Welcome

Dear colleagues,

Welcome to the 5th annual iDigBio-hosted summit for ADBC scientists and students! This year, the summit is a super-summit with an anticipated 150 participants, including those from the 15 TCNs, international colleagues working with biodiversity collections data, guests from the NSF and the Smithsonian Institution, and iDigBio. As in past years, we have a packed agenda of presentations and discussion groups, but we also have plenty of opportunities for networking. The latter include daily morning and afternoon breaks, lunches, an evening reception at the U.S. Botanic Garden, a free evening to organize your own discussion group, and breakout sessions that are open for small groups to organize and discuss any topics of interest to them.

The national effort to digitize information in biocollections as outlined in the NIBA Strategic Plan has been successfully catalyzed by funding from NSF and activities of the TCNs and iDigBio. As a community, we have defined digitization priorities, integrated best practices into workflows, provided cyberinfrastructure resources including a search portal, addressed major challenges via working groups and built collaborations with data providers/users. We have improved digitization practices, increased involvement in digitization and training and adopted informatics tools that improve the efficiency and scalability of digitization in all types of collections.

In its 5th year, iDigBio is working with staff in 482 collections in 250 institutions. We have communicated with our stakeholders to increase access to collections data through workshops, webinars, the iDigBio Spotlight and social media. During its first 4 years, iDigBio sponsored attendance of 2,200 participants from 511 institutions to 63 workshops that targeted digitization-related topics. iDigBio has ingested 638 recordsets containing almost 46 million records and 13 million images. All data ingested are indexed so that queries and other types of index-based access are supported. Searches can be done through a Web-based graphical interface or through APIs. Search and analytical tools enable users to mine diverse data such as taxonomy, location, images, traits and vocalizations.

As we move forward and TCNs generate increasingly complete and valuable data, iDigBio will continue its successful strategies with a greater emphasis on data improvement and use in research and outreach. The national resource created by NSF through ADBC is increasingly recognized as essential for digitized information on biodiversity. Our work is continuing, and the results are increasingly visible to the scientific community. Let’s make Summit V a catalyst for even greater success!

Larry Page, Director
iDigBio
Contacts for Questions or Problems

If you encounter logistical issues prior to or upon your arrival in Arlington and require assistance, contact Cathy Bester at 352-214-5043 or David Jennings at 352-870-7562.

Travel to Arlington, Virginia

As an iDigBio-supported participant, your travel arrangements have been coordinated and finalized by Cathy Bester; you should have already received all travel details in a separate email. If you have any remaining travel questions, please contact Cathy at cbester@flmnh.ufl.edu. If your travel is not being supported by iDigBio, you are responsible for your own travel and expenses.

Hotel and Conference Location


Rail from Reagan National Airport to the Hilton Arlington

There is a Metro rail station at Reagan National Airport. We recommend you take the Blue line heading toward Largo Town Center. Get off at Rosslyn. Switch to the Orange line heading toward Vienna. Get off at Ballston-MU. The trip should take 30 – 40 minutes. At Ballston, you will travel on foot eastbound, one block, along N. Fairfax Drive to N. Stafford St. At Stafford St, you will walk southbound until reaching the Hilton Arlington at 950 N. Stafford St. For reference, the Hilton Arlington is located across from the National Science Foundation. For more info on the Metro please visit their website at: http://www.wmata.com/ and http://www.wmata.com/rail/frequency.cfm

Hotel and Conference Check-In

A block of rooms has been reserved for Summit participants; you are responsible for making your own reservations at our discounted group rate ($189/night plus taxes). Conference materials (including a printed agenda and name tag) may be picked up from David Jennings or Jillian Goodwin during the informal welcome reception at the Lounge at Dan & Brad’s (cash bar) located inside the Hilton during the evening of November 3 for those arriving that day. Guests arriving on November 4 may pick up these materials that evening from Cathy Bester or Jillian Goodwin at the Hilton Conference Desk between 5:30pm and 6:30pm or during the informal welcome reception at the Lounge at Dan & Brad’s (cash bar) located inside the Hilton that evening. Late summit check-in will be available on November 5 between 8:00am and 9:00am in the Pre-Function Space. Wireless network access will be available onsite through the Hilton Arlington for all Summit participants.

iDigBio Summit V Wiki

For the most up-to-date information regarding the Summit agenda, participants, logistics and other items of interest, please visit the event wiki page at https://www.idigbio.org/wiki/index.php/IDigBio_Summit_2015. Recorded presentations and reports will be posted on this site following the Summit for future reference.
Meals and Other Activities

An informal welcome gathering will be held at the Hilton’s Lounge at Dan & Brad’s [cash bar] beginning at 7:00pm on both November 3 and November 4. Breakfasts and lunches, along with break refreshments, will be provided at the Hilton on November 4, 5 and 6 during the Summit sessions and related activities. There will be a catered reception on November 5 from 6:30 - 9:00pm at the U.S. Botanic Garden located at 100 Maryland Ave. SW, Washington DC. Dinner is on your own during the evenings of November 4 and 6. Meals not provided as workshop functions will qualify for reimbursement at our per diem rate; see below for reimbursement procedures.

United States Botanic Garden Reception - November 5, 6:30 - 9:00pm

You can reach the USBG by Metrorail from the Ballston-MU metro stop via the Orange line toward New Carrollton or the Silver line toward Largo Town Center. Get off at the Federal Center SW station. Exit the station, walk north [left] along Third Street SW for two blocks, cross Independence Avenue and continue one more block to Maryland Avenue. Look toward the Capitol and you will see the glass dome of the Conservatory. The Conservatory entrance is on Maryland Avenue. The trip should take about 30 minutes. Guests are welcome to tour the entire Conservatory [with the exception of one gallery that will be under exhibit construction]. To return to the Hilton, get on the Orange line toward Vienna or the Silver line toward Wiehle-Reston East and get off at the Ballston-MU stop.

Rail from the Hilton Arlington to the Reagan National Airport

To return to Reagan National Airport, travel on foot northbound from the Hilton Arlington on N Stafford St. to N Fairfax Dr. Walk westbound on N Fairfax Dr until you reach the Ballston-MU stop. Take the Orange line heading towards New Carrollton to Rosslyn. At Rosslyn, switch to the Blue line heading towards Franconia-Springfield; exit at the airport. For more info on the Metro and Metrorail frequency, please visit their website at: http://www.wmata.com/ and http://www.wmata.com/rail/frequency.cfm

Reimbursements

Project Assistant Cathy Bester will send out an email to all participants during the week following the Summit regarding reimbursement. Any meals not provided as Summit functions will be reimbursed at the State of Florida per diem rate [breakfast $6, lunch $11, dinner $19]; no receipts are needed for meals. Mileage, metro fares, parking fees, and baggage fees may qualify for reimbursement. Please retain your original receipts showing form of payment; copies will not be accepted by UF. If you have any questions, please contact Cathy at 352-249-1949 or cbester@flmnh.ufl.edu.

Adobe Connect

To the extent possible, the Summit sessions will be broadcast and recorded using Adobe Connect, and the meeting hosts will monitor the chat to address questions/concerns. To connect, go to https://idigbio.adobeconnect.com/summit5/ and choose Enter as Guest, type your first and last name, and then click Enter Room. Remote participants are encouraged to visit the iDigBio Web Conferencing Wiki prior to connecting. https://www.idigbio.org/wiki/index.php/Web_Conferencing
HILTON ARLINGTON - SECOND FLOOR

GALLERY I | GALLERY II | GALLERY III

Conf. Services Office
Catering Office
stairs to lobby level

pre-function space
elevators to guestroom floors

stairs

restrooms

1. RENOIR
2. REMBRANDT
3. PICASSO
4. DA VINCI
5. MATISSE
Area Restaurants (all are Arlington 22203)

Dan and Brad's (inside the Hilton Arlington)
Cosi (Healthy Fare/Coffee)
3503 Fairfax Dr.
http://www.getcosi.com/

Potbelly Sandwich Shop (Sandwiches)
4250 Fairfax Dr.
http://www.potbelly.com/

A-Town Bar & Grill (American/Sushi/Pizza)
4100 Fairfax Dr.
http://a-townballston.com/

Uncle Julio's (Mexican)
4301 Fairfax Dr, #100
http://www.unclejulios.com/

Grand Cru Wine Bar & Bistro (Upscale)
4401 Wilson Blvd.
http://www.grandcru-wine.com/

Front Page Arlington (American)
4201 Wilson Blvd.
http://www.frontpagearlington.com/

First Down Sports Bar & Grill (Pub Fare)
4213 N. Fairfax Dr.
http://www.firstdownsportsbar.com/

Tara Temple Restaurant (Asian)
4001 Fairfax Dr.
http://www.taratempearlington.com/

Sweetgreen (Healthy Fare)
4075 Wilson Blvd
http://sweetgreen.com/

Rustico Restaurant & Bar (American)
4075 Wilson Blvd
http://www.rusticorestaurant.com/
### Tuesday, November 3, 2015

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<tr>
<th>Time</th>
<th>Pre-Function Space or Other</th>
<th>Gallery I -II</th>
<th>Gallery III</th>
<th>Picasso &amp; DaVinci</th>
<th>Matisse</th>
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<tbody>
<tr>
<td>7:00pm</td>
<td>Check-In Informal Gathering (Dan &amp; Brad's)</td>
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### Wednesday, November 4, 2015

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<th>Picasso &amp; DaVinci</th>
<th>Matisse</th>
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<tbody>
<tr>
<td>8:00 - 9:00</td>
<td>Breakfast Check-In</td>
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<tr>
<td>9:00 - 10:30</td>
<td>Microfungi Meeting</td>
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<td>GBIF Task Force Meeting</td>
<td>iDigBio External Advisory Board Meeting (closed) 9:30 - 10:30</td>
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<tr>
<td>10:30 - 11:00</td>
<td>Break</td>
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<tr>
<td>11:00 - 12:30</td>
<td>Microfungi Meeting cont’d.</td>
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<td>GBIF Task Force Meeting cont’d.</td>
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<tr>
<td>12:30 - 1:30</td>
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<tr>
<td>1:30 - 3:00</td>
<td>Welcome to New TCNs</td>
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<td>GBIF Task Force Meeting cont’d.</td>
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<td>3:00 - 3:30</td>
<td>Break</td>
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<tr>
<td>3:30 - 4:30</td>
<td>Intro to Project Management</td>
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<td>GBIF Task Force Meeting cont’d.</td>
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<td>4:30 - 5:00</td>
<td>Q &amp; A</td>
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<td>5:30 - 6:30</td>
<td>Summit Check-In</td>
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<tr>
<td>Evening</td>
<td>Informal Gathering (Dan &amp; Brad's)</td>
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### Thursday, November 5, 2015

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<td>Welcome</td>
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<tr>
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<td>10:20 - 10:40</td>
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<td>10:40 - 11:15</td>
<td>Break</td>
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### Thursday continued

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<td>2014 TCN Presentations</td>
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<td>11:45 - 12:15</td>
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<td>2013 TCN Presentations</td>
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<td>12:30 - 1:30</td>
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<td>Lunch</td>
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<tr>
<td>1:30 - 2:45</td>
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<td>Data Management</td>
<td>Education &amp; Outreach</td>
<td>iDigBio Resources</td>
<td>Ad Hoc Discussion</td>
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<td>2:45 - 3:45</td>
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<td>Break</td>
<td>Poster Session</td>
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<td>3:45 - 5:00</td>
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<td>Research Tool Development</td>
<td>iDigSTEAM Workshop</td>
<td>Project Management</td>
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<td>Day 1 Wrap-Up</td>
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<td>6:30 - 9:00</td>
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<td>Reception at U.S. Botanic Garden</td>
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### Friday, November 6, 2015

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<th>Picasso &amp; DaVinci</th>
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<td>Breakfast</td>
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<td>9:00 - 9:20</td>
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<td>Orientation BCon</td>
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<td>9:20 - 10:00</td>
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<td>2012 TCN Presentations</td>
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<td>2011 TCN Presentations</td>
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<td>11:00 - 12:15</td>
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<td>Biodiversity Initiatives</td>
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<td>Lunch</td>
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<td>1:15 - 2:30</td>
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<td>Citizen Science</td>
<td>Sustainability</td>
<td>Symbiota</td>
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<td>Break</td>
<td>Poster Session</td>
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<td>3:30 - 4:45</td>
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<td>Data Use</td>
<td>Attribution</td>
<td>Collaboration &amp; Communication</td>
<td>Ad Hoc Discussion</td>
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<td>Day 2 Wrap-Up</td>
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<td>Summit Wrap-Up</td>
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<td>7:00pm - 9:00pm</td>
<td>Summit Check-In</td>
<td>Dan &amp; Brad's</td>
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<td>Informal Welcome Gathering (cash bar available)</td>
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<td>Evening</td>
<td>Dinner on your own</td>
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<td>8:00am - 9:00am</td>
<td>Breakfast (provided)</td>
<td>Pre-function</td>
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<td>Summit Check-in</td>
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<td>9:00am - 10:30am</td>
<td>Microfungi TCN Meeting</td>
<td>Gallery III</td>
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<td></td>
<td>• The Microfungi Project</td>
<td>Andrew Miller</td>
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<td></td>
<td>• Digitization Workflows &amp; the MyCoPortal</td>
<td>Elizabeth Lippoldt</td>
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<td></td>
<td>GBIF Task Force Meeting</td>
<td>Picasso/DaVinci</td>
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<td>9:30am - 10:30am</td>
<td>iDigbio External Advisory Board Meeting (closed session)</td>
<td>Matisse</td>
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<td>Morning Break (provided)</td>
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<td>11:00am - 12:30pm</td>
<td>Microfungi TCN Meeting (continued)</td>
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<td>• The Voice Data Command Control</td>
<td>Phil Anders</td>
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<td>• The MyCoPortal Taxonomic Thesaurus</td>
<td>Scott Bates</td>
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<td>GBIF Task Force Meeting (continued)</td>
<td>Picasso/DaVinci</td>
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<td>12:30pm - 1:30pm</td>
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<td>1:30pm - 3:00pm</td>
<td>GBIF Task Force Meeting (continued)</td>
<td>Picasso/DaVinci</td>
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<tr>
<td>1:30pm - 3:00pm</td>
<td>Welcome to iDigBio for New TCNs</td>
<td>Gallery I-II</td>
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<td>3:00pm - 3:30pm</td>
<td>Afternoon Break (provided)</td>
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<td>3:30pm - 4:30pm</td>
<td>GBIF Task Force Meeting (continued)</td>
<td>Picasso/DaVinci</td>
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<td>3:30pm - 4:30pm</td>
<td>Introduction to Project Management</td>
<td>Gallery I-II</td>
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<td>4:30pm - 5:00pm</td>
<td>Questions &amp; Answers</td>
<td>Gallery I-II</td>
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<td>Pre-function</td>
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<td>9:00am - 9:10am</td>
<td>Welcome &amp; Orientation</td>
<td>David Jennings</td>
<td>Gallery I-II</td>
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<td>Welcome from the National Science Foundation</td>
<td>James Olds</td>
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<td>10:20am - 10:40am</td>
<td>2015 TCN Presentations</td>
<td>Andrew Miller</td>
<td>Gallery I-II</td>
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<td>11:15am - 11:45am</td>
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<td>Gallery I-II</td>
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<td>11:45am - 12:15pm</td>
<td>2013 TCN Presentations</td>
<td>Gallery I-II</td>
<td></td>
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<tr>
<td>12:15pm</td>
<td>Group Photo</td>
<td>Joanna McCaffrey</td>
<td>Pre-function</td>
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<tr>
<td>12:30pm - 1:30pm</td>
<td>Lunch (provided)</td>
<td>Pre-function</td>
<td></td>
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<tr>
<td>1:30pm - 2:45pm</td>
<td>Discussion Groups</td>
<td>Gallery I-II</td>
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</tr>
</tbody>
</table>

**Discussion Groups**


Keeping up with data requires certain skills and infrastructure. Managing data is integral to the research process, and how data are managed depends on the types of data involved, how data are collected and stored, and how data are used. This group will discuss issues surrounding shared data and will discuss strategies for data cleaning, augmentation, annotations, and more.
Thursday continued

Education & Outreach  [https://goo.gl/vkodnc](https://goo.gl/vkodnc)  Molly Phillips, Bruce MacFadden  Gallery III

This discussion session will serve as an in-person Education & Outreach Working Group meeting. Individuals interested in joining the working group, or anyone interested in the topics proposed, are encouraged to attend. All are welcome. During the session, we will be discussing, and trying to identify, appropriate target audiences for current and projected outreach activities across ADBC. We will also be discussing and selecting topics for an upcoming E & O webinar series. Other E & O topics are welcome as time permits.

iDigBio Resources  [https://goo.gl/KRDQp7](https://goo.gl/KRDQp7)  Joanna McCaffrey, David Jennings  Picasso/DaVinci

Resources on the iDigBio website and wiki have grown considerably over the last 4½ years. This session will briefly review what resources are available and where they can be found. We invite you to share your digitization materials and discuss what other materials you would like to see developed and/or collated.

