

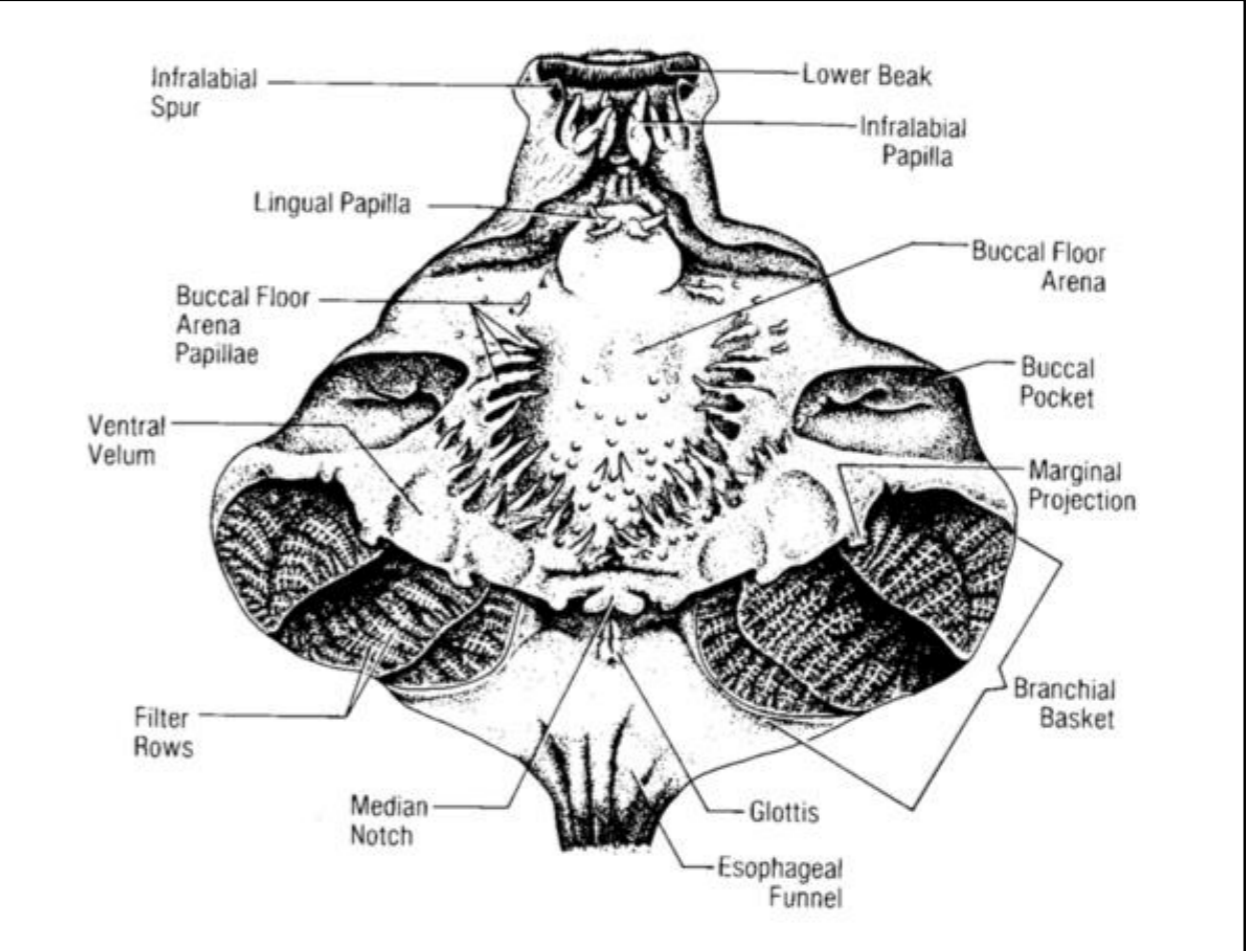
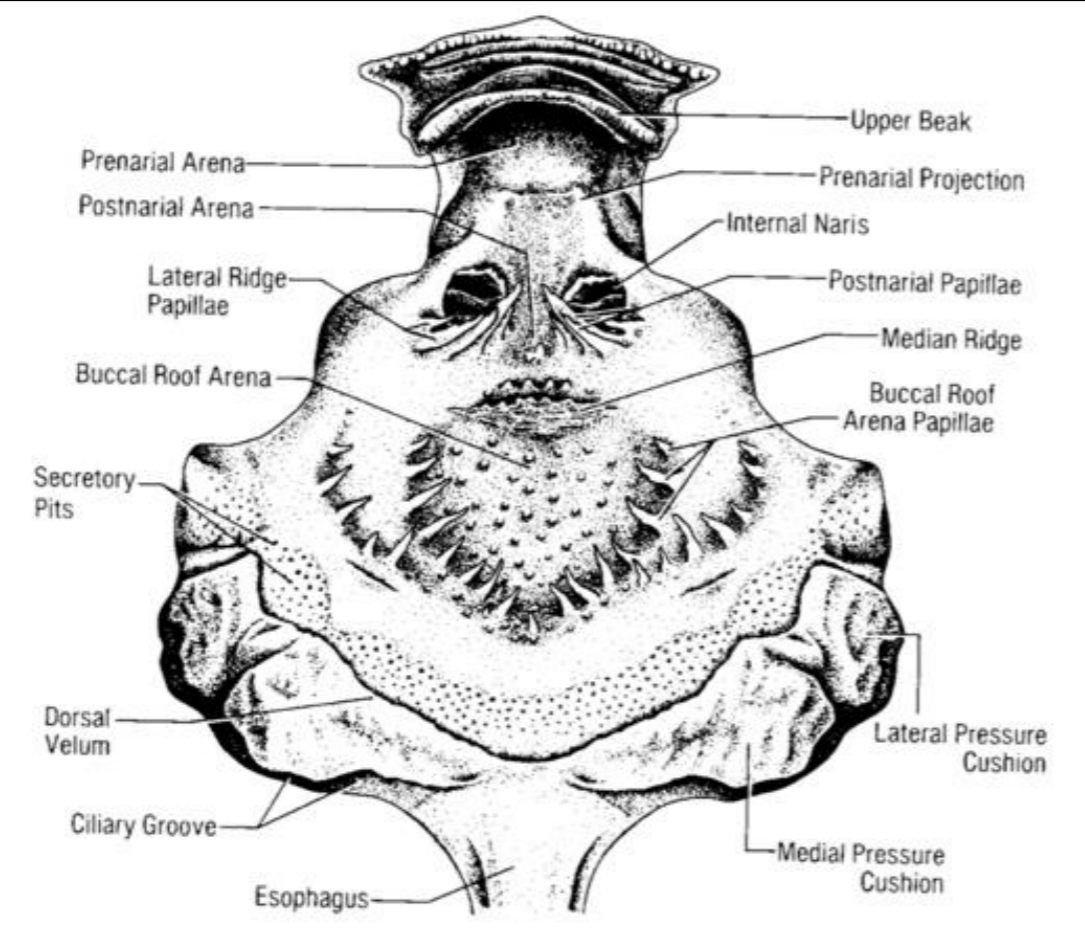
3D Phenotypes for All

David C. Blackburn
Associate Curator of Herpetology
Florida Museum of Natural History
University of Florida

Digital Data in Biodiversity Research
University of California, Berkeley
June 4, 2018



