CONNECTING NH COLLECTION DATA

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Our challenge

- Huge digitization efforts underway
- Need to look outside our own collections
  - What's the big picture
- Opportunity to do more than just facilitate your collection management of specimens
- Identify who we need to connect to and what information they need

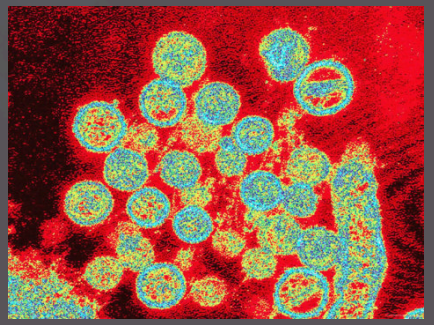
Paradigm shift

- Historically
  - NH collections and data limited to subset academia
  - Guarded access
  - Destructive sampling very rare
  - Museums have paid a price
- Today - future
  - Can't afford to be as restrictive
  - Now creating infrastructure for everyone else
  - Renaissance for NH collections

Significant questions are centered on our ability to assess change.

- Climate change
- Habitat conversion
- Pollutants
- Emerging pathogens
- Introduction of exotics
- Loss of biotic diversity

- Baseline or historic information is critical to documenting changing environments.
- Only NH collections have these samples
  - New questions
  - New technology



Critical time for research and education on biodiversity issues.

- Build connections
- Rethink the traditional role of museum's and databases
- Facilitate use
  - Access allows for creativity, new uses and new ideas
- Connect Big Data
  - Cyberinfrastructure for Informatics

Critical time for education on biodiversity issues

- Data resource will keep growing
- Need to develop human resource

- Train Future Investigators

  …….to creatively explore, utilize and integrate these vast resources across disciplines and into critical science initiatives.

AIM-UP!
Advancing Integration of Museums into Undergraduate Programs

Connecting to……..

- Wide array of academic researchers
- Federal and state agencies
- Public health organizations
- NGOs / Environmental consultants
- Undergrad education
- K-12 educators
- Artists

Varying levels of needs, questions, complexity

Non-traditional users

- Making natural history collections available to non-traditional users
- Artists provide not only new perspectives, but also are advocates for biodiversity issues

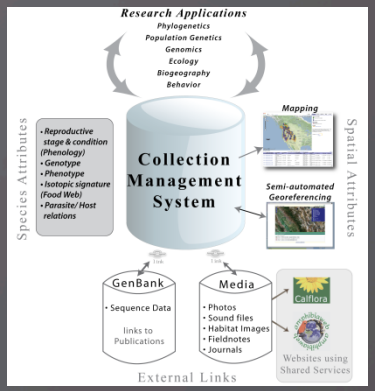
Gendron Jensen lithograph
Last brown bear taken from NM Pecos wilderness in 1917

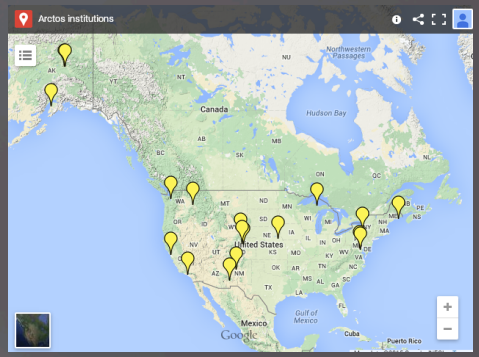
Morphology and Evolution with Brian Conley

Arctos

Collaborative Collection Management System

- Community and comprehensive collection management system
- Open-access specimen database http://arctos.database.museum
- 3M records
- 90 collections,19 institutions
  - Shared instance - TACC
  - Single instance - MCZbase Harvard