Ad Hoc Discussion  [https://goo.gl/W01nO1](https://goo.gl/W01nO1)  Matisse

This room is available for ad hoc meetings and discussions.

<table>
<thead>
<tr>
<th>Time</th>
<th>Session Description</th>
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<tbody>
<tr>
<td>2:45pm - 3:45pm</td>
<td>Afternoon Break (provided)</td>
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<tr>
<td>2:45pm - 3:45pm</td>
<td>Working Groups &amp; Interest Group Poster Session</td>
</tr>
<tr>
<td></td>
<td>- Augmented Reality Public Education/Outreach</td>
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<td>- Augmenting OCR</td>
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<td>- Data Management Interest Group</td>
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<td>- Developing Robust Object to Image to Data</td>
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<td></td>
<td>- Education &amp; Outreach</td>
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<td></td>
<td>- Georeferencing Working Group</td>
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<td></td>
<td>- WeDigBio: Worldwide Engagement for Digitizing Biocollections</td>
</tr>
<tr>
<td></td>
<td>- Small Collections Network &amp; North American Network of Small Herbaria</td>
</tr>
<tr>
<td></td>
<td>- Paleo Digitization Working Group</td>
</tr>
<tr>
<td>3:45pm - 5:00pm</td>
<td>Discussion Groups</td>
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<tr>
<td></td>
<td>Research Tool Development <a href="https://goo.gl/eNhuXK">https://goo.gl/eNhuXK</a></td>
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<td></td>
<td>Pam Soltis</td>
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<td></td>
<td>Gallery I-II</td>
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<td></td>
<td>iDigSTEAM Workshop <a href="https://goo.gl/MckbVi">https://goo.gl/MckbVi</a></td>
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<tr>
<td></td>
<td>Anne Basham</td>
</tr>
<tr>
<td></td>
<td>Gallery III</td>
</tr>
</tbody>
</table>

Learn about the tools currently available for synthetic biodiversity research using digitized specimen data and discuss those that need to be developed to facilitate innovative research using collections data available via the iDigBio portal and other aggregators. What data and/or tools would you like to see available through the iDigBio portal? The discussion will also provide a forum for sharing ideas about how iDigBio can facilitate research through training workshos on data carpentry and analysis.

From “Insect Love Motels” to “Libraries of Life”—this session will give an overview of the exploding movement of STEAM (science, technology, engineering, math, and the arts) which integrates new technologies and the arts in teaching. Participants will be provided with some tools and resources that will serve educators and outreach specialists in the ADBC community who are looking to better serve broader impacts but are not quite sure how or what is available. New tools and technologies are increasingly being used in both informal and formal learning environments to educate and connect diverse audiences with collections and their data in highly visual and interactive ways.
Thursday continued

Project Management  [https://goo.gl/2gT9EW]  David Jennings,  Picasso/DaVinci
Joanna McCaffrey

This group will discuss the importance of project management & administration in keeping your project on time and within budget. We will discuss lessons learned, what worked, and what didn’t work based on your experiences and then brainstorm new approaches. We encourage older TCNs to mentor and advise younger TCNs.

Ad Hoc Discussion  [https://goo.gl/?IXVbw]  Matisse
This room is available for ad hoc meetings and discussions.

5:00pm - 5:30pm  Day 1 Wrap-up: Discussion Group Summaries

5:30pm  Adjourn

6:30pm - 9:00pm  Dinner and Reception at the U.S. Botanic Garden  [www.usbg.gov]
- The trip from Ballston to Federal Center SW on either the Orange or Silver metro lines will take about 30 minutes.
- Guests are welcome to tour the Conservatory.

Friday, November 6, 2015
iDigBio Summit Day 2

8:00am - 9:00am  Breakfast (provided)  Pre-function

9:00am - 9:10am  Orientation to the Day  David Jennings  Gallery I-II
9:10am - 9:20am  Biodiversity Collections Network (BCoN)  Robert Gropp  Gallery I-II
9:20am - 10:00am  2012 TCN Presentations  Patrick Sweeney  Gallery I-II
- Mobilizing New England Vascular Plant Data to Track Environmental Change
- PaleoNICHES  Susan Butts
- The Macrofungi Collection Consortium  Barbara Thiers
- Symbiota Collections of Arthropods Network  Neil Cobb

10:00am - 10:30pm  2011 TCN Lightning Presentations  Gallery I-II
- InvertNet: Year 5 and Beyond  Chris Dietrich
- The Tri-Trophic Thematic Collection Network: A summary of four years of progress and learning  Christine Johnson,  Mari Roberts,  Katja Seltmann
- Lichen, Bryophytes and Climate Change, 4.2 million records later  Thomas Nash

10:30am - 11:00am  Morning Break (provided)  Pre-function

11:00am - 12:15pm  Presentations from National & International Biodiversity Informatics Initiatives  Gallery I-II
- Update on BISON, ITIS and EcoINFORMA Activities Relevant to iDigBio  Stinger Guala
- GBIF’s Accelerating the Discovery of Biocollections Data Task Force  Siro Masinde
- Getting More From Image Libraries – New Computer Vision Tools  John LaSalle
Friday continued

- Brazil’s Virtual Herbarium: Outputs, Outcomes and Challenges  
  Dora Canhos
- Biodiversity Information and Sharing Status in China  
  Zheping XU
- Canadensys: Biodiversity Across the Borders  
  David Shorthouse
- A Network Connecting Science With Conservation  
  Mary Klein
- Interoperability: Fomenting Opportunities at the Intersection of Collections and Ecology  
  Brian Wee

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
<th>Details</th>
</tr>
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<tbody>
<tr>
<td>12:15pm - 1:15pm</td>
<td>Lunch (provided)</td>
<td>Pre-function</td>
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</tbody>
</table>
| 1:15pm - 2:30pm | Discussion Groups                            | **Citizen Science**  
  https://goo.gl/ynSpTG  
  Austin Mast, Libby Ellwood, Betty Dunckel  
  Gallery I-II
  The field of citizen science is rapidly expanding, and iDigBio is actively involved in exploring, understanding, and implementing citizen science practices in digitization activities. To this end, we have hosted hackathons, imaging and transcription blitzes, and the recent Worldwide Engagement for Digitizing Biocollections (WeDigBio) Event. Two iDigBio Working Groups are devoted to advancing citizen science in digitization. The Interoperability for Public Participation in Digitization Working Group is working to improve interoperability among the several online tools that involve public participants in digitization in order to streamline the flow of information between the currently disparate platforms. The User Engagement for Public Participation in Digitization Working Group is working on expanding our knowledge of volunteer motivations and accuracy, as well as developing resources to assist new projects with effective volunteer engagement. Join us in this discussion group to learn more about what we’ve been up to and the resources that are available to you, to help develop an integrated pipeline for making citizen science and crowdsourcing adaptable across the TCNs, and to become involved in our long-term efforts.

- Sustainability  
  https://goo.gl/w3M6wM  
  Larry Page, Mary Klein  
  Gallery III
  Realizing the potential of biological collections as a source of “Big Data” through digitization is a long-term endeavor. The goal of this session is to consider the long-term sustainability of the national digitization effort and its component elements, including Thematic Collections Networks (TCNs) and iDigBio. We will address some of the following issues: [1] What economic models do you know that that might be useful? [2] Which funding agencies promote and support ongoing digitization activities, directly and indirectly, and how can these be leveraged? [3] What are the most effective methods to secure institutional support for digitization and the staff and infrastructure required to underpin this work? [4] What is the long-term technological vision for the next generation of digitization activities? [5] Who and what organizations might support our efforts?

- Symbiota Users  
  https://goo.gl/KUtfo7  
  Neil Cobb  
  Picasso/DaVinci
  Participate in a forum to discuss Symbiota sustainability, collaborative activities among portals, and Symbiota software developments to promote research, education, and outreach.

- Ad Hoc Discussion  
  https://goo.gl/prTZwO  
  Matisse
  This room is available for ad hoc meetings and discussions.

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<tr>
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<td>Afternoon Break (provided)</td>
<td>Pre-function</td>
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</table>
2:30pm - 3:30pm

**Working Groups & Interest Group Poster Session**

- Augmented Reality Public Education/Outreach
  - Anne Basham
- Augmenting OCR
  - Deb Paul
- Data Management Interest Group
  - Shelley James
- Developing Robust Object to Image to Data
  - Gil Nelson
- Education & Outreach
  - Molly Phillips, Bruce MacFadden
- Georeferencing Working Group
  - Mari Roberts
- WeDigBio: Worldwide Engagement for Digitizing Biocollections
  - Deb Paul, Austin Mast
- Small Collections Network & North American Network of Small Herbaria
  - Libby Ellwood, Gil Nelson
- Paleo Digitization Working Group
  - Talia Karim

3:45pm - 4:45pm

**Discussion Groups**

- Data Use in Research & Education
  - Pam Soltis, Molly Phillips, Bruce MacFadden
  - https://goo.gl/6tmQbZ
  - Explore ways to use specimen-based data in research and education. Discussion topics will include use of georeferenced locality data for species distribution modeling and extension to studies of phylogenetic diversity, species' responses to climate change, and conservation. Research applications that make use of specimen images for extraction of species traits – for taxonomy, phylogenetics, or ecological inference – will also be explored. The discussion will emphasize opportunities that link heterogeneous data in novel ways and the methods, cyberinfrastructure, and software needed to do so. We will also discuss how to use specimen data to inform and create outreach materials, curricula/lesson plans, and other resources to engage the public with collections-based science.

- Attribution
  - Shelley James, Gil Nelson
  - https://goo.gl/duLDyV
  - Licensing, citation of data—what are the recommended practices, what is proper attribution for collections data in publications, grant applications, and other documents? In this session we will discuss strategies to motivate the scientific community to cite specimen usage, and explore ideas for best practice from data generation to publication.

- Collaboration & Communication
  - Deb Paul
  - https://goo.gl/E9icMk
  - Picasso/DaVinci
  - The ADBC effort has now funded 15 TCNs involving a diversity of collections – different sizes, preparation types, etc. While parts of the collections community are “involved,” others, for a variety of reasons, are not. A “clearinghouse” for sharing information may be a way to assist expansion of the digitization efforts. Come and explore opportunities to foster communication, interaction, and collaboration across TCNs and related organizations and initiatives.

- Ad Hoc Discussion
  - Matisse
  - https://goo.gl/o5e9UP
  - This room is available for ad hoc meetings and discussions.

4:45pm - 5:15pm

Day 2 Wrap-up: Discussion Group Summaries

5:15pm - 5:45pm

Summit Wrap-up

5:45pm

Adjourn

Evening

Dinner on your own
Project Summary
The Biodiversity Collections Network (BCoN) is a five-year national initiative funded by the U.S. National Science Foundation to support the development of a new, sustainable community of practice that will ensure that all U.S. biodiversity collections are digitally available for research, education, informed decision-making, and other scholarly and creative activities.

Scientists have amassed, annotated, and curated more than one billion specimens in more than 1,600 institutions across the United States. Although these specimens and their associated data are heavily used for research and education, their benefits could be exponentially increased if the data could be accessed and mined online.

BCoN is an outgrowth of recent scientific meetings in which scientists have articulated a need to digitally capture biological specimens and associated data held in natural science collections for use in research, education, and for the public interest. The initiative was founded by the American Institute of Biological Sciences, the Society for the Preservation of Natural History Collections, and the Natural Science Collections Alliance.

Goals for establishing a biological collections network:
• Advance engineering of the U.S. biodiversity collections cyber-infrastructure to support efficient workflows, innovative research, effective policy, and educational engagement.
• Enhance training of existing collections staff and create the next generation of biodiversity information managers.
• Increase buy-in and participation from a broader range of stakeholders.
• Establish an enduring and sustainable knowledge base.
• Infuse specimen-based learning and exploration into formal and informal science education.

Project Sponsor
American Institute of Biological Sciences
NSF Award Number 1441785

Principal Investigators
Robert Gropp & Andrew Bentley

Project Website
http://bcon.aibs.org

Supporting Organizations
American Institute of Biological Sciences
American Society of Plant Taxonomists
Angelo State Natural History Collections
Biodiversity Institute, University of Kansas
Bishop Museum
C.A. Triplehorn Insect Collection, The Ohio State University
Central Michigan University Herbarium
Chicago Botanic Garden
Florida Museum of Natural History
H.A. Stephens Herbarium, Emporia State University
Harvard University Museum of Comparative Zoology
iDigBio
Illinois Natural History Survey Herbarium
Milwaukee Public Museum
Museum of Southwestern Biology, University of New Mexico
Natural Science Collections Alliance
New York Botanical Garden
North American Network of Small Herbaria
Small Collections Network
Society for Preservation of Natural History Collections
SUNY College of Environmental Science and Forestry
The Academy of Natural Sciences of Drexel University
The Field Museum
University of Michigan Herbarium
University of Wisconsin Insect Research Collection
Yale Peabody Museum of Natural History
Integrated Digitized Biocollections (iDigBio)

Project Summary
Integrated Digitized Biocollections (iDigBio) is the national coordinating center for the Advancing Digitization of Biodiversity Collections (ADBC) program funded by the U.S. National Science Foundation (NSF). iDigBio is enabling digitization of data and media for millions of biodiversity specimens from U.S. natural history collections and is making the data available online for the research community, government agencies, students, educators, citizen scientists and the general public to promote understanding of biodiversity and societal consequences of environmental issues.

The vision for ADBC is a permanent repository of digitized information from all U.S. biodiversity collections that leads to new discoveries through research and a better understanding and appreciation of biodiversity through improved outreach, which then leads to improved environmental and economic policies.

