

# Museum Collections on the Internet and in the Classroom

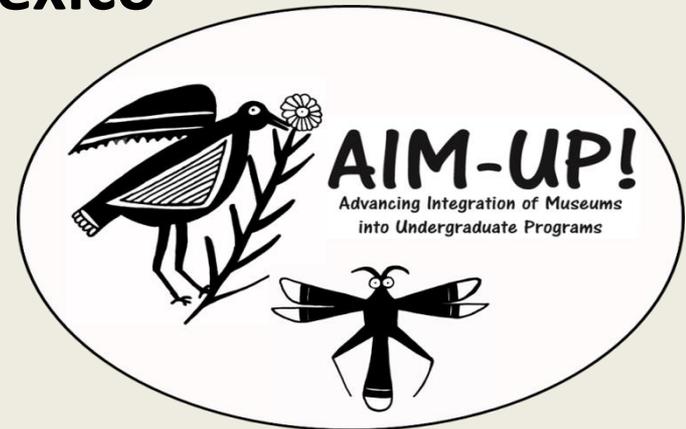
19 October 2013

Kayce Bell

J.L. Dunnum, F. Salazar-Miralles, J.A. Cook

Museum of Southwestern Biology

University of New Mexico



# Education, Training, & Research



**Arctos**  
Multi-Institution, Multi-Collection Museum Database

[Search](#) [Portals](#) [My Stuff](#) [About/Help](#)

Access to 1,766,567 records

[Search](#) [Clear Form](#) [Use Last Values](#) See results as:

Type: any  Require Tissues?

**Identifiers** Customize Show More Options

Collection: Alaska Lepidoptera  
COA Birds  
COA Eggs  
COA Fishes  Catalog Number:

**Identification and Taxonomy** Show More Options

Current Identification CONTAINS  [ Help ]

**Locality** Show More Options

Any Geographic Element:  [Select on Google Map](#)

**Date/Collector** Show More Options

Help | Collector or Preparator

**Biological Individual** Show More Options

Part Name:  Define Add = for exact match

**Usage** Show More Options

Basis of Citation:  Define

**Media** Show More Options

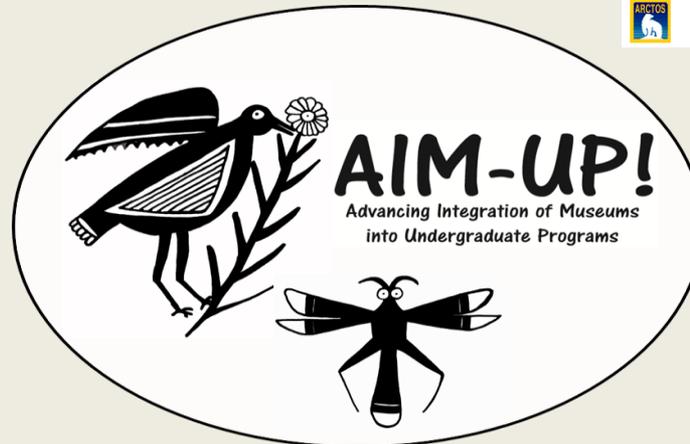
Media Type:  Define

**Relationships** Show More Options

Relationship:

[Search](#) [Clear Form](#) [Use Last Values](#) See results as: Specimen Records

 [Data Providers](#)  
[Report a bug or request support](#)



# Natural History Collections

- Scale—time and space
- Integration
  - biotic and abiotic
  - genomic to organismal to ecosystems
- Database
- Scientific Process
  - experiential vs passive



# Collections-based approaches and undergraduate education

- Complexity-multiple views
- Web-based discovery
- Linking genomic data and physical specimens

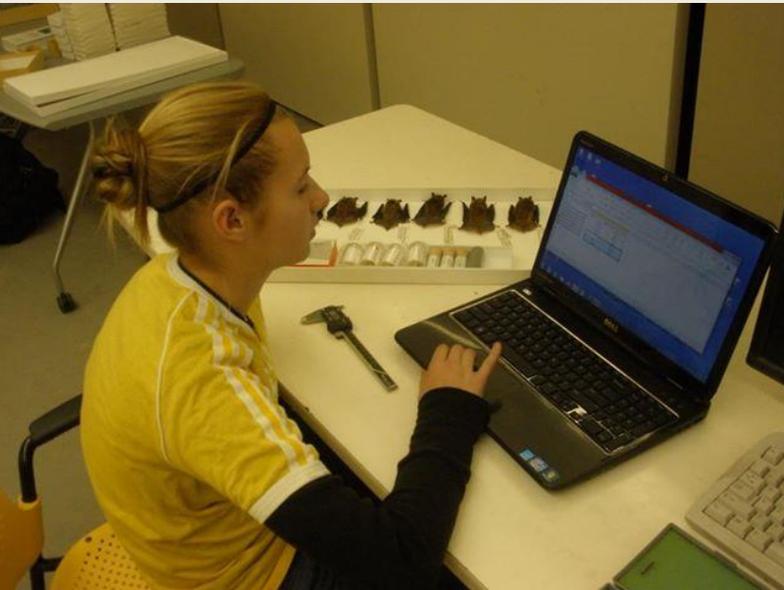


# Natural History Collections Data

- On-line databases
  - Global Biodiversity Information Facility
  - Taxonomic databases: MaNIS, Ornis, HerpNet, FishNet
  - Museum databases: Arctos (MVZ, UAM, MSB, many others), Field Museum, Smithsonian, American Museum of Natural History

# Integrating in the Classroom

- Students can access and use databases
- Address questions of local relevance
- Inquiry-based learning



# Challenges



- Few educators (& fewer students) seem to know:
  - about natural history collections
    - or their role in development of key concepts
  - how to access museum information
  - how to incorporate specimen data in teaching

# A Few More Challenges

Collections (and databases)  
have limitations

Specimen availability

Narrow view of possibilities (systematics)

Collections developed for research

Databases developed for collection  
management, not education.

How do we unleash potential for teaching?



# NSF-RCN

## Research Coordinating Network

- Goal: create new directions in research & education by communicating and coordinating activities across disciplinary, organizational, geographic and international boundaries.