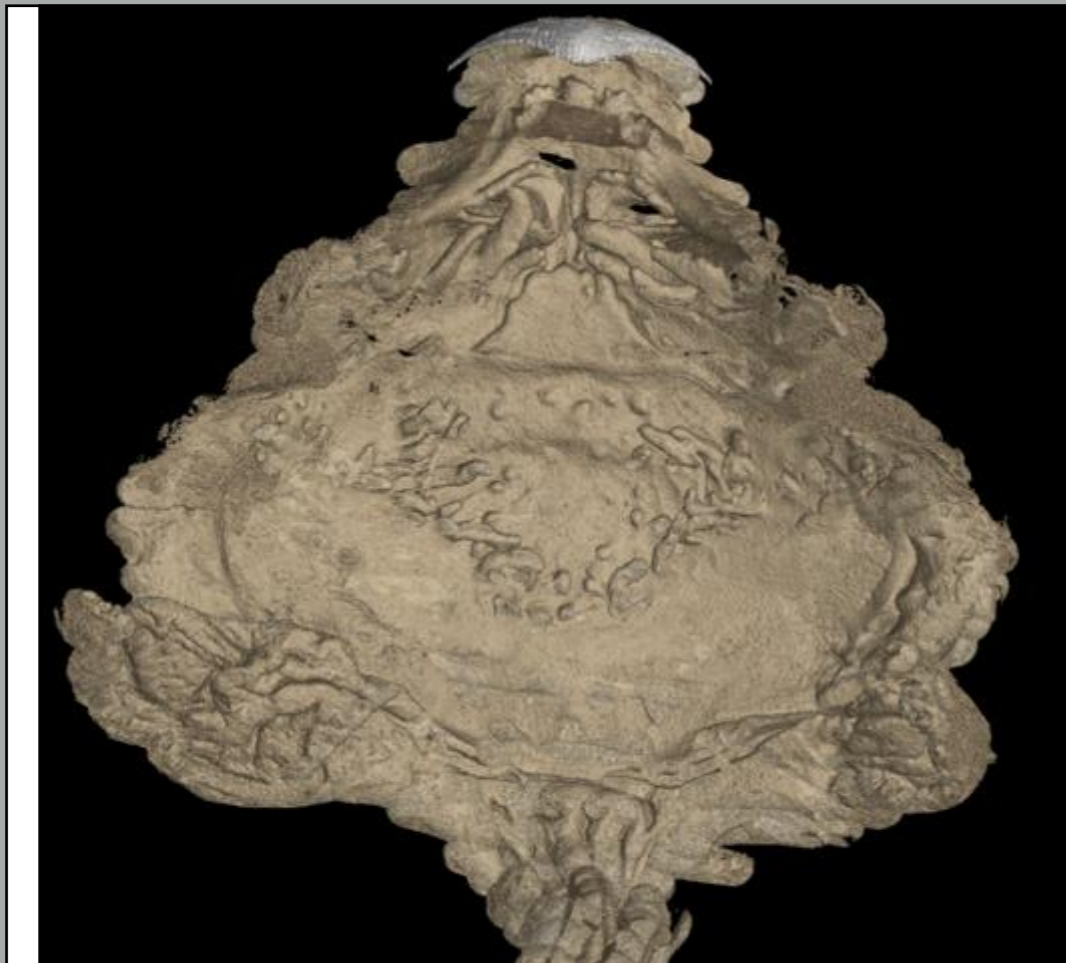
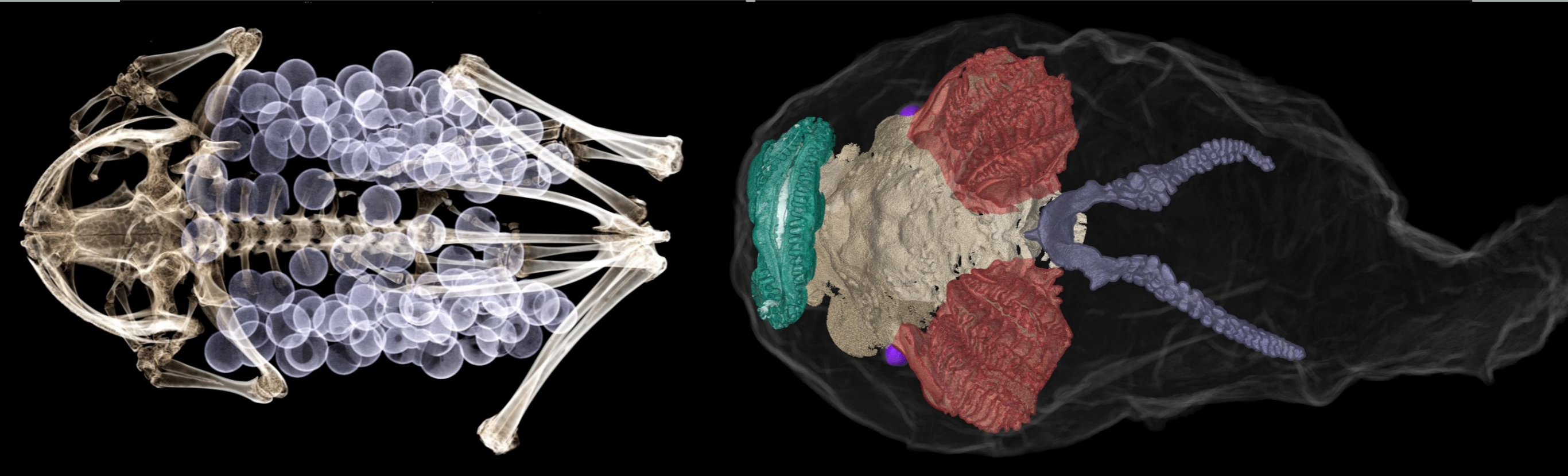
Marsupial Frogs of South America



Florida Museum of Natural History Herpetology Collections

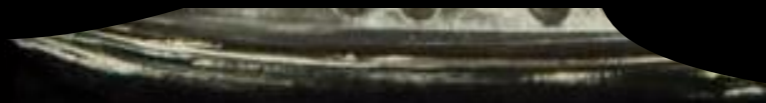


Marsupial Frogs of South America

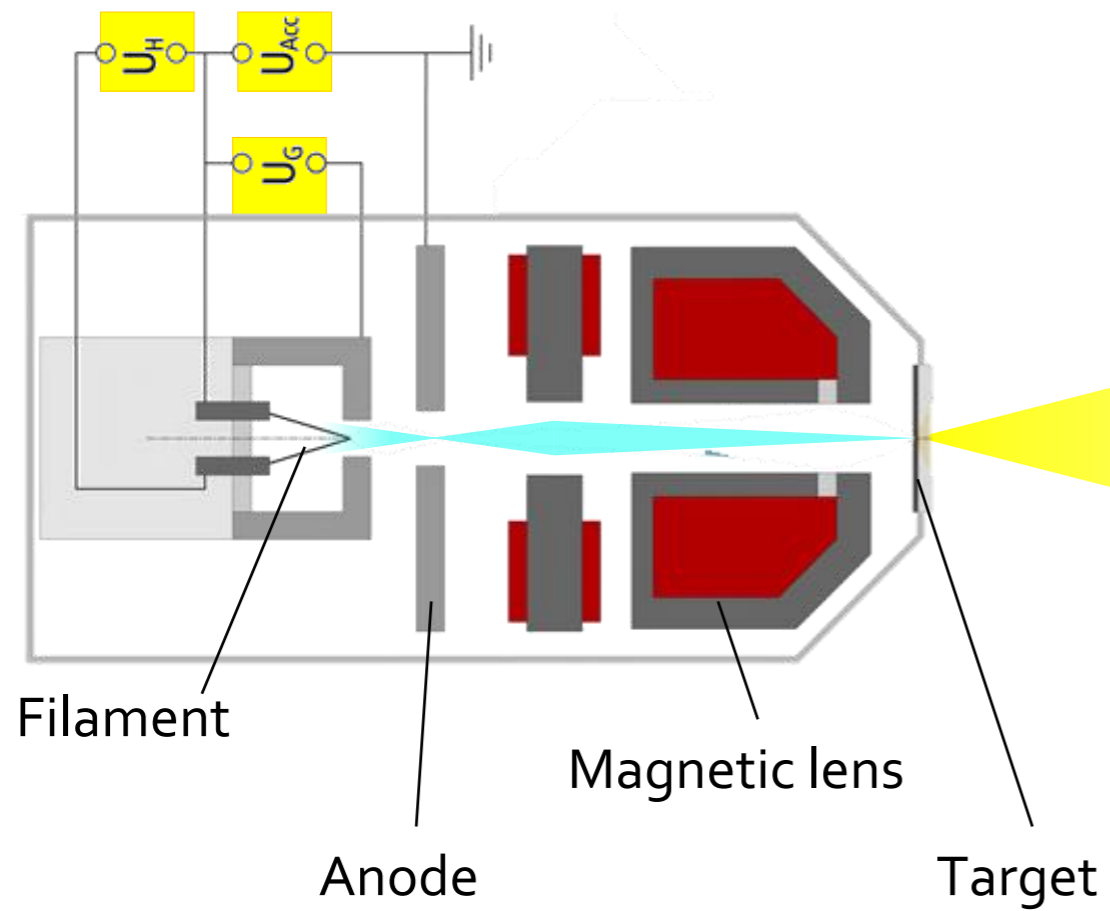


By creating new, freely accessible, digital media, we improve access to and add value to scientific specimens.

This access facilitates discoveries across disciplines and from a growing on-line community of scientists, students, and the public.

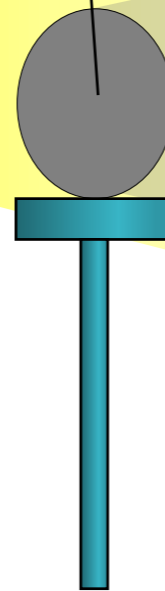


A few CT basics...



