rapid change. Whitish, pinkish, orange, or yellowish, with four or five narrow, faint to dark bars on sides. Bars distinct in juveniles, fade with age. Lower jaw with knob under tip. Eyes comparatively small. First dorsal fin deeply incised. Second anal-fin spine about as long as third. Body deep, robust.

**HABITAT:** Newport, OR, to central Baja California. Found demersally over soft, mixed, hard, and complex bottoms with caves, crevices, and other shelter from about 130 to 1,610 ft. **BIOLOGY:** Usually solitary, but may congregate. Feed on a variety of invertebrates and fishes. May live to 55 years. Populations low due to overfishing.

#### Mexican Rockfish - *Sebastes macdonaldi* (Eigenmann & Beeson, 1893)

**FEATURES:** Mottled reddish black dorsally, becoming reddish below. Larger specimens sometimes with irregular pale blotches on back and sides. Bars may radiate from below eyes. Lateral line pink to pinkish red. Lower jaw protrudes; knob at tip present. A flat, rear-facing spine is present below anterior portion of eyes. Maxilla extend to near rear of eyes. Anal fin with seven to eight rays; second spine shorter than third.

**HABITAT:** Point Sur, CA, to southern Baja California, and central Gulf of California. Occur over rocky outcrops and oil platforms from about 250 to 1,150 ft.

#### Quillback Rockfish - *Sebastes maliger* (Jordan & Gilbert, 1880)

**FEATURES:** Brownish with a large area of yellow on head, irregular yellowish blotches on back that extend into spiny dorsal fin, and a few yellowish speckles on posterior body. Lower jaw protrudes slightly. Maxilla extends to rear of eyes. Spiny dorsal fin tall with deeply incised membranes. Anal fin with six to seven rays; second spine longer than third.

**HABITAT:** Kodiak Island, AK, to southern CA at Anacapa Passage. Found demersally over low- and high-relief rocky bottoms from intertidal zone to about 900 ft. **BIOLOGY:** Occupy home ranges. May be territorial. Often solitary.

#### Black Rockfish - *Sebastes melanops* Girard, 1856

**FEATURES:** Gray, with blackish speckles and mottling dorsally. Pale ventrally. Dark speckles extend into dorsal fin. Some with dense speckles on lower sides that form a loose stripe. Faint dark band may radiate from below eyes. Lower jaw protrudes slightly; knob at tip absent. Maxilla extend to rear of eyes. Head spines reduced to almost absent. Anal fin rounded at lower edge.

**HABITAT:** Amchitka Island, AK, to Huntington Beach, CA. Found demersally to near surface over high-relief rocky bottoms to about 1,200 ft. **BIOLOGY:** Form small to large schools. May leap from water in pursuit of prey.

**Semaphore Rockfish - *Sebastes melanocema* Lea & Eich 1979**
Before digital: 35 mm film photography

- dozens of exposures to get a few keepers

*Paramormyrops* sp. “teugelsi”

*Paramormyrops* sp. “SP9”
Age of digital photography

Gnathonemus petersi
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• color (live/preserved)
• size
• shape
• homologous points
• fins
• scales
Brachyhypopomus walteri Sullivan, Zuanon & Cox Furnandes 2013 holotype
Campylomormyrus

size/shape/homologous points

Campylomormyrus alces

Campylomormyrus numenius
fins/scales

Congochromis squamiceps CUMV 96716
wear & tear on specimens

Paramormyrops sphekodes Sauvage 1879 holotype MNHN A.893
Specimen images facilitate discovery & research

- “Images of type specimens are essential in describing new species when researchers are geographically removed from the types they need for comparison.” Kyle Luckenbill, ANSP

- “Some images generate questions that can lead to studies! For example a few fish I have described were only borrowed and examined because I saw a photo of them.” Randy Singer, UF

*Akysis hardmani*

Photo by Kyle Luckenbill
Mae Nam Chao Phraya and tribus in vicinity of Phayuha Khiri, Nakhon Sawan, Thailand
Holotype, ANSP 178858, Ng & Sabaj, 2005
34.5 mm SL
Discovery: new mormyrid genus

*Cryptomyrus ogoouensis* holotype CUMV 98155

*Cryptomyrus ona* holotype MNHN 2003-0425

Sullivan, Lavoué & Hopkins 2016
“When working on mochokid phylogeny, I was lucky enough that AMNH let me get one of their type series of *Acanthocleithron chapini* scanned by the folks at Digimorph. At that time there wasn't really that much material available, and I probably wouldn't have been able to C&S any of it. The work relied heavily on skeletal features. The scan allowed me to include a unique (morphologically speaking) and monotypic genus in the analysis.”
Morphbank

online image archives

**My Collections/Characters** *(Need Help...) (Feedback...)*

**Antennarius** ([20] images)

| Image Size: | 80 | Post It: On | Off | Icons: On | Off |

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</table>

Morphbank
Siluriformes

All Catfish Species Inventory Image Base

Images of catfish submitted by ACSI Participants:

Search the imagebase.
Table of images by species and image category.
List of images by genus.
List of images by Museum.
List of images by Photographer.
List of images by Submitter.

