

Digital Data in Paleontology. March 27, 2016

MorphoSource

3D Data Repository

Doug M. Boyer / Assistant Prof. (Duke)

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Ed Gomes / Associate Dean of IT (Duke)

Gregg Gunnell / Director of Fossil Primates (Duke)

Seth Kaufman / CEO & Founder Whirligig Inc.

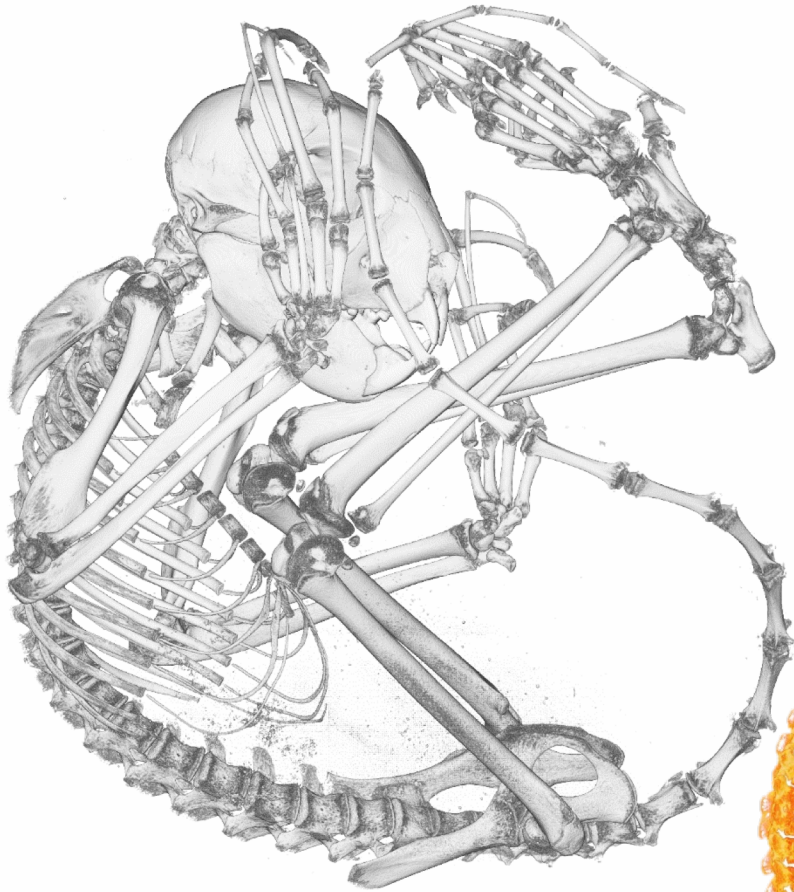




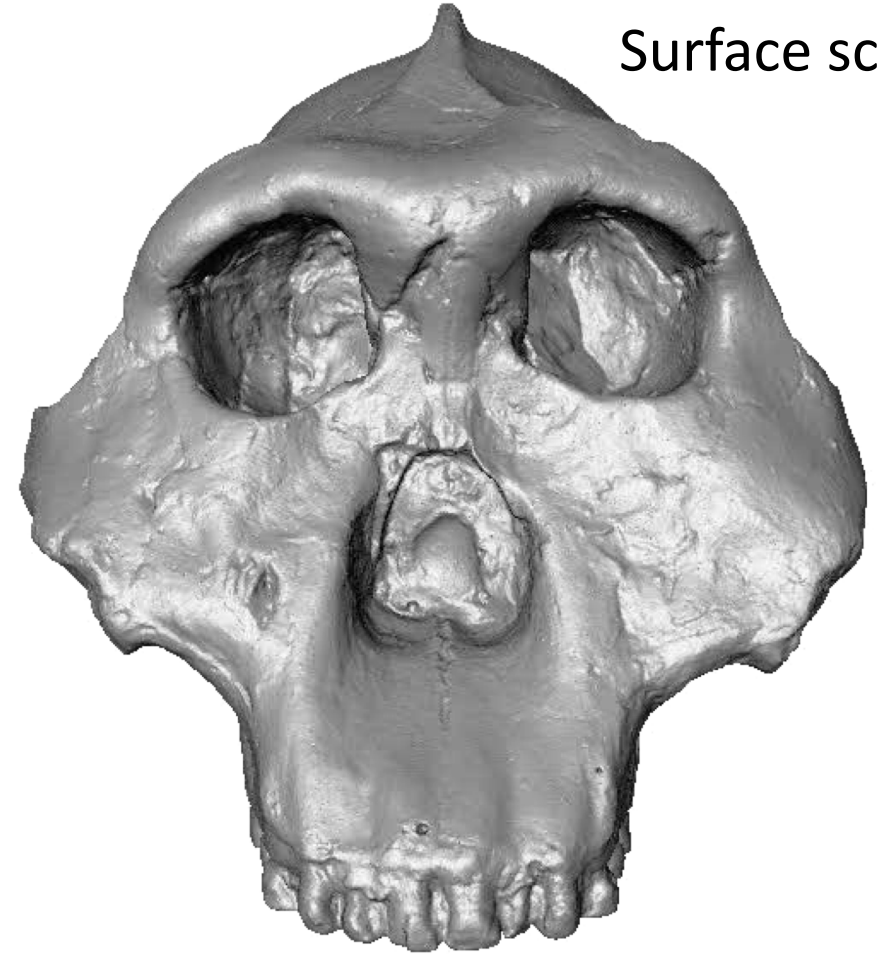
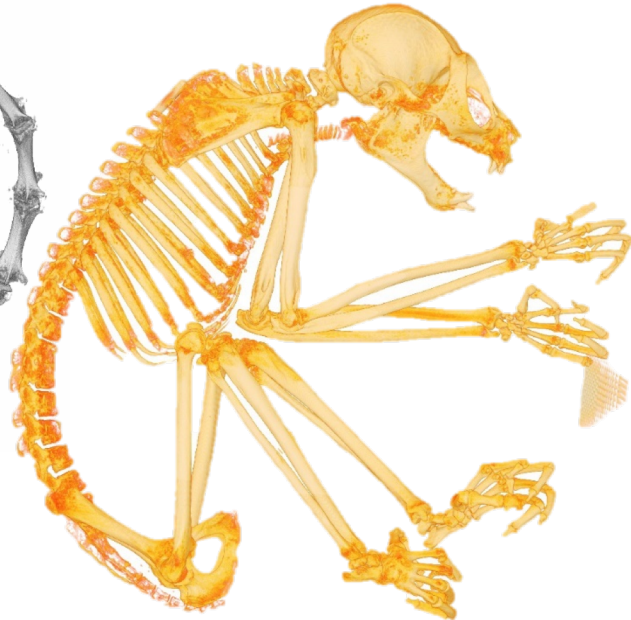
A web-accessible data archive for 3D scan data
Based at Duke University
Started 2013

