Digitization TCN: ESB: Mobilizing Millions of Marine Mollusks of the Eastern Seaboard

Project Start Date: 15 September 2020

Project period: 4 years

Project leads: Rüdiger Bieler & Petra Sierwald
TCNs with molluscan component:

FOSSIL:
• 2012: (TCN) Digitizing Fossils to Enable New Syntheses in Biogeography- Creating a PALEONICHES (Paleoniches)

• 2015: (TCN) Documenting Fossil Marine Invertebrate Communities of the Eastern Pacific - Faunal Responses to Environmental Change over the last 66 million years (EPICC)

• 2016: (TCN): The Cretaceous World: Digitizing Fossils to Reconstruct Evolving Ecosystems in the Western Interior Seaway

EXTANT:
LAND AND FRESHWATER:
• 2014: (TCN) Documenting the Occurrence through Space and Time of Aquatic Non-indigenous Fish, Mollusks, Algae, and Plants Threatening North America's Great Lakes (GLI)

• 2014: (TCN) InvertEBase: Reaching Back to See the Future: Species-rich Invertebrate Faunas Document Causes and Consequences of Biodiversity Shifts (InvertEBase)

• 2019: (TCN) Enhancing Access to Taxonomic and Biogeographical Data to Stem the Tide of Extinction of the Highly Imperiled Pacific Island Land Snails: (PILSBRY)

MARINE: ?
U.S. Mollusk collections: 1973 baseline data

Published October 1975

- Analyzed data from 26 institutional collections with >5,000 lots

https://biodiversitylibrary.org/page/43040030

The Recent Mollusk Collection Resources of North America

A Report to the

Association of Systematics Collections

Compiled and Written by

ALAN SOLEM

for the

Council of Systematic Malacologists
U.S. Mollusk collections: 2017 Survey

• Data from 85 institutional collections, including those identified by Solem (1975) and Cummings et al. (2009)

• 40 U.S. States/Territories, 4 Canadian provinces

• Analyzed data from all collections with >1,000 lots

When overall size does not matter:  **Freshwater mollusks**

<table>
<thead>
<tr>
<th>Collection</th>
<th>catalogued lots in 2017</th>
<th>freshwater</th>
</tr>
</thead>
<tbody>
<tr>
<td>OSUM</td>
<td>120,180</td>
<td>104,280</td>
</tr>
<tr>
<td>USNM</td>
<td>1,000,000</td>
<td>95,000</td>
</tr>
<tr>
<td>UF</td>
<td>497,459</td>
<td>94,518</td>
</tr>
<tr>
<td>CM</td>
<td>170,000</td>
<td>92,350</td>
</tr>
<tr>
<td>UMMZ</td>
<td>251,000</td>
<td>87,850</td>
</tr>
<tr>
<td>ANSP</td>
<td>501,000</td>
<td>76,110</td>
</tr>
<tr>
<td>INHS</td>
<td>86,790</td>
<td>58,748</td>
</tr>
<tr>
<td>FMNH</td>
<td>382,000</td>
<td>57,300</td>
</tr>
<tr>
<td>MCZ</td>
<td>372,000</td>
<td>50,359</td>
</tr>
<tr>
<td>CMNML</td>
<td>100,000</td>
<td>47,500</td>
</tr>
<tr>
<td></td>
<td></td>
<td>764,015</td>
</tr>
</tbody>
</table>
Mollusk lots in U.S. & Canada (2017)

<table>
<thead>
<tr>
<th>Category</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>8.4 million</td>
</tr>
<tr>
<td>Cataloged</td>
<td>6.0 million</td>
</tr>
<tr>
<td>Digitized</td>
<td>4.5 million</td>
</tr>
<tr>
<td>Georeferenced</td>
<td>1.3 million</td>
</tr>
<tr>
<td>Mobilized (at least in part)</td>
<td>34 of 86 collections</td>
</tr>
</tbody>
</table>
Collections community near-term goals

- Complete basic data entry
- Imaging of primary types
- Expanding MolluscaBase
- Collaborative georeferencing