The mission of iDigBio is to develop a national infrastructure that supports the vision of ADBC by overseeing implementation of standards and best practices for digitization; building and deploying a customized cloud computing environment for collections; recruiting and training personnel, including underserved groups; engaging the research community, collections community, citizen scientists and the general public through outreach activities; and planning for long-term sustainability of the national digitization effort.

iDigBio Goals
Develop efficient and effective digitization standards and workflows
- Provide portal access to biodiversity data in a cloud computing environment
- Respond to cyberinfrastructure needs
Facilitate use of biodiversity data to address environmental and economic challenges
- Researchers
- Educators
- General public
- Policy-makers
Plan for long-term sustainability of the national digitization effort
- Expand participation: partners and data sources

Project Sponsors
University of Florida
Florida State University
NSF Cooperative Agreement Number EF-1115210

Principal Investigators
Larry Page (Principal Investigator)
José Fortes (Co - Principal Investigator)
Bruce MacFadden (Co - Principal Investigator)
Greg Riccardi (Co - Principal Investigator)
Pam Soltis (Co - Principal Investigator)

Project Website
http://www.idigbio.org

Social Media
https://www.facebook.com/idigbio
https://twitter.com/idigbio
https://vimeo.com/idigbio
<table>
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<tr>
<th>TCN</th>
<th>Funding Period</th>
<th>PI</th>
<th>Email</th>
<th>Software Interface with iDigBio</th>
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</thead>
<tbody>
<tr>
<td>Microfungi Consortium (MiCC)</td>
<td>2015 - 2018</td>
<td>Andrew Miller</td>
<td><a href="mailto:amiller7@illinois.edu">amiller7@illinois.edu</a></td>
<td>Symbiota</td>
</tr>
<tr>
<td>Fossil Marine Invertebrates (EPICC)</td>
<td>2015 - 2019</td>
<td>Charles Marshall</td>
<td><a href="mailto:crmarshall@berkeley.edu">crmarshall@berkeley.edu</a></td>
<td>Symbiota</td>
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<td>Great Lakes Invasives (GLI)</td>
<td>2014 - 2017</td>
<td>Ken Cameron</td>
<td><a href="mailto:kmcameron@wisc.edu">kmcameron@wisc.edu</a></td>
<td>Symbiota</td>
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<tr>
<td>InvertEBase</td>
<td>2014 - 2018</td>
<td>Petra Sierwald</td>
<td><a href="mailto:psierwald@fieldmuseum.org">psierwald@fieldmuseum.org</a></td>
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<td>Fossil Insect Collaborative (FIC)</td>
<td>2014 - 2018</td>
<td>Dena Smith</td>
<td><a href="mailto:dena@colorado.edu">dena@colorado.edu</a></td>
<td>Specify, EMu and others; developing the iDigPaleo Portal for our main interface</td>
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<td>The Key to the Cabinets (SERNEC - TCN)</td>
<td>2014 - 2018</td>
<td>Zack Murrell</td>
<td><a href="mailto:murrellze@appstate.edu">murrellze@appstate.edu</a></td>
<td>Symbiota</td>
</tr>
<tr>
<td>Vouchered Animal Communication Systems (VACS)</td>
<td>2013 - 2017</td>
<td>Michael Webster</td>
<td><a href="mailto:msw244@cornell.edu">msw244@cornell.edu</a></td>
<td>Symbiota</td>
</tr>
<tr>
<td>Macroalgal Herbarium Consortium (MHC)</td>
<td>2013 - 2017</td>
<td>Chris Neefus</td>
<td><a href="mailto:chris.neefus@unh.edu">chris.neefus@unh.edu</a></td>
<td>Symbiota</td>
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<td>New England Vascular Plants (NEVP)</td>
<td>2012 - 2016</td>
<td>Patrick Sweeney</td>
<td><a href="mailto:patrick.sweeney@yale.edu">patrick.sweeney@yale.edu</a></td>
<td>Symbiota, EMu</td>
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<td>PALEONICHES</td>
<td>2012 - 2015</td>
<td>Bruce Lieberman</td>
<td><a href="mailto:blieber@ku.edu">blieber@ku.edu</a></td>
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<td>Macrofungi Collection Consortium</td>
<td>2012 - 2015</td>
<td>Barbara Thiers</td>
<td><a href="mailto:bthiers@nybg.org">bthiers@nybg.org</a></td>
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<tr>
<td>Symbiota Collections of Arthropods (SCAN)</td>
<td>2012 - 2015</td>
<td>Neil Cobb</td>
<td><a href="mailto:neil.cobb@nau.edu">neil.cobb@nau.edu</a></td>
<td>Symbiota</td>
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<tr>
<td>InvertNet</td>
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<td>Chris Dietrich</td>
<td><a href="mailto:dietrich@inhs.uiuc.edu">dietrich@inhs.uiuc.edu</a></td>
<td>Symbiota</td>
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<td>Tri-trophic Databasing (TTD)</td>
<td>2011 - 2015</td>
<td>Randall Schuh</td>
<td><a href="mailto:schuh@amnh.org">schuh@amnh.org</a></td>
<td>Arthropod Easy Capture, Symbiota, other institutional databases including Specify</td>
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<td>Lichens &amp; Bryophytes (LBCC)</td>
<td>2011 - 2015</td>
<td>Corinna Gries</td>
<td><a href="mailto:cgries@wisc.edu">cgries@wisc.edu</a></td>
<td>Symbiota</td>
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<td></td>
<td></td>
<td>Tom Nash</td>
<td><a href="mailto:tom.nash@asu.edu">tom.nash@asu.edu</a></td>
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<td>microfungi</td>
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<td>&gt;1.2M</td>
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<td>fish, clams, snails, mussels, algae, plants</td>
<td>imaging herbarium sheets and animal specimen lots with the Photo eBox Plus</td>
<td>1.73M</td>
<td>29</td>
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<td>insects, arachnids, mollusks</td>
<td>data capture from labels and label images, data capture via voice recognition and OCR</td>
<td>&gt;2M</td>
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<td>fossil insects</td>
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<td>500k / 200k</td>
<td>7 (1 PEN)</td>
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<td>plants</td>
<td>rapid imaging coupled with citizen science based label transcription and collaborative georeferencing</td>
<td>&gt;3M</td>
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<td>birds, frogs, fish, insects</td>
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<td>58K / 23K</td>
<td>7</td>
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<td>macroalgae</td>
<td>imaging herbarium sheets with the Photo eBox Plus</td>
<td>1.14M / 1.14M</td>
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<td>vascular plants</td>
<td>robotic scanning apparatus for herbarium sheets, specimen-by-specimen label data capture</td>
<td>1.29M / 1.29M</td>
<td>19 (2 PENS)</td>
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<td>fossils: arthropods, brachiopods, echinoderms, and mollusks</td>
<td>specimen-by-specimen label data capture</td>
<td>650K / 3.6K</td>
<td>8 (2 PENS)</td>
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<td>label imaging, crowd-sourcing of label data</td>
<td>1.39M / 1.3M</td>
<td>38 (2 PENS)</td>
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<td>ground dwelling arthropods</td>
<td>Visionary Digital workflow, specimen-by-specimen label data capture, plus ff16K specimen image suites (ff40K images)</td>
<td>.73M / 15K</td>
<td>16 (3 PENS)</td>
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<td>arthropods</td>
<td>robotic scanning of vials, slides and drawers, crowd-sourcing of label data from images</td>
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<td>16 (1 PEN)</td>
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<td>insects (Hemiptera, Hymenoptera) and vascular plants</td>
<td>imaging herbarium sheets with the Photo eBox Plus and direct transcription of insect labels into a database without imaging</td>
<td>1.2M (insects) 1.2M (plants) / 611K</td>
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<tr>
<td>lichens &amp; bryophytes</td>
<td>label imaging, OCR for data capture</td>
<td>2.3M / 2.3M</td>
<td>76 (4 PENS)</td>
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The Microfungi Collections Consortium: A Networked Approach to Digitizing Small Fungi with Large Impacts on the Function and Health of Ecosystems (MiCC)

Project Summary
Microscopic fungi [microfungi] represent a diverse assemblage that is distributed worldwide and includes bread molds, plant pathogens, powdery mildews, rusts, slime molds, and water molds. A large percentage of these organisms are harmless or even beneficial, but some cause disease and death in animals, plants, and other fungi resulting in major economic loss and serious negative implications for human and ecosystem health. Despite their importance, little is known about their distribution, diversity, ecology, or host associations. This project is a collaborative effort involving 38 institutions in 31 states and aims to consolidate data from specimens housed in biodiversity collections for 2.3 million microfungi specimens and make these data available through online resources. The consolidation and increased accessibility of these data is critical to inform and promote new and innovative research, education, and community engagement around this little-known but important group of organisms.

Specimen data generated by this project will be used to assess natural and human-induced environmental changes on microfungi distributions, and evaluate the impact of these changes on the function and health of ecosystems. This project fills a critical gap in the national digitization effort by contributing images, digitizing specimen label data, and linking associated ancillary data for over 1.2 million North American specimens of microfungi. Additionally, nomenclature and taxonomic information will be updated to reflect the newest practices as dictated by the International Codes for Nomenclature. These data will provide a foundation for making informed decisions by agribusinesses, educators, forest managers, government agencies, horticulturalists, policy makers, researchers, and the general public. The broader education goals of this project will be facilitated through the development and implementation of a teaching module for high school biology on the economic importance of microfungi.

Proposed Research
- What are the effects of anthropogenic disturbance to the environment on the temporal and spatial distribution and phenology of microfungi? Human-induced impacts may include downstream effects due to land use changes in agricultural and natural ecosystems, the introduction of herbicides, fungicides, and pesticides, and increased atmospheric pollution.
- Can we use historic and current distributional patterns of microfungi as models for the early detection of invasive species to reduce their potential deleterious effects? Can we use these same data to detect endemism and biodiversity hotspots in microfungi?
- How do climatic changes influence the dispersal, distribution, and functioning of soil microfungi?

Citizen Science and Outreach Projects
WeDigBio @ UIUC

Project Sponsor
University of Illinois at Urbana-Champaign
NSF Award Number 1502735

Principal Investigators
Andrew Miller (Principal Investigator) Illinois Natural History Survey
Phil Anders (Biological Informatician) Illinois Natural History Survey
Elizabeth Lippoldt (Project Manager) Illinois Natural History Survey
Alex Kuhn (Digitizer) Illinois Natural History Survey
Scott Bates (Project Consultant) Purdue University North Central

Project Website
http://www.microfungi.org
Social Media
https://www.facebook.com/microfungi.org

Instagram @microfungi_inhs

Project Collaborators
Tatyana Livshultz  Academy of Natural Sciences
Barbara Kennedy  Bishop Museum
Richard Pyle  Bishop Museum
Julia Kerrigan  Clemson University
Cathie Hodge  Cornell University
Scott LaGreca  Cornell University
Melissa Islam  Denver Botanic Garden
Vera Evenson  Denver Botanic Garden
Don Pfister  Farlow Herbarium
Thorsten Lumbsch  Field Museum
Deborah Lewis  Iowa State University
Jennie Kluse  Louisiana State University
Michael Vincent  Miami University
Alan Fryday  Michigan State University
Marc Cubeta  North Carolina State University
Roy Halling  New York Botanical Garden
Joey Spatafora  Oregon State University
Cathie Aime  Purdue University
Brian Geils  Rocky Mountain Research Station
Jim White  Rutgers University
Ning Zhang  Rutgers University
Dennis Desjardin  San Francisco State University
Alex Weir  State University of New York
Lisa Castelbury  U.S. National Fungus Collections
Martha Powell  University of Alabama
Steve Stephenson  University of Arkansas
Betsy Arnold  University of Arizona
Brent Mishler  University of California, Berkeley
Andrew Doran  University of California, Berkeley
Matthew Smith  University of Florida
Marin Brewer  University of Georgia
Robert Lichtwardt  University of Kansas
Tim James  University of Michigan
Matthew Foltz  University of Michigan
George Weiblen  University of Minnesota
Robert Kaul  University of Nebraska
Carol Ann McCormick  University of North Carolina
John Hayden  University of Richmond
Karen Hughes  University of Tennessee
Mary Ann Feist  University of Wisconsin
Sharon West  University of Wisconsin
Larry Schmidt  University of Wyoming
Mary Barkworth  Utah State University
Dean Glawe  Washington State University
Documenting Fossil Marine Invertebrate Communities of the Eastern Pacific - Faunal Responses to Environmental Change over the last 66 million years (EPICC)

Project Summary
Fossils provide our only direct evidence of past biodiversity and how individual organisms to ecosystems have responded to past and long-term environmental change. This project fills a major gap in the documentation of past environmental change, making available digitized data from the especially rich fossil record of the eastern Pacific marine invertebrate communities of the Cenozoic, the 66 million years that have passed since the extinction of the dinosaurs. Digitization and integration of these data will foster increased accessibility, efficient analysis to understand past change, the identification of factors involved in that change, and enable predictions for how current biodiversity may be impacted by future change. Development of virtual fieldwork experiences will assist stakeholders and educators in understanding how field data and fossil collections are used to infer past ecosystem and environmental conditions.

The data currently exist as a vast collection of fossil specimens and printed materials distributed among multiple natural history collections: this project involves seven primary institutions, one small collection and one federal institution and will integrate this digitized specimen data with the other two ongoing fossil networks through the web portal iDigPaleo, expanding the resource for fossil invertebrate information by spanning over 500 million years. This wealth of data will provide resources not only to researchers, but will be made available to K-16 educators, government, industry, and the general public. Through the national resource (iDigBio), these data will be integrated with information on modern organisms providing the means to understand important questions on niches, environmental change, transitions in sea levels, etc. Additionally, undergraduate and graduate students will be trained in the modern uses of natural history collections.

Proposed research (using collections data of eastern Pacific marine invertebrate fossil collections of the Cenozoic)
- Assessment of how individual species, communities, and ecosystems respond to environmental change on evolutionary and long-term ecological timescales
- Modeling predictions of response to future environmental change
- Verification and standardization of taxonomic assemblages for analysis of distribution
- Food web analysis
- Study of tectonically-induced change on biodiversity

Project Sponsor
University of California-Berkeley
NSF Award Number 1503678

Principal Investigators and Senior Personnel
Charles Marshall (PI) UC-Berkeley Lisa White (Co-PI) UC-Berkeley
Seth Finnegan (Co-PI) UC-Berkeley Patricia Holroyd (Co-PI) UC-Berkeley
Erica Clites UC-Berkeley Peter Roopnarine (PI) California Academy of Sciences
Edward Davis (PI) University of Oregon
Elizabeth Nesbitt (PI) University of Washington Burke Museum
Ron Eng University of Washington Burke Museum
Jere Lipps (PI) John D. Cooper Archaeological and Paleontological Center
Jann Vendetti (PI) Los Angeles County Museum
Austin Hendy Los Angeles County Museum
Gregory Dietl (PI) Paleontological Research Institute
Don Duggan-Haas Paleontological Research Institute
Robert Ross Paleontological Research Institute
Leslie Skibinski Paleontological Research Institute
Patrick Druckenmiller (PI) University of Alaska Museum of the North
Kathy Hollis (PI) Smithsonian Institution National Museum of Natural History

Social Media
https://twitter.com/epicc_tcn
Documenting the Occurrence through Space and Time of Aquatic Non-indigenous Fish, Mollusks, Algae, and Plants Threatening North America’s Great Lakes (GLI)

Project Summary
One of the greatest threats to the health of North America’s Great Lakes is invasion by exotic species, several of which already have had catastrophic impacts on property values, the fisheries, shipping, and tourism industries, and continue to threaten the survival of native species and wetland ecosystems. Additional species have been placed on watchlists because of their potential to become aquatic invasives. This project will create a network of herbaria and zoology museums from among the Great Lakes states of MN, WI, IL, IN, MI, OH, and NY to better document the occurrence of these species in space and time by imaging and providing online access to the information on the specimens of the critical organisms. Several initiatives are already in place to alert citizens to the dangers of spreading aquatic invasives among our nation’s waterways, but this project will develop complementary scientific and educational tools for scientists, students, wildlife officers, teachers, and the public who have had little access to images or data derived directly from preserved specimens collected over the past three centuries.

This bi-national Thematic Collections Network of >25 institutions from eight states and Canada will digitize 1.73 million historical specimens representing 2,550 species of exotic fish, clams, snails, mussels, algae, plants, and their look-alikes documented to occur in the Great Lakes Basin. It is one of the first efforts to digitize liquid preserved specimens and to integrate cross-kingdom taxa and these methods could become national standards for cross taxon digitization. Students will be provided with hands-on experience in modern methods of specimen curation and this cross-taxon network will provide greater flexibility to existing web platforms for integration of data.