www.morphosource.org

Supports open file formats: eg, tiff, jpeg, dicom, stl,
ply



microCT scans




Surface scans

Researchers contribute their datasets

Find & Download Datasets

BROWSE or

enter search terms 

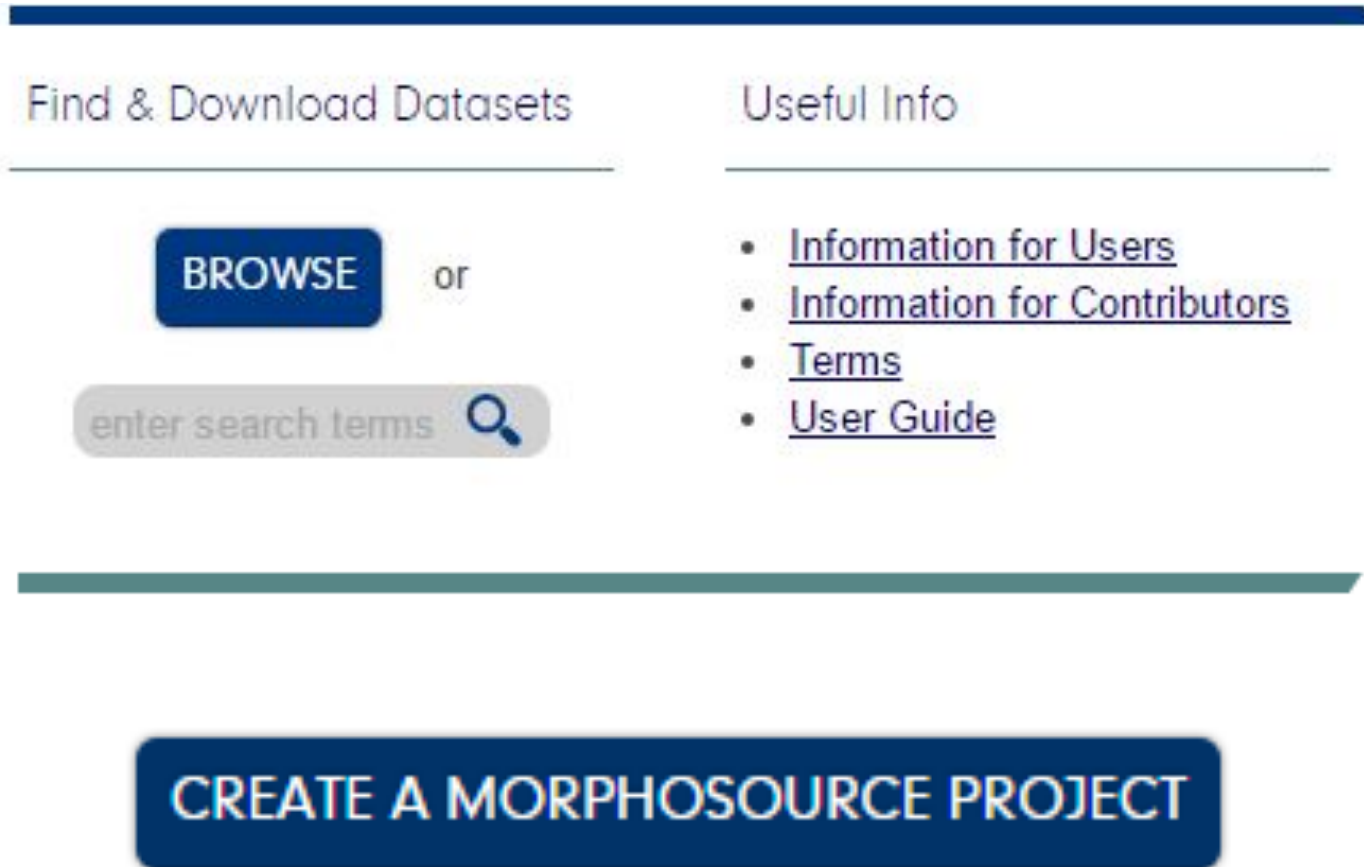
Useful Info

- [Information for Users](#)
- [Information for Contributors](#)
- [Terms](#)
- [User Guide](#)

Interested in creating a MorphoSource project?

BECOME A CONTRIBUTOR

Researchers contribute their datasets



Researchers contribute their datasets

Fossils

P278

NEW PROJECT

PROJECT INFO

MANAGE MEMBERS

CHANGE PROJECT

MEDIA

BIBLIOGRAPHY

TAXONOMY

FACILITIES

Project Members

Douglas Boyer

Number of Project
Media Groups

0

Number of Project
Media Files

0

Project Media Views/
Downloads

0/0

Storage used

0 B

Number of Specimens

0

Number of Citations

0

Created On

September 21 2016 (54 seconds)

0 Project Specimens

VIEW AS LIST

NEW SPECIMEN

Your project has no specimens. Use the "NEW SPECIMEN" button to add specimens, to which media may be added.