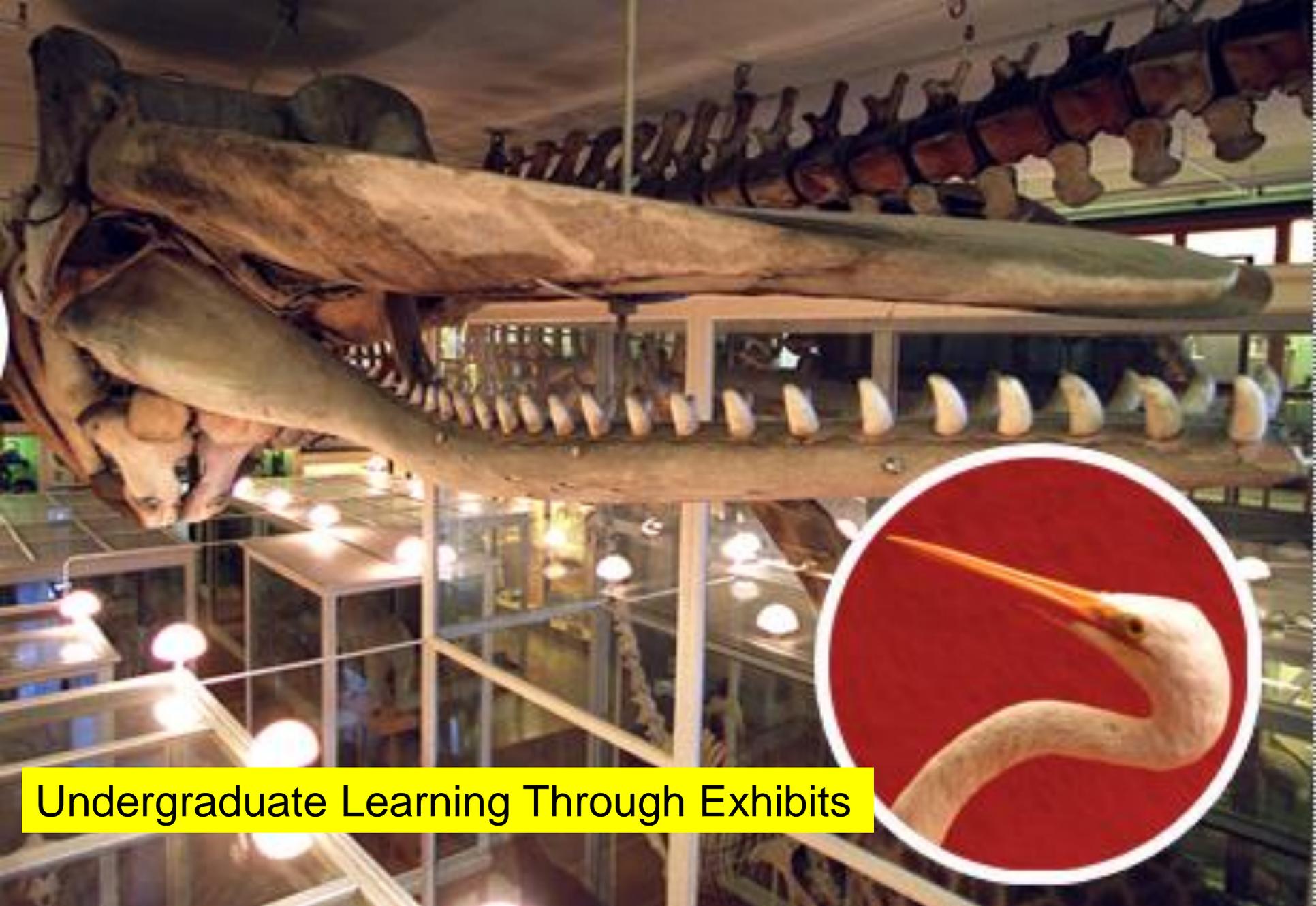


# Undergraduate Experiences in Curation



## Undergraduate Experiences in Museum Fieldwork



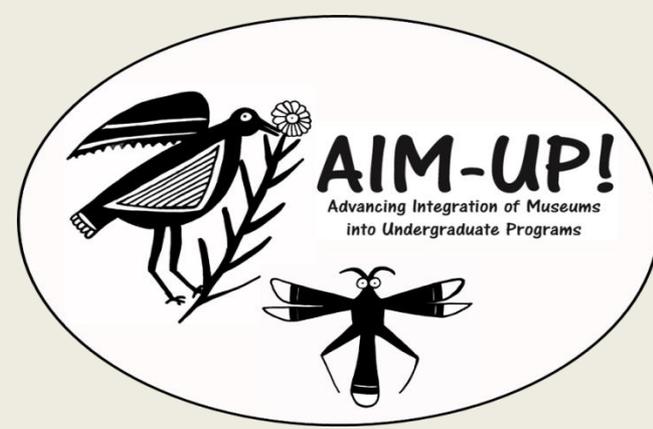


Undergraduate Learning Through Exhibits

# Graduate and Undergraduate Research Experiences Based on Collections

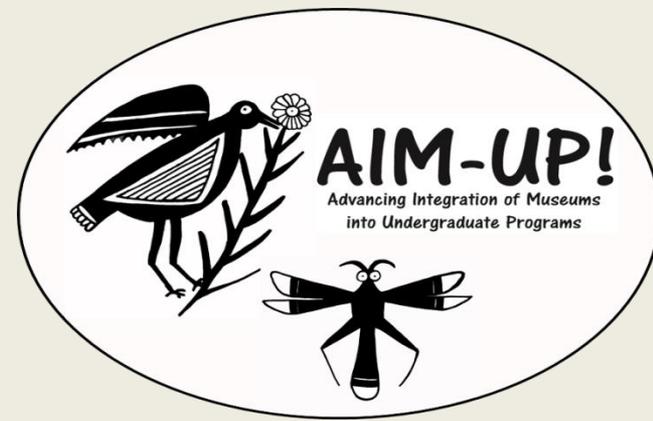


# Expand traditional museum experiences



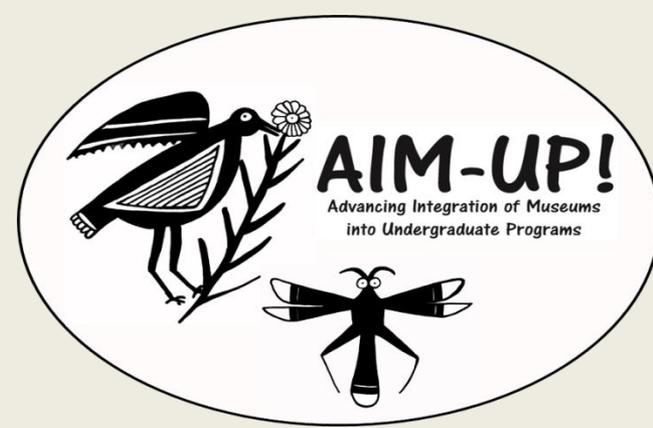
- Develop novel ways of using collections and data.

# Expand traditional museum experiences



- Develop novel ways of using collections and data.
- Increase accessibility of natural history collections to educators/public through databases.

# Expand traditional museum experiences



- Develop novel ways of using collections and data.
- Increase accessibility of natural history collections to educators/public through databases.
- Partner with other non-traditional museum users (e.g., Behavior, Geography, Art)

# AIM-UP!--the network

22 Universities, Community & Tribal Colleges

5 Agencies and free-standing Museums

2 International

2 High Schools



# Educational Modules

## Island Biogeography: Species Richness Across a Northern Archipelago



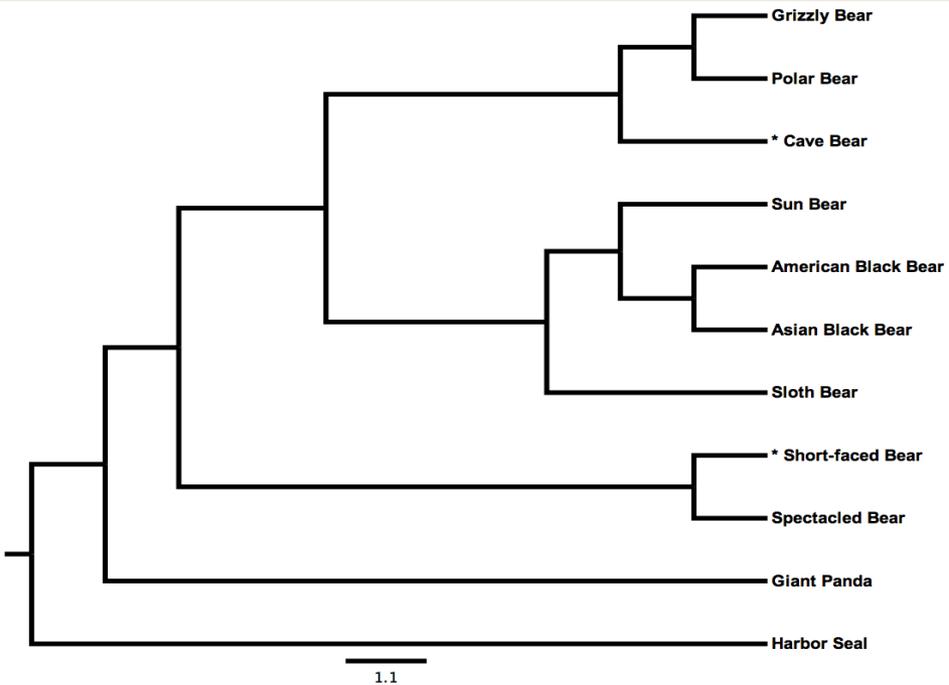
### Key Concepts and Skills: Evolution & Ecology

- Body size on islands
- Competitive exclusion/release
- Isolation and Divergence
- Island biogeography

Conservation biology  
Scientific process & hypothesis testing  
Statistical methods  
Management & analyses of large-scale databases

# Educational Modules

## Reading, Constructing, & Using Phylogenies



### Key Concepts and Skills

Learn about scientific process

Gain appreciation for evolutionary connections across the Tree of Life

Interpret a phylogeny

Learn how phylogenetic trees are constructed

Introduce the different ways to study evolutionary relationships

Learn how comparative phylogenetics is used to understand the biology of organisms



# More Educational Modules

Climate change

Adaptable to local flora and fauna

Activities for other disciplines (art, geography, etc.)

