Colecciones científicas, bases de datos y cambio (climático)

Jose Cook
Universidad de Nuevo México, EE.UU
Resumen de Curso

**Lecturas y Discusión:**

- **Lunes 2, de 9 a 12 hs. y 14 a 17 hs**
  - Museos, datos y web acceso, huesped/parasito archivos
- **Martes 3, de 9 a 12 hs. y 14 a 17 hs**
  - 9-10 hs discusión de literatura
    - (Conroy et al 1999)
  - 10-12 hs Biologia de islas,
    14-15 hs discusión dela literatura
    - (Pyke and Ehrlich 2010)
  - 15-17 hs Museos y cambia de medio ambiente

- **Viernes 6, de 9 a 13 hs., Salón de Seminarios II**
  - Discusión de la Literature, Presentación y Discusión de Proyectos
  - 9-10 hs discusión de la literatura
    - (Moritz et al., 2009; Hope et al., 2013)
  - 10-13 hs, Presentación y Discusión de Proyectos
Pero Primero Evaluación

- AIM-UP! perception of museums--pretest
- Despues de Island Module (Viernes)
  - module evaluación
  - y Fin de curso–post-test evaluación
Resumen de Tema de Colecciones

• Museos / research collections
  – Overview
  – Relevance today
• Web Interfaces
• Tema de Integración
• Linking “Big Data”
• Datos (y mas-muestras)
• New users
Museos (en general)

• Arte
Museos (en general)

• Arte
• Historia

Museo Histórico Nacional. Casa del Gral. Fructuoso Rivera
Museos (en general)

- Arte
- Historia
- Temas particulares

Museo del Mate
Museos (en general)

• Arte
• Historia
• Temas particulares
• Museos de Historia Natural
Museos (en general)

• Arte
• Historia
• Temas particulares

• Museos de Historia Natural
  – La Historia
    • Curiosities
    • First used to discover and describe novelties
Museos (en general)

From “Cabinets of Curiosity” in Renaissance Europe

- Unusual specimens
- One of a kind
- Displays-exhibits

Corals
Museos de Historia Natural

• Historia Natural
  – Exhibición—Este función bien conocido
Natural History Museums

• **Exhibits** play an important role in natural history & biodiversity education:
  – Highly visible/large visitor base
  – Informal education on the wonder of life
• Build appreciation for natural world
Museos de Historia Natural

- Museos
  - Exhibición
  - Colecciones (especímenes)
How is the Role of NH Museums Changing?

• Are specimens only curiosities (unusual)?

• What are the other uses of specimens?

• How should collections change to meet new challenges in science, management, and education?
University of Alaska Museum
http://www.youtube.com/watch?v=KFms-9hy5KY

http://www.youtube.com/watch?v=MyIT3EyVz0k
Colecciones
Ruta de una muestra
Colecciones de Museos de Historia Natural

• Museos de Historia Natural
  – Curiosities
  – New Species Descriptions
Ctenomys pearsoni  Lessa & Langguth, 1983

• Fotografia: Marcelo Casacuberta
A few comments on biodiversity discovery

• About 54 new species of mammals described annually since 1980
• In last 40 years, number of amphibian species has increased > 35%
• Mega-diverse groups—(e.g., arthropods and nematodes) tremendous increase in species numbers
### Estimated Number of Species on Earth

<table>
<thead>
<tr>
<th>Species</th>
<th>Earth</th>
<th></th>
<th>±SE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Catalogued</td>
<td>Predicted</td>
<td></td>
</tr>
<tr>
<td><strong>Eukaryotes</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Animalia</td>
<td>953,434</td>
<td>7,770,000</td>
<td>958,000</td>
</tr>
<tr>
<td>Chromista</td>
<td>13,033</td>
<td>27,500</td>
<td>30,500</td>
</tr>
<tr>
<td>Fungi</td>
<td>43,271</td>
<td>611,000</td>
<td>297,000</td>
</tr>
<tr>
<td>Plantae</td>
<td>215,644</td>
<td>298,000</td>
<td>8,200</td>
</tr>
<tr>
<td>Protozoa</td>
<td>8,118</td>
<td>36,400</td>
<td>6,690</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1,233,500</td>
<td>8,740,000</td>
<td>1,300,000</td>
</tr>
<tr>
<td><strong>Prokaryotes</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Archaea</td>
<td>502</td>
<td>455</td>
<td>160</td>
</tr>
<tr>
<td>Bacteria</td>
<td>10,358</td>
<td>9,680</td>
<td>3,470</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>10,860</td>
<td>10,100</td>
<td>3,630</td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td>1,244,360</td>
<td>8,750,000</td>
<td>1,300,000</td>
</tr>
</tbody>
</table>