Researchers can obtain data GUIDs (DOIs)


DNMNH-G-22149, *Procavia sp.*



M6014-5467

3D Mesh (Polygon File Format), 92.61
MB

[Citation Elements](#)

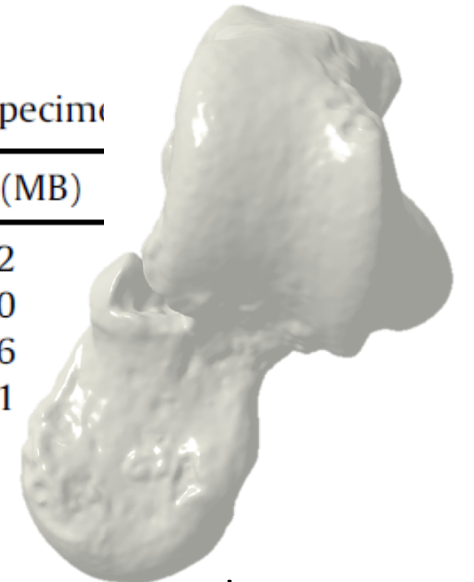
ADD 

To include in published papers

Table 1

Astragali and calcanei attributed to *Anchomomys frontanyensis* and used in this study with information about each specimen

Specimen	Element	Side	MoSo media	Doi	File type	File size (MB)
IPS-7712	Astragalus	Left	M6345-6065	doi:10.17602/M2/M6065	Ply, mesh file	8.02
IPS-7713	Astragalus	Left	M6346-6066	doi:10.17602/M2/M6066	Ply, mesh file	11.20
IPS-7750	Astragalus	Right	M6347-6067	doi:10.17602/M2/M6067	Ply, mesh file	10.66
IPS-7796	Astragalus	Right	M6348-6068	doi:10.17602/M2/M6068	Ply, mesh file	10.41



www.morphosource.org

Anyone can get data from MorphoSource

Exploring specimens & media

Find & Download Datasets

BROWSE

or

Ptilocercus skull

Useful Info

- [Information for Users](#)
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Anyone can get data from MorphoSource

Exploring specimens & media

Media results for “Ptilocercus skull”

Jump to page: GO

17 results

◀ Previous page 1/3 Next ▶

OPTIONS ▶



ADD



ADD

M6508
[USNM-481103.](#)
[Ptilocercus lowii](#)
CT Volume Data
1 file



ADD

M6509
[USNM-481103.](#)
[Ptilocercus lowii](#)
CT Volume Data
2 files



ADD

M6516
[USNM-481103.](#)
[Ptilocercus lowii](#)
Reference photos
5 files

Specimen results

3 results

[USNM-481103. *Ptilocercus lowii*](#)
[USNM-481107. *Ptilocercus lowii*](#)
[USNM-488052. *Ptilocercus lowii*](#)

Stats

- 23,000 scan datasets
- 5,400 specimens
- 1,200 taxonomic names
- 139 institutions
- 57 scanning facilities
- 470,000 views
- 47,000 downloads
- 3,700 user accounts

Specimen Information

Specimen: [DPC-18651](#), *Parapithecus grangeri*

Specimen taxonomy: *Parapithecus grangeri*

Institution: Duke Lemur Center Divison of Fossil Primates, Durham, NC, USA

Scan Information

Type: Image (TIFF)

Filesize: 710.14 MB

Is this media copyrighted?: Yes

Copyright permission: Person loading media owns copyright and grants permission for use of media on MorphoSource

Copyright license: Attribution-NonCommercial CC BY-NC - reuse but noncommercial

Copyright Holder: Duke Division of Fossil Primates

Facility: Duke SMIF

X res: 0.035305630415678 mm

Y res: 0.035305630415678 mm

Z res: 0.035305630415678 mm

Voltage: 140 kv

Amperage: 200 µa

Watts: na

Projections: 2900

Frame averaging: 2

Wedge: none

Scanner calibrations: No calibrations are listed

Technicians: Gabriel Yapuncich

Media created on: June 6 2013 at 13:04:26

Media last modified on: September 8 2014 at 12:50:55



[DOWNLOAD MEDIA](#)

Datasets on MorphoSource

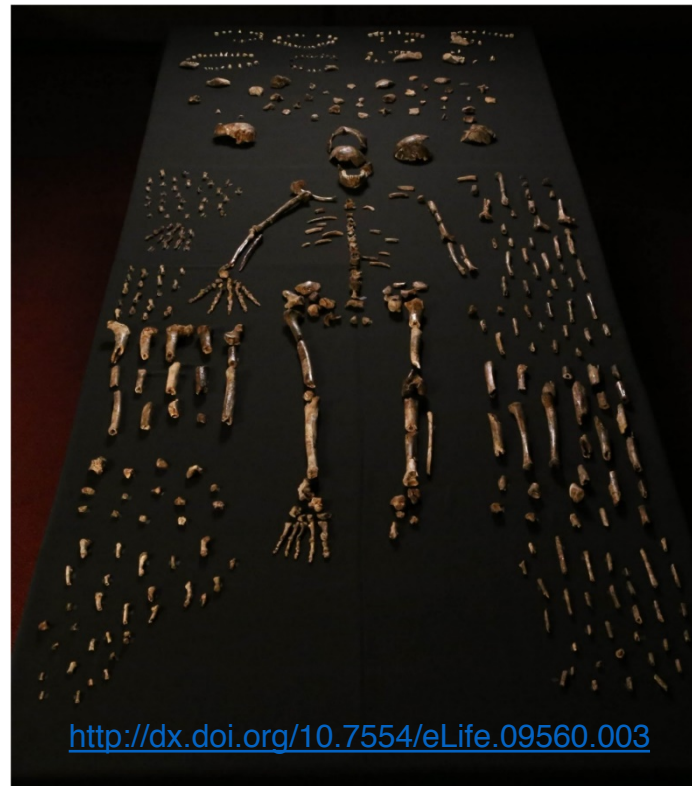
Published Datasets for Download

- 91 specimens of Newly described South African hominid



Article | **Figures & data** | Metrics | Article & author info

Homo naledi, a new species of the genus *Homo* from the Dinaledi Chamber, South Africa
(*eLife*. Berger et al. 2015)