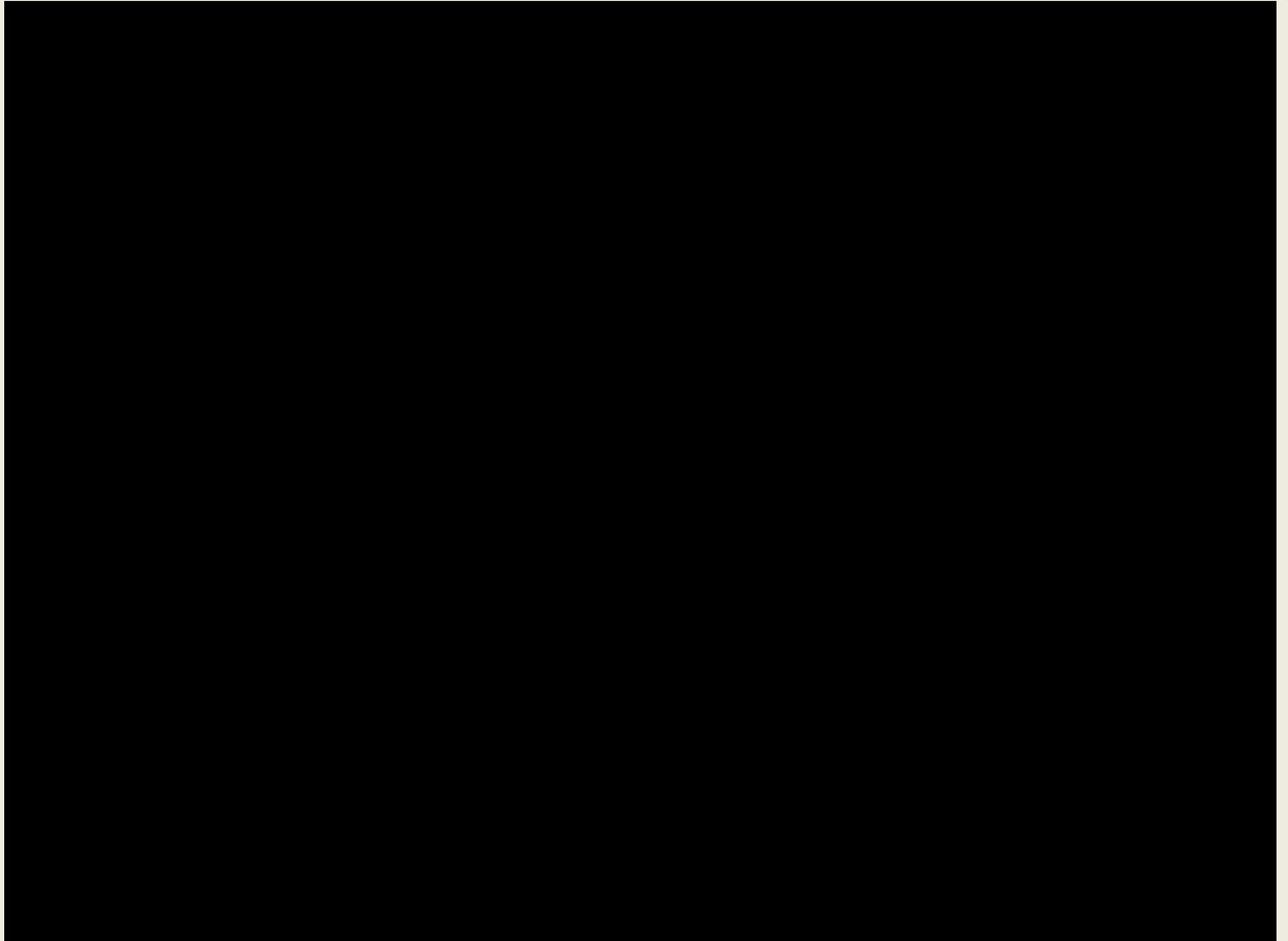
Scalable – high school and undergraduate

Develop Spanish-language Modules

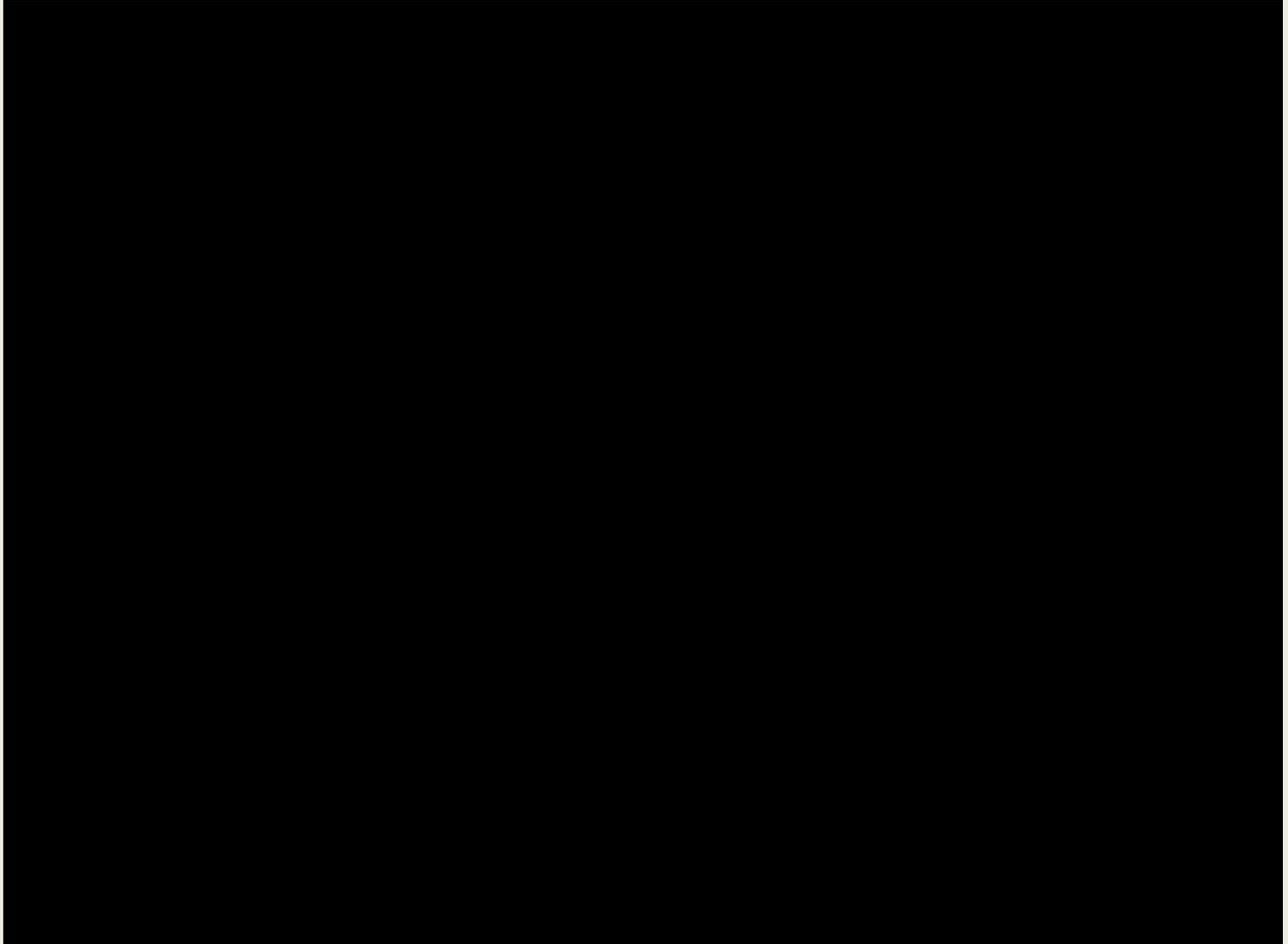


AIM-UP! [www.aim-up.org](http://www.aim-up.org)