Proposed research
- Identification and documentation of presence and spread of non-indigenous and potentially invasive or harmful species in the Great Lakes
- Track, monitor, and predict the spread of invasives through space and time, especially in the face of a more rapidly changing climate in the upper Midwest
- Studying points of access, migration routes, lag times, and speed of colonization of different lineages of non-indigenous organisms already established in the Great Lakes to help prevent future invasions

Project Sponsor
University of Wisconsin - Madison
NSF Award Number 1410683

Principal Investigator
Kenneth Cameron  University of Wisconsin - Madison

Collaborating Award PIs
Kevin Cummings  UI Urbana-Champaign
Marymegan Daly  Ohio State University
Thomas Duda  University of Michigan, Ann Arbor
John Freudenstein  Ohio State University
Andrew Hipp  Morton Arboretum
Brenda Molano-Flores  UI Urbana-Champaign
Christine Niezgoda  Field Museum of Natural History
Rick Phillippe  UI Urbana-Champaign
Richard Rabeler  University of Michigan - Ann Arbor
David Seigler  UI Urbana-Champaign
Andrew Simons  University of Minnesota-Twin Cities
Chris Taylor  UI Urbana-Champaign
Melissa Tulig  New York Botanical Garden
George Watters  Ohio State University

Project Website
http://greatlakesinvasives.org/portal/index.php
**InvertEBase: Reaching Back to See the Future: Species-rich Invertebrate Faunas Document Causes and Consequences of Biodiversity Shifts (InvertEBse)**

**Project Summary**

The rapid biodiversity change in North America has significant effects on essential ecosystem services, from impact on soil health and nutrient cycling, to agriculture, forestry and water quality. Exploding populations of invasive species threaten fresh water and terrestrial habitats and potentially impact the natural resources of the nation. Easy access to robust, expertly vetted baseline data for species occurrences, abundances, and distribution ranges, and monitoring how these parameters have changed through time, will facilitate the protection of the nation’s natural resources, and vastly improve the capacity for effective restoration, land management planning, and conservation management. Numerous undergraduate students will receive training in digitization technologies and a modular exhibit will be developed to engage public interest in biodiversity changes.

Effective monitoring requires easy electronic access to historical specimen baseline information for temporal and regional species diversity comparisons that can facilitate informed land management decisions. Vast amounts of specimen data are housed within the nation’s natural history collections, but most of these data are not readily accessible from digital resources. Size and complexity of scientific specimen collections require major technological advances in capturing specimen data. The goal of this four-year collaborative project is the rapid digitization of >2 million specimens and their locality data from ten arthropod and mollusk collections housed at six major U.S. museums in six states [IL, OH, AL, MI, DE, PA]. This project will significantly automate specimen data capture by utilizing optical character and voice-recognition technologies. The digitized data from this project will be immediately deployed for habitat-based distribution modeling and analyses.

**Proposed Research**

- Study of temporally and spatially correlated changes in species distribution patterns of eastern North American terrestrial and freshwater mollusks and arthropods (e.g., range changes of ecologically interconnected species at landscape scales, along latitudinal gradients, and particular points on the earth’s surface)
- Development of historical and present day niche-based distribution models using predictive tools
- Assessment of impact of climate change on invertebrate diversity and distribution in the eastern United States
- Assessment of protected areas for the conservation of invertebrate diversity
- Workflow development for invertebrate collections in differing forms of preservation

**Project Sponsor**

Field Museum of Natural History  
NSF Award Number 1402667

**Principal Investigator**

Petra Sierwald  
Field Museum of Natural History

**Collaborating Award PIs**

Nasreen Aziz  
Delaware Museum of Natural History  
Rüdiger Bieler  
Field Museum of Natural History  
Jason Bond  
Auburn University  
Andrew Deans  
Pennsylvania State University - University Park  
James Hanken  
Harvard University  
Taehwan Lee  
University of Michigan, Ann Arbor  
Paul Morris  
Harvard University  
Diarmuid O’Foighil  
University of Michigan - Ann Arbor  
Elizabeth Shea  
Delaware Museum of Natural History  
Gavin Svenson  
Cleveland Museum of Natural History

**Project Website**

http://www.invertebase.org/portal/index.php
Fossil Insect Collaborative: A Deep-Time Approach to Studying Diversification and Response to Environmental Change (FIC)

Project Summary
Fossil insects provide a unique deep-time record of ecological and evolutionary response to past environmental changes and therefore are invaluable for understanding the impacts of climate change on the current biodiversity crisis. Given current models of future climate change and the important role that insects play in human society (biodiversity, pests, pollination, vectors of disease) the ability to access these data and make predictions about future insect populations becomes even more urgent. The Fossil Insect Collaborative will make available all the major collections of fossil insect specimens in the United States by creating electronic specimen records consisting of digital images and associated collection data.

The digitized fossil insect collections will be made broadly accessible to the research community, K-16 education, government and industry, the general public, and the media through the project website and a central site integrating all the paleobiological Thematic Collections Networks called iDigPaleo. Mobile apps and activities that allow a wide variety of users to experience and interact directly with the collections data will be developed.

Proposed Research
The fossil insect data are of great importance to understanding insect response to environmental change and patterns of biodiversity through time. These fossils can aid in phylogenetic reconstruction, examinations of the evolution of morphological characteristics and in studies of overall patterns of diversification in deep time.

Digitization of fossil insect collections can support studies related to:
- parasitic insect co-evolution,
- insect pollination,
- insects as vectors of disease, and
- gigantism as a result of climate change.

Project Sponsor
University of Colorado at Boulder
NSF Award Number 1305066

Principal Investigators
Dena Smith [Principal Investigator]  Museum of Natural History, University of Colorado, Boulder
Talia Karim [Co-Principal Investigator]  Museum of Natural History, University of Colorado, Boulder

Collaborating Award PIs
Sam Heads  University of Illinois Urbana-Champaign
David Grimaldi  American Museum of Natural History
Alton Dooley  Virginia Museum of Natural History
Michael Engel  University of Kansas
Brian Farrell  Harvard University
Susan Butts  Yale University
Christopher Norris  Yale University
Diane Erwin  University of California, Berkeley

Project Website
http://fossilinsects.colorado.edu/
The Key to the Cabinets: Building and Sustaining a Research Database for a Global Biodiversity Hotspot (SERNEC)

Project Summary
The southeastern USA is botanically rich, with areas of high global biodiversity in both the Appalachians and the coastal plain. Millions of plant specimens have been collected from this region over the past four centuries, and these specimens and the information they contain currently reside in museums, or herbaria, at universities across the area. Scientists study these specimens intently; however, it is difficult to retrieve information at broad geographic and taxonomic scales without pipelines to move the information electronically from the specimen to an accessible pool of data. SERNEC, or the SouthEast Regional Network of Expertise and Collections, is a large regional network of botanical experts and collections that has, through an NSF-sponsored research coordination network (RCN) project, developed critical skills in biodiversity informatics. The current project will allow the SERNEC group to make data available for over 3 million specimens using the latest photography and information capture tools and to engage citizen scientists and students to assist in transcribing and georeferencing this large dataset. The research generated through this project can help regional planners, land managers and communities to manage their natural resources in our ever-changing environment.

The interaction of scientists, citizen scientists, and students will provide a synergy to build a research tool of an unparalleled scale and scope. The ultimate goal of this project is to develop an imaged and databased set of over 3 million specimens from over 100 herbaria in one of the most floristically diverse regions in North America and a global hotspot of plant diversity. This will represent a valuable data source for research on the response of vegetation to climate change, human development, and rapid migrations of introduced species. This region has been a biodiversity hotspot for 100 million years and this project should encourage research on changes over time to develop better predictive models as areas of biodiversity change. By partnering with Symbiota, Notes from Nature, GEOLocate, Adler Planetarium, iPlant/TACC, and Specify, the project will develop ways to best integrate various efforts for data accessibility.

Citizen Science and Outreach Projects
This project will utilize Notes From Nature (http://www.notesfromnature.org/) to engage citizen scientists in museum related science activities.

The project will develop Notes From Nature-based lesson plans to target state-based standards of learning (SOLs) for grades 6 - 12.

FSU’s Robert K. Godfrey Herbarium hosted a successful crowdfunding campaign raising over $2000 to provision six 1-day citizen science events in 2015. We brought 100+ people from the Tallahassee region onto campus to learn about local biodiversity and the role of biodiversity specimens in research and education. The longer-term, bigger-picture goal is to develop a new model for sustaining biodiversity data creation by providing resources to the nation’s 1500 museums, universities, field stations, and other institutions with similar collections so that they find it easier to do something similar. Those collections together house about a billion specimens—plants, fossils, birds, mammals, sponges, insects, etc. The plan is to establish a virtuous circle in which, as the collections engage more people in their local communities in the events, the crowdfunding support for those events grows. Visit http://spark.fsu.edu/Projects/121/Blazing-a-New-Trail-for-Sustainability-with-Citizen-Science for more information.

Proposed Research
This project proposes to utilize plant collection data to determine the threats to the native biota of the southeastern region of North America, including:

- climate change,
- invasive species,
- human population growth, and
- species extinction.

Compare of geographic distributions and habitat requirements of endemic species with non-endemics.
Determine the origins of biogeographic richness of the region and maintenance of diversity over geologic time.
Ecological niche or species distribution modeling of current and future distributions of rare and endemic species.
Project Sponsor
Appalachian State University
NSF Award Number 1410069

Principal Investigator
Zack Murrell Appalachian State University

Project Website
http://sernec.appstate.edu/

Collaborating Award Pls

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<tr>
<th>Alan Harvey</th>
<th>Georgia Southern University</th>
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Developing a Centralized Digital Archive of Vouchered Animal Communication Signals (VACS)

Project Summary
This thematic collection network will digitize and make accessible media recordings associated with physical voucher specimens, broadly organized around the research theme of understanding the evolution and ecology of communication signals. Research on these questions has been challenged by the relative inaccessibility of the signal recordings and their associated physical specimens. This project will meet this challenge by partnering together multiple biological research collections and the Macaulay Library of Natural Sounds, the world’s largest scientific archive of animal signal recordings. Collectively, these institutions will co-curate and make accessible digitized and vouchered recordings of the communication signals of birds, frogs, fish and insects, and will establish direct and transparent links across collections between physical voucher specimens and their digitized recordings. This project will make accessible digital audio recordings of animal signals that can be used to address a host of scientific questions, including the responses of animals to anthropogenic noise and other human activities. By providing a useful co-curation system and encouraging collection of recordings along with physical specimens, this project will have a transformative influence on the way that researchers collect and use biological specimens in the future, and will serve as a useful model for collections facing similar co-curation challenges.

This project will also provide materials for extensive educational outreach at all age levels, and will have significant conservation impacts because the digitized material will contribute directly to our ability to assess and monitor biodiversity. Finally, this project will expand biological collection methods and help train the “next generation” of museum curators, collectors, and researchers.

Proposed Research
- Understanding the response of organisms to anthropogenic noise and other perturbations
- Discovery of cryptic species
- Determining the extent to which vocal and other signals evolve in concert, mechanisms of sound production, role of morphology in signal evolution
- Influence of habitat and ecological selection pressures on animal signals
- Population variation both temporally and geographically
- Behavioral variation and sexual selection
- Seasonality and circadian dependencies

Project Sponsor
Cornell University
NSF Award Number 1304425

Principal Investigators
Michael Webster (Principal Investigator) Cornell University
Gregory Budney (Co-Principal Investigator) Cornell University
Edwin Scholes (Co-Principal Investigator) Cornell University

Collaborating Award PIs
Rafe Brown University of Kansas
David Kavanaugh California Academy of Sciences
Travis LaDuc University of Texas at Austin
Daniel Lane Louisiana State University & Agricultural and Mechanical College
The Macroalgal Herbarium Consortium: Accessing 150 Years of Specimen Data to Understand Changes in the Marine/Aquatic Environment (MHC)

**Project Summary**
This project is supporting investigators from a consortium of 50 herbaria at universities, botanical gardens, and natural history museums across the U.S. to digitize their collections of macroalgae. When they have finished, high resolution images and information about when and where each specimen was collected will be openly accessible for more than a million specimens through the consortium's web portal and the iDigBio web resource. Macroalgae are the foundation of marine, estuarine and freshwater benthic ecosystems providing food, substrata and protection for a myriad of other aquatic organisms. Many macroalgal species are sensitive to environmental change. The data provided through the portal will allow researchers and the public at large determine how macroalgal biodiversity and our aquatic ecosystems have changed over the past 150 years as a result of climate change, bioinvasions, and a wide range of human activity.

A number of macroalgal species, including kelp, nori, and others are grown extensively via aquaculture or harvested from the wild for human food and for extraction of colloids used in cosmetics, food products, and pharmaceuticals. The consortium's web portal will provide opportunities for the public to learn about the economic and ecological importance of macroalgae. Tools will be provided for citizen scientists to contribute to the project by helping transcribe some of the ancillary details from specimen labels into the database. Interactive exhibits and educational modules will be developed by the education departments of the museums in the consortium where hundreds of thousands of visitors will experience them each year. The project will also provide integrative training in collections and informatics research for undergraduate and graduate students through participation in the digitization effort and through internships at one of the museums.

**Proposed Research** (focusing on ecological changes in marine, estuarine and freshwater environments)
- Temporal and spatial data on macroalgal distribution will help track the spread of invasive species, identify the dispersal vectors, allow assessment of the impact on native community structure
- Assessment of the effects of climate change on aquatic environments temporal changes in the geographic distribution of macroalgae can be used to understand the impact of human activity on aquatic ecosystems
- Taxonomic research, species identification, species distribution and documentation of range extensions

**Project Sponsor**
University of New Hampshire
NSF Award Number 1304924

**Principal Investigator**
Christopher Neefus  University of New Hampshire

**Collaborating Award PIs**
Christopher Dick  University of Michigan, Ann Arbor
Brent Mishler  University of California Berkeley
David Giblin  University of Washington
Alan Weakley  University of North Carolina at Chapel Hill
Kenneth Karol  New York Botanical Garden

**Project Website**
http://macroalgae.org
Mobilizing New England Vascular Plant Specimen Data to Track Environmental Change (NEVP)

Project Summary
Herbarium specimens provide a source of historical information useful to the study of global environmental change. The goal of this project is to provide data to support studies of the nature and consequences of environmental change in the New England region over the last three centuries. This project will digitally capture specimen data and images from about 1.3 million vascular plant specimens from herbaria across New England, enhancing the data with georeferencing, habitat, and phonological information. The digitization process will integrate with existing community efforts and will develop novel high-throughput digitization technologies to increase efficiency and decrease costs. All resulting data and images will be freely available on-line.

The data from this project will be of immediate use to scientists who study climate and land-use change, and will provide a better understanding of how global changes will impact the distribution of native and introduced plant species. This project will benefit research in taxonomy, ecology, morphology, biogeography, and evolutionary history by making available data on an entire regional flora in an electronic format. The methodologies developed will provide a model for other regions around the nation. In addition the project will utilize citizen scientists, school groups, and students providing training, research, and educational opportunities.