X-ray tube

Specimen

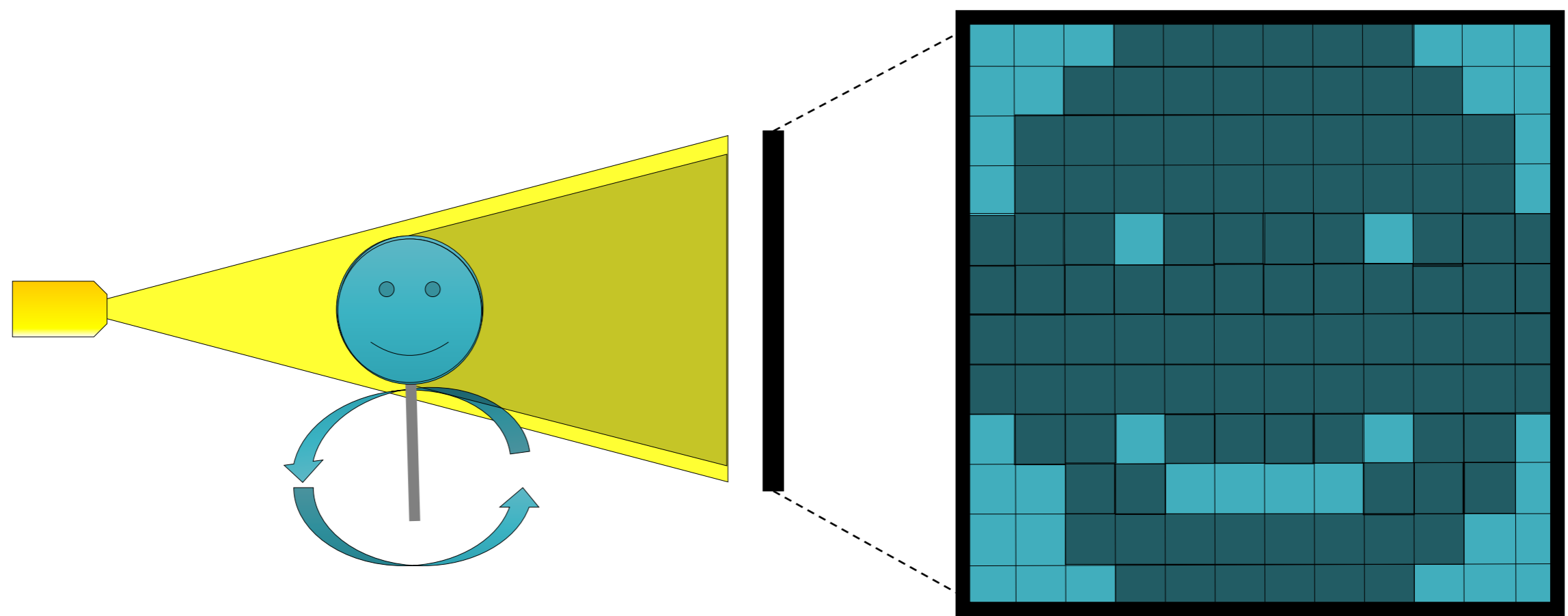


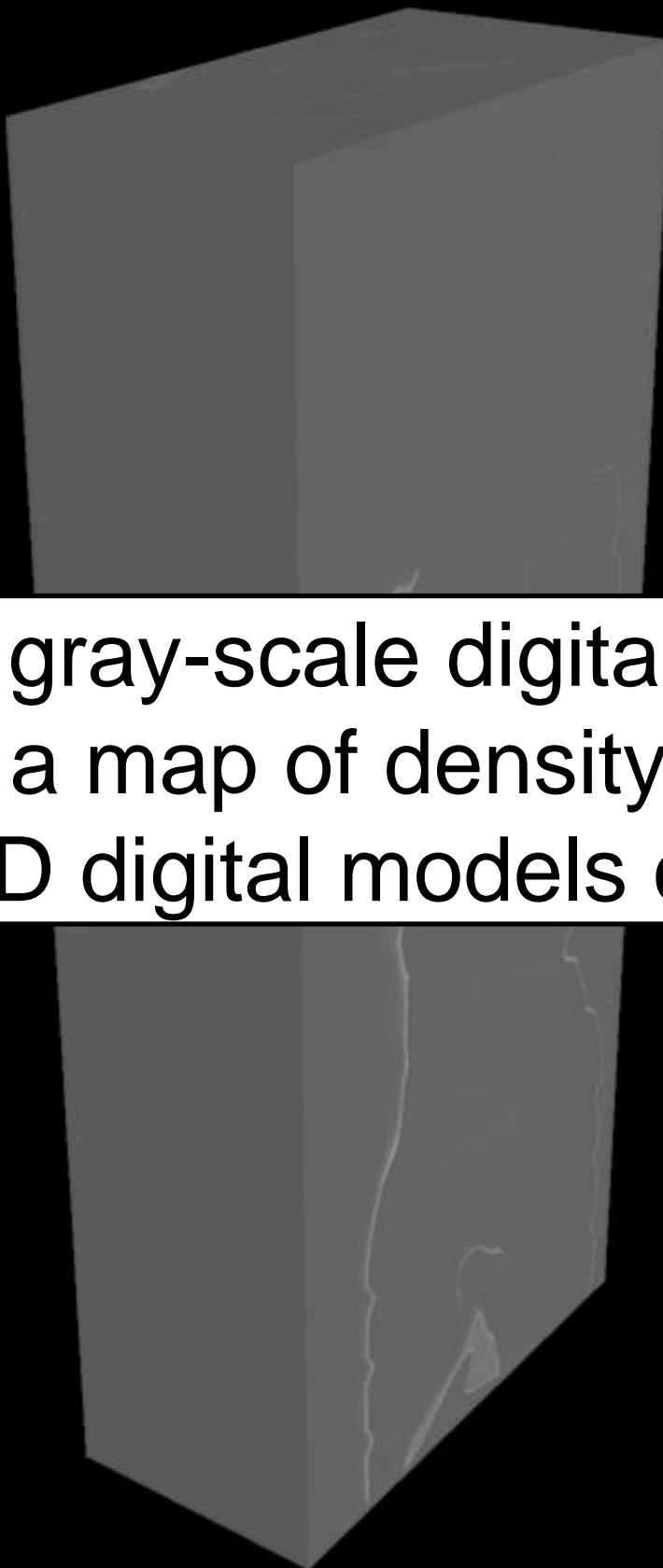
Stage



detector

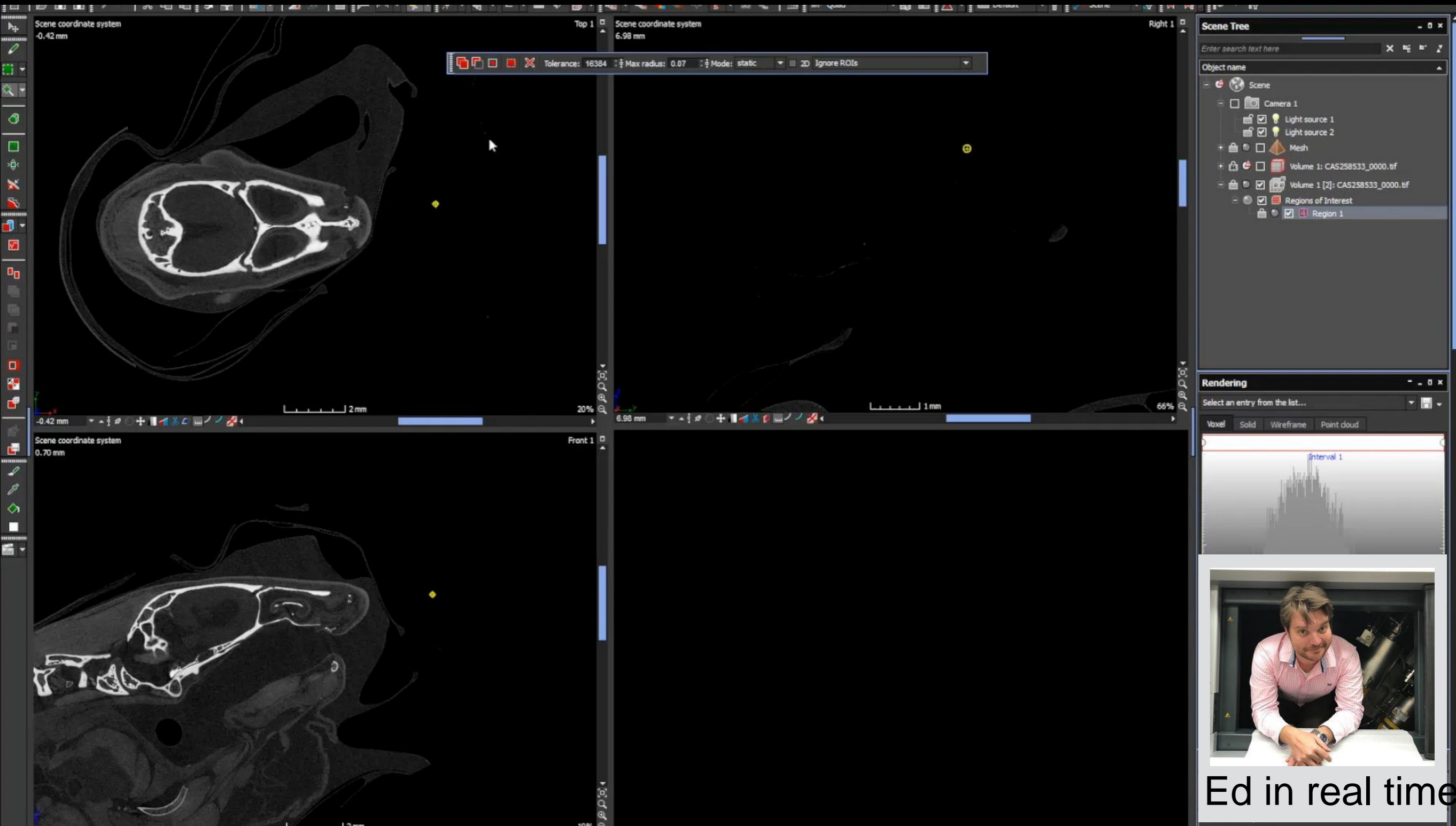
A few CT basics...





series of gray-scale digital images
representing a map of density in a volume
from which 3D digital models can be created

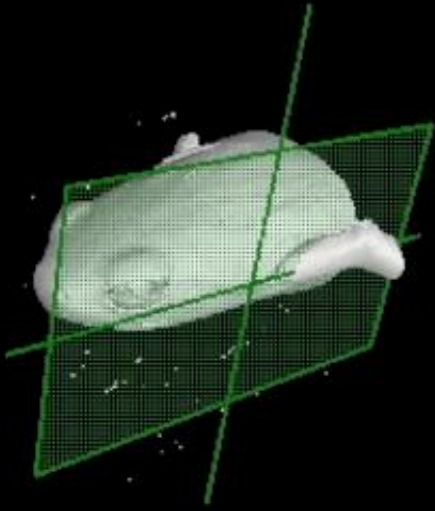
What can you do with these data? *create models*