Museum of Southwestern Biology
University of New Mexico

The Museum of Vertebrate Zoology at Berkeley

UNIVERSITY OF ALASKA MUSEUM OF THE NORTH

Cornell University
Museum of Vertebrates

DENVER MUSEUM OF NATURE&SCIENCE

HARVARD UNIVERSITY
Museum of Comparative Zoology

Breadth of Collections

Mammals

Birds

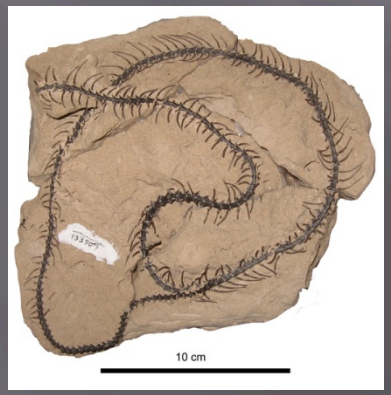
Herps

Plants

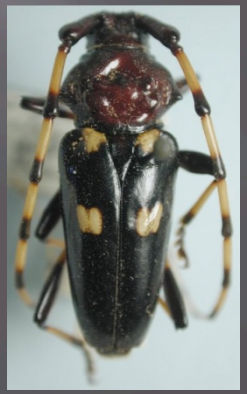
Culture

Eggs/Nests

Parasites



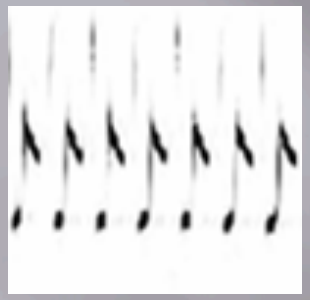
Fossils



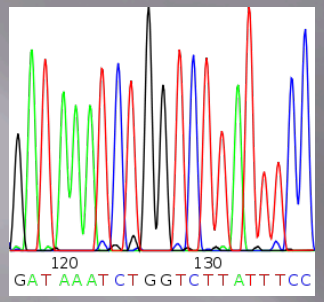
Insects

Fishes

Breadth of Data Types in ARCTOS

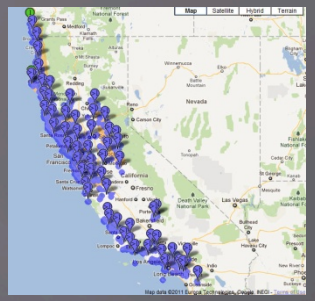


Audio



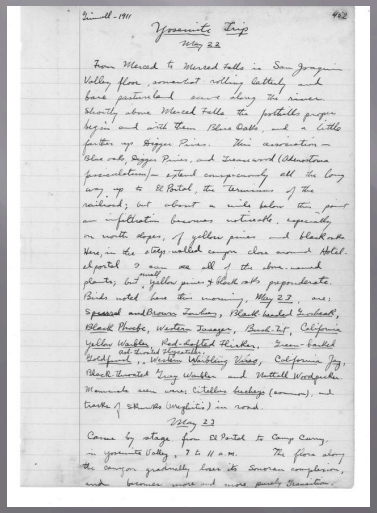
DNA

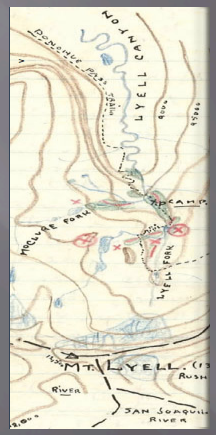
Relations

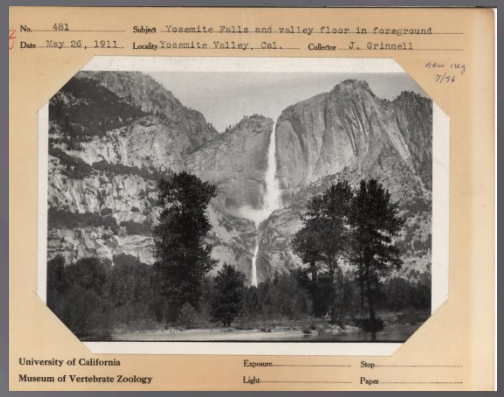


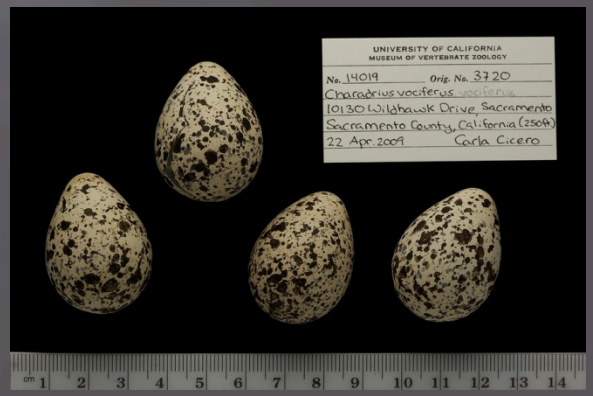
GIS

Projects/Pubs



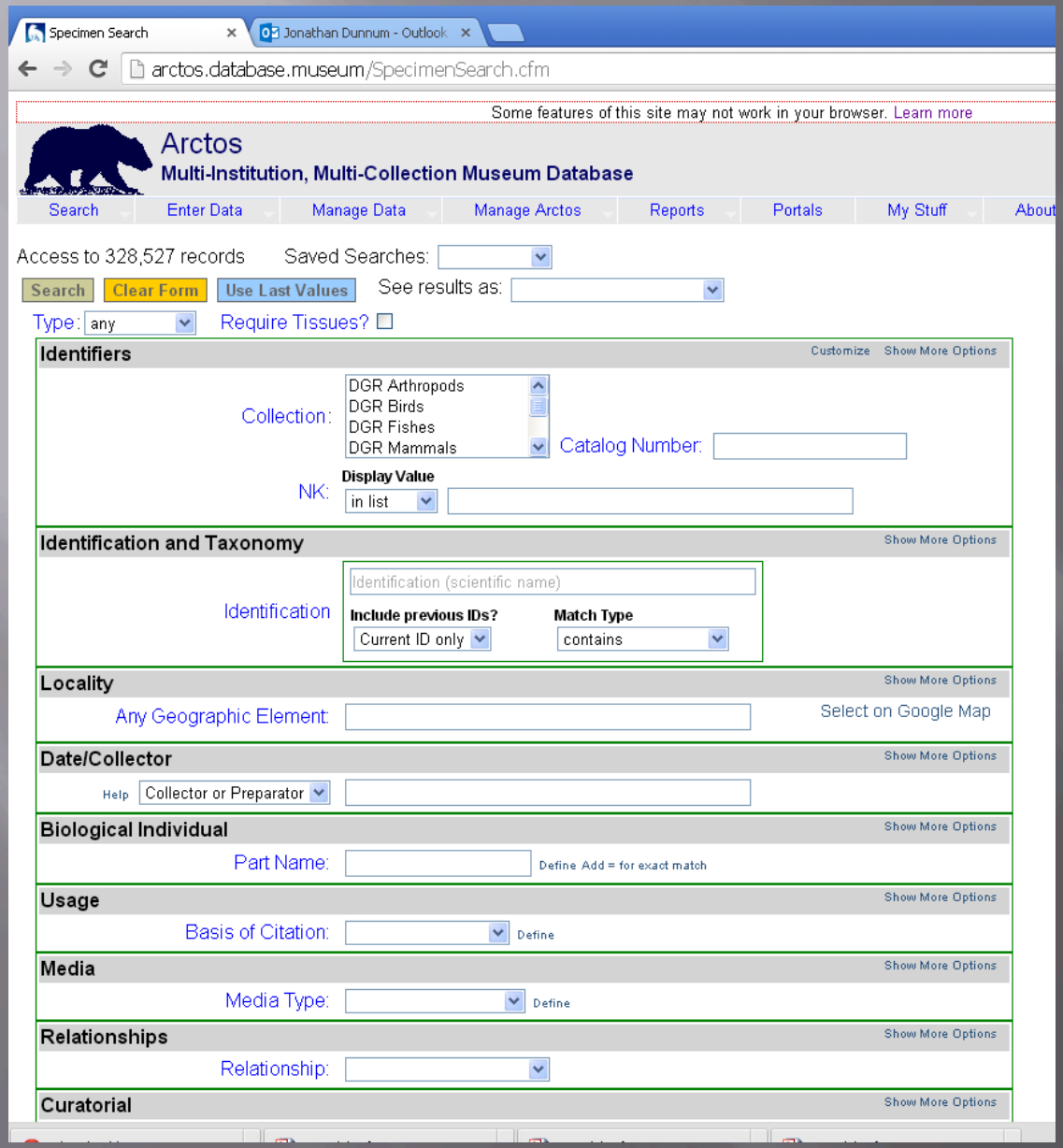






Fieldnotes, Maps, and Images

Queriable database



Internal collection management

Connectivity to other databases

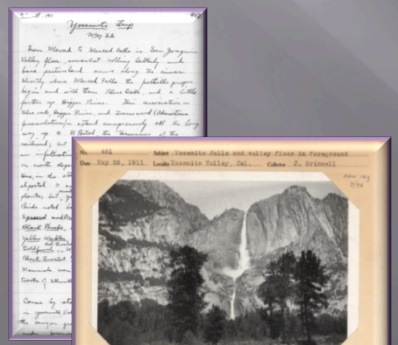
Connecting data within a collection

- Diverse parts and associated data
- Stored in many places
- In multiple databases

Holistic voucher

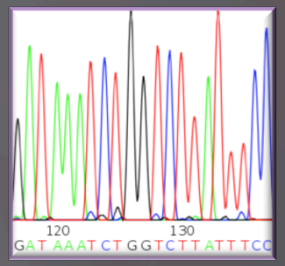
Traditional skin, skeleton or fluid voucher

Ecto & endo parasites



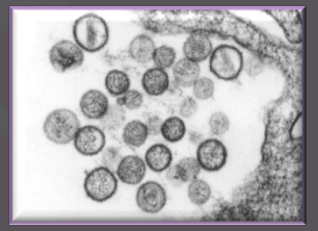
Field notes, ecological data

Frozen tissues



Genomic data

Karyotypes



Virus isolates

Specimen record

MSB Mammals 55245
NK: 12402
Andalgalomys pearsoni dorbignyi
<< Return to results
get a DOI

29.5 KM W ROBORE, 475 M; 18D19'S, 60D02'W
South America, Bolivia, Santa Cruz
07-Oct-1984

skin; skull; postcranial skeleton; kidney (frozen); karyotype (frozen); liver (frozen); liver (frozen); heart, kidney (frozen); liver (frozen) sample; liver (frozen) sample

[Report Bad Da
(1 annotatio
MSB Mamma
first prevnext
Record 2

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

Edit
Andalgalomys pearsoni dorbignyi
Animalia Chordata Mammalia Rodentia Cricetidae Andalgalomys pearsoni dorbignyi Olds, Anderson and Yates, 1987
sensu Olds et al. 1987
Identified by Terry L. Yates, Sydney Anderson, Nancy Olds on 1987-09-04
Nature of ID: type specimen

Andalgalomys pearsoni
sensu D'elia et al. 2005
Identified by Phil Myers, Ulyses F. J. Pardinas, Guillermo D'Elia on 2005
Nature of ID: molecular data

Andalgalomys pearsoni
sensu D'elía et al. 2003
Identified by Ulyses Pardiñas, Guillermo D'Elía on 2003
Nature of ID: molecular data

Andalgalomys pearsoni
sensu Martínez et al. 2012
Identified by
Nature of ID: molecular data

Andalgalomys pearsoni
sensu Weir and Schluter 2007
Identified by
Nature of ID: molecular data
Remarks: Weir and Schulter 2007

Andalgalomys pearsoni
sensu Steppan et al 2007
Identified by Scott J. Steppan
Nature of ID: molecular data

Andalgalomys pearsoni
Identified by Terry L. Yates, Jerry W. Dragoo, David S. Tinnin, Jorge Salazar-Bravo
Nature of ID: molecular data
Remarks: ID from citation in Salazar-Bravo et al. 2001.