Proposed Research
- Understanding the effects of rising temperature on the phenology (flowering and leafing-out stage) for New England taxa
- Impact on landscape of human activity through deforestation, agriculture, and the development of human infrastructure on New England habitat
- Intersection of climate change and land use and effects on biotic systems in New England, such as sensitivity of habitats, changes in species abundance and phenology
- Documentation and conservation of biological diversity, including assessing the distribution of rare and endangered species, changes in species abundance over time, arrival and expansion of non-native and invasive species

Project Sponsor
Yale University
NSF Award Number 1209149

Principal Investigators
Patrick Sweeney (Principal Investigator) Yale University
Michael Donoghue (Co-Principal Investigator) Yale University

Project Website
http://nevp.org/
http://portal.neherbaria.org/portal/
Digitizing Fossils to Enable New Syntheses in Biogeography - Creating a PALEONICHES

Project Summary
Museum collections of fossils, along with their associated locality data, provide millions of records representing data on the temporal and geographic distribution of species in deep time. However, to reach their greatest scientific potential, these collections data need to be available on-line and in a format that facilitates quantitative biogeographic analyses. We will enter information about the age and precise location of fossil specimens from parts of several key paleontological collections into electronic databases. During this process improvements to computer programs for collections will be enhanced to allow paleontological specimens to be integrated with modern specimen data, thereby benefiting research on distribution of organisms over time. Our efforts will digitize nearly 450,000 specimens belonging to 900 species from several museums throughout the U.S. and will focus on three different time periods in the history of life: the Ordovician, Pennsylvanian, and Neogene. We will create on line digital atlases illustrating and describing these fossils and providing maps showing where they can be found. We will also create an ‘app’ so these atlases can be used on handheld devices.

The museum collections and fossils provide large amounts of data useful for studying what causes species to migrate, go extinct, or evolve over long time periods. They are of great relevance for considering how global change has and will continue to affect life on this planet. Our study will make these data available on line and accessible to scientists, facilitating many scientific analyses. The on-line and portable device digital atlases will be useful for educating amateur paleontologists and K-12 students about fossils both in classrooms and in the field. We will also provide training to students and scholars.

Proposed Research
Using Ecological Niche Modeling for analyzing neontological and paleontological data in biogeographic and ecological studies pertaining to:
- the biotic effects of climate change,
- changes to species associations in the face of changes in physical environment,
- influences of abiotic and biotic factors on species distribution, and
- determining species distributions from the Ordovician, the Pennsylvanian, and the Neogene time periods.

Thus far around 700,000 specimens have been databased and 9,000 localities have been georeferenced. Further, these data have been shared with iDigBio and provided on line via institutional websites. We have created online digital atlases, www.digitalatlasofancientlife.org, for more than 900 species from the time intervals studied. For each species ecological, stratigraphic, and taxonomic information is provided, along with images and geographic range maps. Our Digital Atlas of Ancient Life project is described in greater detail in an article in Palaeontologia Electronica in 2015. Our Digital Atlas of Ancient Life “App” is available at the Apple App Store for free download. Studies associated with the project have been published by the PIs in several journals including: Global Biogeography and Ecology; Journal of Biogeography; Paleobiology; and Proceedings of the Royal Society, Series B. A total of nine graduate students (seven of them women), ten undergraduate students (eight of them women), and one female post-doctoral fellow received training and were supported by this project.

Project Sponsor
University of Kansas
NSF Award Number 1206757

Principal Investigators
Bruce Lieberman (Principal Investigator) University of Kansas
Jonathon Hendricks (Principal Investigator) San Jose State University
Alycia Stigall (Principal Investigator) Ohio University
James Beach (Co-Principal Investigator) University of Kansas
Una Farrell (Co-Principal Investigator) University of Kansas

Project Website
http://www.digitalatlasofancientlife.org/
The Macrofungi Collection Consortium: Unlocking a Biodiversity Resource for Understanding Biotec Interactions, Nutrient Cycling and Human Affairs (MaCC)

Project Summary
Mushrooms and related fungi (macrofungi) play a critical role in the lives of plants and animals, including humans, yet their diversity is underestimated. Understanding this diversity will be critical in analyzing impacts of habitat change, nutrient cycling in ecosystems, and distributions and diversity of host organisms. Scientists in the U.S. have been studying these fungi for the past 150 years, resulting in a legacy of approximately 1.4 million dried scientific specimens conserved in 35 institutions in 24 states. These institutions have now joined in an effort to digitize and share online all data associated with macrofungi specimens. The resulting resource will enable a national census of macrofungi, never before attempted, and will allow researchers to better understand the diversity of these organisms and the relationship between macrofungi and the organisms with which they form intimate relationships.

Organized into clubs across the country, citizen mycologists play an important role in documenting macrofungi diversity, and these enthusiastic individuals are the conduit between professional scientists and the general public for critical information about wild edible and poisonous fungi. Citizen mycologists will join the collections institutions in this project to help to create the online resource. The project will fund two workshops for high school teachers to promote classroom study of fungi. University students employed by the project will gain work experience in digitization and formal training about fungi. Students will share the knowledge they gain through oral and video presentations.

Current Research
Herbarium collections of fungi with conspicuous spore-bearing structures commonly known as macrofungi (e.g., mushrooms, boletes, puffballs, club fungi, morels, stink horns, truffles and cup fungi) are the subject of this Thematic Collections Network. We propose to unite established and nascent collections of macrofungi into the Macrofungi Collections Consortium (MaCC) of 35 institutions that collectively will digitize collection information from about 700,000 specimen labels, capture 110,000 images of fungal specimens and digitize about 500,000 critical ancillary items such as photographs, field notes and fieldbook pages. The result will be a dataset of almost 1.4 million enriched specimen records that includes essentially all the macrofungal collections deposited in U.S. herbaria during the past 150 years. The data generated through this project will allow researchers to address the questions: To what extent do the diversity and distribution of macrofungi determine the diversity and distribution of the organisms with which they form commensal or symbiotic relationships, and by extension, how will changes in macrofungal diversity and distribution affect those organisms and ultimately human affairs?

So far, approximately 650,000 items have been newly digitized (includes specimens, specimen labels, photographs, field notes, field book records), and 1,933,000 specimen records have been added to the Mycoportal [http://mycoportal.org/portal/index.php]. This total includes specimens digitized prior to the start of this project as well as newly digitized specimens. The Portal contains 54,000 are skeletal records (i.e. locality data yet to be added), 1,824,000 are records with complete text locality information, and approx. 300,000 records have complete locality data with geocoordinates. The MycoPortal also has been populated with 509,000 images (approximately 25,000 of these are living fungi, the remainder are images of dried fungi, labels, and field notes), 41 checklists, including a checklist for North American fungi with more than 15,000 entries). With eight months remaining in the grant, we have already exceeded the number of specimens to be digitized through this project by 50,000, and the Mycoportal contains more than 300,000 more records than originally anticipated.

Three training courses were held at NYBG for 12 participants in the project, and three training courses were held at participant institutions for 10 participants. A 125 page training manual was prepared to guide the training sessions. The procedure manual provides step-by-step instructions for all aspects of the project, with the majority of time spent on learning to set up the camera equipment, capturing images of specimen labels and specimens, creating skeletal records, and uploading data to the portal. Follow up included phone calls and emails with NYBG staff, and sessions via phone or skype with Portal Manager to
review data upload procedures for newly digitized data as well as helping institutions to configure existing data for upload. All training documents were placed on the project website for additional reference.

Approximately 200 people have been actively engaged in the Macrofungi Collection Consortium project across the funded institutions, including 42 senior personnel, 32 paid staff, and 126 student workers (or recent graduates). At least 33 presentations or articles have been produced for a scientific audience, and 55 presentations or publications (including blogs) have been produced for a general audience. Instead of developing our own crowdsourcing application, we decided to join forces with Notes from Nature, a Zooniverse crowdsourcing application [13]. To date, approximately 50,000 records have been transcribed.

At least 12 presentations or articles have been given to a scientific audience about the project during the period 1 July – 31 March, and 15 Presentations, publications (including blogs) about the project have been presented or published for a general audience. About 200 university students (not including student workers on the project) have attended demonstrations, lectures or tours relating to the MaCC project.

The first high school teacher training course for the project was held at North Carolina State University in Raleigh, NC 5-7 August 2013 for five high school teachers from North Carolina, one Assistant Professor (Dr. Mozley-Standridge) and four undergraduate students from Middle Georgia State College. The workshop taught participants about macrofungi in both the field and the lab, and included training in the use of the MycoPortal, and ways to use macrofungi and the MycoPortal in high school biology courses to meet curriculum standards for North Carolina. A second course for high school teachers will be offered in conjunction with the annual meeting of the Mycological Society of America at University of California, Berkeley in June 2016.

Two PEN awards have supplemented the original consortium: University of Vermont and University of Maine. The project is currently in a one year no-cost extension that will continue the project through June 2016.

**Project Sponsor**
New York Botanical Garden
NSF Award Number 1207526

**Principal Investigator**
Barbara Thiers  New York Botanical Garden

**Collaborating Award PIs**
Rytas Vilgalys  Duke University
Meredith Blackwell  Louisiana State University Herbaria
Peter White  North Carolina State University

**Project Websites**
http://mycoportal.org
Symbiota Collections of Arthropods Network: A Model for Collections Digitization to Promote Taxonomic and Ecological Research (SCAN)

Project Summary
The Symbiota Collections of Arthropods Network (SCAN) brings together 10 diverse arthropod collections at universities and museums throughout the Southwest to create a virtual network of ground dwelling arthropods which are notably responsive to temporal and spatial environmental changes. These 10 collections document much of the Southwest’s biodiversity, but currently the data associated with millions of arthropod specimens are not easily accessible. To overcome this, SCAN will develop methods for integrating existing databases, catalogue-image specimens, develop new electronic identification techniques, and produce a virtual library of ground-dwelling arthropods (beetles, grasshoppers, spiders, ants). In addition the project will work with the existing project Filtered Push to increase the capacity of experts to provide remote identifications and annotations of data that can be sent throughout the network.

The comprehensive SCAN online library and expert information will be available to the public as well as professionals in taxonomy, ecology, and climate change science. Smaller institutions will be provided increased access to large data sets for promoting research. The SCAN datasets will support a number of ongoing projects examining the effects of environmental and land-use change on individual arthropod species. By increasing access to this information, SCAN will stimulate new research and increased awareness in biodiversity conservation throughout the region. Over 50 undergraduates also will be trained in cyberinfrastructure, systematics, and ecology.

Current Research
The current research focus is to use the data for niche/biodiversity modeling, historical ecology, and improving taxonomic resources for inventories, monitoring, and ecological studies that do not have the direct involvement of taxonomists.

The modeling aspect involves a suite of possible activities including present-day niche modeling, species distribution modeling (e.g., MaxEnt), and multi-species modeling to examine patterns of biodiversity. All formal modeling can include both forward projections under various climate change scenarios, and backward projections to understand possible historical or paleo distributions.

Project Sponsor
Northern Arizona University
NSF Award Number 1207371

Principal Investigators
Neil Cobb (Principal Investigator) Northern Arizona University
Kelly Miller (Co-Principal Investigator) Northern Arizona University
Paul Heinrich (Co-Principal Investigator) University of New Mexico

Collaborating Award PIs
Nico Franz Arizona State University
Boris Kondratieff Colorado State University
Paula Cushing DMNS
Scott Bundy New Mexico State University
Wendy Moore University of Arizona
Kelly Miller University of New Mexico
James Hanken Harvard University

Ed Gilbert Arizona State University
Frank Krell DMNS
John Oswald Texas A&M
Ed Riley Texas A&M
Deane Bowers UC - Boulder
James Cokendolpher Texas Tech University
Paul Morris Harvard University

Project Websites
http://scan1.acis.ufl.edu
http://symbiota4.acis.ufl.edu/scan/portal/index.php
InvertNet: An Integrative Platform for Research on Environmental Change, Species Discovery and Identification (InvertNet)

Project Summary
Arthropods (insects, spiders, crabs) are the most diverse and abundant group of macro-organisms in biological collections, but are underrepresented in databases accessible online or elsewhere. This project will centralize access to and synthesize information from 160 years of North American arthropod collections. It will use innovative technology, including optical 3D imaging and reconstruction, to support scientific inquiry on the effects of land use change on biodiversity, and basic research on species discovery and identification. The award will provide IT infrastructure for collection digitization, digitally-assisted curation, and collection management; availability of specimen-level data for scientific inquiry on human impacts on biodiversity; and greater use of and appreciation for scientific collections by non-scientists through access to specimen images and related data.

Current Research
The main research focus of the InvertNet team has been on developing robust hardware and efficient workflows for digitizing various kinds of objects deposited in arthropod collections [vials, slides, and pinned specimens]. A ZooKeys paper [doi: 10.3897/zookeys.209.3571] describes our approach, the goal of which is to achieve the $0.10/specimen cost benchmark while, at the same time, minimizing damage to specimens through excessive handling and obtaining the highest quality of data possible. To date, we have tested and implemented workflows for digitizing vials of ethanol-preserved specimens and trays of slide-mounted specimens. We have also tested three prototype robotic systems for capturing images of whole drawers of pinned specimens. The most recent prototype, based on a four-armed linear delta robot, is in the final stages of testing; we anticipate implementing the system at collaborating institutions beginning later this year. Two graduate students in computer science have so far been involved in developing and testing algorithms that will enable us to create 3D models of drawers of pinned insects, allowing for virtual tilting to reveal details of specimens and labels not visible in a top-down view.

Project Sponsor
University of Illinois at Urbana-Champaign
NSF Award Number 1115112

Principal Investigators
Christopher Dietrich [Principal Investigator] University of Illinois at Urbana-Champaign
Umberto Ravaioli [Co-Principal Investigator] University of Illinois at Urbana-Champaign
Nahil Sobh [Co-Principal Investigator] University of Illinois at Urbana-Champaign
John Hart [Co-Principal Investigator] University of Illinois at Urbana-Champaign
Christopher Taylor [Co-Principal Investigator] University of Illinois at Urbana-Champaign

Collaborating Award PIs
Gregory Zolnerowich Kansas State University Anthony Cognato Michigan State University
Paul Tinerella University of Minnesota Paul Johnson South Dakota State
Daniel Young UW Madison Johannes Klompen Ohio State University
Jennifer Zaspel UW Oshkosh Andrew Short University of Kansas
Jeffrey Holland Purdue University John Rawlins Carnegie Institute
Robert Sites UM Columbia Gregory Courtney Iowa State University
David Rider NDSU-Fargo

Project Website
http://invertnet.org
Plants, Herbivores, and Parasitoids: A Model System for the Study of Tri-trophic Associations

Project Summary
All the nearly 20,000 plant species in North America are attacked by insect pests, including those in the group Hemiptera (known as the “true bugs”), which are in turn attacked by parasitoid insects in the Hymenoptera (sawflies, wasps, ants), widely used for biological control of agricultural pests. This project will unify some eight million records in 34 collections to answer how the distributions and phenologies of the plants, pests and parasitoids relate to each other, in a Tri-Trophic Databasing and imaging project – the TTD. Data from this approach will benefit basic scientific questions and practical applications in the agricultural sciences, conservation biology, ecosystem studies and climate change and biogeography research. Technological tools and methods will be introduced to graduate students, affiliated universities, and grant-sponsored students from other institutions through a short course. A data-mining and species-distribution modeling symposium at the University of California-Riverside will foster interactions between systematics and ecological researchers, and explore the TTD as a platform for instruction and inquiry.

A few recent highlights include:

- Many newly digitized records! TTD had approximately 1,151,424 newly transformed insect records and 1,325,086 plant images completed as of June, 2015.
- Dissemination of information through attendance at iDigBio workshops, meetings, and two articles in the recent ZooKeys special issue, No Specimen Left Behind (http://www.pensoft.net/journals/zookeys/issue/209/).
- An intensive, research focused, specimen level biodiversity informatics short course was held in 2013.
- Numerous volunteers increased georeferencing and databasing productivity at participating institutions, particularly at the NYBG and AMNH.
- The TTD at AMNH offered a Research Experience for Undergraduates in Summer 2014 to Jeremy Frank, who is now an incoming Richard Gilder Graduate Student.
- DiscoverLife, one of the TTD partners, had developed a host interaction public portal (http://www.discoverlife.org/tttn/) and a series of sophisticated locality cleaning and matching services for the project.
- One of our AMNH digitizers received an EOL Rubenstein Fellow (http://eol.org/info/52) to pursue her interest in altitude specificity in floral coloration.
- The principal software for capturing host – insect – parasitoid data from natural history collections, Arthropod Easy Data Capture, has been open-sourced (http://sourceforge.net/projects/arthropodeasy/).