Ed in real time

Hemisus
family Hemisotidae

What can you do with these data? *digital dissection*



Chaperina
family Microhylidae

Rare taxa

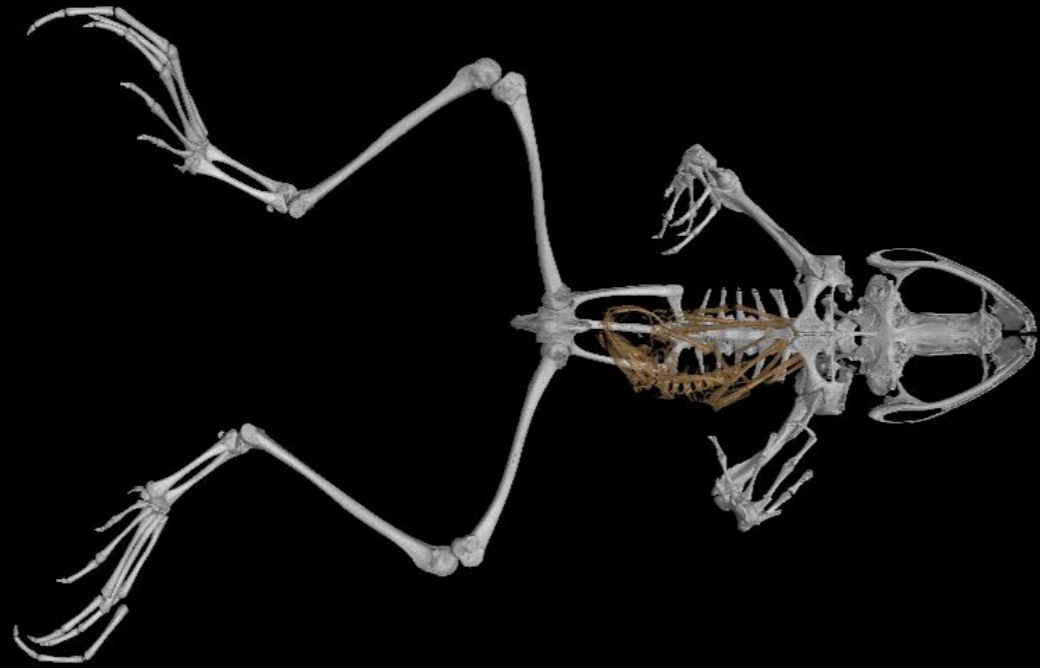


Cryptotora thamicola

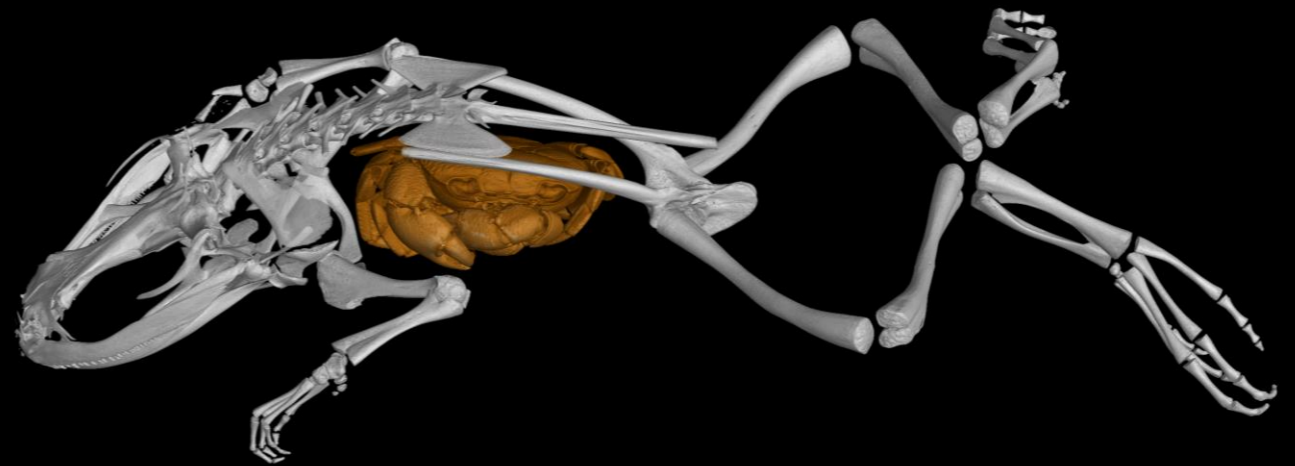
Total specimens in iDigBio:
110,711,328

Cryptotora specimens in iDigBio: 0

Natural History By-catch



Phrynobatrachus



Barbourula

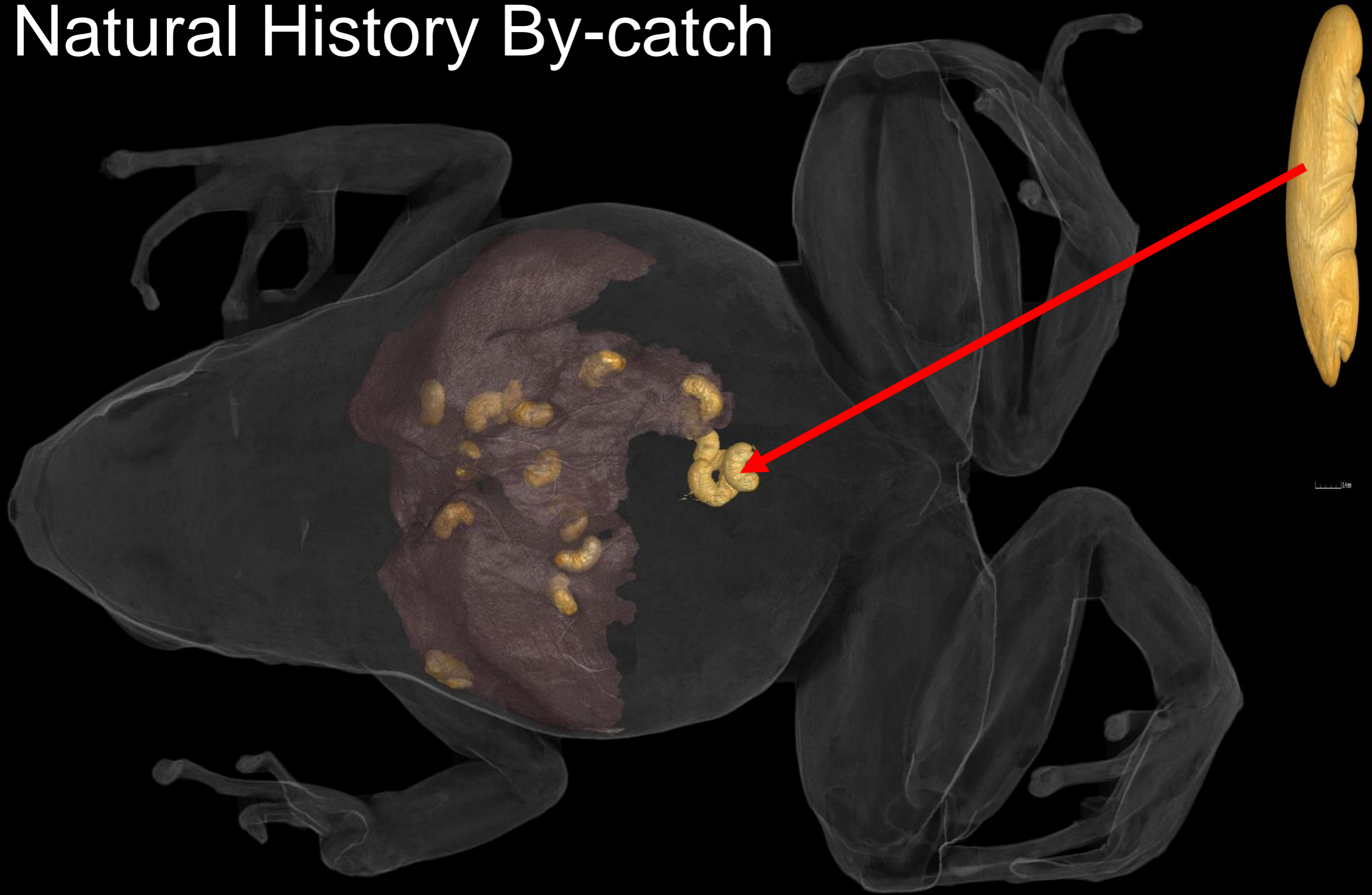


Paedophryne



Brachycephalus

Natural History By-catch



Colostethus
family Dendrobatidae

4.5 mm



openVertebrate Thematic Collections Network

\$2.5M from NSF's *Advancing Digitization of Biodiversity Collections* program

2017–2021



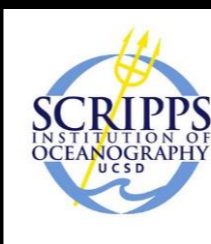
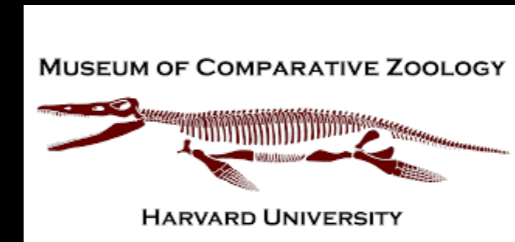
CT-scan >20,000 fluid-preserved vertebrate specimens