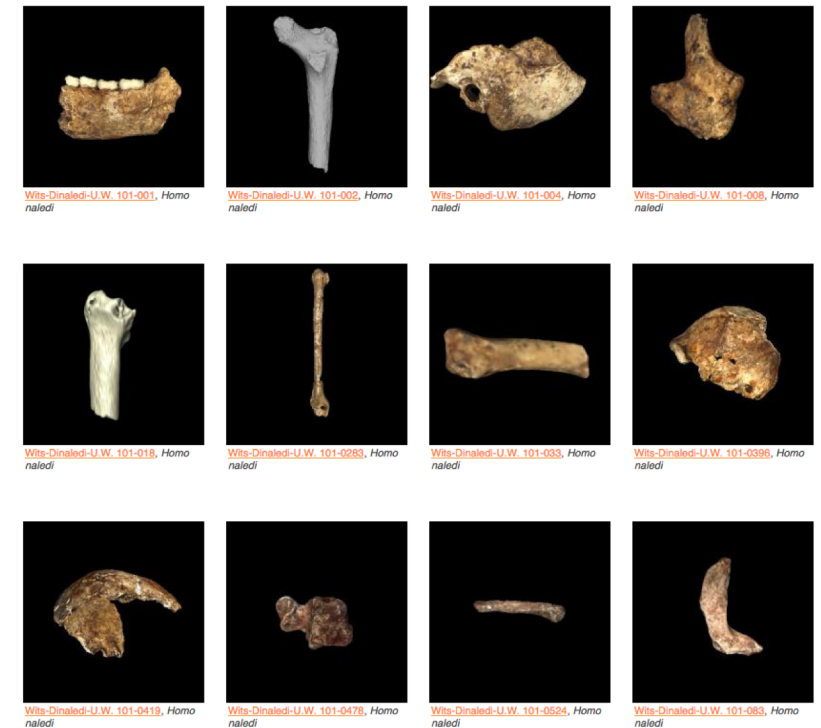
MORPHO SOURCE

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Project: Rising Star BACK

86 Project Specimens

Order by: Specimen number | Taxonomic name



Datasets on MorphoSource

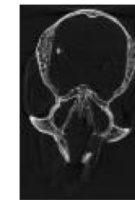
Media results

Jump to page: GO 311 results [Previous](#) [page 1/39](#) [Next](#)

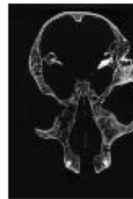
OPTIONS



M2601
[MCZ-25626](#),
[Cercocebus torquatus](#)
DICOM medical
imaging data image
series ZIP file
3.01 MB



M2602
[MCZ-25630](#),
[Cercocebus torquatus](#)
DICOM medical
imaging data image
series ZIP file
2.59 MB



M2852
[MCZ-62639](#),
[Cercocebus torquatus](#)
DICOM medical
imaging data image
series ZIP file
2.63 MB



M2853
[MCZ-32625](#),
[Cercocebus torquatus](#)
DICOM medical
imaging data image
series ZIP file
3.47 MB



M2854
[MCZ-32624](#),
[Cercocebus torquatus](#)
DICOM medical
imaging data image
series ZIP file
3.44 MB



M2860
[MCZ-23195](#),
[Cercocebus sp.](#)
DICOM medical
imaging data image
series ZIP file
2.82 MB



M2861
[MCZ-19982](#),
[Cercocebus torquatus](#)
DICOM medical
imaging data image
series ZIP file
3.52 MB



M2862
[MCZ-19184](#),
[Cercocebus torquatus](#)
DICOM medical
imaging data image
series ZIP file
3.54 MB

Specimen results

308 results

[MCZ-10131](#), [Saimiri oerstedii](#)
[MCZ-10132](#), [Saimiri oerstedii](#)
[MCZ-10133](#), [Saimiri oerstedii](#)
[MCZ-10134](#), [Saimiri oerstedii](#)
[MCZ-10138](#), [Ateles geoffroyi](#)
[MCZ-12758](#), [Macaca fascicularis](#)
[MCZ-14657](#), [Euoticus elegantulus](#)
[MCZ-14659](#), [Galago alleni](#)
[MCZ-14725](#), [Cercocebus albigena](#)
[MCZ-15312](#), [Pan troglodytes troglodytes](#)
[MCZ-15324](#), [Saguinus sp.](#)
[MCZ-16075](#), [Galago senegalensis](#)
[MCZ-16354](#), [Eulemur fulvus fulvus](#)
[MCZ-16356](#), [Eulemur fulvus rufus](#)
[MCZ-16370](#), [Eulemur fulvus rufus](#)
[MCZ-16375](#), [Propithecus verreauxi verreauxi](#)
[MCZ-16382](#), [Varecia variegata variegata](#)
[MCZ-16390](#),
[MCZ-16391](#), [Lemur catta](#)
[MCZ-16392](#), [Lemur catta](#)
[MCZ-16393](#), [Eulemur fulvus rufus](#)
[MCZ-17548](#), [Perodicticus potto](#)
[MCZ-17550](#), [Perodicticus potto](#)
[MCZ-17589](#), [Galago alleni](#)
[MCZ-17590](#), [Euoticus elegantulus](#)
[MCZ-17591](#), [Euoticus elegantulus](#)
[MCZ-17592](#), [Euoticus elegantulus](#)
[MCZ-17593](#), [Euoticus elegantulus](#)
[MCZ-18607](#), [Perodicticus potto](#)

Published Datasets for Download

- 431 specimens of extant primate skulls & skeletons
- Harvard Museum of Comparative Zoology (MCZ)
(*Nature Science Data*, Copes et al. 2016)



Datasets on MorphoSource

Published Datasets for Download

- Herp's
- D. Blackburn (UF)

Project: Digitizing the Florida Museum of Natural History's Herpetology collections

BACK

80 Project Specimens

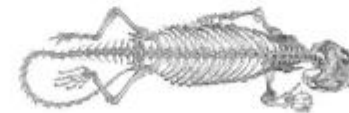
Order by: [Specimen number](#) | [Taxonomic name](#)



[UF-11978](#), *Sphenodon punctatus*



[UF-H-100788](#), *Spea multiplicata*



[UF-H-14110](#), *Sphenodon punctatus*



[UF-H-43506](#), *Kinosternon hirtipes tarascense*

Datasets on MorphoSource

Published Datasets for Download

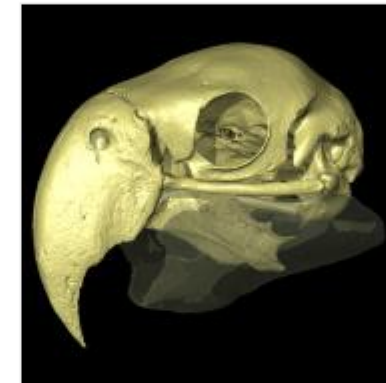
- Birds
- L. Witmer (OU)

Specimen Information

Specimen: [OUVC-OUVC 10633, *Ara macao*](#)
Specimen taxonomy: *Ara macao*
Element: dried skull and mandible
Institution: Ohio University, Athens, OH, United States