Current Research
All the nearly 20,000 plant species in North America are attacked by insect pests, including those in the group Hemiptera (known as the “true bugs”), which are in turn attacked by parasitoid insects in the Hymenoptera (sawflies, wasps, ants), widely used for biological control of agricultural pests. This project will unify some three million records in 34 collections to answer how the distributions and phenologies of the plants, pests and parasitoids relate to each other, in a Tri-Trophic Databasing and imaging project – the TTD. Data from this approach will benefit basic scientific questions and practical applications in the agricultural sciences, conservation biology, ecosystem studies and climate change and biogeography research.

Project Sponsor
American Museum of Natural History (AMNH)
NSF Award Number 1115080

Principal Investigator
Randall T. Schuh [Principal Investigator] American Museum of Natural History (AMNH)
Christine Johnson [Co-Principal Investigator] American Museum of Natural History (AMNH)
Collaborating Award PIs
Richard Rabeler  University of Michigan, Ann Arbor
Charles Bartlett  University of Delaware
Robert Naczi  New York Botanical Garden
Melissa Tulig  New York Botanical Garden
Robert Magill  Missouri Botanical Garden
John Heraty  University of California, Riverside
Christiane Weirauch  University of California, Riverside
Benjamin Normark  University of Massachusetts, Amherst

Project Website
http://tcn.amnh.org/

Social Media
www.facebook.com/Insects-Plants-and-Parasites-Digitizing-Natural-History-Collections

Award winning digitizers at the American Museum of Natural History. The top contender digitized 40,000 specimens.
North American Lichens and Bryophytes: Sensitive Indicators of Environmental Quality and Change (LBCC)

Project Summary
Lichens and bryophytes (mosses and their relatives) are sensitive indicators of environmental change, and are dominant organisms in arctic-alpine and desert habitats, where the effects of climate change are well-documented. This project will image about 2.3 million North American lichen and bryophyte specimens from more than 60 collections to address questions of how species distributions change after major environmental events, both in the past and projected into the future. Large-scale distribution mapping will help identify regions where such changes are likely, fostering programs designed to protect these organisms. Awardees plan to build and enhance a national volunteer community, and provide online seminars, extensive online training materials, and local workshops and field trips.

Proposed Research
How are changes in distribution patterns of lichens and bryophytes over time correlated with man-made environmental changes, such as land use change, atmospheric pollution, global climate change due to greenhouse gases, and damage to the ozone layer?

Can mapping of historic and recent lichen and bryophyte collections be used to document such changes and can these organisms be used as bioindicators to draw our attention to issues and geographic regions where action is required to maintain a healthy environment?

How accurately can we predict where specific species can be found using existing herbarium data and GIS information, both currently and in the future?

Flora projects include:
• Arctic lichen flora and of the Southern Subpolar region
• Bryophyte flora of Fiji
• Bryophytes of Illinois, Maine, Missouri, North Carolina and Pennsylvania
• Frullania species
• Lichens of Alaska, Arizona, California, Colorado, Florida, Massachusetts, North & South Carolina, and Wisconsin
• Lichens of U.S. National Parks

Project Sponsor
University of Wisconsin - Madison
NSF Award Number 1115116

Principal Investigators
Corinna Gries (Principal Investigator) University of Wisconsin - Madison
Thomas Nash (Co-Principal Investigator) University of Wisconsin - Madison
Collaborating Award PIs
Andrew Miller  University of Illinois at Urbana-Champaign
Edward Schilling  University of Tennessee Knoxville
Meredith Blackwell  Louisiana State University & Agricultural and Mechanical College
Donald Pfister  Harvard University
Francois Lutzoni  Duke University
Robert Luecking  Field Museum of Natural History
Bruce Allen  Missouri Botanical Garden
Timothy James  University of Michigan, Ann Arbor
Larry St.Clair  Brigham Young University
Stefanie Ickert-Bond  University of Alaska, Fairbanks
William Buck  New York Botanical Garden
John Freudenstein  Ohio State University
Tatyana Livschultz  Academy of Natural Sciences Philadelphia
David Giblin  University of Washington
Alan Fryday  Michigan State University
Brent Mishler  University of California, Berkeley

Project Websites
http://lbcc1.acis.ufl.edu
http://lichenportal.org/
http://bryophyteportal.org/
http://symbiota.org/nalichens/index.php
http://symbiota.org/bryophytes/index.php
Publications Produced as a Result of ADBC


Johnson PJ. 2015. Two new species, a new country record, and a key to the species of *Aulonothroscus* Horn (Coleoptera: Throscidae) from The Bahamas. *Insecta Mundi*, 0412: 1-6.


Cathie Aime
Co-Principal Investigator
*TCN - Microfungi Collections Consortium (MiCC)*
MAIME@PURDUE.EDU

Cathie is an Associate Professor of Mycology at Purdue University and the Director of the Arthur and Kriebel Herbaria. Her research interests are focused on the biodiversity and systematics of early diverging lineages of Basidiomycota and fungal ecology and diversity in tropical ecosystems.

Betsy Arnold
Collaborator
*TCN - Macrofungi Collections Consortium (MaCC); TCN - Microfungi Collections Consortium (MiCC)*
BARNOLDAZ@GMAIL.COM

Betsy is an Associate Professor at the University of Arizona and a Curator at the Robert L. Gilbertson Mycological Herbarium. She studies the diversity, evolution and ecological roles of plant-associated fungi.

Diego Barroso
Project Manager
*TCN - Great Lakes Invasives (GLI)*
BARROSO@UMICH.EDU

Diego is based at the University of Michigan Herbarium in Ann Arbor. A biochemist by training, Diego oversees the imaging and databasing of invasive vascular plants, fish, and mollusks at U of M, and serves as liaison for coordinating similar digitization efforts at other institutions in Michigan and Ohio. His interests include data management and biodiversity informatics.

Anne Barber
Project Manager
*PEN - Symbiota Collections of Arthropods Network (SCAN)*
ANNE.BARBER@GMAIL.COM

Anne is the Project Manager for the bit Lab at the California Academy of Sciences, a dedicated space for biodiversity specimen digitization and information management. She manages staff and volunteers who turn the Cal Academy’s specimens into digital bits.

Philip Anders
Biological Informatician
*TCN - Microfungi Collections Consortium (MiCC)*
ANDERS2@ILLINOIS.EDU

Phil is a Biological Informatician at the Illinois Natural History Survey at the University of Illinois, Urbana-Champaign.

Anne Basham
Education and Outreach Coordinator
*TCN - Symbiota Collections of Arthropods Network (SCAN)*
MELODY.BASHAM@ASU.EDU

Anne is director of iDigBio’s Libraries of Life project and ARPEO (Augmented Reality for Public Education and Outreach) Working Group. Anne’s research focuses on the potential cognitive impact of AR/MR/VR technologies in STEM education and as a tool in promoting educational equity.
Scott Bates  
Project Consultant  
TCN - Microfungi Collections Consortium (MiCC)  
SCOTT.THOMAS.BATES@GMAIL.COM

A plant biologist, Scott is an Assistant Professor of Chemistry at Purdue University North Central.

Reed Beaman  
Program Director  
National Science Foundation (NSF)  
RSBEAMAN@NSF.GOV

Reed is in NSF’s Division of Biological Infrastructure (DBI) and has program responsibilities for Advances in Biological Informatics (ABI), Collections in Support of Biological Research (CSBR), and Dimensions of Biodiversity FY2016.

Rüdiger Bieler  
Principal Investigator  
TCN - InvertEBase  
RBIELER@FIELDMUSEUM.ORG

Rüdiger is Curator of Invertebrates at the Field Museum in Chicago. He is involved with various collections and data management projects and serves as an editor of WoRMS and MolluscaBase. His research focuses on evolutionary systematics and biodiversity of mollusks.

David Baxter  
Collaborator  
TCN - Microfungi Collections Consortium (MiCC)  
DBAXTER@BERKELEY.EDU

David is based at the University of California, Berkeley. He serves as Technical Editor for the Consortium of California Herbaria and the Jepson eFlora where he is responsible for development for the collection management software CollectionSpace.

Cathleen Bester  
Project Assistant; Event Coordinator  
iDigBio  
CBESTER@FLMNH.UFL.EDU

A biologist by training, Cathy is the Lead Project Assistant at iDigBio in Gainesville. She is responsible for coordinating and organizing iDigBio workshops and other events. She also assists with travel reservations, meeting spaces, catering and social functions and co-manages iDigBio's social media efforts.

Amy Bolton  
Member  
iDigBio Education & Outreach Working Group  
BOLTANAM@SI.EDU

Amy is the Manager of Deep Time Education and Outreach, a role that includes developing activities and programs around paleontology. She serves on the team that is redesigning the new fossil halls opening in 2019.
**Participant Bios**

**Jason Bond**  
Collaborator  
*TCN - InvertEBase*  
JBOND@AUBURN.EDU

Jason is the Director of the Auburn University Museum of Natural History. His research interests include systematics, taxonomy and evolution of terrestrial arthropods with an emphasis on arachnids and myriapods, specifically spiders and millipedes.

**Benjamin Brandt**  
Lead Developer  
*Symbiota*  
BBRANDT2@ASU.EDU

Ben is based at Arizona State University. He is one of the lead developers of the Symbiota software platform and provides support for many of the current TCNs that are using Symbiota as their main data entry system.

**Marin Talbot Brewer**  
Co-Principal Investigator  
*TCN- Microfungi Collections Consortium* (MiCC)  
MTBREWER@UGA.EDU

Marin is an Assistant Professor at the University of Georgia in Athens. Her teaching and research interests are in the molecular evolution and population biology of plant-pathogenic fungi.

**Susan Butts**  
Collaborating Award Principal Investigator  
*TCN - Fossil Insect Collaborative (FIC); TCN - Paleoniches*  
SUSAN.BUTTS@YALE.EDU

Susan is the Senior Collections Manager of Invertebrate Paleontology at the Yale Peabody Museum of Natural History. Her main interest is in Carboniferous brachiopods and brachiopod paleocommunities.

**Kenneth Cameron**  
Principal Investigator  
*TCN - Great Lakes Invasives (GLI)*  
KMCAMERON@WISC.EDU

Ken is a Professor at the University of Wisconsin-Madison and also Director of the Wisconsin State Herbarium (WIS). He leads his TCN’s effort to document invasive aquatic plants, fish and mollusks in the Great Lakes Basin. His personal research is focused mainly on molecular systematics of orchids.

**Dora Ann Lange Canhos**  
Associate Director  
*Centro de Referência em Informação Ambiental (CRIA)*  
DORA@CRIA.ORG.BR

Dora is based in Brazil, at CRIA, and is part of the development team of speciesLink.
Simon Checksfield
Manager of Digital Collections and Bioinformatics Group
National Research Collections Australia (NRCA); Commonwealth Scientific and Industrial Research Organisation (CSIRO)
SIMON.CHECKSFIELD@CSIRO.AU
Simon is based at NRCA in Canberra, Australia. His background is in leading teams to deliver large scale information systems. He has interests in archaeology and palaeontology and is currently developing a strategy for the digital aspects of NRCA as well as implementing a new CMS.

Anne Marie Countie
Collaborator
TCN - North American Lichens and Bryophytes (LBCC)
ACCOUNTIE@OEB.HARVARD.EDU
Anne Marie is Digital Imaging Project and Program Manager at Harvard University’s Herbaria and Libraries.

Eduardo Dalcin
Member
Global Biodiversity Information Facility (GBIF): Accelerating the Discovery of Biocollections Data Task Force
EDALCIN@JBRJ.GOV.BR
Eduardo is the Director of the Instituto de Pesquisas Jardim Botânico do Rio de Janeiro.

Marc Cubeta
Co-Principal Investigator
TCN - Macrofungi Collections Consortium (MaCC); TCN - Microfungi Collections Consortium (MiCC)
MACUBETA@NCSU.EDU
Marc is Professor of Soil Mycology and Plant Disease Ecology at NC State in Raleigh. His research focuses on disease management with the goal of reducing economic losses to plant disease while promoting increased productivity, sustainability and plant health.

Edward Davis
Principal Investigator
TCN - Fossil Marine Invertebrate Communities of the Eastern Pacific (EPICC)
EDAVIS@UOREGON.EDU
Edward is the Curator of Fossil Collections at the Museum of Natural and Cultural History and Assistant Professor in Geological Sciences at the University of Oregon in Eugene. His TCN activities include digitizing UO’s collection of Cenozoic marine invertebrates and georeferencing localities from coastal Oregon.

Neil Cobb
Principal Investigator
TCN - Symbiota Collections of Arthropods Network (SCAN)
NEIL.COB@NAU.EDU
Neil is based at Northern Arizona University in Flagstaff. A biologist by training, his teaching and research interests include arthropod biodiversity, ecological gradients, climate change and land use change.
Andrew Deans
Collaborator
TCN - InvertEBase
ADEANS@PSU.EDU

Andy is an Associate Professor of Entomology at Penn State and is the Director of the Frost Entomological Museum.

Christopher Dietrich
Lead Principal Investigator
TCN - InvertNet
CHDIETRI@ILLINOIS.EDU

Chris is an insect systematist and Curator of Insects at the Illinois Natural History Survey, Prairie Research Institute, University of Illinois. His research focuses on the phylogeny, biogeography and evolution of leafhoppers and treehoppers.

Shari Ellis
Program Evaluator
iDigBio
SELLIS@UFL.EDU

Shari is based at the Florida Museum of Natural History in Gainesville. She conducts needs assessments and evaluations for iDigBio and its partners including Data Carpentry, WeDigBio and GBIF.

Libby Ellwood
Postdoctoral Researcher
iDigBio
EELLWOOD@BIO.FSU.EDU

Libby currently splits her time between Florida State University in Tallahassee and southern California. A biologist by training, Libby’s research focuses on broadening public participation in the digitization of biodiversity research specimens. She is a member of the WeDigBio planning team.

Michael Denslow
Project Manager
TCN - Southeast Regional Network of Expertise and Collections (SERNEC)
MICHAEL.DENSLow@GMAIL.COM

Michael is based at Appalachian State University in Boone, North Carolina. In addition to his SERNEC activities, he is a part of the Notes from Nature transcription project. His research focuses on the spatial and temporal patterns of vascular plants.

Betty Dunckel
Science Educator
iDigBio
BDUNCKEL@FLMNH.UFL.EDU

Betty is based at the Florida Museum of Natural History in Gainesville. She is a member of the Education and Outreach Working Group, Public Participation in Digitization Interest Group, and WeDigBio planning team.
Participant Bios

**Diane Erwin**
Principal Investigator
*PEN - Fossil Insect Collaborative (FIC)*
DMERWIN@BERKELEY.EDU

Diane is based at the University of California Museum of Paleontology on the Berkeley campus. She is the Paleobotany Collection Manager and Editor of the museum’s journal *PaleoBios*. Her main research focus is on Cenozoic plants of western North America.

**Renato Figueiredo**
Senior Personnel
*iDigBio*
RENATO@ACIS.UFL.EDU

Renato is a senior member of the iDigBio IT team at the ACIS lab at UF. His research interests are in cyberinfrastructure and cloud computing.

**Linda Ford**
Member
*iDigBio External Advisory Board*
LFORD@OEB.HARVARD.EDU

Linda is Director of Collections Operations for the Museum of Comparative Zoology at Harvard. She oversees museum-wide projects and initiatives that encompass the museum’s ten research collection departments, including the museum-wide database and IT infrastructure.