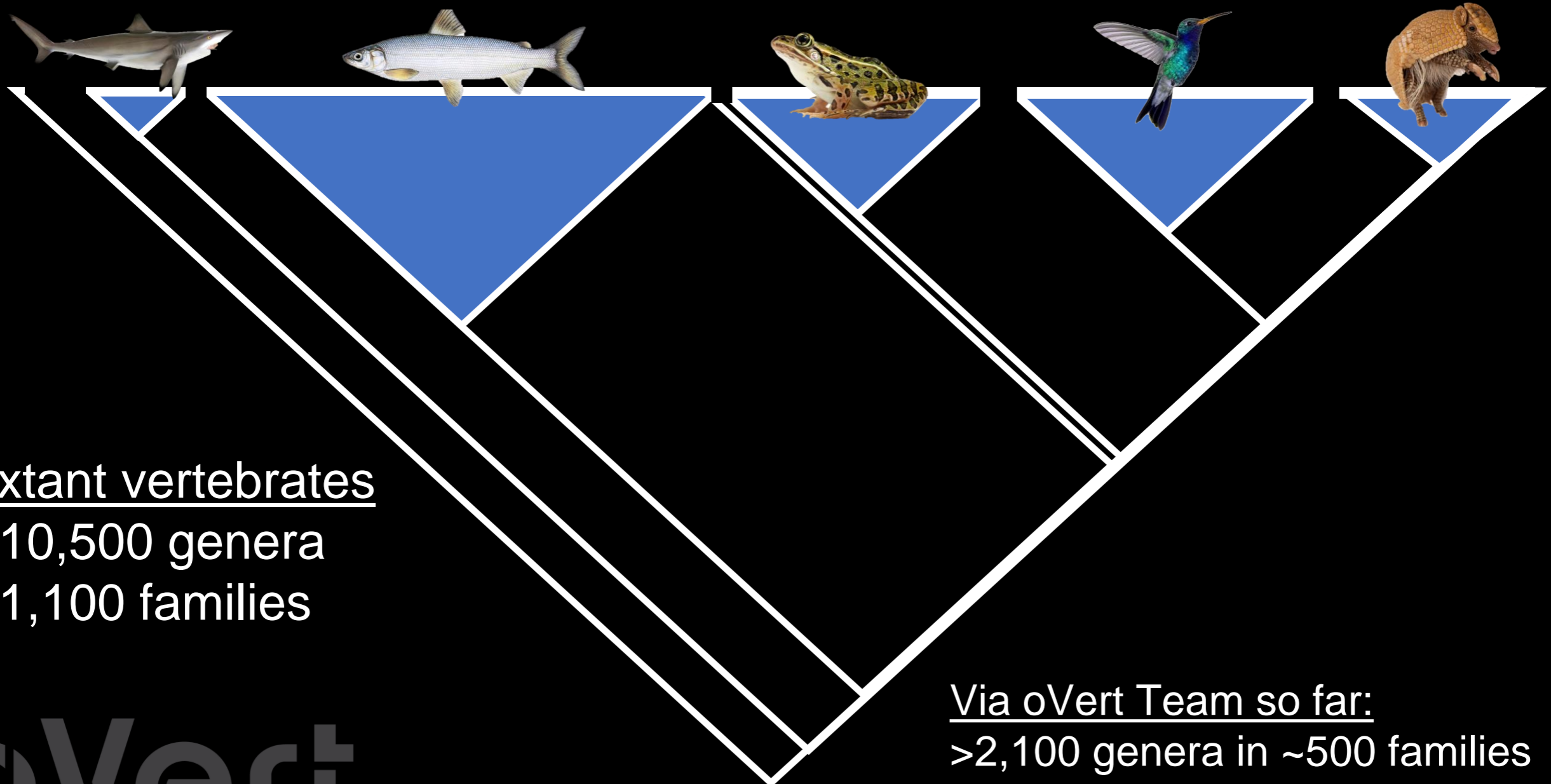
Scan >80% extant genera; “soft tissue” scan >60% extant families

Make both raw and processed data freely available on-line

overt

18 funded institutions, including 16 museums and 6 imaging centers





extant vertebrates

~10,500 genera

~1,100 families

Via oVert Team so far:

>2,100 genera in ~500 families

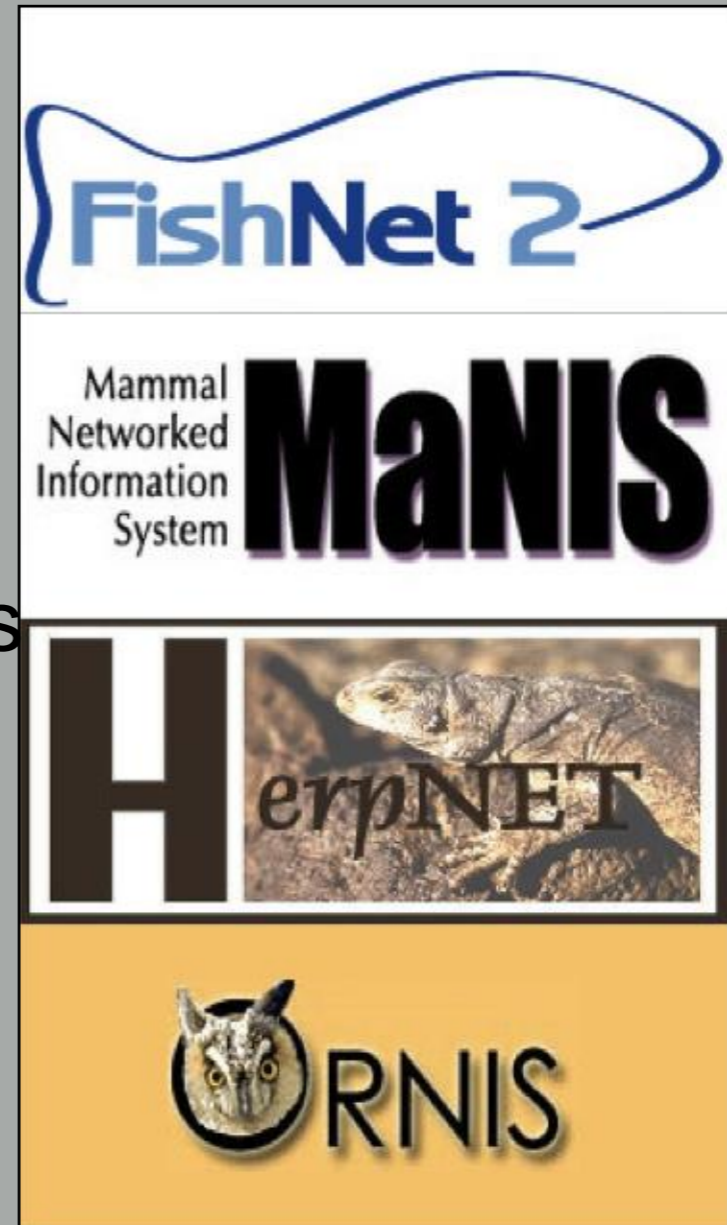
(resolution of most scans: ~20–80 μm)

oVert

Builds on previous collections digitization efforts

In US, most scientific collections of vertebrates are digitized

Digital inventory allows oVert to (1) discover specimens and (2) prioritize particular specimens





How do we choose specimens to scan?

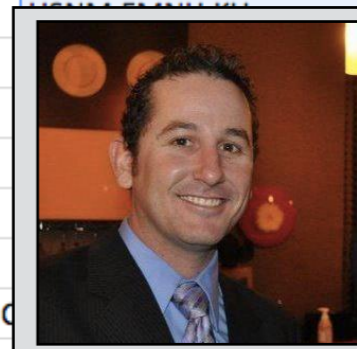
FISHES: idigbio currentTypeSpecies SUMMARY