Andalgalomys pearsoni
sensu Salazar-Bravo et al 2003
Identified by Terry L. Yates, Jorge Salazar-Bravo, Luis F. Aguirre
Nature of ID: published referral

Andalgalomys pearsoni
sensu Salazar-Bravo et al 2003

Parts

Edit
Identifiers
GenBank: AY963176
GenBank: AF159285
NK: 12402
original identifier: NK 12402
preparator number: 1457

Edit

Part Name	Condition	Disposition	Qty	Label	Remarks
heart, kidney (frozen)	unchecked	in collection	1		
karyotype (frozen)	unchecked	in collection	1		
kidney (frozen)	unchecked	in collection	1		
liver (frozen)	unchecked	in collection	1		
liver (frozen)	unchecked	on loan	1		
liver (frozen)	unchecked	in collection	1		
liver (frozen)	good	on loan	1		
postcranial skeleton	good	in collection	1		moved to type case
skin	excellent	in collection	1		moved to type case
skull	excellent	in collection	1		moved to type case

Edit
sex: male
Joseph A. Cook, 1984-10-07

Citations
voucher of *Andalgalomys pearsoni*, page 808 in Steppan et al 2007
voucher of *Andalgalomys pearsoni dorbignyi* Olds, Anderson and Yates, 1987, page 1101 in Musser and Carleton 2005
voucher of *Graomys pearsoni dorbignyi*, page 461 in Anderson 1997
voucher of *Andalgalomys pearsoni* in Weir and Schluter 2007
voucher of *Andalgalomys pearsoni* in Martínez et al. 2012
voucher of *Andalgalomys pearsoni*, page 241 in D'elia et al. 2005
voucher of *Andalgalomys pearsoni*, page 356 in D'elía et al. 2003

Edit
Determination Type: accepted place of collection
assigned by Satya M. Witt on 2003-10-10
Higher Geography: South America, Bolivia, Santa Cruz

Joseph A. Cook, 1984-10-07
Std. Meas.

total length	tail length	hind foot	efn	weight
246 mm	123 mm	27 mm	24 mm	45 g

reproductive data: T=11mm
Joseph A. Cook, 1984-10-07

Edit
Remarks: PLUS ET, ENDO, CHROM
Entered By: Dusty L. McDonald on 2005-02-17
Last Edited By: JLDUNNUM on 2013-09-24

Edit
Accession
1985.097.Mamm

Usage
Loan History: Click for loan list

Edit
Media


image (image/jpeg)
Media Details
Media Preview Image


image (image/jpeg)
Media Details
Media Preview Image

Images


image (image/jpeg)
Media Details
Media Preview Image

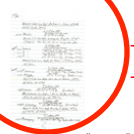


image (image/jpeg)
Media Details
Joseph A. Cook field catalog
page (JAC 1457)

Fieldnotes


image (image/jpeg)
Media Details
Media Preview Image


image (image/jpeg)

DB needs to keep everything connected

Object Tracking

2-piece cryotube label

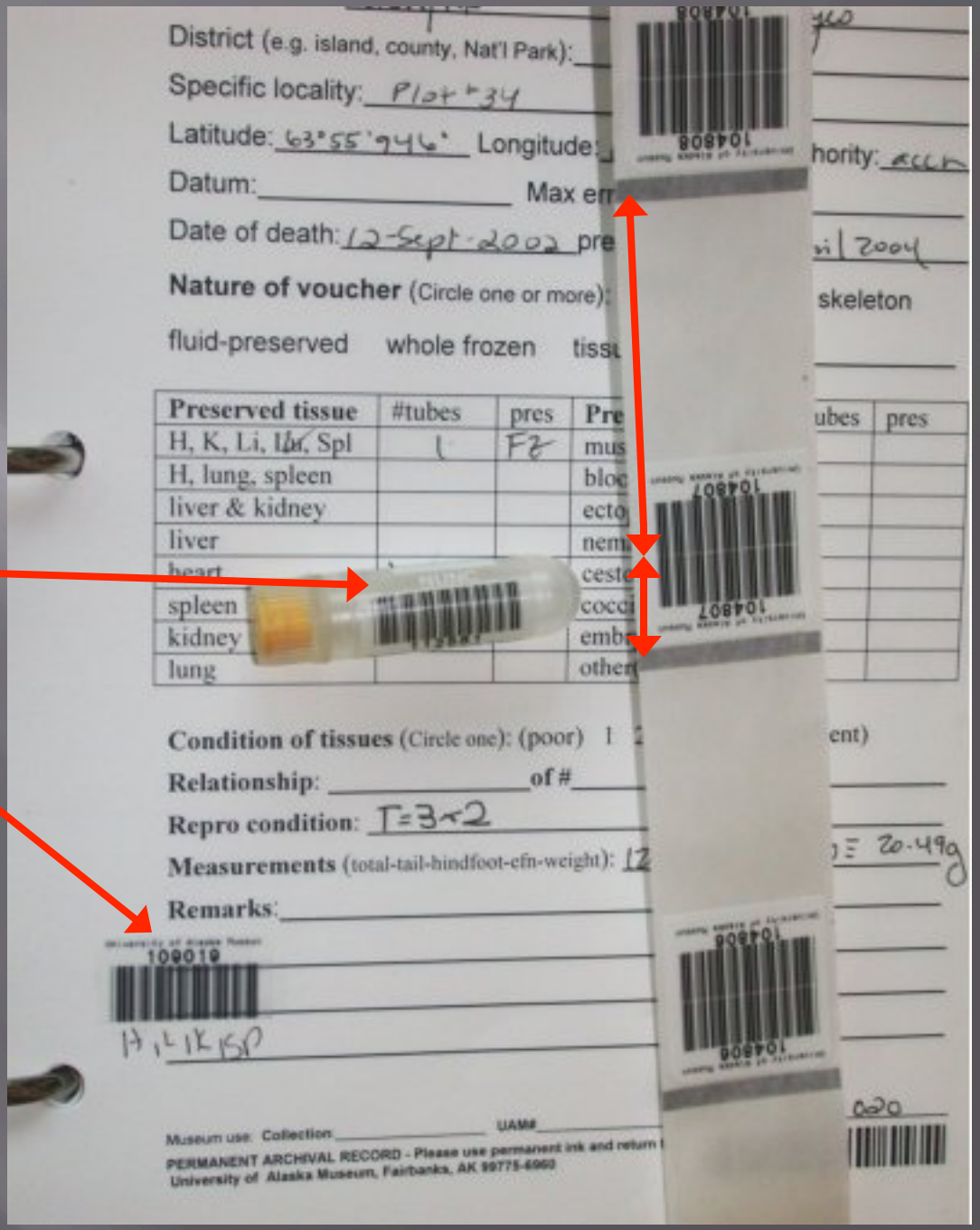
One piece wraps cryotube.

