

InvertEBase

Reaching Back to See the Future:

Species-rich Invertebrate Faunas Document Causes and Consequences of Biodiversity Shifts in North America



Petra Sierwald, PI
Rüdiger Bieler, Co-PI
Field Museum of Natural History, Chicago



iDigBio is funded by a grant from the National Science Foundation's Advancing Digitization of Biodiversity Collections Program (Cooperative Agreement EF-1115210). Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

More Digitizing

Petra Sierwald, PI InverteBase

current PI on new Parasite Tracker TCN:
bat flies, feather lice, fleas, mosquitos



current PI on SCAN PEN, digitizing US specimens of four beetles families:
meal worms or darkling beetles (Tenebrionidae),
featherwing beetles (Ptiliidae),
Pselaphinae (they are really really small)
ironclad beetles (Zopherinae)



Rudiger Bieler, PI InverteBase

Senior collaborator on new TCN PILS, subaward to FMNH, data to be mirrored on **InverteBase**





InverteBase: North American terrestrial & aquatic invertebrates

- Selected insects (e.g., dragonflies, water beetles); arachnids, myriapods, mollusks
- Digitize, georeference, mobilize up to 3 million specimen data
- Several museums serve data online for the first time (DMNH, AUMNH, CMNH)



- Arthropod data served on
- 2019: UMMZ Insects added to SCAN: 285,758 occurrence, 16% georeferenced
- Invertebrate data served on InverteBase



InverteBase Portal moved to Arizona State University in 2019

Eight institutions, 13 collections, 2nd year no-cost extension



EF 14-02667, Petra Sierwald,
Rüdiger Bieler, 2nd year no-cost
extension

The Frost
Entomological
Museum

EF 14-00993, Andy Deans, 2nd
year no-cost extension



EF 14-02697, Elizabeth Shea,
2nd year no-cost extension



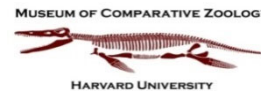
EF 14-01176, Jason Bond,
Melissa Callahan, completed,
on iDigBio



EF 14-04964, Diarmaid
O'Foighil, Taehwan Lee,
completed



EF 14-02785, Gavin Svenson,
2nd year no-cost extension



FilteredPush

EF 14-01450, James Hanken,
completed

PEN 2016: Chicago Academy of Sciences



EF 16-01700, Dawn Roberts
completed

PEN 2018: Museum of Northern Arizona



EF 17-01842, Lawrence Stevens,
Gary Alpert, ongoing



Collections

California Academy of Sciences – Inverts

Invertebrate Collection at the Natural History Collection of Utah

Carnegie Museum of Natural History – Mollusks

Naturalis Biodiversity Center (NL)-Mollusca

Chicago Academy of Sciences – Mollusks

North Carolina Museum of Natural Sciences –Mollusk Collection

Colorado Plateau Biodiversity Center –

Mollusks Sam Noble Oklahoma Museum of Natural History – Inverts

Mollusks Texas A&M University Biodiversity Research and Teaching Collections

Eastern Kentucky University Mollusk Collection

University of Alaska Museum – Inverts

Florida Museum of Natural History – Mollusks

Yale University Peabody Museum – Inverts

Illinois Natural History Survey- Mollusk Collection



iDigBio is funded by a grant from the National Science Foundation's Advancing Digitization of Biodiversity Collections Program (Cooperative Agreement EF-1115210). Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

Lessons learned

Pre-curation, pre-curation, pre-curation

Voice recognition is popular with students, not with data entry staff (works well for field notes)

Collection databases developed during period of grant, slowing down data entry speed

IPT development problems for certain databases

Data entry requires extensive training, long-term personnel increases speed and accuracy

2018-2019: extensive Georeferencing effort:

Outreach: DMNH Exhibit development completed



iDigBio is funded by a grant from the National Science Foundation's Advancing Digitization of Biodiversity Collections Program (Cooperative Agreement EF-1115210). Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.



2019 accomplishments:

2018-2019: extensive Georeferencing effort,
monitored trial, time and accuracy assessments



Outreach:

Completed Digitization Exhibit:
Little creatures, Big Data



High-throughput pin and vial imaging: in progress



Contribution to taxonomic authority files



Outreach: Elizabeth Shea, DMNH

Completed Digitization Exhibit: Little creatures, Big Data Six poster panels as retractable banners



Little Creatures, Big Data

Digitizing Natural History Collections

Preserving Nature

For every animal or plant you see at a natural history museum, there are millions more behind the scenes.

- Fish in jars
- Shells in boxes
- Insects on pins
- Birds in drawers
- Plants on paper
- ...and so many more



What are natural history collections?

Examples of animals and plants that are preserved, labeled, and organized so they can be studied—like unique books in a giant library of life.

Where do the animals and plants come from?

All over the world—every continent, every country, every ocean. Scientists climb mountains, wade in rivers, hike through forests, and even dive under the sea to find them.

Why are there so many?

Scientists need to have many examples of animals and plants to identify and name different species, find out how they are related, and document where they live.

What do the labels say?

A label with each specimen gives its scientific name, who collected it, and when and where it was collected. These essential pieces of information are the specimen's data. Scientists record these data so the specimen will be useful for study.

What are all these collections for?

Understanding life on Earth—past, present, and future.

Big Question: Why do scientists collect plants and animals they "don't" need?

That's easy, Sam! A "specimen" is a single plant or animal that scientists use for study or display.

Little Creatures, Big Data

Digitizing Natural History Collections

Big and Small— We Have Them All

There are billions of specimens in natural history collections all around the world. The variety of specimens in these vast collections is amazing.