File Edit View Insert Format Data Tools Add-ons Help All changes saved in Drive

100% \$ % .0 .00 123 Calibri 12 B I S A

fx hasTissueOrImage

	A	B	C	D	E
1	currentTypeSpecies	oVert collaborating institutions	non-funded US institutions	hasTissueOrImage	hasOtherNameInData
2	aapticheilichthys websteri	CAS			CAS
3	aaptosyax grypus	UMMZ,CAS	USNM		
4	abactochromis labrosus	YPM			
5	abbottina rivularis	CAS,UMMZ,UWFC,ANSP,FMNH	USNM	UWFC	CAS,USNM,ANSP,FMNH
6	ablabys taenianotus	CAS,FMNH,SIO	BPBM,USNM	USNM,FMNH,CAS	
7	ablennes hians	CAS,UF,SIO,MCZ,FMNH,ANSP,UMMZ,TCWC,TNH	NCSM,USNM,LACM,TU,BPBM,UAIC,AUM,OS	UF,KU,USNM	
8	aboma etheostoma	MCZ,CAS	USNM		
9	abramis brama	ANSP,SIO,UF,MCZ,CAS,UMMZ,FMNH,CU	USNM,UAIC,LACM,OSM,OS,NCSM		
10	abramites hypselonotus	MCZ,CAS,ANSP,FMNH,UMMZ	USNM,INHS,AUM	FMNH	
11	abudehduf sordidus	MCZ,SIO,CAS,FMNH,ANSP,UWFC,UF,TCWC,KU,Y	USNM,LACM,BPBM,OS,JFBM,TU,NCSM		
12	abyssoberyx levisquamosus		USNM		
13	abyssobrotula galathea	CAS,UF,SIO	USNM,OS		
14	abyssocottus korotneffi	UMMZ,FMNH	USNM		
15	acanthaluteres spilomelanurus	ANSP,SIO	USNM		
16	acanthanectes hystrix		USNM		
17	acantharchus pomotis	UMMZ,KU,CU,ANSP,UF,MCZ,CAS,FMNH,SIO,YPM	NCSM,AUM,LACM,INHS,TU,JFBM,USNM,MMNS,UAIC		
18	acanthemblemaria spinosa	FMNH,UF,ANSP,SIO,UMMZ,KU,MCZ	USNM,BPBM,TU,OS,AUM,LACM		



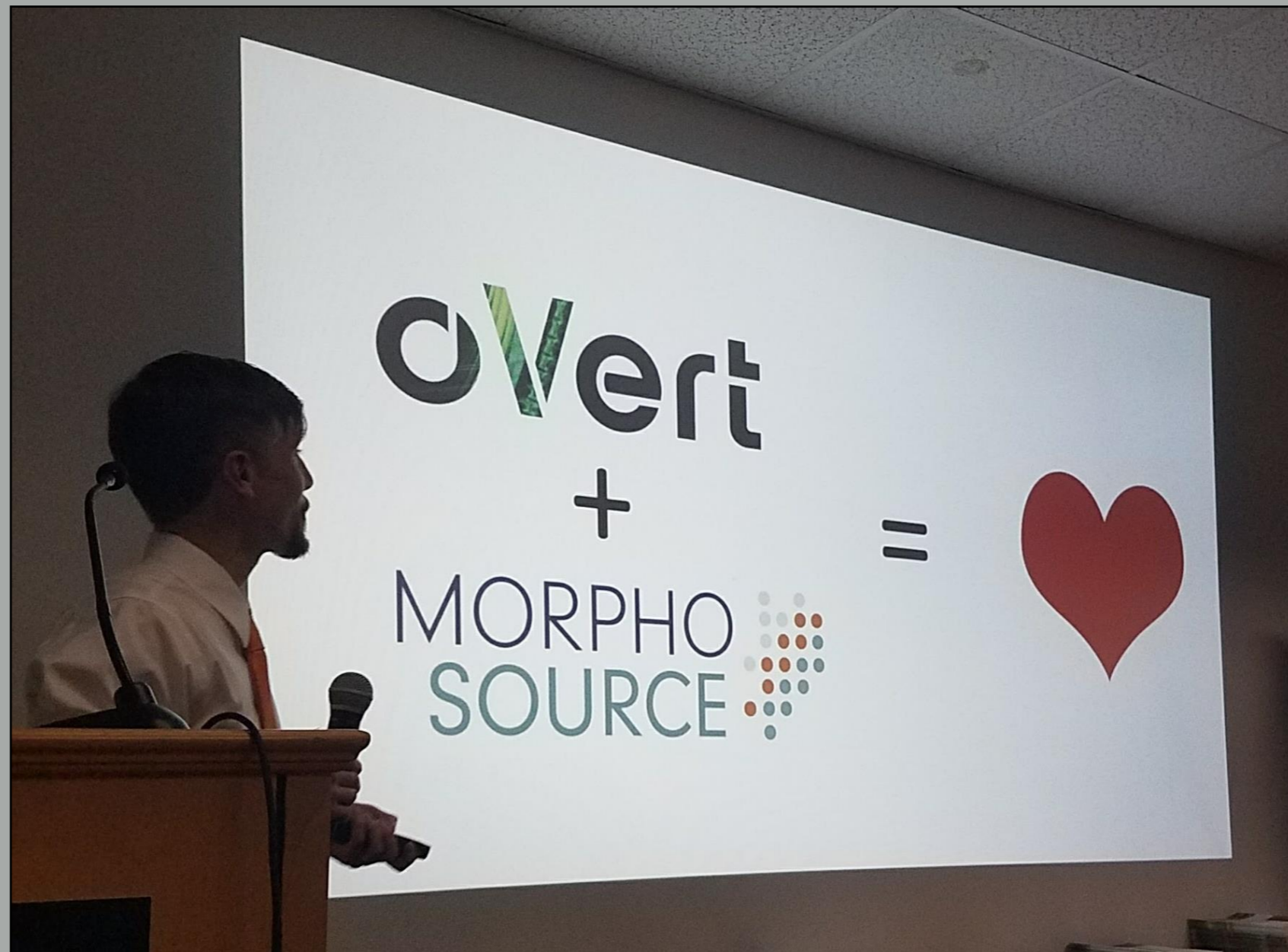
Kevin Love
iDigBio



Zach Randall
FLMNH

oVert

How can we best share these data?



Doug Boyer, Duke University
lead PI for MorphoSource; oVert coPI



On-line digital depository for 3D data
\$1.5M from NSF ABI Development

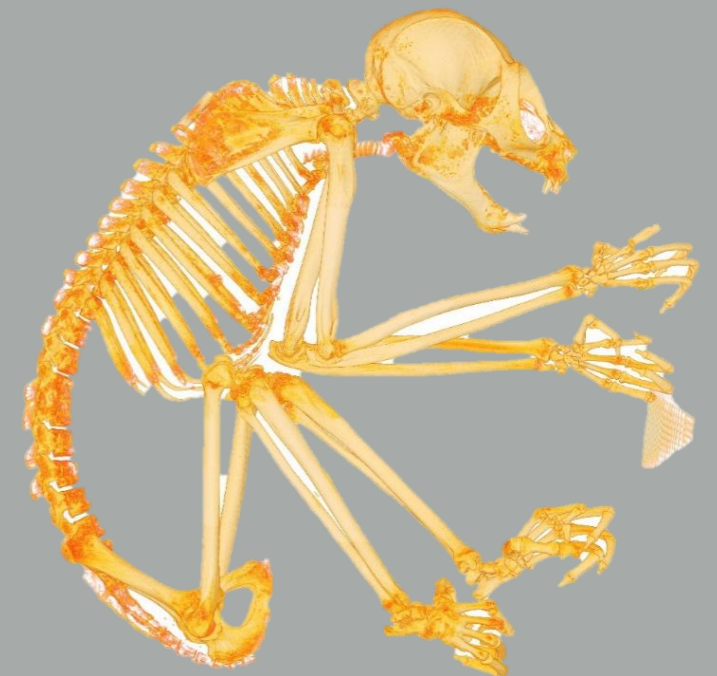


Supports various forms of data

User-contributed datasets

Working with oVert to improve workflows

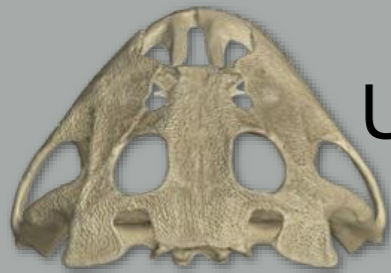
All data traceable back to specimens



Learn more tomorrow (Tuesday): Sibley Auditorium
1:45–2:00 PM Julie Winchester (MorphoSource)
2:15–3:00 PM, Q&A with oVert & MorphoSource

overt

Builds on previous collections digitization efforts



UF-Herp-12345

MorphoSource sends request



iDigBio
Application
Program Interface
(API)



iDigBio sends metadata

Darwin Core
structured metadata

referenceID
occurrenceID
locality
collectionDate
etc.

Getting information on media files back to collections



UF-Herp-12345

for each collection
(i.e., UF
Herpetology)



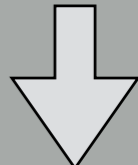
Darwin Core
structured metadata

referenceID
occurrenceID
locality
collectionDate
etc.