(movie demonstrating the AIM-UP! website)



GBIF [www.gbif.org](http://www.gbif.org)  
(movie demonstrating GBIF)





Mammalia &gt; Rodentia &gt; Caviidae

**Cavia aperea**

Brazilian Guinea Pig

[Download Spatial data](#)

Erxleben, 1777

[>Back to Red List Page](#)

NE DD



&gt;

NT

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EN

CR

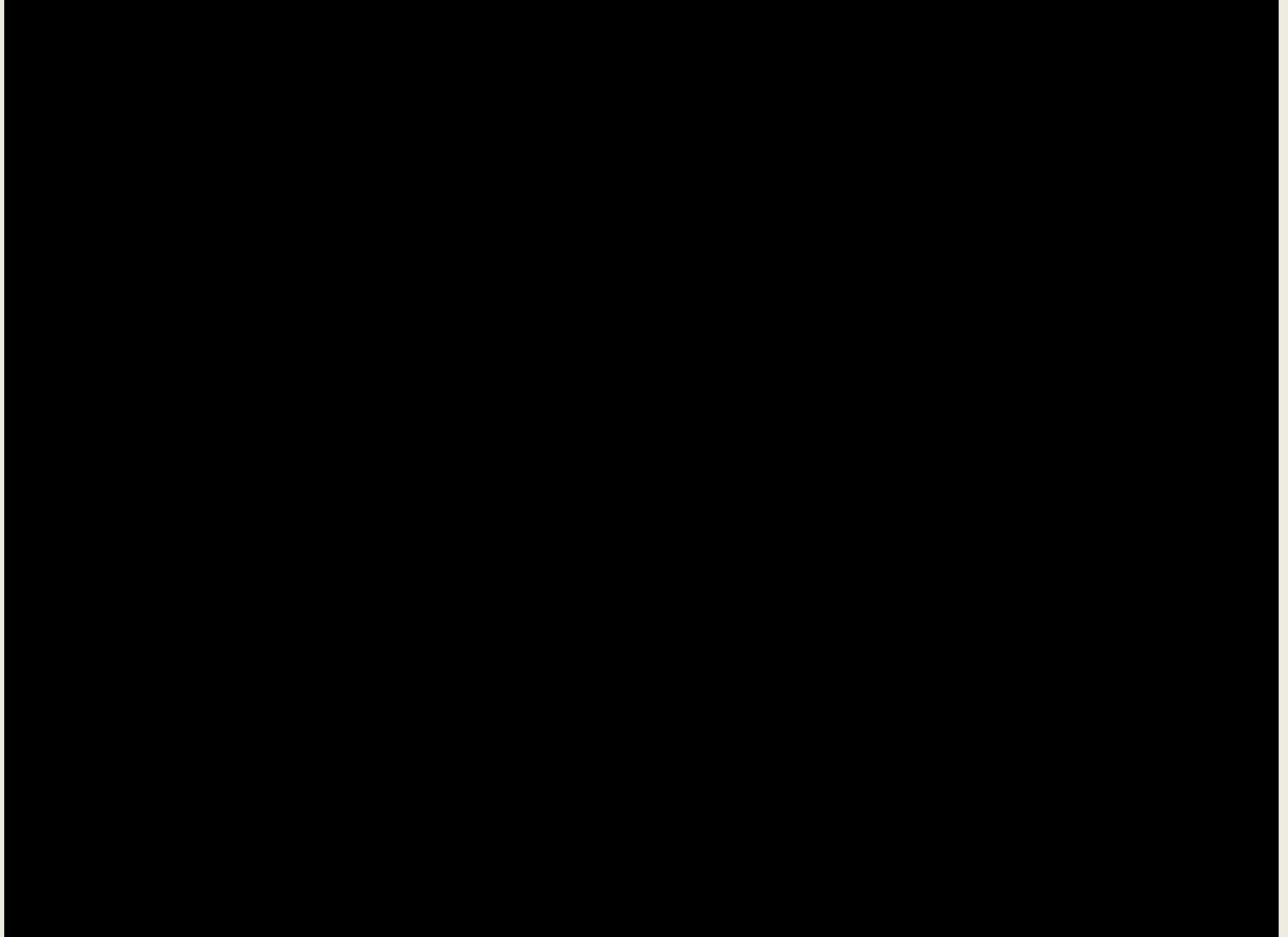
EW

EX

 Extant (resident)
**BROWSE IMAGES**
 [ARKive \(6 found\)](#)

IUCN (International Union for Conservation of Nature) 2008. *Cavia aperea*. In: IUCN 2013. IUCN Red List of Threatened Species. Version 2013.1

Arctos <http://arctos.database.museum/>  
(movie demonstrating the Arctos)



# Other Biodiversity Resources

Map of Life, GenBank, Animal Diversity Web,  
Tree of Life, iNaturalist, IUCN,

# Map of Life

www.mappinglife.org

Search  Go

Species Lists  Radius 50 km Group Mammals

76 species of Mammals within 50 km of 0.747° S 123.003° E

List Images IUCN Download

Data type/source: Expert range map, IUCN Red List. All seasonalities.

Scientific Name	English Name	Order	Family	Rank	IUCN
▼ <i>Ailuropus ursinus</i>	Bear Cuscus, Bear Phalanger, Sulawesi Bear Cuscus	Diprotodontia	Phalangeridae	16	VU
▼ <i>Strigocuscus celebensis</i>	Small Sulawesi Cuscus, Little Celebes Cuscus, Small Cuscus	Diprotodontia	Phalangeridae	16	VU
▼ <i>Strigocuscus pelengensis</i>	Peleng Cuscus	Diprotodontia	Phalangeridae	16	LC
▼ <i>Macaca tonkeana</i>	Tonkean Macaque, Tonkean Black Macaque	Primates	Cercopithecidae	53	VU
▼ <i>Tarsius dentatus</i>	Dian's Tarsier, Diana Tarsier	Primates	Tarsiidae	56	VU

Base Map: Basic Political Roadmap Terrain Satellite

Dashboard Status About Feedback Help

Imagery ©2013 TerraMetrics - Terms of Use Report a map error

# GenBank

www.ncbi.nlm.nih.gov

- NCBI Home
- Resource List (A-Z)
- All Resources
- Chemicals & Bioassays
- Data & Software
- DNA & RNA
- Domains & Structures
- Genes & Expression
- Genetics & Medicine
- Genomes & Maps
- Homology
- Literature
- Proteins
- Sequence Analysis
- Taxonomy
- Training & Tutorials
- Variation

## Welcome to NCBI

The National Center for Biotechnology Information advances science and health by providing access to biomedical and genomic information.

[About the NCBI](#) | [Mission](#) | [Organization](#) | [Research](#) | [RSS Feeds](#)

## Get Started

- [Tools](#): Analyze data using NCBI software
- [Downloads](#): Get NCBI data or software
- [How-To's](#): Learn how to accomplish specific tasks at NCBI
- [Submissions](#): Submit data to GenBank or other NCBI databases

### Genetic Testing Registry

A portal to clinical genetics resources with detailed information about genetic tests and laboratories.