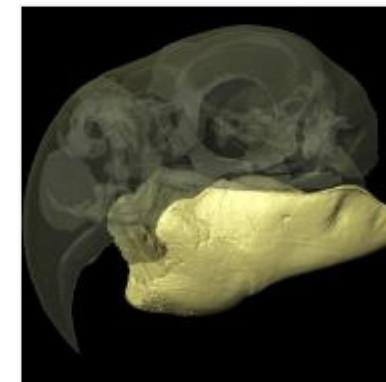
Scan Information

Description: Visible Interactive Parrot
Notes: zip file of μ CT scan data in DICOM format
Grant support: NSF grants IOB-0517257, IOS-1050154, IOS-1456503
Media citation instructions: WitmerLab at Ohio University provided access to these data originally appearing on The Visible Interactive Parrot website, the collection of which was funded by NSF. The files were downloaded from www.MorphoSource.org, Duke University.
Facility: Ohio University MicroCT Facility
X res: 0.09 mm
Y res: 0.09 mm
Z res: 0.09 mm
Voltage: 80 kv
Amperage: 450 μ a



M9970-14114
3D Mesh (Standard Tessellation Language File), 48.17 MB
Visible Interactive Parrot
STL of skull,
derivative file

[ADD](#)



M9970-14115
3D Mesh (Standard Tessellation Language File), 36.51 MB
Visible Interactive Parrot
STL of mandible,
derivative file

[ADD](#)

6 media files

Datasets on MorphoSource

Published Datasets for Download

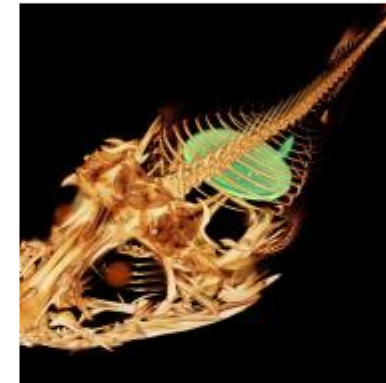
- Fish
- A. Summers (UW)



[BMNH-2001.1.21.58-71](#),
Gastromyzon borneensis



[OSU-013876](#), *Cottus asper*



[ROM-50997](#), *Chorisochismus dentex*



[TCWC-11247.01](#), *Mystus armatus*



[TCWC-13988.05](#), *Corydoras sp.*



[TCWC-16994.04](#), *Cyprinella lepida*



[TCWC-UnCat](#)

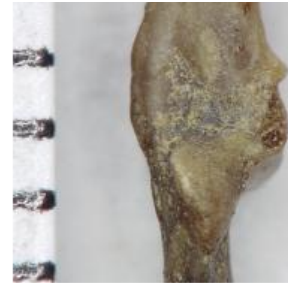


[UW-118012](#), *Arteidiellus camchaticus*

Datasets on MorphoSource

Published Datasets for Download

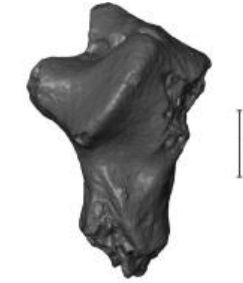
- Fossil primate material
- e.g., University of Colorado Museum



[UCM-56852](#), *Tetonius homunculus*



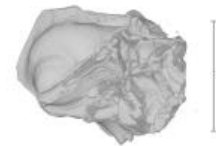
[UCM-56853](#), *Anemorhysis pearcei*



[UCM-56854](#), *Omomyidae incertae sedis*



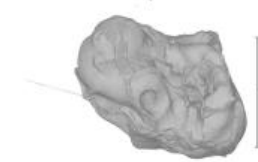
[UCM-57458](#), *Hemiacodon gracilis*



[UCM-57459](#), *Omomys carteri*



[UCM-57460](#), *Omomys carteri*



[UCM-57461](#), *Omomys carteri*



[UCM-60901](#), *Anemorhysis pearcei*



[UCM-60918](#), *Notharctus ventricolus*



[UCM-60920](#), *Notharctus ventricolus*



[UCM-60940](#), *Cantius mckennai*



[UCM-62671](#), *Notharctus ventricolus*

Datasets on MorphoSource

Published Datasets for Download

- Invertebrates

Specimen Media



[M1642](#), New centipede source images
unknown image series ZIP file, 1.86
GB

Specimen Information

Specimen: CBSS-CHP517-1, *Eupolybothrus cavernicolus*,
Unvouchered, Female

The Croatian Biospeleological Society (CBSS) is non-governmental, non-profit organization acknowledged, registered and supported by Ministry of Science, Education and Sport that has been working successfully since its foundation in 1996. It is an organization for biospeleology that deals with research and conservation of subterranean fauna and its habitats on the whole territory of the Republic of Croatia with its members being both scientists, experts and cavers.

Locality: country: Croatia; stateProvince: Knin; locality: NP Krka, village Kistanje, Hydroelectric power plant Miljacka, cave Miljacka II; verbatimElevation: 115 m;
44.000306, 16.016250

Institution: Croatian Biospeleological Society (CBSS), Zagreb, Croatia

Bibliography

Pavel Stoev, Ana Komericki, Nesrine Akkari, Shanlin Liu, Xin Zhou, Alexander M. Weigand, Jeroen Hostens, Christopher I. Hunter, Scott C. Edmunds, David Porco, Marzio Zapparoli, Teodor Georgiev, Daniel Mietchen, David Roberts, Sarah Faulwetter, Vincent Smith, Lyubomir Penev. 2013. *Eupolybothrus cavernicolus* Komericki & Stoev sp. n. (Chilopoda: Lithobiomorpha: Lithobiidae): the first eukaryotic species description combining transcriptomic, DNA barcoding and micro-CT imaging data. *Biodiversity Data Journal*. Vol. 1. Pensoft Publishers.