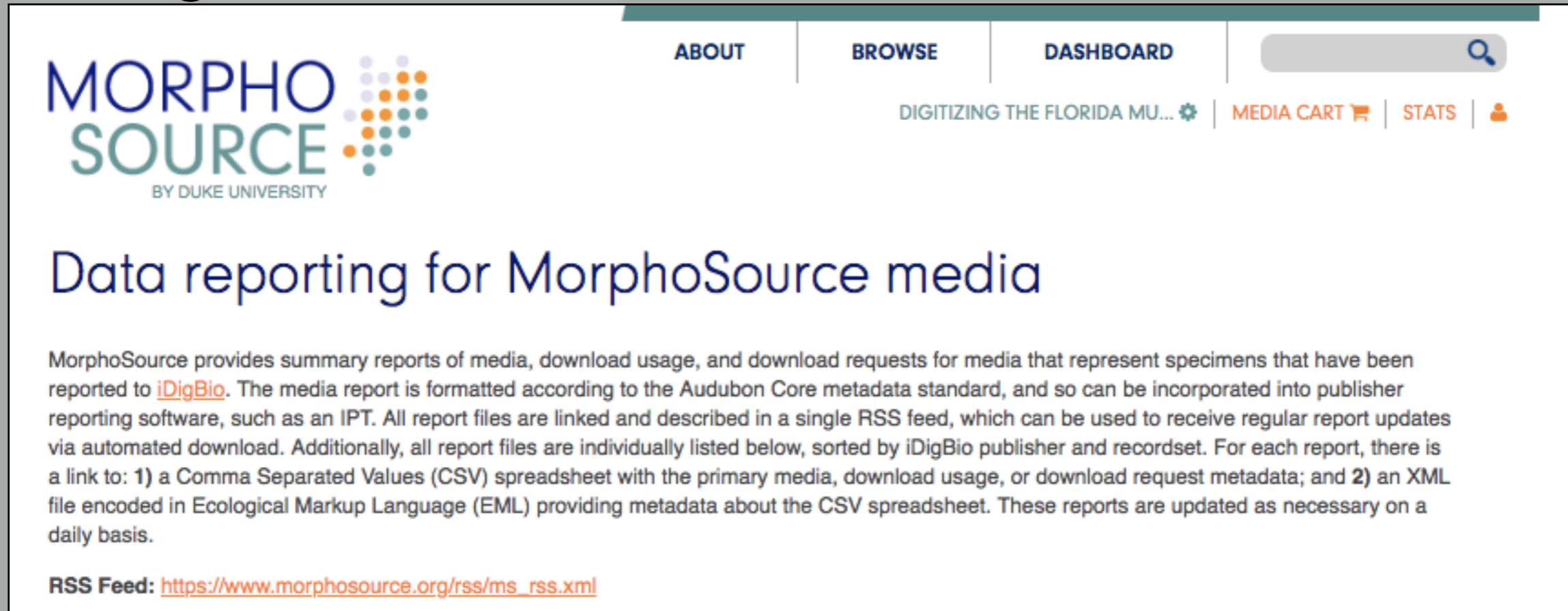
MorphoSource RSS Feed
(via referenceID)
containing
1) Audobon Core metadata
2) usage statistics



add Audobon Core
to IPT



Getting information on media files back to collections



The screenshot shows the MorphoSource website interface. At the top left is the MorphoSource logo with the text "BY DUKE UNIVERSITY". To the right are navigation links: "ABOUT", "BROWSE", "DASHBOARD", "DIGITIZING THE FLORIDA MU...", "MEDIA CART", "STATS", and a user icon. A search bar is also present. The main heading is "Data reporting for MorphoSource media". Below this is a paragraph explaining that MorphoSource provides summary reports of media, download usage, and download requests for media that represent specimens that have been reported to iDigBio. The reports are formatted according to the Audubon Core metadata standard and can be incorporated into publisher reporting software. All report files are linked and described in a single RSS feed. For each report, there is a link to: 1) a Comma Separated Values (CSV) spreadsheet with the primary media, download usage, or download request metadata; and 2) an XML file encoded in Ecological Markup Language (EML) providing metadata about the CSV spreadsheet. These reports are updated as necessary on a daily basis. At the bottom of the text is an RSS Feed link: https://www.morphosource.org/rss/ms_rss.xml

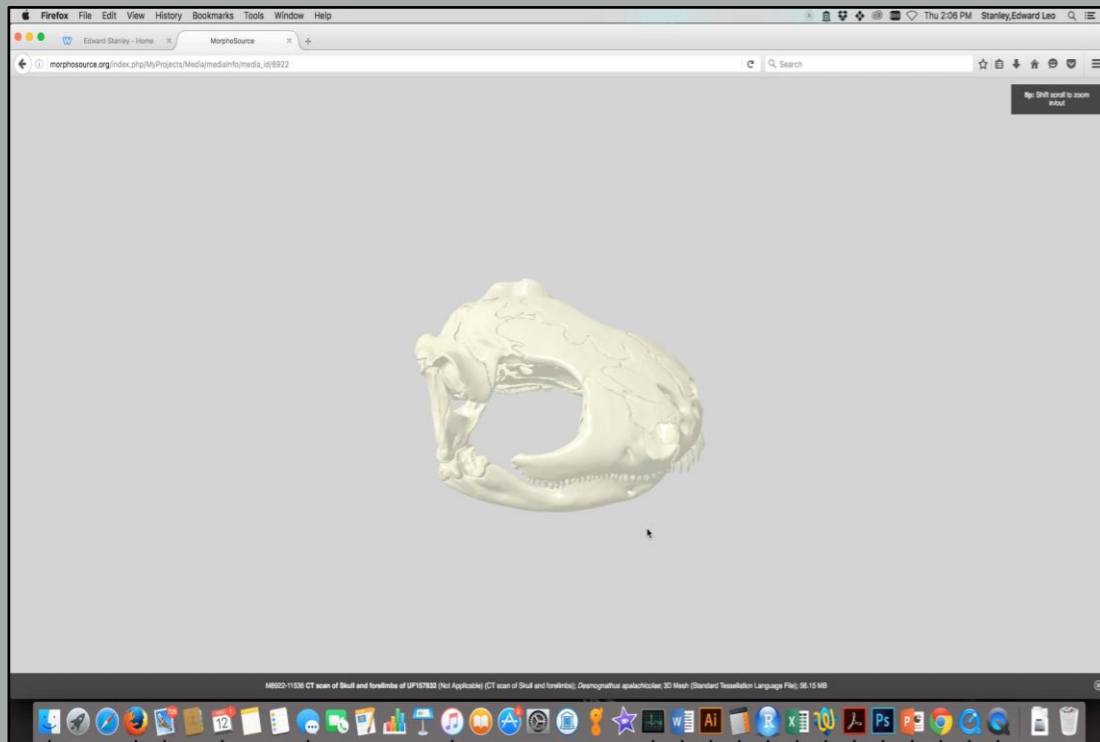
Berkeley Natural History Museums IPT (552a0e1a-4152-43ae-bad6-9314b4234536)

Recordset	Media	Downloads	Download Requests	Pub Date
University of California Museum of Paleontology_(5ab348ab-439a-4697-925c-d6abe0c09b92)	CSV EML	CSV EML	CSV EML	Thu, 24 May 2018 12:46:05 -0400

overt

Data deposited in MorphoSource

- 3D mesh files (.stl)
- image stacks (.zip of .TIFF)



Download or view in browser

Project: Frog Diversity

BACK

Members

David Blackburn, Trevor McCabe, Daniel Paluh, Maria Passarotti, Amber Singh, Edward Stanley, Olivia Trumble

Data

109 published media
173 specimen with published media

More Information

www.blackburnlab.org

About the project

The Blackburn Lab at the University of Florida's Florida Museum of Natural History is assembling a collection of CT scan data representing all extant families of frogs. This comparative dataset provides a library of anuran skeletons diversity that can be used in studies of diversity, evolution, comparative morphology, and paleontology.

173 Project Specimens

Group by: [Specimen Number](#) | [Family](#) | [Genus](#) | [Species](#)



Allophryinae
[2 Specimens](#)



Alsodidae
[2 Specimens](#)



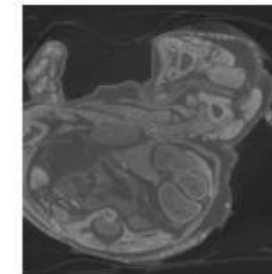
Alytidae
[2 Specimens](#)



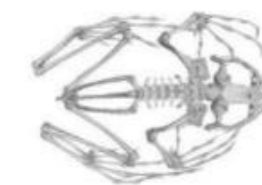
Aromobatidae
[1 Specimen](#)



Arthroleptidae
[8 Specimens](#)



Ascaphidae
[1 Specimen](#)



Batrachylidae
[3 Specimens](#)



Bombinatoridae
[2 Specimens](#)



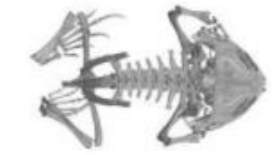
Brachycephalidae
[10 Specimens](#)



Brevicipitidae
[6 Specimens](#)



Bufonidae
[16 Specimens](#)



Calyptocephalellidae
[1 Specimen](#)

In ~2 years, 177 UF Herpetology specimens on MorphoSource
>23,000 media views, and ~2,822 downloads

example: *Shinisaurus crocodilurus*

>1,000 views on MorphoSource, 30+ downloads in Australia, UK, and US

The screenshot shows the MorphoSource website interface. At the top, there is a navigation bar with 'ABOUT', 'BROWSE', and 'DASHBOARD' links, along with a search bar and utility links for 'FROG DIVERSITY', 'MEDIA CART', and 'STATS'. The main content area is titled 'Media: M12414'. On the left, there are sections for 'Project' (Digitizing the Florida Museum of Natural History's Herpetology collections), 'Specimen Information' (Specimen: UF-H-60925, *Shinisaurus crocodilurus*; Specimen taxonomy: *Shinisaurus crocodilurus*; Element: CT scan of body; Institution: University of Florida, Florida Museum of Natural History, Gainesville, Florida, United States), and 'Scan Information' (Description: CT scan of *Shinisaurus crocodilurus*; Facility: Florida Museum of Natural History Herpetology; X res: 0.10264768 mm; Y res: 0.10264768 mm; Z res: 0.10264768 mm; Voltage: 100 kv; Amperage: 200 µa; Watts: 20 W; Projections: 1200; Wedge: air; Scanner calibrations: geometric calibration; Technicians: Edward Stanley; Media created on: December 7 2016 at 13:00:09; Media last modified on: December 7 2016 at 13:00:09). The right side of the page displays '3 media files' with a 'Citation Elements' link and a 'BACK' button. Three media items are listed: M12414-20363 (3D Mesh, 142.67 MB), M12414-20364 (3D Mesh, 39.27 MB), and M12414-20365 (TIFF image series ZIP file, 1.37 GB). Each item has a thumbnail image and an 'ADD' button. At the bottom of the page, there are links for 'CONTACT', 'LOGOUT', 'TERMS AND CONDITIONS', and 'USER GUIDE', along with a disclaimer: 'Commercial use of MorphoSource media is strictly prohibited.'