Museos de Historia Natural

- Curiosities
- New Species Descriptions
- Systematics
- Species Distributions
- “Natural History”
- Y mas (otro usos nuevos)
Natural History Research Collections

• Research collections
  – Thousands of collections worldwide
    • (with >3 billion specimens)
  – Vast resources poorly known (public & scientists)
    • Out of the public eye and locked away
    • But now digitization of billions of specimens and data points on WWW
Specimens are Primary Biodiversity Baselines

• Porque baseline?
Specimens are Primary Biodiversity Baselines

- Geographic scale – locality
  - Precise georeference information (GPS)
- Temporal scale - collection date
Specimens are Primary Biodiversity Baselines

• Geographic scale – locality
• Temporal scale - collection date

• What other information can we get from museum collections?
Specimens are Primary Biodiversity Baselines

• Geographic scale – locality
• Temporal scale - collection date
• Other information
  – Reproductive, natural history, ecological
  – Tissue/parasites/karyotypes
Significant questions are centered on our ability to assess change.

- Climate change
Significant questions are centered on our ability to assess change.

- Climate change
- Habitat conversion
Significant questions are centered on our ability to assess change.

- Climate change
- Habitat conversion
- Pollutants
Significant questions are centered on our ability to assess change.

- Climate change
- Habitat conversion
- Pollutants
- Emerging pathogens
Significant questions are centered on our ability to assess change.

- Climate change
- Habitat conversion
- Pollutants
- Emerging pathogens
- Introduction of exotics
Significant questions are centered on our ability to assess **change**.

- Climate change
- Habitat conversion
- Pollutants
- Emerging pathogens
- Introduction of exotics
- Loss of biotic diversity
Significant questions are centered on our ability to assess change.

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

- All require BASELINE DATA & SAMPLES
  - Historic information
  - New questions
  - New technology
How is a specimen prepared?

• http://www.youtube.com/watch?v=azNkyFpPfGc
Across stakeholders

- Connect managers, scientists, general public through collaborations
- Make museum data electronically available through the web.
  - What data?

- One example:
- ARCTOS as an example (http://arctosdb.org/)
  - Data are archived in ARCTOS; a web accessible relational database with samples
1. Baselines
2: Integration

Across stakeholders
Across scientists
  • Connect Big Data
    • Cyberinfrastructure for Informatics
      • (GIS, GenBank, Isotopes, Pathogens, Toxins, Morphology, Ecology, etc)
1. Baselines
2: Integration

Across stakeholders
Across scientists

- Connect Big Data
  - Cyberinfrastructure for Informatics
  - (GIS, GenBank, Isotopes, Pathogens, Toxins, Morphology, Ecology, etc)

- One example:
  - ARCTOS as an example ([http://arctosdb.org/](http://arctosdb.org/))
  - Data are archived in ARCTOS; a web accessible relational database with samples
Arctos
A Database for Biodiversity Researchers and Students
http://arctos.database.museum

- ARCTOS a dynamic collaboration (>40 colecciones) integrating access to specimen data, collection-management tools, and external resources on the Web.
Breadth of Data in ARCTOS

Audio  DNA  Relations  GIS  Projects/Pubs

SPECIMENS

Fieldnotes, Maps, and Images
Who Uses ARCTOS?