Other piece affixed to data sheet.

Less transcription work.
Less (no?) transcription errors.

Tubes (containers) can be installed immediately.
Specimen's parent container is scanned in at data-entry.

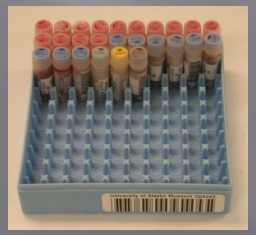
Tissue, parasites, skels, etc.

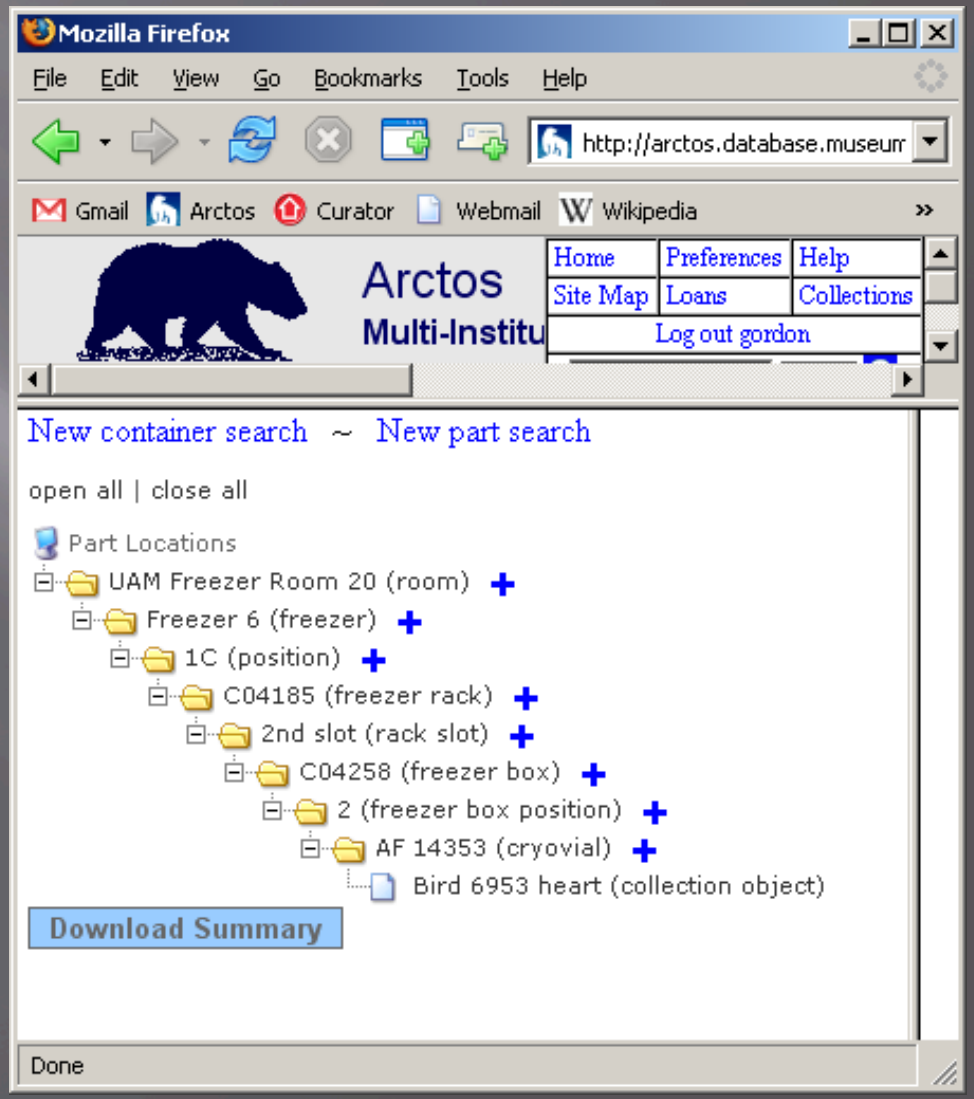


Hierarchical data structure (containers within containers)

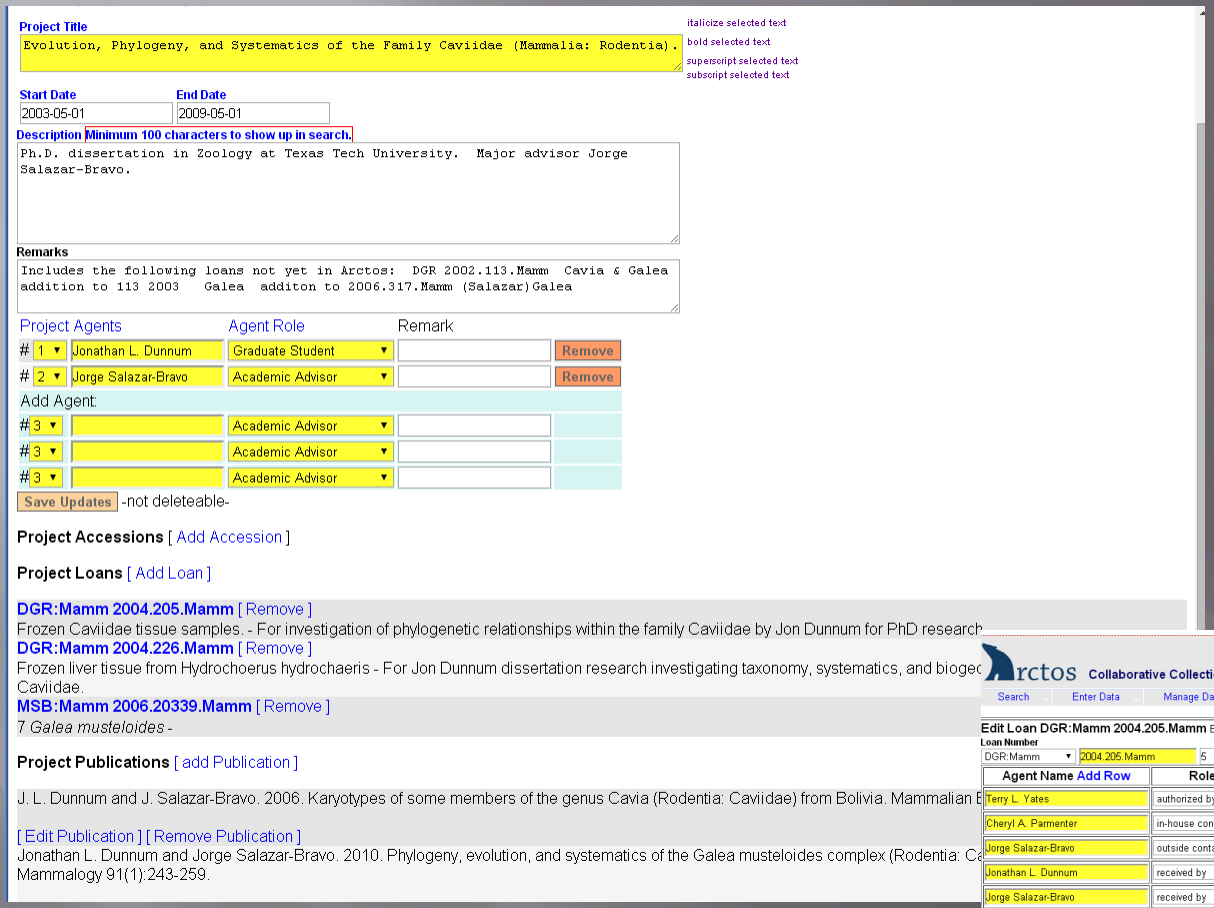
Every container is within a parent container