A Matter of Life and Death

- Many shelled mollusks were dead-collected
- “Dead” records are problematic in meta analyses (poor data quality to address time & space questions)
- We have no community standards for the live/fresh/dead/subfossil spectrum
- We do not consistently flag this in our databases (EMu, Specify, Arctos, FileMaker)
- Aggregators cannot compile such data unless we provide them
- Some can be “automated” based on taxonomy or annotations
(A) The holotype of *Cyphoma mcgintyi* from Florida, clearly collected alive, with dried tissue visible on the shell. (B) A syntype of *Fenimorea halidorema* from Florida, clearly dead-collected with worn ribs and a hole in the spire. (C) A syntype of *Neptunea stonei*, with eroded shell layers and lacking pigment, an extinct species sometimes found on beaches in New Jersey.
Other molluscan infrastructure developments

- Authority files
- MolluscaBase
Western Atlantic Focus

- Malacolog

Malacolog is a database for research on the systematics, biogeography, and diversity of mollusks. Malacolog attempts to document all names that have ever been applied to marine mollusks in the Western Atlantic from Greenland to Antarctica. The database was described in Rosenburg, G. 1993. A database approach to studies of molluscan taxonomy, biogeography, and diversity, with examples from Western Atlantic marine gastropods. American Malacological Bulletin 16:257-268. Malacolog now includes all mollusks, not just gastropods. Gastropod species have the most complete coverage followed by bivalves, while polyplacophorans, aplacophorans, monoplacophorans and cephalopods are a work in progress, and cephalopods include only a small subset of names. Malacolog also includes dictionaries for gender of names, a bibliography, and browse lists for families and geographic ranges, as well as search help and an information model.

- South Florida diversity

- Expanding online outreach
• Focus on East Coast
• From shore to edge of EEZ (200 nm)
• Coastline of 18 States
• Capture 85% of all ESB mollusks holdings in U.S. collections (add others via PENs)
<table>
<thead>
<tr>
<th>Institution</th>
<th>Acronym</th>
<th>State</th>
<th>ESB lots</th>
<th>ESB specimens</th>
</tr>
</thead>
<tbody>
<tr>
<td>Academy of Natural Sciences of Philadelphia (L)</td>
<td>ANSP</td>
<td>PA</td>
<td>44,385</td>
<td>498,000</td>
</tr>
<tr>
<td>Bailey-Matthews National Shell Museum (ML)</td>
<td>BMSM</td>
<td>FL</td>
<td>20,836</td>
<td>85,428</td>
</tr>
<tr>
<td>Carnegie Museum of Natural History (ML)</td>
<td>CM</td>
<td>PA</td>
<td>11,436</td>
<td>102,924</td>
</tr>
<tr>
<td>Delaware Museum of Natural History (L)</td>
<td>DMNH</td>
<td>DE</td>
<td>33,500</td>
<td>385,250</td>
</tr>
<tr>
<td>Field Museum of Natural History [Lead] (L)</td>
<td>FMNH</td>
<td>IL</td>
<td>68,500</td>
<td>660,000</td>
</tr>
<tr>
<td>Fish and Wildlife Research Institute (M)</td>
<td>FWRI</td>
<td>FL</td>
<td>51,551</td>
<td>[412,408]</td>
</tr>
<tr>
<td>Florida Museum of Natural History (L)</td>
<td>UF</td>
<td>FL</td>
<td>83,000</td>
<td>435,000</td>
</tr>
<tr>
<td>Harbor Branch Oceanographic Museum (S)</td>
<td>HBOM</td>
<td>FL</td>
<td>5,700</td>
<td>27,000</td>
</tr>
<tr>
<td>Houston Museum of Nature and Science (M)</td>
<td>HMNS</td>
<td>TX</td>
<td>18,400</td>
<td>368,387</td>
</tr>
<tr>
<td>Museum of Comparative Zoology (L)</td>
<td>MCZ</td>
<td>MA</td>
<td>82,775</td>
<td>710,000</td>
</tr>
<tr>
<td>National Museum of Natural History (L)</td>
<td>USNM</td>
<td>DC</td>
<td>63,000</td>
<td>570,000</td>
</tr>
<tr>
<td>Natural History Museum of Los Angeles Co. (L)</td>
<td>LACM</td>
<td>CA</td>
<td>6,675</td>
<td>53,550</td>
</tr>
<tr>
<td>North Carolina Museum of Natural Sciences (M)</td>
<td>NCSM</td>
<td>NC</td>
<td>20,000</td>
<td>60,000</td>
</tr>
<tr>
<td>Rosenstiel School of Marine and Atmospheric Science (S)</td>
<td>RSMAS</td>
<td>FL</td>
<td>20,000</td>
<td>100,000</td>
</tr>
<tr>
<td>University of Michigan Museum of Zoology (L)</td>
<td>UMMZ</td>
<td>MI</td>
<td>5,000</td>
<td>40,000</td>
</tr>
</tbody>
</table>
ESB Collaborative 2020