[GO](#)

1 2 3 4 5 6 7 8

## Popular Resources

- PubMed
- Bookshelf
- PubMed Central
- PubMed Health
- BLAST
- Nucleotide
- Genome
- SNP
- Gene
- Protein
- PubChem

## NCBI Announcements

Now Available: NCBI Insights Blog!  
28 Jan 2013

NCBI has just released a new blog called *NCBI Insights*. Blog posts will provide an insider's perspective to help users better

Come to the NCBI Discovery Workshops

# Animal Diversity Web

<http://animaldiversity.ummz.umich.edu/>

Animal Diversity Web

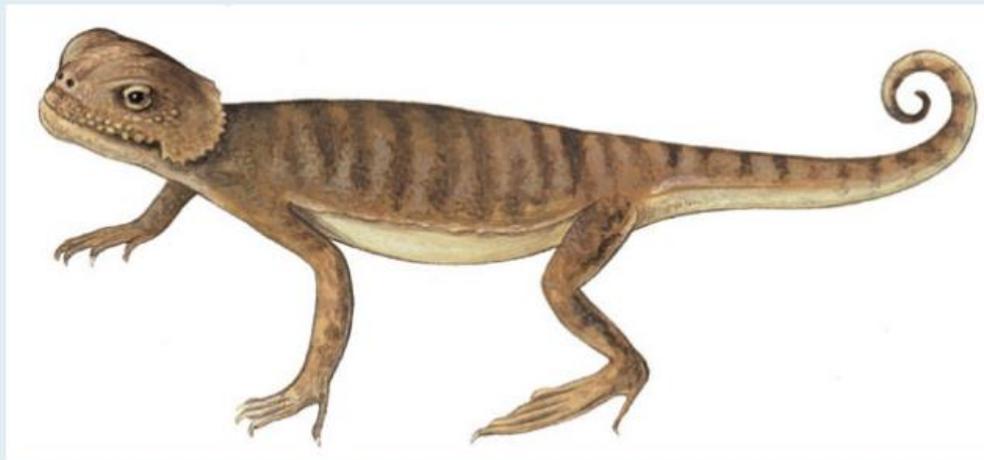


University of Michigan  
MUSEUM OF ZOOLOGY



- Home
- About Us
- About Animal Names
- Teaching Resources
- Special Collections
- Glossary
- Browse Animalia

## Browse Animalia



← **REPTILIA** *Phrynocephalus mystaceus* →  
turtles, snakes, lizards, and relatives Secret Toadhead Anana

[Take our survey!](#)  
Help us improve the site!

Search ADW

Taxon Information

[Explore Data @ Quardvark](#)

[Search Guide](#)

### ADW Mission

The Animal Diversity Web is an online database and encyclopedia of animal natural history, built through contributions from students, photographers, and many others.

It is a rich and flexible resource designed both as an encyclopedia for exploring biodiversity and for use in formal, inquiry-based education.

# IUCN

<http://www.iucnredlist.org/>



The IUCN Red List of Threatened Species™

2013.1

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Enter Red List search term(s)



[OTHER SEARCH OPTIONS](#)

[Discover more](#)

DONATE NOW!

LEAST CONCERN  
LC

NEAR THREATENED  
NT

VULNERABLE  
VU

ENDANGERED  
EN

CRITICALLY ENDANGERED  
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EXTINCT IN THE WILD  
EW

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EX



## [A users' guide to The IUCN Red List web site](#)

03 April 2009 - In October 2008, the IUCN Red List web site was given a brand new look. The new site has more functionality than ever before. This also means that the site has more detailed search pages that... [more](#)



## [The most traded wild mammal - the Pangolin - is being eaten to extinction](#)

24 July 2013 - The Chinese Pangolin (*Manis pentadactyla*), one of eight extant pangolins or scaly anteaters as they are also... [more](#)



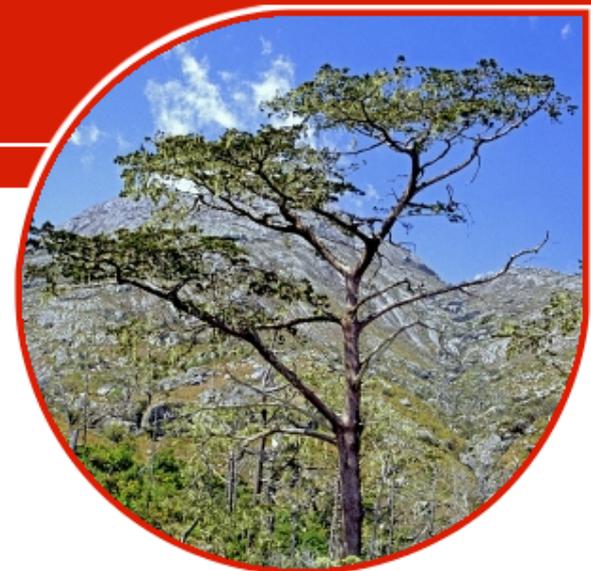
## [Moving Closer to Nature - Miyun Landscape, China](#)

18 July 2013 - Substantial efforts have been made over the last 30 or 40 years to reforest the Miyun landscape. These efforts were a response to the very urgent need to protect the Miyun reservoir and its... [more](#)



## [Planting, protecting, and sharing: three indispensable links in mangroves conservation](#)

17 July 2013 - On a recent trip to Lang Co Lagoon in Thua Thien Hue Province, an MFF small grant project site, I met Nguyen Xuan Vinh who runs a local



**MULANJE CEDAR**  
*Widdringtonia whytei*

© Russ Clare



Amazing Species

# Tree of Life

<http://tolweb.org>

home browse help features learning contribute about  Search

## TREE OF LIFE web project

Explore the Tree of Life

**Browse the Site**

- Root of the Tree
- Popular Pages
- Sample Pages
- Recent Additions
- Random Page
- Treehouses
- Images, Movies,...

Search

**News**

Darwin 200: the celebration continues... [read more](#)

**Learn about ...**

**Agaricales**  
(a group of fungi)



[image info](#)

The Agaricales, or euagarics clade, is a monophyletic group of approximately 8500 mushroom species... [read more](#)

[more featured pages](#)

The Tree of Life Web Project (ToL) is a collaborative effort of [biologists and nature enthusiasts](#) from around the world. On more than 10,000 World-Wide-Web pages, the project provides information about biodiversity, the characteristics of

# Resources and How to Contribute to Biodiversity Data

- Databases: <http://www.aim-up.org/resources/databases>
- Activities: <http://www.aim-up.org/educational-modules>
- Notes on Nature: <http://www.notesfromnature.org/>
- iNaturalist: <http://www.inaturalist.org/>

# Funding and Participation



National Science Foundation  
Grant 0956129



University of New Mexico; University of Alaska, Fairbanks; Harvard University; University of California, Berkeley; Texas A&M University; City University of New York; Occidental University; University of Nevada, Reno; Arizona State University; University of Ohio; Florida Natural History Museum; University of Illinois, Champaign-Urbana; College of Southern Nevada; Northern Michigan University; University of Michigan; Massachusetts College of Liberal Arts; University of Colorado, Boulder; Denver Museum of Nature & Science; United States Geological Survey; United States Department of Agriculture