Datasets on MorphoSource

Published Datasets for Download

- invertebrates

Media results

3 results

OPTIONS ▾



M6432
[ZSM-C CT1](#),
[Limbodessus baliem](#)
Limbodessus
baliem, male
2 files

ADD 🛒



M6433
[ZSM-C CT3](#),
[Limbodessus alexanderi](#)
Limbodessus
alexanderi female
2 files

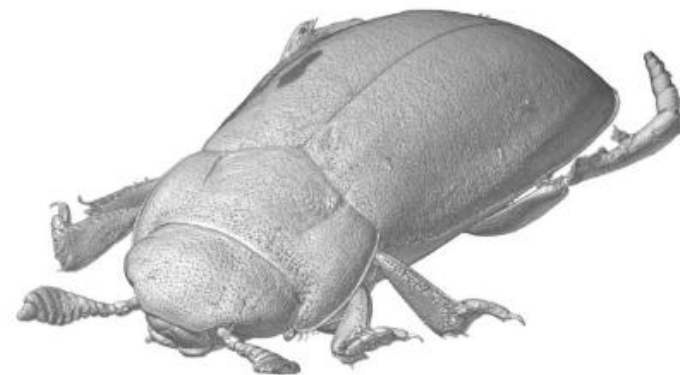
ADD 🛒



M6434
[ZSM-C CT2](#),
[Limbodessus alexanderi](#)
Limbodessus
alexanderi male
2 files

ADD 🛒

M6433



ZSM-C CT3, *Limbodessus alexanderi*
SNSB X-ray facility

Specimen results

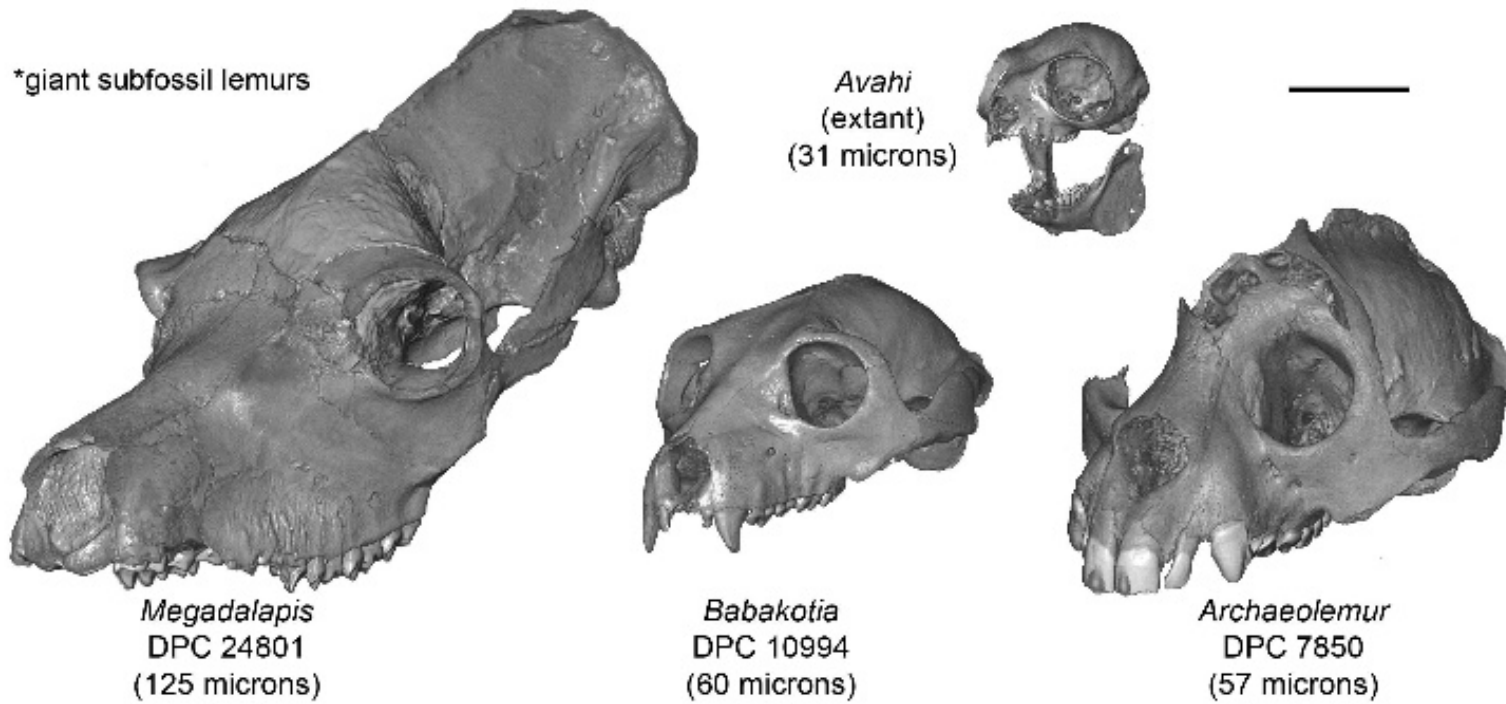
3 results

[ZSM-C CT1, *Limbodessus baliem*](#)
[ZSM-C CT2, *Limbodessus alexanderi*](#)
[ZSM-C CT3, *Limbodessus alexanderi*](#)

[CONTACT](#) | [USER GUIDE](#)

oSource media is strictly prohibited.

Duke's own fossils on MorphoSource



Fossils from Duke's Fossil Primate Center
(~32,000 specimens from Egypt, Madagascar, Columbia and US)

Educational Collections

MORPHO SOURCE

ABOUT | BROWSE | DASHBOARD | K12 HUMAN EVOLUTION | MEDIA CART | STATS | MANAGE | BIBLIOGRAPHY | FACILITIES | INSTITUTIONS | PROJECTS | TAXONOMY | SPECIMEN | USERS | STATS





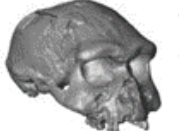







K-12 Human Evolution

MEDIA | BIBLIOGRAPHY | TAXONOMY | FACILITIES

42 Project Specimens

VIEW AS LIST | NEW SPECIMEN

Order by: Specimen number | Taxonomic name

 EA-CCC-01, <i>Pan troglodytes</i>	 EA-CCC-02, <i>Australopithecus africanus</i>	 EA-CCC-03, <i>Australopithecus boisei</i>	 EA-CCC-04, <i>Homo habilis</i>
 EA-CCC-05, <i>Homo erectus</i>	 EA-CCC-06, <i>Homo erectus</i>	 EA-CCC-07, <i>Homo neanderthalensis</i>	 EA-CHC-01, <i>Homo sapiens</i>
 EA-DCC-01, <i>Australopithecus afarensis</i>	 EA-DCC-02, <i>Australopithecus boisei</i>	 EA-DCC-03, <i>Homo heidelbergensis</i>	 EA-HC-01, <i>Homo sapiens</i>