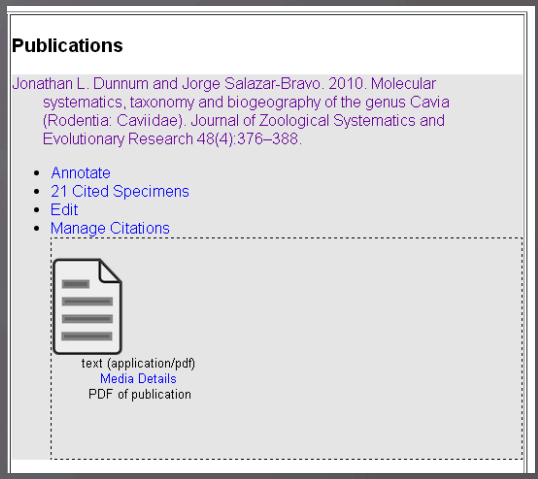
Recorded dimensions and logic prevent placement of a large container into a smaller parent.

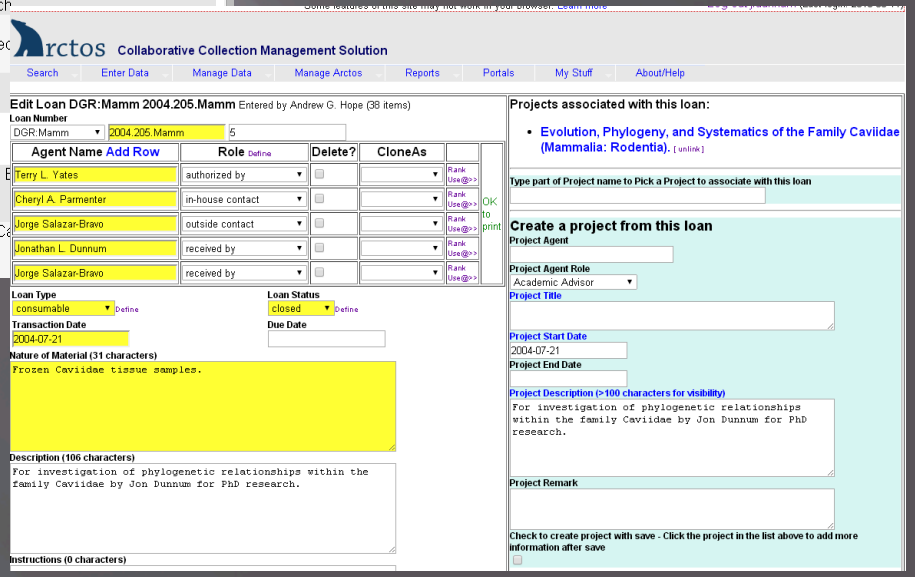




Projects







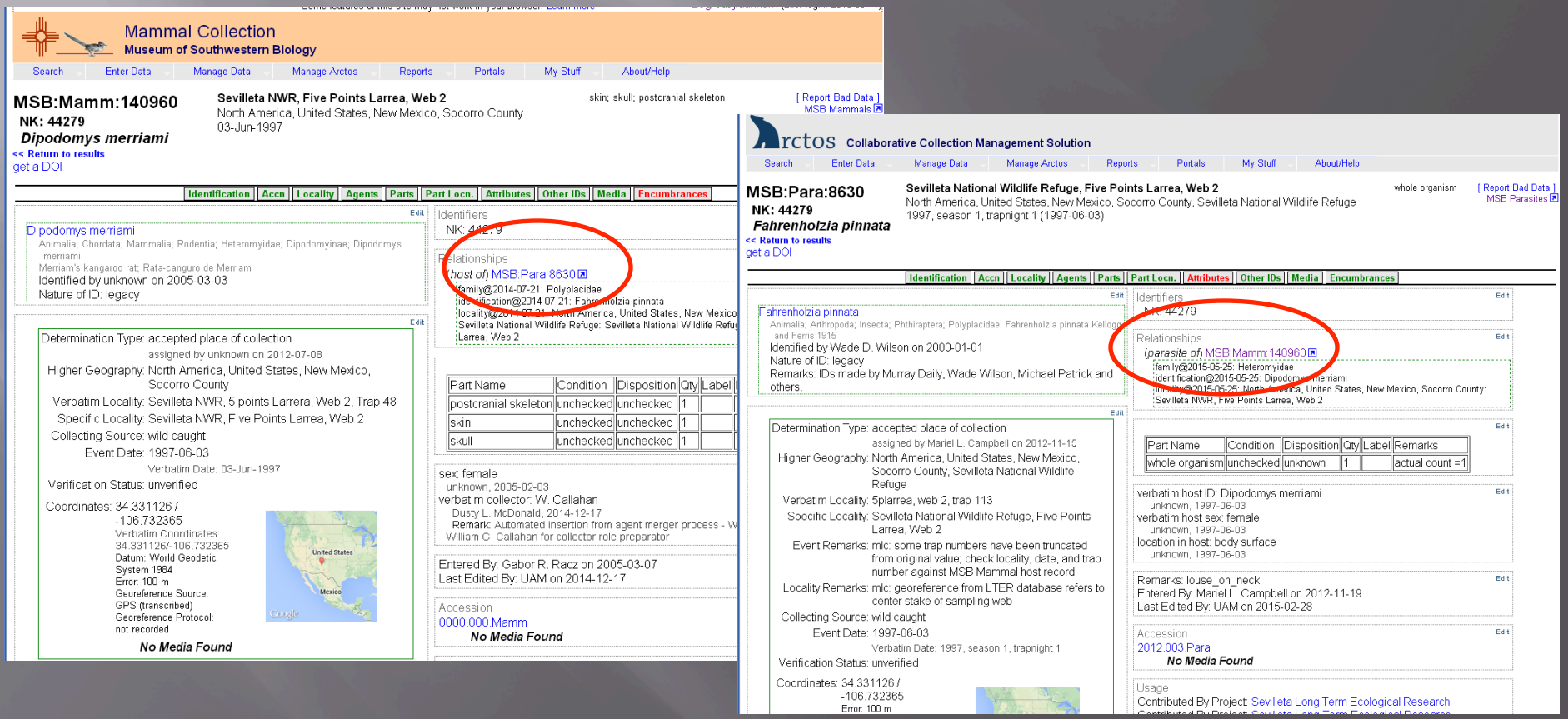
Ties projects, specimens, permits, loans, publications together

Conversion of catalog numbers to GUIDs

- URL and Darwin core triplet
- http://arctos.database.museum/guid/MSB:Mamm:123456
- Unique and standardized
- Can go around VPDs
- Allows your data to go out and play with others

Between collections – within and among Institutions

- Integrated collections
  - Host / parasites
  - Division of parts between institutions



Linkage to publications

Symbiotype example

	MSB:Mamm:96073 symbiotype(2)	101588	GenBank=DQ285046; GenBank=DQ285047; GenBank=EU192164; GenBank=EU192190; NK=101588; preparator number=444

arctos.database.museum/guid/MSB:Mamm:96073

Search | Enter Data | Manage Data | Manage Arctos | Reports | Portals | My Stuff | About/Help

MSB:Mamm:96073
NK: 101588
Oligoryzomys fulvescens
<< Return to results
get a DOI

LAS TABLAS; 7D46.068M N, 80D17.060M W
Central America, Panama, Los Santos
06-Mar-2000
skull; carcass (alcohol); liver (frozen); liver (frozen)

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

Edit
Oligoryzomys fulvescens
Animalia; Chordata; Mammalia; Rodentia; Cricetidae; Sigmodontinae; Oligoryzomys fulvescens
fulvous pygmy rice rat
Identified by unknown on 2005-02-15
Nature of ID: legacy

Oligoryzomys fulvescens
fulvous pygmy rice rat
sensu Vincent et al. 2000
Identified by James N. Mills, David S. Tinnin, Luis A. Ruedas on 2000
Nature of ID: legacy

Oligoryzomys fulvescens
fulvous pygmy rice rat
sensu Nelson et al. 2010
Identified by Jerry W. Dragoo, Blas Armien, Anibal Armien, Juan M. Pascale, Fred Koster, Randin Nelson, Raul Canate
Nature of ID: type specimen
Remarks: ID from citation in Nelson et al. 2010.