• Academics (students, postdocs, profs.)
• Museum curators and researchers
• Federal and state agencies
• Non-government organizations
• Environmental consultants
• K-12 educators
• Artists
Network to Increase Availability for---Managers, Scientists and the General Public

Fig. 6. ARCTOS database visitor statistics. a). Visitors, b). Referring sources, c). Geographic origin of visitors.

![Graph showing visitor statistics over time.](image-url)
b). Source [Medium]

<table>
<thead>
<tr>
<th>Source</th>
<th>Visits</th>
</tr>
</thead>
<tbody>
<tr>
<td>(direct) [(none)]</td>
<td>714</td>
</tr>
<tr>
<td>google [organic]</td>
<td>423</td>
</tr>
<tr>
<td>uaf.edu [referral]</td>
<td>142</td>
</tr>
<tr>
<td>biologie.uni-ulm.de [referral]</td>
<td>104</td>
</tr>
<tr>
<td>msb.unm.edu [referral]</td>
<td>47</td>
</tr>
<tr>
<td>curator.museum.uaf.edu [referral]</td>
<td>41</td>
</tr>
<tr>
<td>yahoo [organic]</td>
<td>16</td>
</tr>
<tr>
<td>mail.google.com [referral]</td>
<td>12</td>
</tr>
<tr>
<td>nix.msb.unm.edu [referral]</td>
<td>7</td>
</tr>
</tbody>
</table>

(c). World map showing visits from different sources.
Ctenomys pearsoni

Animalia Chordata Mammalia Rodentia Ctenomyidae Ctenomys pearsoni Lessa and Langguth, 1983
Identified by Museum of Vertebrate Zoology, University of California, Berkeley on 1999-01-27
Nature of ID: legacy

Ctenomys pearsoni

Identification: accepted place of collection
Assigned by Satyish M. Witt on 2003-10-27

Higher Geography: South America, Uruguay, Departamento Maldonado
Specific Localities: Punta Rasa
Collecting Source: wild caught
Event Date: 22 Nov 1994
Verification Status: unverified
Coordinates: -34.9/-55.23333

Determination Type: accepted place of collection
Assigned by Satyish M. Witt on 2003-10-27

Part Name | Condition | Qty | Remarks
--- | --- | --- | ---
tissue (95% ethanol) | unchecked | 1 | ground allozyme extract
tissue extract (frozen) | unchecked | 1 | ground allozyme extract
tissue extract (frozen) | unchecked | 1 | ground allozyme extract
whole organism (ethanol) | unchecked | 1 | ground allozyme extract

sex: male
Museum of Vertebrate Zoology, University of California, Berkeley, 2005-11-01

Accession
13059
Two instances
>3M total specimens

50 collections
15 institutions
1.8 M specimens

7 collections
1 institution
1.6M specimens
Collections- Taxonomic Integration

- Mammals
- Birds
- Herps
- Plants
- Nematodes
- Insects
- Fishes
Collections - Integration of Science

Skins

Tissues

Eggs

Nests

Fossils

Parasites

Skeletons
Ultra-frozen Tissues

• Multiple Kinds of Tissue
  – Heart
  – Kidney
  – Liver
  – Muscle
  – Spleen
  – other
  – Why?
Arctos also includes observational data!
Collections - Integration Across Levels of Biodiversidad

- Genetic diversity
  - = within-species variability (reflects evolutionary history and future?)
- Species diversity (richness)
- Ecosystem diversity
- Biogeographic
Arctos Collection Management Functions:

- Search, enter, update data
- Georeference and map localities
- Manage transactions (projects, loans, accns, permits)
- Track specimen citations (pubs, GenBank)
- Track collection objects (e.g., tissue vial barcoding)
- Link to external web resources
Web Demo of Arctos
**Identifiers**

- **Collection**: All
- **Number**: 

**Identification and Taxonomy**

- **Any Taxonomic Element**: 

**Locality**

- **Any Geographic Element**: 

**Date/Collector**

- **Collector**: 

**Biological Individual**

- **Part Name**: 

**Usage**

- **Basis of Citation**: 

---

- Data Providers
- Report a bug or request support
Linking Big Data—Space, Time, Genetics
Mapping
Arctos is part of a broader data museum network community
Overview of Web-accessible Databases