21,000 views, 2,000 downloads



Leveraging other work



- Collaborations with other bioinformatics databases
- Mutual ingest and synchronization of records where appropriate



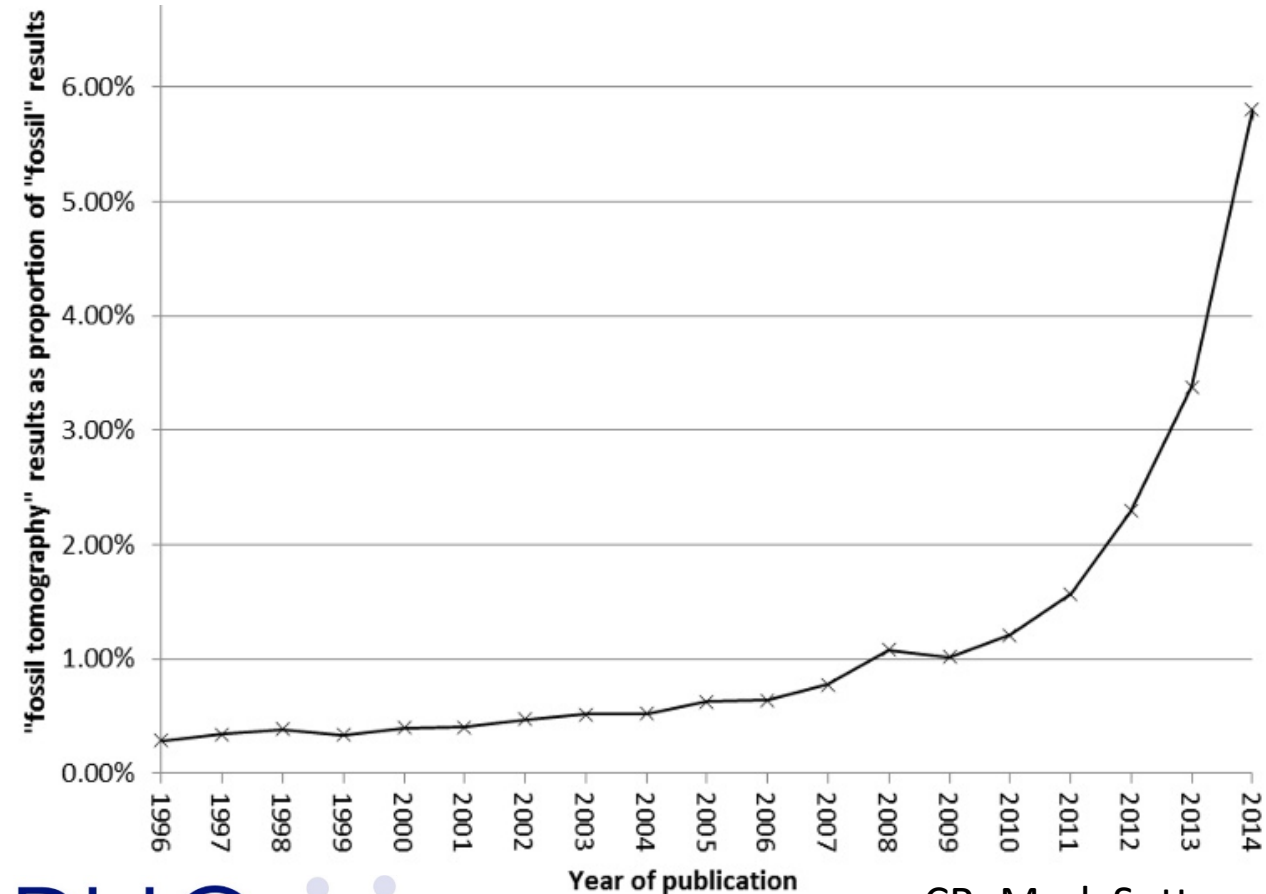
PBDB



GRBio
GLOBAL
REGISTRY OF
BIODIVERSITY
REPOSITORIES

Why do we need a database for 3D data?

1. 3D data are becoming fundamental to research in anatomy and paleontology
2. Transparency in science means access to these data
3. Time consuming, costly, and risky to generate scans
4. Excellent reuse potential



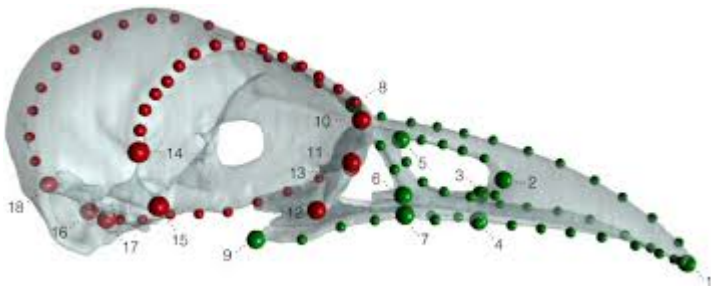
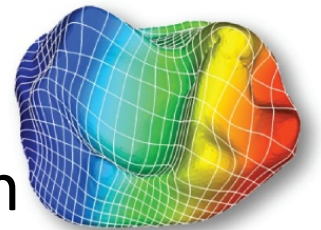
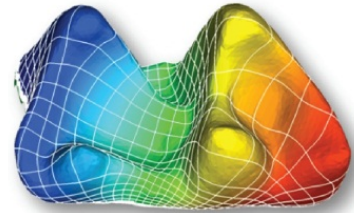
CR: Mark Sutton



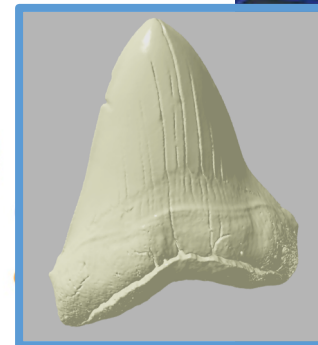
Why do we need a database for 3D data?