Citations
symbiotype of Oligoryzomys fulvescens in Vincent et al. 2000
not specifically cited but one of the positives from the group that was subsequently sequenced in Nelson et al 2010
symbiotype of Oligoryzomys fulvescens , page 2 in Nelson et al. 2010
Choclo virus positive

Edit
Determination Type: accepted place of collection
assigned by unknown on 2012-07-08
Higher Geography: Central America, Panama, Los Santos
Verbatim Locality: LAS TABLAS; 7D46.068M N, 80D17.060M W, Las Tablas
Specific Locality: LAS TABLAS; 7D46.068M N, 80D17.060M W
Collecting Source: wild caught
Event Date: 2000-03-06
Verbatim Date: 06-Mar-2000
Verification Status: unverified

Identifiers
GenBank: DQ285047
GenBank: DQ285046
GenBank: EU192190
GenBank: EU192164
NK: 101588
preparator number: 444

Part Name	Condition	Disposition	Qty	Label	Remarks
carcass (alcohol)	unchecked	unchecked	1		
liver (frozen)	good	in collection	1		Choclo
liver (frozen)	good	on loan	1		Choclo
skull	good	in collection	1		

Edit
sex: male
unknown, 2005-02-15

Edit
Remarks: Symbiotype of Choclo Hantavirus
Entered By: Dusty L. McDonald on 2005-02-17
Last Edited By: JLDUNNUM on 2015-02-24

Edit
Accession
2000.768.Mamm
No Media Found

Usage
Loan History: Click for loan list

Media
No Media Found

NCBI Resources How To — Sign in to NCBI
Nucleotide — Nucleotide — Search — Advanced — Help

Display Settings: GenBank — Send:

Choclo virus segment M, complete sequence
GenBank: DQ285047.1
FASTA Graphics

Go to:

```
LOCUS       DQ285047               3685 bp    RNA     linear   VRL 05-DEC-2005
DEFINITION  Choclo virus segment M, complete sequence.
ACCESSION   DQ285047
VERSION     DQ285047.1  GI:82780786
KEYWORDS    .
SOURCE      Choclo virus
  ORGANISM  Choclo virus
            Viruses; ssRNA viruses; ssRNA negative-strand viruses;
            Bunyaviridae; Hantavirus; unclassified Hantavirus.
REFERENCE   1  (bases 1 to 3685)
  AUTHORS   Nelson,R., Canate,R., Pascale,J.M., Dragoo,J.W., Armien,B.,
            Armien,A. and Koster,F.
  TITLE     Characterization of Choclo virus, a cause of hantavirus
            cardiopulmonary syndrome in Panama
  JOURNAL   J. Med. Virol. (2006) In press
REFERENCE   2  (bases 1 to 3685)
  AUTHORS   Nelson,R., Canate,R., Pascale,J.M., Dragoo,J.W., Armien,B.,
            Armien,A. and Koster,F.
  TITLE     Direct Submission
  JOURNAL   Submitted (08-NOV-2005) Biology, University of New Mexico, 1
            University of New Mexico, MSC03 2020, Albuquerque, NM 87131, USA
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                     /isolation_source="spleen"
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                     Biology, Division of Mammals"
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                     /segment="M"
                     /country="Panama"
     misc_feature    1..50
                     /note="5' noncoding region"
     CDS             51..3467
                     /codon_start=1
                     /product="envelope glycoprote
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                     /db_xref="GI:82780787"
```

Change region shown
Customize view
Analyze this sequence
Run BLAST
Pick Primers
Highlight Sequence Features
Find in this Sequence
LinkOut to external resources
MSB Mammals 96073 [Arctos Specimen Database]
LANL Hemorrhagic Fever Virus sequence database [LANL Hemorrhagic Fever Virus ...]
ViPR - Virus Pathogen Resource [Virus Pathogen Resource]
Related information
Full text in PMC
Protein
Taxonomy
Recent activity

Virology 277, 14–19 (2000)
doi:10.1006/viro.2000.0563, available online at http://www.idealibrary.com on IDEAL®

RAPID COMMUNICATION

Hantavirus Pulmonary Syndrome in Panama: Identification of Novel Hantaviruses and Their Likely Reservoirs

Martin J. Vincent,* Evelia Quiroz,† Fernando Gracia,† Angela J. Sanchez,* Thomas G. Ksiazek,* Paul T. Kitsutani,* Luis A. Ruedas,‡ David S. Tinnin,‡ Lorenzo Caceres,† Arsenio Garcia,† Pierre E. Rollin,* James N. Mills,* C. J. Peters,* and Stuart T. Nichol*,²

*Special Pathogens Branch, Division of Viral and Rickettsial Diseases, National Center for Infectious Diseases, Centers for Disease Control and Prevention, Atlanta, Georgia 30333; ‡Museum of Southwestern Biology, University of New Mexico, Albuquerque, New Mexico 87131; and †Instituto Conmemorativo Gorgas de Estudios de la Salud, Avenida Justo Arosemena, Panama City, Panama

Received June 16, 2000; returned to author for revision July 17, 2000; accepted August 1, 2000

Hantavirus pulmonary syndrome (HPS), a severe respiratory disease with high mortality caused by rodent-borne hantaviruses, has previously been identified in the United States and Canada as well as central and southern South America. In late 1999 and early 2000, an outbreak of acute illness compatible with HPS was reported in Los Santos, Panama, with the death of 3 of the 12 (25%) suspected cases. Hantavirus-specific antibodies were detected in patient sera, and virus RNA was detected by reverse transcriptase-polymerase chain reaction. Sequence analysis of virus genome N- G1-, and G2-encoding fragments showed this to be a novel hantavirus, Choclo virus. Serologic and virus genetic analyses of rodents trapped in the area showed *Oligoryzomys fulvescens* to be the likely reservoir for the HPS-associated Choclo virus. In addition, *Zygodontomys brevicauda* rodents were shown to harbor another genetically unique hantavirus, Calabazo virus. © 2000 Academic Press

Introduction. The genome organization of hantaviruses is typical of other members of *Bunyaviridae*, consisting of three negative-stranded RNA segments, large (L), medium (M), and small (S), which encode the virus L polymerase, the G1 and G2 glycoproteins, and the nucleocapsid protein, respectively (*5, 7*). Hantaviruses in the Old World, such as Hantaan, Seoul, Puumala, and Dobrava viruses, are associated with hemorrhagic fever with renal syndrome (HFRS) and are prevalent in Asia and Europe (*1, 9*). The New World hantaviruses are associated with hantavirus pulmonary syndrome (HPS) (*13, 15, 17*). HPS is characterized by abrupt onset of fever, headache, myalgia, hypotension, and thrombocytopenia, followed by bilateral pulmonary infiltrates and rapid progression to respiratory failure. The mortality rate associated with HFRS ranges from less than 1 to 7% and from 40 to 50% for HPS. Each specific hantavirus is associated with a specific rodent that serves as host and vector, and the New World hantaviruses are hosted by various members of the subfamily Sigmodontinae.