PDF documents related to catfish submitted by ACSI Participants:

List of documents by author.

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If you would like to cite the ACSI Imagebase in a publication please use the citation: Morris, P.J., H.M. Yager, [programmers] and M.H. Sabaj Perez [editor], 2006. ACSIImagebase: A digital archive of catfish images compiled by participants in the All Catfish Species Inventory. [WWW image Database] URL http://acsi.acnatsci.org/base. If you cite individual images in the image base, please credit the people and institutions who provided the images.

Summary as of 2016 03 27, 02:03 EDT

Total images: 9967
Total institutions represented: 60
Total photographers: 92
Total submitters: 51
Total type specimens: 2804
Total images of types: 9433

Images of types by kind of type:
Holotype: 4465
Syntype: 4088
Lectotype: 359
Paratype: 273
Paralectotype: 152
Unknown: 67
NotProvided: 4
Iconotype: 1

Species represented by type images: 2177
Institutions represented by type images: 53
Fish Collection
Cornell University Museum of Vertebrates

CUMV:Fish:91223
collector number: JPF-0356; JPF-0374
Campylomormyrus elephas
get a DOI

Samta Rapids at pontoon on Chambeshi River, Africa, Zambia, Northern Province
2005-10-11

tissue (95% ethanol); whole organism (ethanol); tissue (95% ethanol)

Identification | Accn | Locality | Agents | Parts | Part Locn. | Attributes | Other IDs | Media | Encumbrances

Campylomormyrus elephas
Animalia: Chordata; Actinopterygii; Osteoglossiformes: Mormyridae; Campylomormyrus elephas (Boulenger, 1888)
Norsukala; Rypoun slin; Sosha; elephant-trunk mormyrid
Identified by John P. Sullivan on 2005-10-11
Nature of ID: legacy

Campylomormyrus mirus
Rypoun podivny
Identified by John P. Friel
Nature of ID: legacy

Determination Type: accepted place of collection
assigned by unknown on 2014-02-28

Higher Geography: Africa, Zambia, Northern Province

Specific Locality: Samta Rapids at pontoon on Chambeshi River
Collecting Method: dipnets, electrofisher, seine
Collecting Source: wild caught
Event Date: 2005-10-11
Verbatim Date: 2005-10-11

Verification Status: unverified

Coordinates: +10.8521003723 / 31.1672992796
Georeference Source: unknown
Georeference Protocol: not recorded

No Media Found

Collectors:
Roger Bills, Alex Chilala, John P. Friel

Accession
2005-XI:07
No Media Found

Showing Media results 1 - 2 of 2 [view details]
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CUMV Fishes

By: Cornell University Museum of Vertebrates

57 photos • 42 views
AC or DC? Two newly described electric fish from the Amazon are wired differently

Aug 28, 2013

This is an image of the two new species with their electric organ discharges (EODs). Brachyhypopomus waltei (top) has a longer, thinner tail and produces an EOD with both positive and negative phases. Brachyhypopomus bennetti (bottom) has a … more

Much as human siblings can have vastly different personalities despite their similar resemblance and genetics, two closely related species of electric fish from the Amazon produce very different electric signals. These species, new to science, are described in the open access journal ZooKeys by Drs. John Sullivan of Cornell University in Ithaca, New York, Jansen Zuanon of the National Amazonian Research Institute in Manaus, Brazil and Cristina Cox Fernandes of the University of Massachusetts, Amherst.
Researchers Find Fish That Walks the Way Land Vertebrates Do

Carl Zimmer
MARCH 24, 2016

Cryptotora thamicola, a waterfall-climbing cave fish that appears to walk the way land vertebrates do, researchers say. Danile Perotto/Science Source
democratizing taxonomic knowledge
Thanks!
Thanks!

Acknowledgments:

Stacey Farina, Kyle Luckenbill, Nathan Lujan, Frank Pezold, Mark Sabaj Pérez, Aurélie Pinton Norma Salcedo, Randy Singer, Brian Sidlauskas, Melanie Stiassny, Tom Vigliotta, Brandon Waltz