Benefits

1. **Researchers** (quick access, bigger samples, more sophisticated analyses)
2. **Museums** (improved real & demonstrable value of collections, reduced demand for new scanning, & eliminates need develop own web archive)
3. **Education** (access to previously off-limits collections)



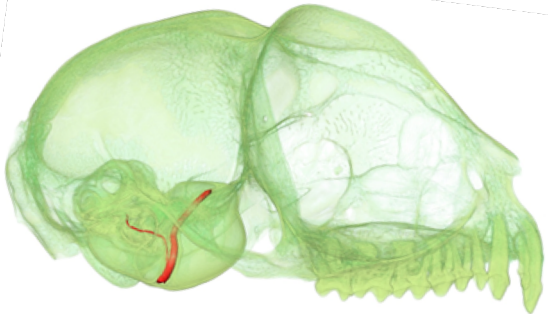
MORPHO
SOURCE



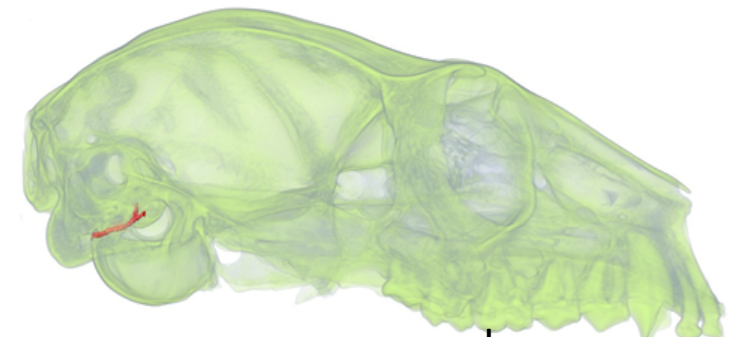
Why not use a more general archive?

Other archives, DataDryad, Figshare, and Open Science Framework

1. Are not organized to maintain explicit relationships between taxonomy, specimens, scanning events, and files.
2. Lack 3D and anatomy specific metadata
3. Do not allowing in-browser viewing of 3D data
4. Limited searching, sorting, filtering, and downloading features



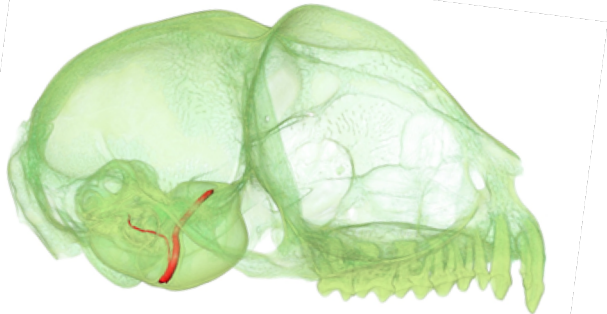
MORPHO
SOURCE 



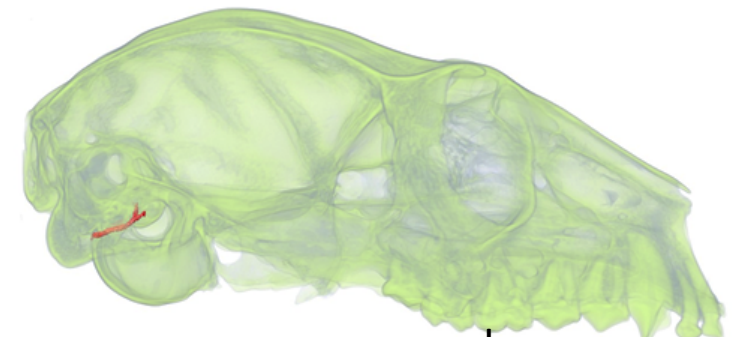
Shouldn't museums host 3D data representing their specimens?

They should, but...

1. Costly to start and manage a digital archive
2. Researchers need control of when and how they publish raw data
3. Many isolated institutional platforms are less useable and sustainable than an integrated platform
4. Redundancy is not necessarily a bad thing



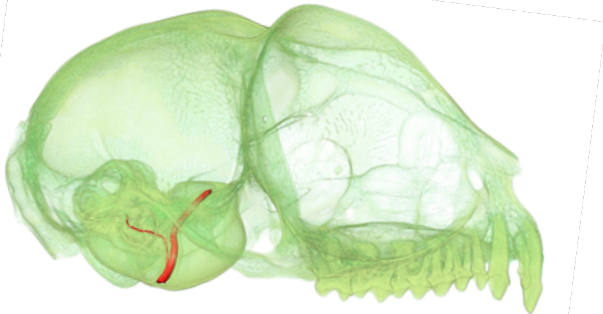
MORPHO
SOURCE 



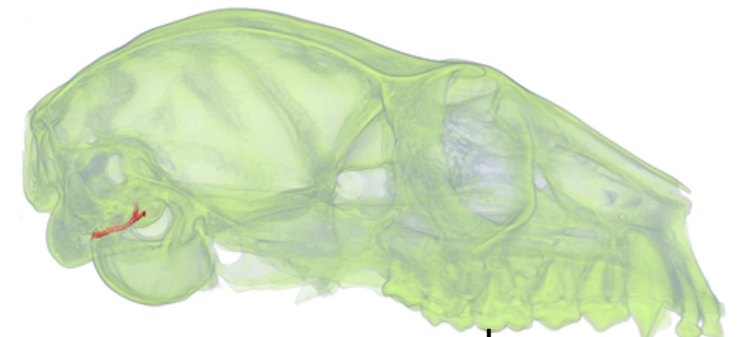
Issues for further discussion

“open” questions

1. Incentives for data sharing
2. When to reject data contributions (establishing standards)
3. When to restrict data access (copyright)
4. How to manage growth of data archives with large datasets
5. How to ensure long term access



MORPHO
SOURCE





Acknowledgments



For invitation to speak and support for attendance

- Pat Holroyd, Talia Karim, Gil Nelson, iDigBio, conference organizers

For support & funding of MorphoSource Development

- Duke University Trinity College of Arts & Sciences (major funder so far)
- Duke Shared Materials Instrumentation Facility
- Duke Biology IT Center
- Ed Gomes & Trinity Technology Services

For discussion leading to development of concepts

- Jukka Jernvall, Alistair Evans, & Gudrun Evans

For work loading specimen media

- Technicians & students: Mercedes Zapata-Garcia, Shane Daly, Sunghoon Liu, Ksenia Sokolova, Anne Driscoll, Kevin Vo, Annie Lott, Callie Crawford, and many more.