In North America, most of the HPS cases have been reported from the western United States and Canada; sporadic occurrences have also been reported in other areas. Sin Nombre (SN) virus (*4, 13*) or viruses closely resembling the SN virus have been responsible for most of the cases. HPS has not been previously reported from south of the United States, Central America, the Caribbean Islands, and northern South America. In contrast, South American countries, such as Argentina, Chile, Paraguay, Peru, Brazil, and Bolivia, have previously had several HPS outbreaks (*14*). This is the first report to describe the presence of hantaviruses and HPS cases in Panama, Central America.

Between December 1999 and February 2000, cases of acute febrile respiratory illness exhibiting typical symptoms of HPS were identified in the town of Las Tablas in Los Santos Province, Panama. Serologic testing of samples obtained from the patients and trapped rodents indicated antibody reactivity with prototype Sin Nombre (SN) virus antigens. Further analyses of nucleotide sequences of S and M segment fragments amplified by polymerase chain reaction (PCR) indicate that the virus responsible for the outbreak in Panama has unique and novel genetic sequences. We have also tentatively identified *Oligoryzomys fulvescens* as the reservoir for this virus as evidenced by nearly 100% identity of viral nucleotide sequences obtained from both HPS patients and *O. fulvescens*.

Results. Detection of Hantavirus Infection in Samples. Seven patients were found to be positive for the presence of hantavirus-specific antibodies, on initial

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Data Harvesting

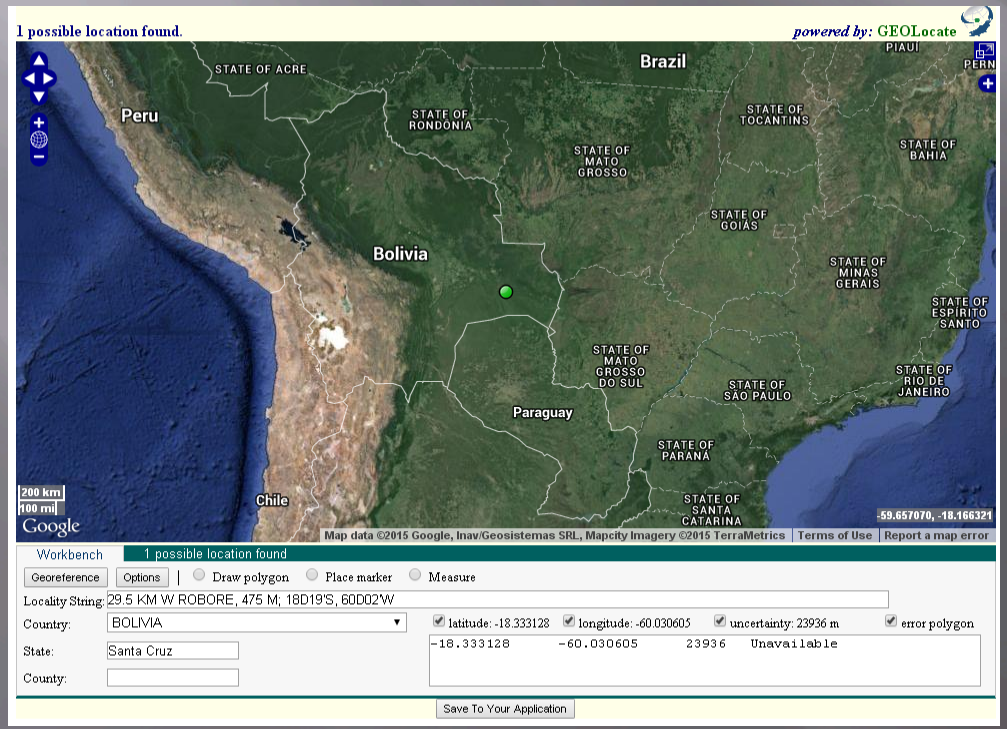
- In format that can be accessed and served by other databases.
  - IDigBio
  - GBIF
  - VertNet
- Active links back to Arctos

Other Big Data

- GIS
- GenBank
- IsoBank

Linkages to GIS applications

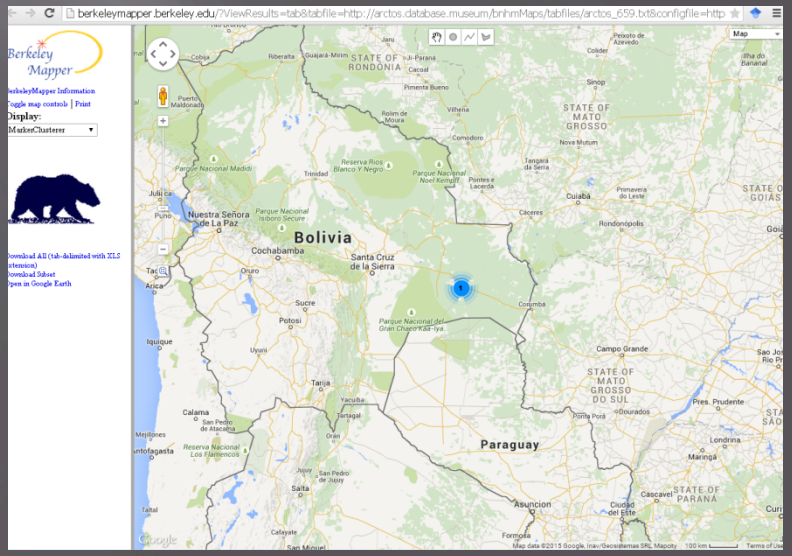
- Geolocate
- Berkeleymapper
- Googlemaps



Determination Type: accepted place of collection
assigned by Satya M. Witt on 2003-10-10
Higher Geography: South America, Bolivia, Santa Cruz
Specific Locality: 29.5 KM W ROBORE, 475 M; 18D19'S, 60D02'W
Collecting Source: wild caught
Event Date: 1984-10-07
Verbatim Date: 07-Oct-1984
Verification Status: unverified