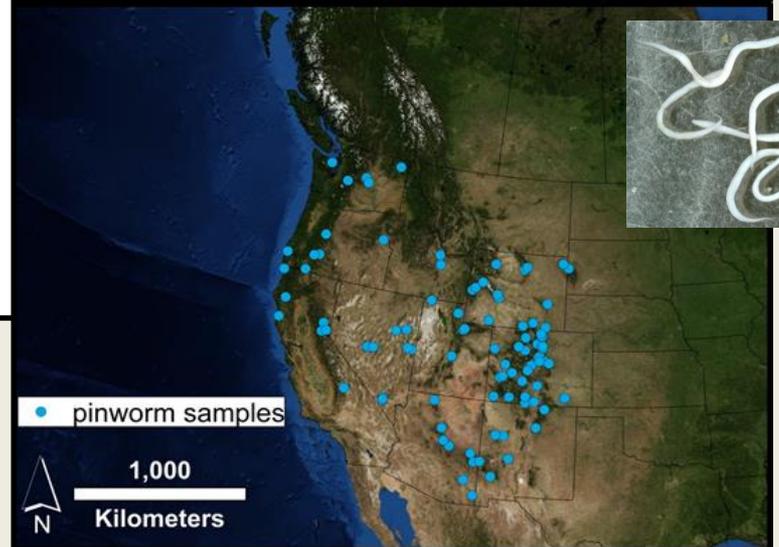
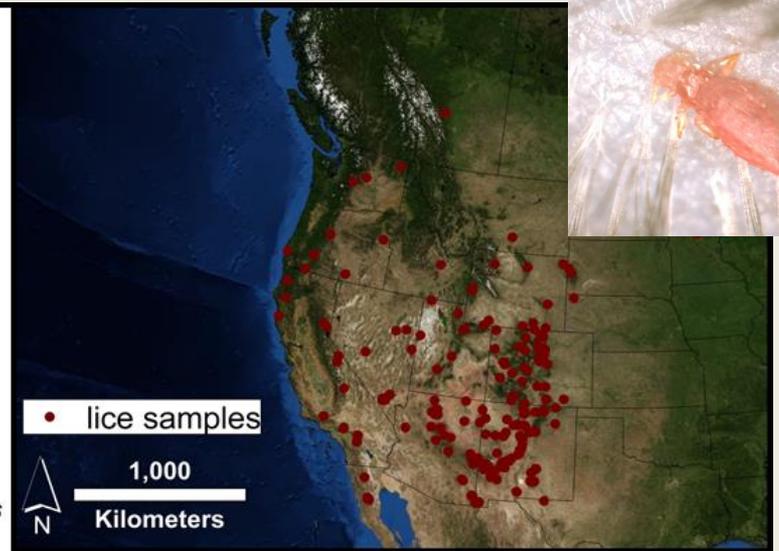


# Research

Host-parasite evolution

# Research

## Host-parasite evolution



# Annual Conceptual Themes:

- 1) Integrative Inventories: Exploring Complex Biotic Associations Across Space and Time
- 2) Decoding Diversity: Making Sense of Geographic Variation
- 3) Evolutionary Dynamics of Genomes
- 4) Fast Forward: Biotic Response to Climate Change
- 5) Coevolving Communities and the Human Dimension



# Workshops & Seminars--Spring 2012



- 1) Fluid Taxonomy -- on the dynamic, ever shifting practice of classification
- 2) Cataloguing Wonder -- collecting through the senses
- 3) Morphology and Evolution -- investigating change in nature and culture through place and time

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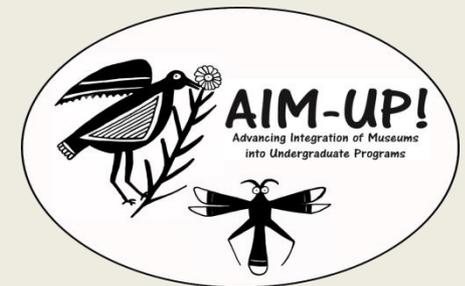
# Products

- **Better understanding of existing programs**
- **Survey of educators and students**
- **Stimulate interdisciplinary use of specimens**
- **Publications—**
  - perspectives, we can lead educational venues, texts
- **Educational modules** centered around themes