- AmphibiaWeb http://amphibiaweb.org/
- Animal Diversity Web http://animaldiversity.ummz.umich.edu/site/index.html
- Arctos http://arctos.database.museum/home.cfm
- Barcode of Life http://www.boldsystems.org/views/login.php
- Encyclopedia of Life http://www.eol.org/
- Faunmap http://www.museum.state.il.us/research/faunmap/query/
- FishNET http://www.fishnet2.net/
- Global Biodiversity Information Facility (GBIF) http://www.gbif.org/
- HerpNet http://www.herpnet.org/
- Host-Parasite Database http://www.nhm.ac.uk/research-curation/research/projects/host-parasites/index.html
- IUCN Red List of Threatened Species http://www.iucnredlist.org
- Mammal Networked Information System (MaNIS) http://manisnet.org/
- NatureServe http://www.natureserve.org/getData/
- ORNIS http://www.ornisnet.org/
- Paleobotany Project http://www.paleobotanyproject.org/default.aspx
- TIGR Reptile Database http://www.reptile-database.org/
- Tree of Life http://tolweb.org/tree/
- VertNet http://vertnet.org/index.php
Specimens tie together research projects, track research and allow retesting of previous work and hypotheses.

Scientific Process
(Replication without vouchers is difficult)
Andogalosus pearsoni (M&L 55245)

**MORPHOLOGIC DATA**

  USE: Holotype voucher

- Anderson 1993. Los mamíferos bolivianos: notas de distribución y claves de identificación. JOURNAL: Publicaciones Especiales de el Instituto Ecológico (Colección Boliviana de fauna)
  USE: Diagnostic keys and distributional records

**TAXONOMIC REFERENCES**

  USE: Taxonomy and distribution


  USE: Taxonomy and distribution

  USE: Taxonomy and distribution

  USE: Taxonomic list


**GENETIC DATA**

  USE: Genetic voucher for Topeomys diagnosis

  USE: Genetic voucher for Calomys phylogenetcs

- D’Elia et al. 2003. Phylomatic analysis of sigmodontine rodents (Muridae), with special reference to the abdonid genus Delomys. JOURNAL: Mammalian Biology
  USE: Genetic voucher in sigmodontine phylogeny

  USE: Genetic voucher in sigmodontine phylogeny

- Haag et al. 2007. Phylogenetic relationships among species of the genus Calomys with emphasis on south american lowland taxa. JOURNAL: Journal of Mammalogy
  USE: Genetic voucher for Calomys phylogenetics

- Steppan et al. 2007. A molecular reappraisal of the systematics of the leaf-eared mice Phyllotis and their relatives. JOURNAL: Journal of Mammalogy
  USE: Genetic voucher in phyllostine phylogeny

- Weir and Schluter, 2007. The latitudinal gradient in Recent Speciation and Extinction Rates of Birds and Mammals. JOURNAL: Science
  USE: Genetic data for tropical sister species

  USE: Genetic voucher in sigmodontine phylogeny
Animal Diversity Web

http://animaldiversity.ummz.umich.edu/
Public Contribution to Biodiversity Data


Citizen science: utilize the huge populace with interest in biodiversity issues
Map of Life

www.mappinglife.org
Tree of Life

http://tolweb.org
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.
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 foundation called ... more
Big Data

Map of Life, Tree of Life, GBIF, GenBank, IUCN, GIS applications

Museum data need to be in a format that can be accessed and served by other databases.

Creating the linkages is critical.
What’s Available from Uruguay?

- Argentina?
- Brasil?
New perspectives

• Making natural history collection available to non-traditional users
  – Especially non-systematists

• Artists provide not only new perspectives and criticality, but also are advocates for biodiversity issues
Gendron Jensen lithograph
Last brown bear taken from NM Pecos wilderness in 1917
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

http://ae.unm.edu/
Morphology and Evolution with Brian Conley
Novel perspectives are needed from museum specimens and data to unlock the answers to the current and future biodiversity crisis.
Natural History Collections in Education

- Train Future Investigators

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