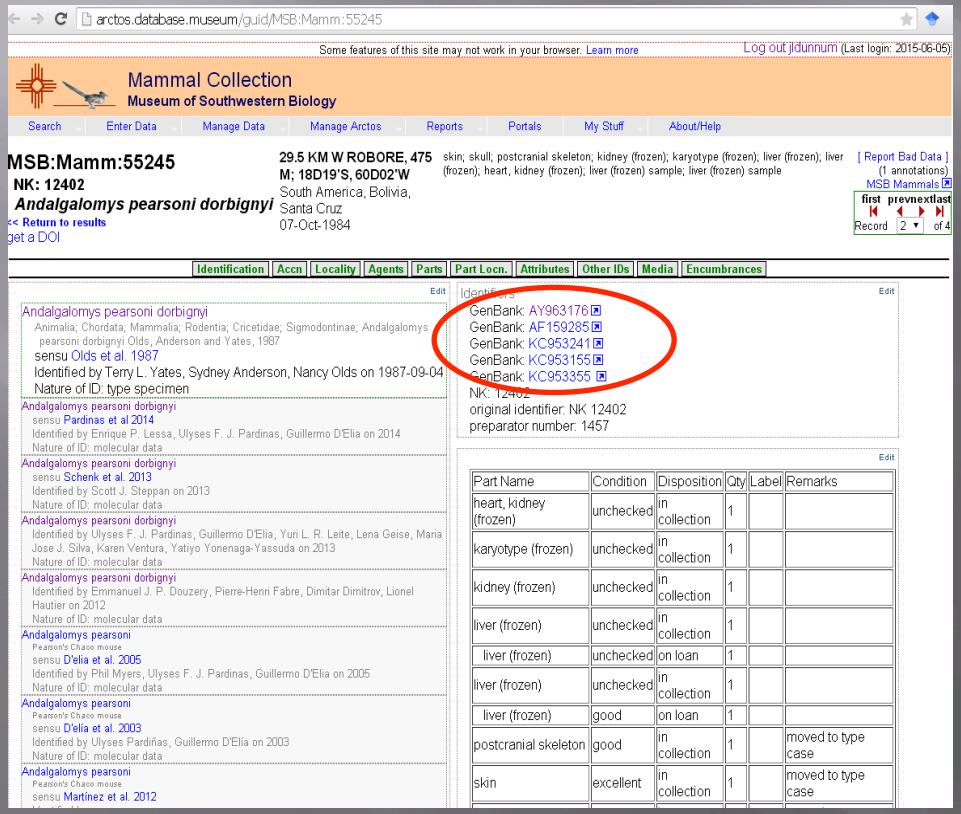
Coordinates: -18.33333 / -60.03333
Verbatim Coordinates: -18.33333/-60.03333
Datum: unknown
Error: 29.869 km
Georeference Source: non-USGS map
Georeference Protocol: not recorded

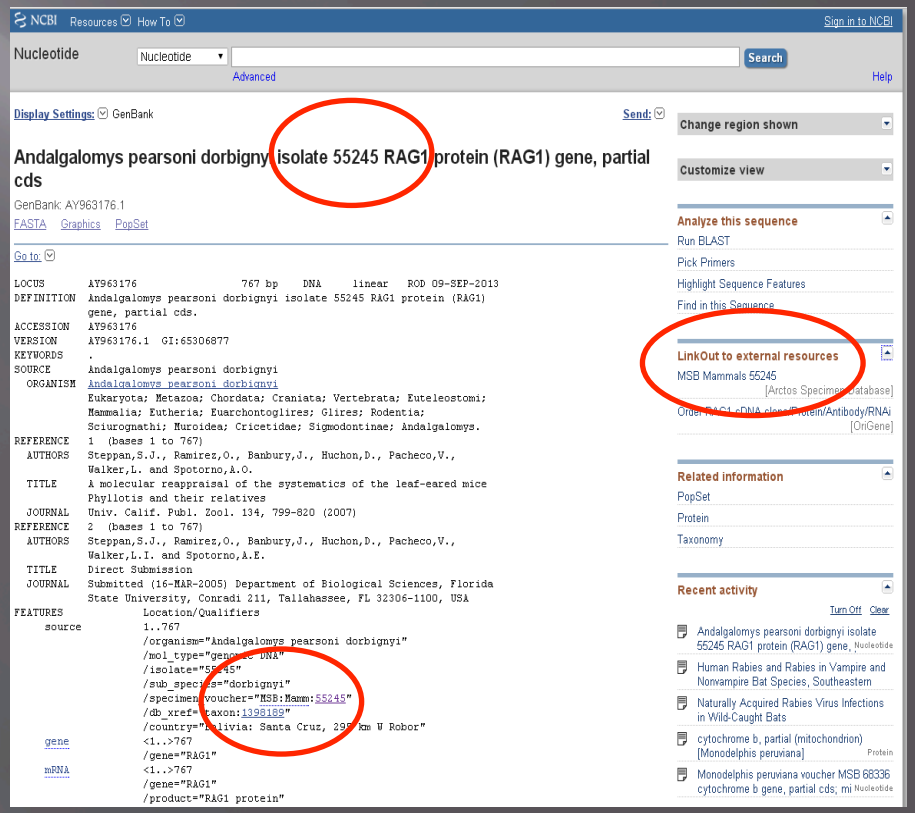
No Media Found



Linkage to GenBank

- Reciprocal links in Arctos and GenBank
- Darwin Core triplet (MSB:Mamm:123456)
- Cat # in voucher and definition fields
- Tying genes to time and space – only vouchered material





Andalgalomys pearsoni **dorbignyi (MSB 55245)**

DNA sequence submitted to GenBank
AF159285

Genetic data

1. Anderson and Yates. 2000.
2. Salazar-Bravo et al. 2001.
3. D'elía et al. 2003.
4. D'Elia et al. 2005.
5. Haag et al. 2007.
6. Steppan et al. 2007.
7. Weir and Schluter. 2007.
8. Martinez et al. 2012.
9. Fabre et al. 2012
10. Alvarado-Serrano and D'Elia. 2013
11. Schenk et al. 2013
12. Ventura et al. 2013
13. Pardinas et al. 2014
14. Zeballos et al. 2014

Morphologic data

1. Olds et al. 1987.
2. Anderson 1993.

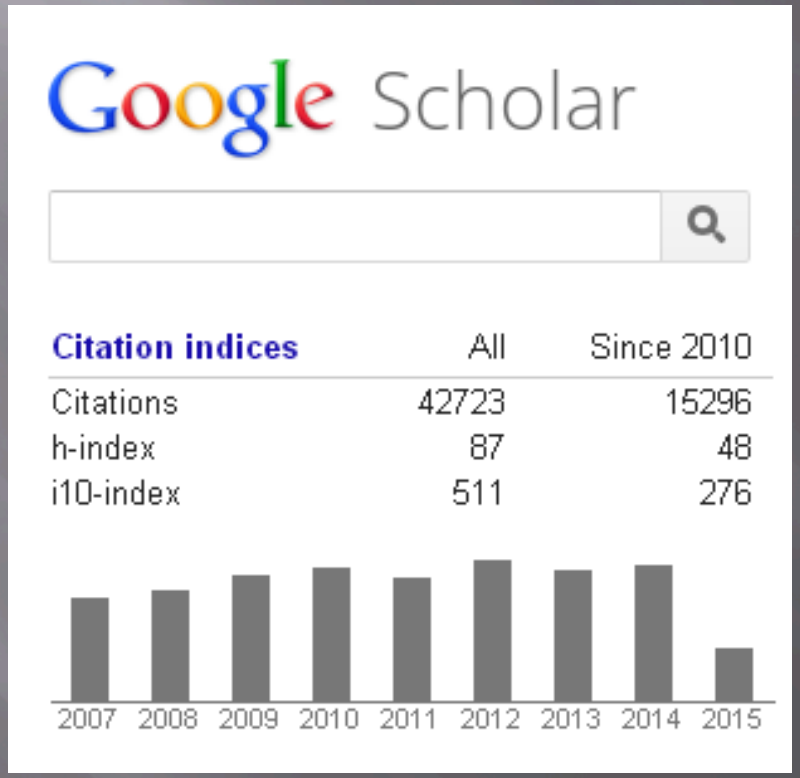
Taxonomic References

1. Novak, R.M. 1991.
2. Musser and Carlton 1993.
3. Anderson 1997.
4. Novak, R.M. 1999.
5. Salazar-Bravo et al. 2003.
6. Musser and Carlton 2005.

22 publications using data from a single specimen collected in 1984

Google Scholar Profile

MSB Division of Mammals:



Use recognized metrics to demonstrate value

Questions?

Demos?