Natural history specimens are:

- Huge** (Foot of a handspan whale)
- Single** (Great orange butterfly)
- and Many** (Cassiopeia agrippina)
- and Tiny** (Small open stream fish)
- Rare** (Flora near white cloud)
- Wet** (Crabs and insects)
- and Dry** (Sand dollar)
- and Common** (Cuckoo)

Natural history specimens come in all shapes and sizes.

Imagine organizing and taking care of all these different specimens.

You can't get a whole lot of space with a bank of drawers!

Little Creatures, Big Data

Digitizing Natural History Collections

Data Connects Collections

Look at all the photos that are going to be taken!

Big question: How do we make pictures of the millions and millions of specimens that we have?

Real specimens in drawers are essential, but what if someone far away wants to study a specimen? Or analyze specimen data from hundreds of collections around the world? Scientists can **DIGITIZE** each specimen so its image and data can be shared over the Internet.

Digitization is much more than just taking a picture. There are many steps:

- IDENTIFY** the specimen
- LOCATE** where it was collected
- ENTER THE SPECIMEN'S DATA** into a computer database
- CHECK** the information for accuracy
- PHOTOGRAPH** the specimen
- PUBLISH** the data online

Natural history museums share all these data in a free online catalog called **iDigBio** (Integrated Digitized Biocollections).

iDigBio has data for more than 100 million specimens, and it's growing every day.

Anyone can search iDigBio and download data—no matter where they are.

Outreach: Elizabeth Shea, DMNH

Completed Digitization Exhibit: Little creatures, Big Data Six poster panels as retractable banners



Big Data for Big Questions

Scientists have collected animal and plant specimens for hundreds of years.

Digitizing these huge collections creates lots of data. We can use these data to answer big questions about how the natural world works and changes over time.

QUESTION

How does climate affect animal populations?

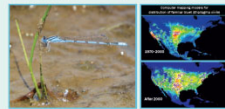
ANSWER

Locations of insect populations followed the changing temperatures across North America.

WHO: Emily L. Sandell, Ph.D. student, and Dr. Andrew R. Drown

WHERE: The Frost Entomological Museum at Pennsylvania State University

WHAT: Digital data from 13 species of damselflies in North America



Left: A single damselfly (adult specimen) (right): Insect pins on a sheet show how the warmer habitats these specimens prefer. The dots show where the insects were collected.

QUESTION

How fast can animal populations change?

ANSWER

Populations of land snails can change appearance in less than 100 years.

WHO: Dr. Melgorita Ojeda from Poland, with colleagues from Malaysia and the Netherlands

WHERE: Naturalis Biodiversity Center, Leiden, the Netherlands

WHAT: Digitized historical specimens of grove land snails compared to recently collected specimens



Left: The dark coloration of Ocenebra nemoralis was common in the past (right): The light coloration is more common now.

QUESTION

Does biodiversity ever change?

ANSWER

Revisiting past collecting sites may reveal changes in the distribution of multiple species over time.

WHO: Dr. Gray Rosenberg, with students and collaborators

WHERE: The Academy of Natural Sciences of Drexel University, Philadelphia

WHAT: Digital data for massive mollusk specimens collected from the late 1800s to now on the New Jersey coast



A researcher collects mollusks on the beach to build a natural history collection.

Collecting specimens and data helps us to understand biodiversity now and in the future.

After using natural history collection kits to travel back in time!
We can learn so much from digitized data!



Collections Are for Everyone

People of all ages can use natural history collections and digitized data to learn about the natural world. What animals and plants are you curious about?



STUDENTS

Undergraduate students from Widener University in Pennsylvania spent a semester at the Delaware Museum of Natural History. They used digital data and specimens to learn about birds, mollusks, and the scientific method.



ARTISTS
Art students sharpen their observation and technical skills by drawing insect specimens from the Frost Entomological Museum at Pennsylvania State University.



FAMILIES

Hundreds of volunteers are helping the Natural History Museum of Los Angeles County to survey land snails and find out how urbanization is affecting snails in the region.



AND YOU!

Get Involved

You don't need a science degree to work with digital natural history collections. You can:

- Use the iNaturalist app to collect and share natural history data
- Come to an iDigBio digitizing event
- Volunteer to help digitize specimens in a museum
- And more!

Digital data inspires exploration and discovery of life on Earth.



That's what you get to see up close!

The closer you look, the more you find!



Behind the Scenes at the Delaware Museum of Natural History

Did you know this Museum contains some of the largest shell and bird collections in the country? The specimens come from all over the world. Our staff build, protect, and preserve our collections with the help of volunteers. We also do research and teach using the collections.

Here are a few of our favorite things.

Liz

We used a remotely operated underwater vehicle to collect fish and sea slug eggs. It's essential in the diversity of organisms and depths that live in deep-sea oceans.



Jean

I study shorebirds like this one that fly up to 20,000 kilometers every spring from South America to the Arctic. We analyze the chemicals in feathers from this species to find out where individuals spend the winter.



Alex

Hidden on these fossil ivory shells are almost always in the same spot. The shells in that ancient collection figured out the best way to attack and eat coconuts.



Nadinni

One of the many researchers who use the Delaware Museum collections. My colleagues and I are examining how the changing climate is affecting the breeding biology of tropical birds in South America.



Some of our important collections:

- More than 2 million mollusk specimens
- 77,000 bird specimens
- 36,000 bird egg specimens
- 400 herbarium sheets
- 6,000 mammal specimens
- 1,500 insect specimens

That's a lot of natural history! Come and explore our bird and mammal collections. The future is in the past.

Researcher Elizabeth Shea, DMNH, is a member of the Delaware Museum of Natural History's staff. She is a member of the Delaware Museum of Natural History's staff.