**Mary Ann Feist**
Principal Investigator
*TCN - Microfungi Collections Consortium (MiCC)*
MFEIST@WISC.EDU

Mary Ann is based at the University of Wisconsin in Madison. Mary Ann is a Senior Academic Curator at the Wisconsin State Herbarium. Her research focuses on the systematics of the Apiaceae family and the flora of Wisconsin.

**Matthew Foltz**
Project Coordinator
*TCN - Macrofungi Collection Consortium*
MFOLTZ@UMICH.EDU

Matthew is based at the University of Michigan Herbarium in Ann Arbor where he coordinates and participates in efforts to digitize the extensive macrofungal collections held at this institution. His research interests include fungal systematics, molecular phylogeny, fungal diversity, increasing access to scientific data and public science education.

**José Fortes**
Co-Principal Investigator, Director of Cyberinfrastructure
*iDigBio*
FORTES@ACIS.UFL.EDU

José is based at the University of Florida. He supervises the design, development and operation of iDigBio’s IT cyberinfrastructure. His research interests are in the areas of distributed computing, autonomic computing, computer architecture, parallel processing and fault tolerant computing.
Edward Gilbert
Lead Developer
Symbiota
EGBIODIVERSITY@GMAIL.COM

Ed is a Biodiversity Informatician & Faculty Research Associate at Arizona State University. His research and service activities focus on biodiversity informatics, and particularly on the lead development of Symbiota.

Jean Ganglo
Member
Global Biodiversity Information Facility (GBIF): Accelerating the Discovery of Biocollections Data (ADBC) Task Force
GANGLOCJ@GMAIL.COM

Jean is a Senior Lecturer at the Faculty of Agronomy of the University of Abomey-Calavi, Cotonou, and the Node Manager of GBIF-Benin.

Lauren Gonzalez
Graduate Student
iDigBio
LAURENAGONZALEZ@UFL.EDU

Lauren is a graduate student with iDigBio based in the Soltis Molecular Systematics and Evolutionary Genetics Lab at the Florida Museum of Natural History. Her research involves using natural history collections to inform phylogenetics, biogeography and conservation of plants.

Charlotte Germain-Aubrey
Postdoctoral Researcher
iDigBio
CHARLOTTEGERMAINAUBREY@GMAIL.COM

Charlotte is a postdoctoral fellow with iDigBio working in the Molecular Systematics and Evolutionary Genetics Lab under Drs. Doug and Pam Soltis at the Florida Museum of Natural History.

Jillian Goodwin
Project Assistant
iDigBio
JGOODWIN@FLMNH.UFL.EDU

Jillian is iDigBio Project Assistant based at the Florida Museum of Natural History in Gainesville. A biologist and educator by training, Jillian assists with daily operations.

Christopher Grinter
Collection Manager
TCN - InvertNet
CGRINTER@ILLINOIS.EDU

Chris is the Collection Manager of Insects at the Illinois Natural History Survey. He is responsible for the daily management of an ever increasing 7 million specimen collection.
Robert Gropp  
Director of Public Policy  
American Institute of Biological Sciences (AIBS); Biodiversity Collections Network (BCoN)  
RGROPP@AIBS.ORG

Rob writes regularly about science policy and edits the AIBS journal’s Washington Watch column, the AIBS Public Policy Report, and the NSC Alliance Washington Report. Rob also leads the advisory council for the Biodiversity Collections Network.

Gerald “Stinger” Guala  
Director  
Biodiversity Information Serving Our Nation (BISON); Integrated Taxonomic Information System (ITIS)  
GGUALA@USGS.GOV

Stinger is Branch Chief for Eco-Science Synthesis at USGS. He directs the activities of Biodiversity Information Serving Our Nation (BISON) and the Integrated Taxonomic Information System (ITIS). He also co-chairs BioEco, a multi-agency working group on environmental data sharing and use.

Robert Guralnick  
Collaborating Award Principal Investigator  
TCN - Southeast Regional Network of Expertise and Collections [SERNEC]  
RGURALNICK@FLMNH.UFL.EDU

Rob is an Associate Curator of Biodiversity Informatics at the Florida Museum of Natural History. His research focuses on what causes spatiotemporal changes in genetic and species diversity. He is also a member of the Notes from Nature transcription project.

John Hall  
Collaborator  
TCN - Macroalgal Herbarium Consortium (MHC)  
JDHALL@UMD.EDU

John is a Curator at the Norton-Brown Herbarium at the University of Maryland. His research interests include molecular systematics of green algae with a particular focus on conjugating green algae, biodiversity and distribution of freshwater algae, green algal genomics and preservation of biological collections.

James Hanken  
Principal Investigator  
TCN - Symbiota Collections of Arthropods Network (SCAN); TCN - InvertEBase  
HANKEN@OEB.HARVARD.EDU

Jim is Professor of Biology at Harvard University, where he is Director and Curator of Herpetology in the Museum of Comparative Zoology. He is PI/co-PI of FilteredPush and Kurator projects, which are developing software tools for annotation and quality control of collections databases.

Rosanne Healy  
Postdoctoral Researcher  
TCN - Microfungi Collections Consortium (MiCC)  
ROSANNE.HEALY@GMAIL.COM

Rosanne is based at the University of Florida. She is a mycologist by training, and her research centers on fungal diversity, systematics and evolution. She is involved with FLAS as part of the Microfungi Collections Consortium Digitization TCN.
Kathie Hodge  
Principal Investigator  
TCN - Microfungi Collections Consortium (MiCC)  
KH11@CORNELL.EDU  

Kathie is the Director of the Cornell Plant Pathology Herbarium in Ithaca, NY. She teaches and does research about fungal systematics, especially of microfungi. Her teaching ranges from grad and undergrad mycology courses to public outreach about fungi.

Patricia Holroyd  
Co-Principal Investigator  
TCN - Fossil Marine Invertebrate Communities of the Eastern Pacific (EPICC)  
PHOLROYD@BERKELEY.EDU  

Pat is located at the Museum of Paleontology at University of California Berkeley. Her research focuses on understanding the pattern and process of change in the continental biota during warm intervals in the past using mammals and turtles.

Steffi Ickert-Bond  
Principal Investigator  
TCN - North American Lichens and Bryophytes (LBCC)  
SMICKERTBOND@ALASKA.EDU  

Steffi is the Curator at the Herbarium (ALA), University of Alaska Fairbanks. Her research interests include phylogeny, biogeography and gene evolution among ferns, gymnosperms and flowering plants to infer historical evolutionary processes that have resulted in current patterns of biodiversity.

Shelley James  
Data Management Coordinator  
iDigBio  
SJAMES@FLMNH.UFL.EDU  

Shelley is based at the Florida Museum of Natural History in Gainesville. She serves as a liaison between collections staff, researchers, educators and cyberinfrastructure staff to enhance the use of natural history collections data in answering big science questions.

David Jennings  
Project Manager  
iDigBio  
DJENNINGS@FLMNH.UFL.EDU  

David is based at the Florida Museum of Natural History in Gainesville. A mechanical/industrial engineer by training, David oversees daily operations of iDigBio including progress tracking, budget vs. expenditures, coordination of diverse teams and preparation of documentation and reports.

Kathy Hollis  
Collaborator  
TCN - Fossil Marine Invertebrate Communities of the Eastern Pacific (EPICC); TCN - Fossil Insect Collaborative (FIC)  
HOLLISK@SI.EDU  

Kathy is the Collections Manger of the Paleobiology Collections at the Smithsonian National Museum of Natural History. She and her team are collaborators on two TCN projects.
**Christine Johnson**  
Co-Principal Investigator  
*TCN - Tri-trophic: Plants, Herbivores, and Parasitoids (TTD)*  
CJOHNSON@AMNH.ORG  

Chris is based at the AMNH in New York City. She is a Curatorial Associate in Invertebrate Zoology and manages the entomological, terrestrial arthropod and marine invertebrate collections. Her research focuses on ant parasite-host ecology and the use of museum collections.

**Talia Karim**  
Co-Principal Investigator  
*TCN - Fossil Insect Collaborative (FIC)*  
TALIA.KARIM@COLORADO.EDU  

Talia is the Invertebrate Paleontology Collection Manager at the University of Colorado Museum of Natural History in Boulder. She is trilobite systematist by training and is an active member of the iDigBio Paleo Digitization and DROID working groups.

**Mary Klein**  
Member  
iDigBio External Advisory Board  
MARY.KLEIN@NATURESERVE.ORG  

Mary is President and CEO of NatureServe, a nonprofit organization that provides scientific information to guide effective conservation. NatureServe aids in the identification, mapping and analysis of species and ecosystems to help protect the Earth’s most unique and imperiled places.

**Patricia Kaishian**  
Digitization Technician  
*TCN - Microfungi Collections Consortium (MiCC)*  
PKAISHIAN@GMAIL.COM  

Patty is a first year doctoral student at SUNY Environmental Science & Forestry, studying mycology under Dr. Alex Weir. Her research interests include neotropical fungi and fungal-insect interactions. She is in charge of digitizing the ESF collection of microfungi.

**Paul Kimberly**  
Member  
iDigBio External Advisory Board  
KIMBERLYP@SI.EDU  

Paul is an IT Specialist and Digitization Manager at the Smithsonian National Museum of Natural History in Washington, DC.

**Jennifer Kluse**  
Co-Principal Investigator; Project Manager  
*TCN - North American Lichen And Bryophytes (LLBC); TCN - Macroalgal Herbarium Consortium (MHC); TCN - Microfungi Collections Consortium (MiCC)*  
JKLUSE@LSU.EDU  

Jennie is based at the Louisiana State University, Baton Rouge. She is the Collections Manager of the Vascular Plant, Lichen, Bryophyte and Fungi Herbaria (LSU and LSUM). Her research interests are in plant ecology.
Leonard Krishtalka
Chair
Global Biodiversity Information Facility (GBIF): Accelerating the Discovery of Biocollections Data Task Force
Krishtalka@KU.EDU

Kris is Director of the Biodiversity Institute, University of Kansas. A vertebrate paleontologist, his work involves advancing global biodiversity science and deploying the world’s biocollections and their associated data for 21st century research, education, science and public policy.

John La Salle
Director
Atlas of Living Australia (ALA); Commonwealth Scientific and Industrial Research Organisation (CSIRO)
JOHN.LASALLE@CSIRO.AU

John’s vision is to use emerging technologies to bridge the digital divide and accelerate the processes of taxonomy, species discovery and description, and unlocking and delivering the rich store of information from natural history collections.

Taehwan Lee
Co-Principal Investigator
TCN - InvertEBase
TAEHWANL@UMICH.EDU

Taehwan is Mollusk Collection Manager and Assistant Research Scientist at the University of Michigan Museum of Zoology. His research interests include molluscan evolution, systematics and phylogeography.

Ronny Leder
Postdoctoral Researcher
iDigBio; Fostering Opportunities for Synergistic STEM with Informal Learners (FOSSIL)
LEDER.RONNYMAIK@GOOGLEMAIL.COM

Ronny is based at the Florida Museum of Natural History in Gainesville. A paleobiologist, Ronny bridges iDigBio and the FOSSIL Project, an NSF funded project building connections among the amateur and professional paleo communities. His research focuses on fossil fish faunas and sharks.

Deborah Lewis
Co-Principal Investigator
TCN - Microfungi Collections Consortium (MiCC)
DLEWIS@IASTATE.EDU

Deb is the Curator of the Ada Hayden Herbarium [ISC] at Iowa State University. Her research interests include the study of Iowa floristics and systematics of New World Linderniaceae. Deb also enjoys interacting with the public to promote botanical/natural history understanding and appreciation.
Elizabeth Lippoldt  
Project Manager  
*TCN - Microfungi Collections Consortium (MiCC)*  
LIPPOLD2@ILLINOIS.EDU

Elizabeth is based at the Illinois Natural History Survey at the University of Illinois in Urbana-Champaign. A librarian by training, Elizabeth is responsible for guiding, training and communicating with project personnel to ensure timely meeting of the MiCC project’s goals.

Tatyana Livshultz  
Co-Principal Investigator  
*TCN - Macroalgal Herbarium Consortium (MHC)*;  
*TCN - Microfungi Collections Consortium (MiCC)*  
TLS34@DREXEL.EDU

Tanya is Assistant Professor in the Department of Biodiversity, Earth & Environmental Science and Assistant Curator of Botany, Academy of Natural Sciences at Drexel University in Philadelphia. Her research interests include understanding how natural selection acts on floral function to produce diversity among floral forms.

Thorsten Lumbsch  
Co-Principal Investigator  
*TCN - Microfungi Collections Consortium (MiCC)*  
TLUMBSCH@FIELDMUSEUM.ORG

Thorsten is the Curator and Director at the Integrative Research Center at the Field Museum in Chicago. Thorsten’s research program focuses on the largest crown group of fungi, the sac fungi (Ascomycota), especially species that form associations with algae and cyanobacteria, so-called lichens.

Holly Little  
Collaborator  
*TCN - Fossil Insect Collaborative (FIC)*;  
*TCN - Fossil Marine Invertebrate Communities of the Eastern Pacific (EPICC)*  
LITTLEH@SI.EDU

Holly is the Paleo Informatics Specialist for the Paleobiology Department at the Smithsonian National Museum of Natural History. She oversees data management and digitization efforts for the collections.

Kevin Love  
Information Technology Expert  
iDigBio  
KLOVE@FLMNH.UFL.EDU

As an IT Expert with iDigBio based at the University of Florida in Gainesville, Kevin assists with IT infrastructure, software architecture, data management and general user service requests.

Bruce MacFadden  
Co-Principal Investigator; Director of Education & Outreach  
iDigBio  
BMACFADD@FLMNH.UFL.EDU

Bruce is a vertebrate paleontologist and curator at the FLMNH. He represents and promotes iDigBio E&O as well as matters related to paleontological collections. He is particularly interested in lifelong learning (e.g., fossil clubs), K-12 education and broader impacts on society.
Anne Maglia  
Deputy Division Director (Acting)  
National Science Foundation (NSF)  
AMAGLIA@NSF.GOV

Anne is the cognizant program director for the iDigBio award, and helps manage the ADBC program. She provides sponsor-level oversight and (when required) approval of iDigBio’s activities.

Charles Marshall  
Lead Principal Investigator  
TCN - Fossil Marine Invertebrate Communities of the Eastern Pacific (EPICC)  
CRMARSHALL@BERKELEY.EDU

Charles is Director of the University of California Museum of Paleontology and Professor in Integrative Biology at the University of California, Berkeley. Charles has broad interest in the patterns and processes of deep time evolutionary and ecological change.

Siro Masinde  
Programme Officer for Content Mobilization  
Global Biodiversity Information Facility (GBIF)  
SMASINDE@GBIF.ORG

Currently Senior Research Scientist and formerly Head of the Botany Department at the National Museums of Kenya, Siro has extensive experience in digitization and databasing, including as African regional coordinator for JSTOR/ITHAKA, for which he helped develop the Global Plants Initiative.

Blaine Marchant  
Research Assistant  
iDigBio  
DBMARCHANT@UFL.EDU

Blaine is a PhD student at the University of Florida and Florida Museum of Natural History in the Molecular Systematics and Evolutionary Genetics Lab under Drs. Doug and Pam Soltis. His research interests revolve around plant evolution and polyploidy.

Derek Masaki  
Technical Coordinator  
Biodiversity Information Serving Our Nation (BISON)  
DMASAKI@USGS.GOV

Derek works with the USGS Core Science Systems. His interests include developing new and interesting apps and GIS tools which utilize collections data.

Austin Mast  
Public Participation Lead  
iDigBio  
AMAST@BIO.FSU.EDU

Austin is a botanist based at Florida State University in Tallahassee. He is a Steering Committee member for iDigBio, Notes from Nature, and WeDigBio. He is also Chair of the Public Participation Working Group.
Joanna McCaffrey  
Biodiversity Informatics Manager  
iDigBio  
JMCCAFFREY@FLMNH.UFL.EDU

As a representative of iDigBio, Joanna works with data providers to mobilize their biodiversity data. She supports TCNs as their first point of contact about iDigBio resources, Wiki and collaborator map, and she co-leads the bi-monthly IAC meeting. Joanna is based in Chicago.