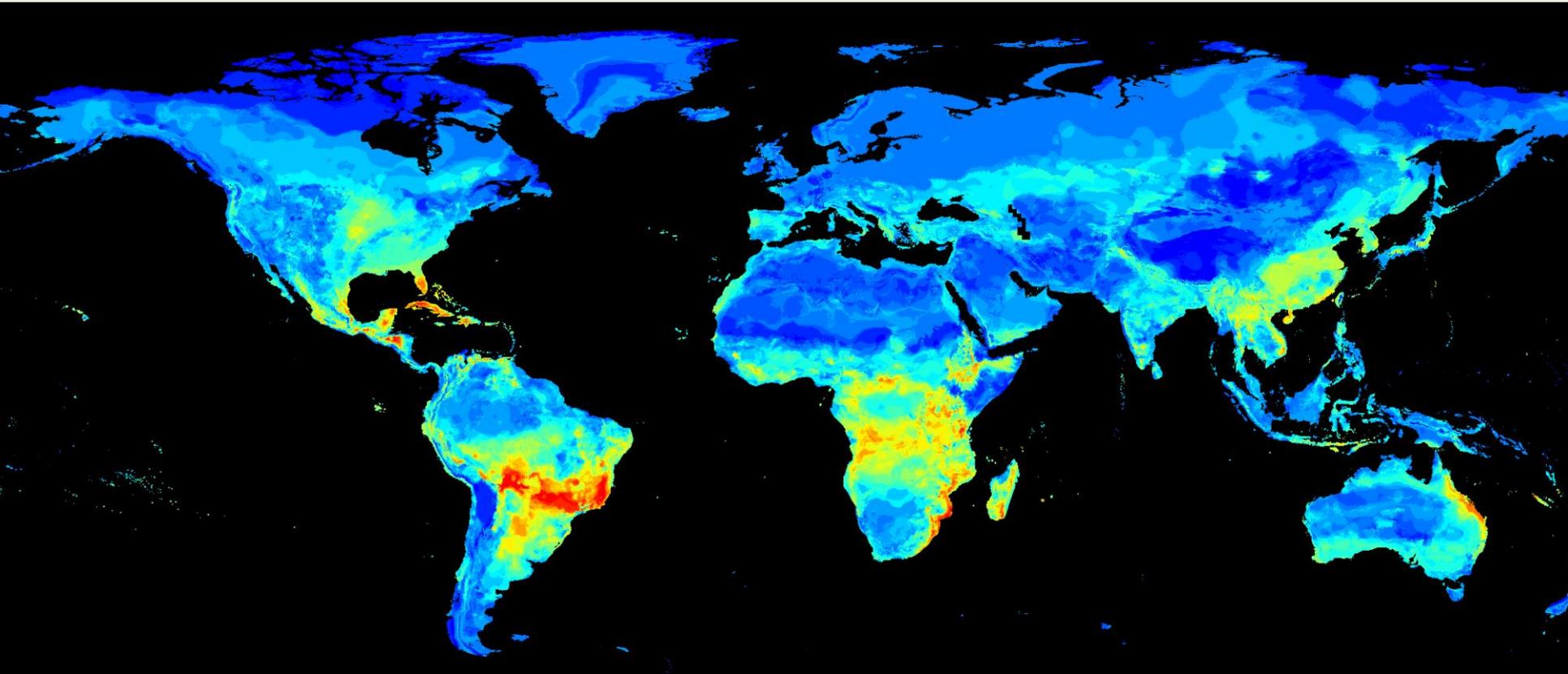
## Grow the Community of Users

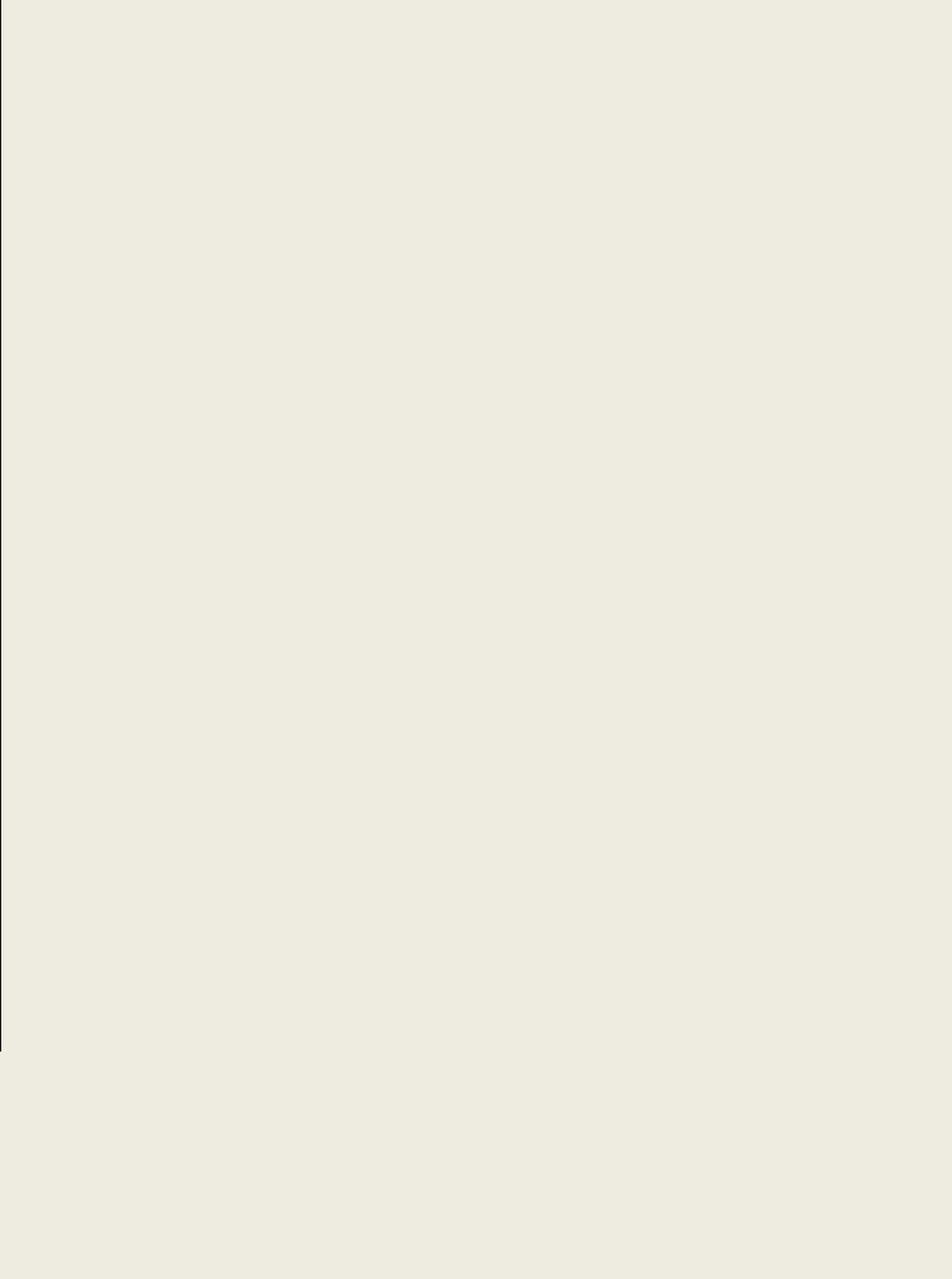
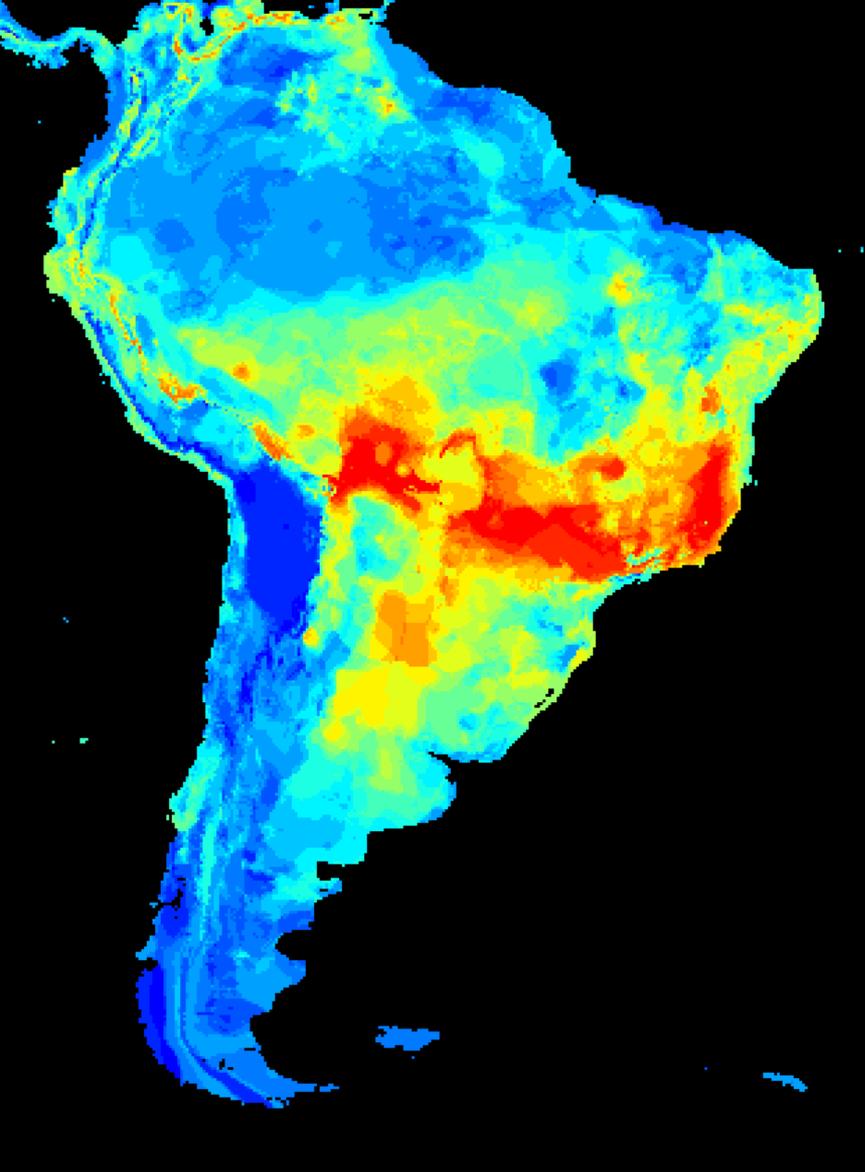
# Future of Natural History Collections in Education

- Tree of Life
- Spatial and Temporal Genetic Variation
- Scientific Process (Replication--without vouchers, difficult to impossible)
- Connecting Big Data (GenBank to GIS Applications)
- Genes and Developmental Biology
- Are Museums Supermarkets for Genomics?
- Founder Effects, Island Syndrome



# GBIF niche model for *Ctenomys boliviensis*







free and open access to biodiversity data  
**GLOBAL BIODIVERSITY INFORMATION FACILITY**



**397,098,605** indexed records  
**10,085** datasets  
**486** publishers

[Access data portal](#)

The Global Biodiversity Information Facility (GBIF) was established by governments in 2001 to encourage free and open access to biodiversity data, via the Internet. Through a global network of countries and organizations, GBIF promotes and facilitates the mobilization, access, discovery and use of information about the occurrence of organisms over time and across the planet.

[Why join GBIF?](#)

[Current Participants](#)

[Data use cases](#)

**LATEST NEWS**

Think bigger, GBIF award winner urges biologists

[INFORMATICS](#) ▶

[PARTICIPATION](#) ▶

[GOVERNANCE](#) ▶

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GLOBAL  
BIODIVERSITY  
INFORMATION  
FACILITY



[SPECIES](#) [COUNTRIES](#) [DATASETS](#) [OCCURRENCES](#) [SETTINGS](#) [ABOUT](#)

Search for occurrence records

```
<?xml
<response
<header>
<source accesspoint="http://145.18.162
<software name="TapirLink" version="0.2(re
```



... free and open access to biodiversity data

**Search**  
species/country/dataset

Start new search Search

## Welcome to the GBIF Data Portal

Access 397,098,605 data records (344,209,481 with coordinates) shared via the GBIF network.