- **Delaware Museum of Natural History**
  DMNH/Greenville [Elizabeth Shea/Jean Woods]
  - Rosenstiel School of Marine and Atmospheric Science
    RSMAS/Miami, FL [Nikki Traylor-Knowles]
  - GEOLocate
    Yale University/New Haven, CT [Nelson Rios]

- **Field Museum of Natural History** [lead]
  FMNH/Chicago, IL [Rüdiger Bieler/ Petra Sierwald/ Jochen Gerber]
  - Fish & Wildlife Research Institute
    FWRI/St. Petersburg, FL [Paul Larson]
  - Harbor Branch Oceanographic Museum
    HBOM/Ft. Pierce, FL [Dennis Hanisak]
  - Houston Museum of Nature and Science
    HMNS/Houston, TX [Tina Petway/ Gary Kidder]
  - BDI-Apps (Symbiota), ASU/Tempe, AZ [Edward Gilbert]

- **Academy of Natural Sciences of Philadelphia**
  ANSP/Philadelphia, PA [Gary Rosenberg]

- **Bailey-Matthews National Shell Museum**
  BMSM/Sanibel, FL [José Leal]

- **Carnegie Museum of Natural History**
  CM/Pittsburgh, PA [Timothy Pearce]

- **Florida Museum of Natural History**
  UF/Gainesville, FL [John Slapcinsky]

- **Museum of Comparative Zoology**
  MCZ/Cambridge, MA [Gonzalo Giribet/ Adam Baldinger]

- **Natural History Museum of Los Angeles County**
  LACM/CA [Jann Vendetti]

- **North Carolina Museum of Natural Sciences**
  NCSM/NC [Jamie Smith/ Arthur Bogan]

- **University of Michigan Museum of Zoology**
  UMMZ/MI [Thomas Duda/ Taehwan Lee]

- **National Museum of Natural History**
  USNM/Washington, DC [Ellen Strong]
Scope/Intellectual merit

- 14 institutions + Smithsonian
- 3,000 species, including numerous economically important taxa
- Mobilization of 4.5 million specimens
  - 1.1 million: de novo data entry
  - 3.4 million: improved data quality & access
- Georeferencing
  - Complete via CoGe (currently at 15%)
  - Add bathymetric data, benthic habitat, and marine conservation areas to GeoLocate
- Trait data linkages
  - Live vs. dead (address Darwin Core issues)
  - Epibiont data (learn from TPT)
  - Metadata from field books and expedition logs
- Temporal data (build agent authority files across institutions)
- Specimen images (types and verified exemplars)
- Integration of Malacolog
- Development of MolluscaBase
Broader Impacts

- Training of 44 undergrads and 8 grad students with strong recruitment efforts toward minority students
- Engagement of public (e.g., with online shell ID guides [BMSM, FMNH rapid Color Guides], tying common names to MolluscaBase)
- Involvement of avocational community (e.g., regional shell clubs)
- Updating Museum exhibitions (e.g., Carnegie, MCZ, HMNS)
- Strong social media presence (e.g., BMSM: eSeaboard Spotlight)
- Citizen Science projects (e.g., UF: iNaturalist Blast from the Past, LACM: SLIME)
- Brain Scoop Episode (FMNH – importance on citizen science involvement)
- Student workshops at annual Mollusca meetings focused on georeferenced biodiversity data
- Collaboration with RCN-UBE “BCEENET” (DMNH – use of natural history data in course-based undergraduate research experiences)