Stats on *Shinisaurus* Specimens

202 records in iDigBio

176 specimens in US

47 skeletons in 4 US institutions



In ~2 years, 177 UF Herpetology specimens on MorphoSource
>23,000 media views, and ~2,822 downloads

[M8691](#), 8/31/2017

maher, alice (A.E.Maher@liverpool.ac.uk)

For research project on body elongation

[M15979](#), 8/31/2017

Schwippert, Sophie (sophie_schwippert@web.de)

I want to use the data for my Bachelor Thesis, which I am currently working on at the University of Hamburg. My Thesis focuses on malformations of the sacrum of anurans. Thank you!

APPROVE

DENY

[M8902](#), 4/7/2017

Currier, Aaron (acurrier@central.k12.or.us)

8th grade classroom instruction

[M10212](#), 9/1/2017

Lee, Aaron (aaronlee70@gmail.com)

3D print of model for personal use. File will be stored. Will not be uploaded or shared. No commercial element.

[M9784](#), 4/7/2017

lewis, chris (cloois@gmail.com)

3d print for surgery planning

[M9207](#), 3/18/2017

Thomas, Lauren (lauren@thomasthomas.ca)

Import into Houdini, do cool stuff, post on my Instagram.

oVert

>50% download requests are for 'non-research'
most state an intention to 3D print

K12 classrooms



Academy of Holy Names
Tampa, Florida

Undergrad Teaching



Chris Sheil
John Carroll University

Art: "Creature Design" class

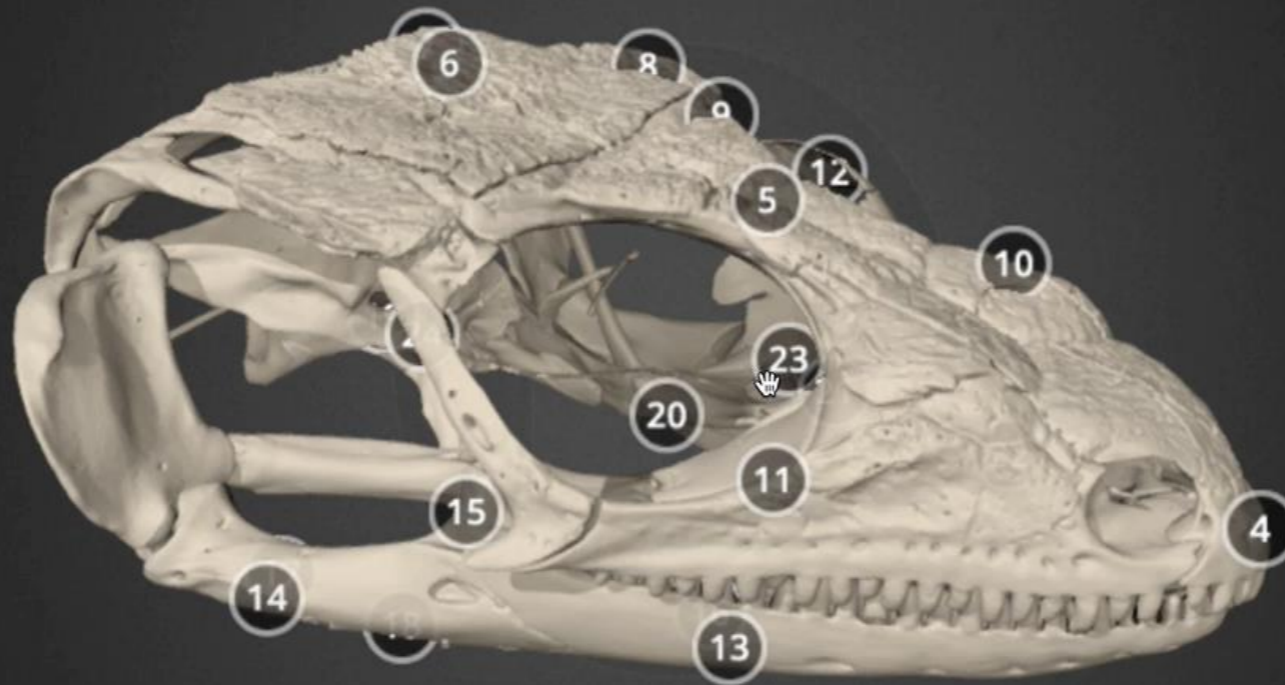


Lars Grant-West
Rhode Island School of Design

oVert is working to:

engage high school teachers in lesson plan development

develop on-line tutorials for using 3D data in research and education



Next step: distributed trait annotation

Methods in Ecology and Evolution



Methods in Ecology and Evolution 2016, 7, 472–482

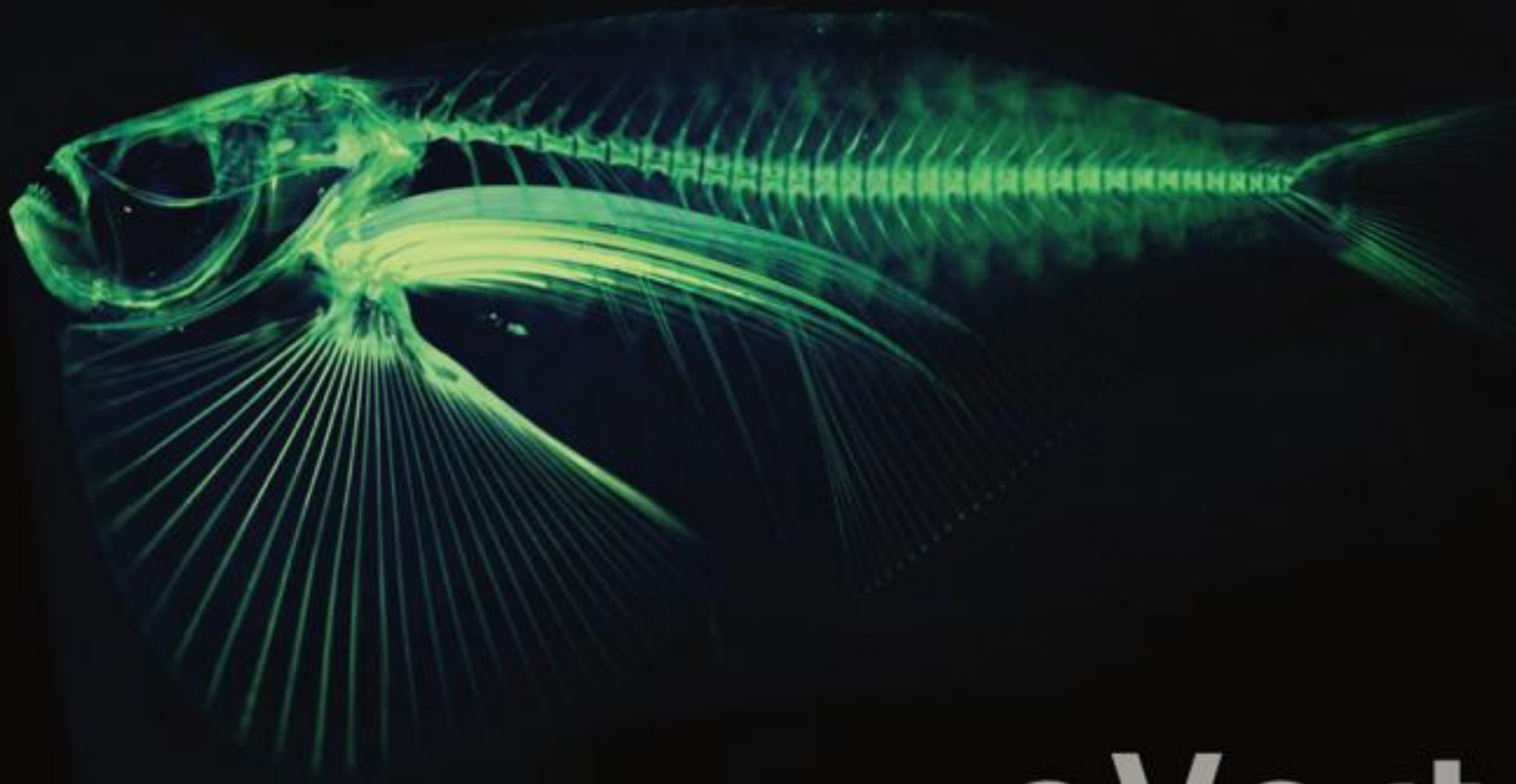
doi: 10.1111/2041-210X.12508

Crowdsourced geometric morphometrics enable rapid large-scale collection and analysis of phenotypic data

Jonathan Chang^{1*} and Michael E. Alfaro¹

http://bit.ly/oVert_iDigBio

#oVertTCN



oVert