To learn how to use this site, please see [About](#).

To tune this site for smaller displays, see [Settings](#).

Version 1.2.6 - [click here](#) to see what is new!



### Explore Species

Find data for a species or other group of organisms.

#### Species

Information on species and other groups of plants, animals, fungi and



### Explore Countries

Find data on the species recorded in a particular country, territory or island.

#### Countries

Information on the species



### Explore Datasets

Find data from a data publisher, dataset or data network.

#### Datasets

Information on the data publishers, datasets and data networks that



**GLOBAL  
BIODIVERSITY  
INFORMATION  
FACILITY**

[SPECIES](#) [COUNTRIES](#) [DATASETS](#) **[OCCURRENCES](#)** [SETTINGS](#) [ABOUT](#)

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**Countries**  
Information on the species



### Explore Datasets

Find data from a data publisher, dataset or data network.

**Datasets**  
Information on the data publishers, datasets and data networks that



## Occurrence search

Please add filters and click Search to perform a search for occurrences records. Specify more filters to narrow your search to get more accurate results for the species, area or time period that is of interest.

### Add search filter

Basis of record  Specimen

Select a basis of record from the pick list and click Add Filter. The filter will return records that are based on the selected type of object or observation.

- **Observation** - A report by a known observer
- **Specimen** - A physical object representing one or more organisms
- **Living** - An organism removed from its natural occurrence and now living in captivity or cultivation.
- **Germplasm** - Plant, animal and bacterial genetic material for use in breeding new organisms
- **Fossil** - A physical object representing one or more fossil organisms

### Your current search

Filters can be removed by clicking on the minus signs.

Scientific name is *Cavia tschudii* -

Country is Peru -

**Basis of record is Specimen** -

[Search](#)[Portals](#)[My Stuff](#)[About/Help](#)

Access to 1,766,567 records

[Search](#)[Clear Form](#)[Use Last Values](#)See results as: Type: Require Tissues? 

#### Identifiers

[Customize](#) [Show More Options](#)

Collection:

Catalog Number:

#### Identification and Taxonomy

[Show More Options](#)

Current Identification IS

[\[ help \]](#)

#### Locality

[Show More Options](#)

Any Geographic Element:

[Select on Google Map](#)

#### Date/Collector

[Show More Options](#)[Help](#)

Collector or Preparator

#### Biological Individual

[Show More Options](#)

Part Name:

Define Add = for exact match

#### Usage

[Show More Options](#)

Basis of Citation:

Define

#### Media

[Show More Options](#)

Media Type:

Define

#### Relationships

[Show More Options](#)

Relationship:

[Search](#)[Clear Form](#)[Use Last Values](#)See results as: 

- [Data Providers](#)
- [Report a bug or request support](#)

# Arctos <http://arctos.database.museum/>

to open spatial query tool, click



to cancel. [More Info](#)

Click the Arctos Search button (at the top or bottom of the page), NOT the Google Search button on the map, to run your query.

Query by points only

Search the Map

**-15.683658724078835, -69.72802734374994; -17.195218163749264, -72.58886718750006**



# Arctos <http://arctos.database.museum/>

Remove	GUID	NK	Identification	Other Identifiers	Country	State	County	Specific Locality	Verbatim Locality	Verbatim Date	Ended Date	Parts	Sex
<input type="checkbox"/>	<a href="#">MSB:Mamm:210529</a>	11641	<a href="#">Ctenomys boliviensis</a>	DGR: Division of Genomic Resources (MSB)=DGR:Mamm:7488 NK=11641 institutional catalog number=AMNH M 260820 preparator number=7944	Bolivia		Santa Cruz	San Miguel Rincon, 0300 m.	SAN MIGUEL RINCON, 0300 m.	14-Aug-1984	1984-08-14	liver (frozen) heart, kidney (frozen) karyotype (frozen)	female
<input type="checkbox"/>	<a href="#">MSB:Mamm:210551</a>	11679	<a href="#">Ctenomys boliviensis</a>	DGR: Division of Genomic Resources (MSB)=DGR:Mamm:7510 NK=11679 institutional catalog number=AMNH M 260831 preparator number=8034	Bolivia		Santa Cruz	12 KM S OF SANTA CRUZ DE LA SIERRA 0435 m.	12 KM S OF SANTA CRUZ DE LA SIERRA 0435 m.	18-Aug-1984	1984-08-18	heart, kidney (frozen) liver (frozen)	female
<input type="checkbox"/>	<a href="#">MSB:Mamm:210552</a>	11680	<a href="#">Ctenomys boliviensis</a>	DGR: Division of Genomic Resources (MSB)=DGR:Mamm:7511 NK=11680 institutional catalog number=AMNH M 260832 preparator number=237	Bolivia		Santa Cruz	12 KM S OF SANTA CRUZ DE LA SIERRA, 0435 m.	12 KM S OF SANTA CRUZ DE LA SIERRA, 0435 m.	18-Aug-1984	1984-08-18	liver (frozen) heart, kidney (frozen) karyotype (frozen)	female
<input type="checkbox"/>	<a href="#">MSB:Mamm:210553</a>	11681	<a href="#">Ctenomys boliviensis</a>	DGR: Division of Genomic Resources (MSB)=DGR:Mamm:7512 NK=11681 institutional catalog number=AMNH M 260833 preparator number=238	Bolivia		Santa Cruz	12 KM S OF SANTA CRUZ DE LA SIERRA, 0435 m.	12 KM S OF SANTA CRUZ DE LA SIERRA, 0435 m.	18-Aug-1984	1984-08-18	heart, kidney (frozen) liver (frozen)	male



## MSB Mammals 210551

**12 KM S OF SANTA CRUZ DE LA SIERRA 0435 m.**  
 South America, Bolivia, Santa Cruz  
 18-Aug-1984

heart, kidney (frozen); liver (frozen)

[\[ Report Bad Data \]](#)  
[MSB Mammals](#)

NK: 11679

*Ctenomys boliviensis*

[<< Return to results](#)  
[get a DOI](#)

first prevnext last  
 Record 2 of 100

[Taxa](#) | 
 [Accn](#) | 
 [Locality](#) | 
 [Agents](#) | 
 [Parts](#) | 
 [Part Locn.](#) | 
 [Attributes](#) | 
 [Other IDs](#) | 
 [Media](#) | 
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*Ctenomys boliviensis*

Animalia Chordata Mammalia Rodentia Ctenomyidae Ctenomys boliviensis  
 Identified by unknown on 2005-03-10  
 Nature of ID: legacy

Identifiers

DGR: Division of Genomic Resources (MSB): DGR:Mamm:7510  
 NK: 11679  
 institutional catalog number: AMNH M 260831  
 preparator number: 8034

Determination Type: accepted place of collection

assigned by unknown on 2012-07-08

Higher Geography: South America, Bolivia, Santa Cruz  
 Specific Locality: 12 KM S OF SANTA CRUZ DE LA SIERRA 0435 m.  
 Locality Remarks: Verbatim Coordinates: 17.54S 63.11W; elevation given as '435'  
 Collecting Source: wild caught  
 Event Date: 18-Aug-1984  
 Verification Status: unverified

Part Name	Condition	Disposition	#	Label	Remarks
heart, kidney (frozen)	unchecked	unchecked	1		
liver (frozen)	unchecked	unchecked	1		

sex: female

unknown, 2005-03-10

Remarks: Nature: SC: MUS: SW BIOL: NK11679.ET, KARYO, ENDOPAR, BLOOD EM; Body

Parts: SKINSKULLSKELE. ALC. OTHER  
 Entered By: Dusty L. McDonald on 2005-03-14  
 Last Edited By: JLDUNNUM on 2011-12-06

Collectors

Bolivian Expedition 1984, Sydney A. Anderson

Accession

[1111.111.Mamm](#)



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