Richard McCourt  
Co-Principal Investigator  
TCN - Macroalgal Herbarium Consortium (MHC); TCN - Microfungi Collections Consortium (MiCC)  
RMM45@DREXEL.EDU

Rick is Curator and Professor, Earth & Environmental Science at the Academy of Natural Sciences of Drexel University. They will be digitizing approximately 30,000 specimens of algae. He works on the molecular systematics of green algae and teaches courses in phylogenetic biology and botany.

Andrew Miller  
Principal Investigator  
TCN - Microfungi Collections Consortium (MiCC)  
AMILLER7@ILLINOIS.EDU

Andy is based at the University of Illinois Urbana-Champaign where he serves as the Mycologist and Director of the Fungarium/Herbarium. His research focuses on the systematics, biodiversity and evolution of fungi in temperate and tropical areas.

Ellen McCallie  
Program Director  
National Science Foundation (NSF)  
EMCCALLI@NSF.GOV

Ellen is a program director in the Division of Research on Learning at the National Science Foundation. Ellen's interests include learning in informal environments, public participation in scientific research, citizen science, public engagement with science and argumentation.

Matthew Medler  
Project Manager  
TCN - Vouched Animal Communication Signals (VACS)  
MDM2@CORNELL.EDU

Matt is the Collections Management leader at the Macaulay Library. He works with external contributors and ML media specialists to archive audio and video recordings and distribute these recordings to researchers, educators, conservationists, and others.

Brendan Morris  
Graduate Student  
TCN - InvertNet  
BRENOLMORRIS@GMAIL.COM

Brendan is a graduate student at the University of Illinois working to digitize the Illinois Natural History Survey insect collection under Christopher Dietrich. His research focuses on taxonomy and systematics of Caribbean treehoppers.
Zack Murrell  
Project Director  
TCN - Southeast Regional Network of Expertise and Collections (SERNEC)  
MURRELLZE@APPSTATE.EDU

A botanist, Zack is Professor in the Department of Biology at Appalachian State University in Boone, North Carolina. His research focuses on species boundaries, phylogeography and systematics, floristics and biodiversity informatics.

Andre Naranjo  
Graduate Student  
iDigBio  
AANARANJO@UFL.EDU

Andre is a biology graduate student at the University of Florida. His research interests include comparative phylogeography, conservation and population genetics.

Christopher Neefus  
Principal Investigator  
TCN - Macroalgal Herbarium Consortium (MHC)  
CHRIS.NEEFUS@UNH.EDU

Chris is Professor of Plant Biology at the University of New Hampshire and Director of the Hodgdon Herbarium. He teaches courses in Biostatistics, Integrated Multitrophic Aquaculture, and Aquatic Botany. Chris is especially interested in developing tools to facilitate the use of MHC’s data to answer biogeographic research questions.

Masanori Nakae  
Member  
Global Biodiversity Information Facility (GBIF): Accelerating the Discovery of Biocollections Data Task Force  
NAKAE@KAHAKU.GO.JP

Masanori is based at the National Museum of Nature and Science, Tsukuba City, Ibaraki, Japan. His curatorial activities include studying fish morphology and digitizing metadata of the fish collection at the museum.

Thomas H. Nash III  
Co-Principal Investigator  
TCN - North American Lichens and Bryophytes (LBCC); Symbiota  
TOM.NASH@ASU.EDU

An ecologist and lichenologist, Tom is a Senior Scientist at the Wisconsin State Herbarium and Emeritus Professor at Arizona State University.

Gil Nelson  
Digitization Specialist; Senior Personnel  
iDigBio  
GNELSON@BIO.FSU.EDU

Gil is the iDigBio Digitization Specialist, focusing on digitization research and implementation. He is a faculty member at Florida State University and a Beadel Fellow in Botany at Tall Timbers Research Station and Land Conservancy.
Ian Owens
Member
Global Biodiversity Information Facility (GBIF):
Accelerating the Discovery of Biocollections Data Task Force
iOWENS@NHM.AC.UK
Ian is Director of Science at the Natural History Museum London and responsible for collections, research and science facilities. His personal research is based on a combination of experimental, phylogenetic and molecular approaches to study the evolutionary ecology of vertebrates, particularly birds.

Larry Page
Project Director; Lead Principal Investigator
iDigBio
LPAGE@FLMNH.UFL.EDU
Larry is Curator of Fishes at the Florida Museum of Natural History and Adjunct Professor of Biology at the University of Florida in Gainesville. His primary research interests are the systematics, ecology and conservation of freshwater organisms.

Deb Paul
Digitization and Technology Specialist
iDigBio; Global Biodiversity Information Facility (GBIF):
Accelerating the Discovery of Biocollections Data Task Force
DPAUL@FSU.EDU
Deb is based at the Florida State University School of Information in Tallahassee, Florida. She is involved in all aspects of iDigBio, but focuses primarily on the professional development of the collections community and building national and international collaborations related to digitization.

Donald Pfister
Principal Investigator
TCN - Macroalgal Herbarium Consortium (MHC); TCN - Macrofungi Collections Consortium (MaCC); TCN - Microfungi Collections Consortium (MiCC); TCN - North American Lichens and Bryophytes (LBCC)
DPFISTER@OEB.HARVARD.EDU
Don is Professor in Organismic and Evolutionary Biology and Curator at the Farlow Library and Herbarium at Harvard University. He teaches about plants and fungi, and his research is on the Ascomycota.

Molly Phillips
Education and Outreach Coordinator
iDigBio
MPHILLIPS@FLMNH.UFL.EDU
A biologist by training, Molly is responsible for coordinating and implementing iDigBio education and outreach activities and communicating and facilitating coordination and networking among the TCNs. Molly also edits the iDigBio newsletter, the iDigBio Spotlight, and co-manages iDigBio's social media efforts.

Jorrit Poelen
Open Data Tool Developer
Freelance
JHPOELEN@XS4ALL.NL
Jorrit is based in Oakland, California. He builds open data software tools (e.g. GloBI, GoMexSI) for science and education. He’s worked with organizations such as Encyclopedia of Life, Texas A&M, UC Berkeley, Indiana University, iDigBio and Manylabs to help the liberation and use of ecological data.
Alan Prather  
Collaborator  
TCN - Microfungi Collections Consortium (MiCC)  
ALAN@PLANTBIOLOGY.MSU.EDU  

Alan is a professor at Michigan State University Director and Curator of the MSC Herbarium.

Greg Riccardi  
Co-Principal Investigator; Director of Digitization iDigBio  
GRICCARDI@FSU.EDU  

Greg is a professor in the School of Library and Information Studies at Florida State University. His research specialization is in scientific information management.

Mari Roberts  
Project Coordinator & Volunteer Coordinator  
TCN - Tri-trophic : Plants, Herbivores, and Parasitoids (TTD) ; TCN - North American Lichens and Bryophytes (LBCC)  
MROBERTS@NYBG.ORG  

Mari is based at the New York Botanical Garden in the Bronx. She is a member of the iDigBio Education and Outreach Working Group. Mari is responsible for training data-entry to personnel, providing assistance to partner institutions and recruiting volunteers for multiple TCNs.

Roland Roberts  
Program Director  
National Science Foundation (NSF)  
RLOROBER@NSF.GOV  

Roland is in NSF’s Division of Biological Infrastructure (DBI) and has program responsibilities for Advancing Digitization of Biodiversity Collections (ADBC) and Collections in Support of Biological Research (CSBR).

Richard Rabeler  
Principal Investigator  
TCN - Great Lakes Invasives (GLI) ; TCN - Tri-trophic : Plants, Herbivores, and Parasitoids (TTD)  
RABELER@UMICH.EDU  

Rich is Senior Collections Manager and Associate Research Scientist at University of Michigan Herbarium in Ann Arbor. His research interests focus on Caryophyllaceae floristics and phylogeny and efficient data capture from herbarium specimens.

Rusty Russell  
Collections Manager  
Smithsonian Institution  
RUSSELLR@SI.EDU  

Rusty is responsible for the development of programs to support collections, informatics and outreach in the Department of Botany at the Smithsonian. He also prepares strategic plans for collections based programming, informatics and outreach activities.
Katja Seltmann
Project Manager
*TCN - Tri-trophic: Plants, Herbivores, and Parasitoids (TTD)*
ENICOSPILUS@GMAIL.COM
Katja lives in Santa Barbara, California. Her interests are in entomology, collections management, and research involving data mining and modeling of specimen-based information. She enjoys developing novel approaches to biodiversity outreach including radio shows, museum and gallery exhibitions and science-themed musical releases.

Lawrence Schmidt
Collaborator
*TCN - Microfungi Collections Consortium (MiCC)*
LSCHMIDT@UWYO.EDU
Larry is Head of the Brinkerhoff Geology Library and is an Associate Librarian at the University of Wyoming in Laramie.

Elizabeth Shea
Principal Investigator
*TCN - InvertEBase*
ESHEA@DELMNH.ORG
Liz is the Curator of Mollusks at the Delaware Museum of Natural History in Wilmington, Delaware. She is a biologist with research interests in cephalopod ecology and evolution. Liz is the InvertEBase representative to the iDigBio Education and Outreach Working group.

Petra Sierwald
Principal Investigator
*TCN - InvertEBase*
PSIERWALD@FIELDMUSEUM.ORG
Petra is an Associate Curator at The Field Museum in Chicago. Her research interests include evolutionary biology; biodiversity, phylogeny, biogeography and systematics of Arthropoda; morphological evolution; and museum collections analyses.

David Shorthouse
Biodiversity Informatics Manager
*Canadensys*
DAVID.SHORTHOUSE@UMONTREAL.CA
David is based at the Biodiversity Centre at the Université de Montréal where he coordinates training for and development of the Canadensys cyberinfrastructure.

Michaela Schmull
Coordination and Oversight
*TCN - North American Lichens and Bryophytes (LBCC)*
MSCHMULL@OEB.HARVARD.ED
Michaela is based at the Harvard University Herbaria in Cambridge. A biologist by training, Michaela is interested in lichen taxonomy and ecology.
Participant Bios

Andrew Simons
Co-Principal Investigator
TCN - Great Lakes Invasives (GLI)
ASIMONS@UMN.EDU

Andrew is the Curator of Fishes at the Bell Museum of Natural History, University of Minnesota. His research interests include phylogeography of North American freshwater fishes and the evolution of trophic morphology and diet shifts in fishes.

Randy Singer
Graduate Student
iDigBio
RSINGER@FLMNH.UFL.EDU

Randy is a PhD student with iDigBio in Gainesville, Florida, focusing on museum communications with regards to interdisciplinary research, education and outreach. He specializes in ichthyology (deep sea fishes and Southeast Asian loaches) and is a former collection manager of fishes.

Dena Smith
Principal Investigator
TCN - Fossil Insect Collaborative (FIC); TCN - Fossil Marine Invertebrate Communities of the Eastern Pacific (EPICC)
DENA.SMITH@COLORADO.EDU

Dena is the Curator of Invertebrate Paleontology and Associate Professor of Geological Sciences at CU Boulder and Executive Director of STEPPE. She loves fossil insects and supports efforts to make specimens, data and tools available to everyone to enable multidisciplinary collaboration and big science.

Matthew Smith
Co-Principal Investigator
TCN - Microfungi Collections Consortium (MiCC)
TRUFFLESMITH@UFL.EDU

Matt is based at the University of Florida (Department of Plant Pathology) and is curator of the Fungal Collection for the Florida Museum of Natural History. Matt teaches fungal biology and conducts research on fungal systematics, ecology and evolution.

Annie Simpson
Data Coordinator
United States Geological Survey (USGS)
ASIMPSON@USGS.GOV

Annie is an entomologist and Information Scientist based in Reston, Virginia, within the USGS Core Science Systems Mission Area. She recruits invasive species and other biodiversity datasets for inclusion in the Biodiversity Information Serving Our Nation (BISON) mapping project.

Judy Skog
Program Director
National Science Foundation (NSF)
JSKOG@NSF.GOV

Judy is in NSF’s Division of Earth Sciences (EAR) and has program responsibilities for Sedimentary Geology and Paleobiology (SGP).
Vincent Smith  
Member  
*iDigBio External Advisory Board*  
VINCE@VSMITH.INFO

Vince is based at the Natural History Museum, London, and leads various biodiversity informatics initiatives. Recent examples include the NHM Data Portal (http://data.nhm.ac.uk) and the EU-funded SYNTHESYS3 project.

Steve Stephenson  
Co-Principal Investigator  
*TCN - Microfungi Collections Consortium (MiCC)*  
SLSTEPH@UARK.EDU

Steve is based at the University of Arkansas in Fayetteville. His research interests are directed towards the distribution and ecology of myxomycetes (plasmodial slime molds) in terrestrial ecosystems.

Greg Stull  
Graduate Student  
*iDigBio*  
GWSTULL@GMAIL.COM

Greg is a graduate student with iDigBio working in the Molecular Systematics and Evolutionary Genetics Lab under Drs. Doug and Pam Soltis at the Florida Museum of Natural History.

Pamela Soltis  
Co-Principal Investigator;  
Director of Research Activities  
*iDigBio*  
PSOLTIS@FLMNH.UFL.EDU

Pam is Curator of Molecular Systematics at the Florida Museum of Natural History. She leads the development of research applications for specimen data and media. Her research interests are in plant phylogenetics, genome evolution and linking diverse data for integrated analyses of biodiversity.

Dan Stoner  
Data Integration Expert  
*iDigBio*  
DSTONER@ACIS.UFL.EDU

Dan is part of the Advanced Computing and Information Systems (ACIS) Laboratory at the University of Florida. He is a member of the iDigBio Cyberinfrastructure Implementation Team with a focus on data ingestion.

John Sullivan  
Digitization Technician & Archivist  
*TCN - Microfungi Collections Consortium (MiCC); TCN - Vouchered Animal Communication Signals (VACS)*  
JS151@CORNELL.EDU

John is based at Cornell University where he works as a digitization technician both in the Museum of Vertebrates and Plant Pathology Herbarium. He is interested in developing best practices for collection digitization. His research interests include the systematics of weakly electric fishes.
Participant Bios

Alex Thompson
Infrastructure Engineer and Programmer
iDigBio
GODFODER@ACIS.UFL.EDU

Alex is based in the Advanced Computing and Information Systems (ACIS) Laboratory at the University of Florida in Gainesville. He is the primary technical contact for the development and maintenance of all infrastructure services provided by ACIS to iDigBio.

Patrick Sweeney
Principal Investigator
TCN - New England Vascular Plants (NEVP)
PATRICK.SWEENEY@YALE.EDU

Patrick is based at the Yale Peabody Museum of Natural History where he manages the herbarium. A botanist by training, Patrick's interests are far ranging and include flowering plant systematics and evolution, North American floristics and biodiversity informatics.

Barbara Thiers
Principal Investigator
TCN - Macrofungi Collections Consortium (MaCC); PEN - New England Vascular Plants (NEVP); iDigBio External Advisory Board
BTHIERS@NYBG.ORG

Barbara is a botanist based at the New York Botanical Garden in the Bronx. She is the Director of the NYBG Herbarium and Head of the Science Division at the Garden. Her interests include collection management and digitization, the history of herbaria and tropical bryophytes.

Jana U'Ren
Postdoctoral Researcher
TCN - Microfungi Collections Consortium (MiCC)
JUREN@EMAIL.ARIZONA.EDU

Jana is based in the School of Plant Sciences at the University of Arizona in Tuscon. She is interested in microbial biodiversity, ecology and evolution.

Michael Vincent
Co-Principal Investigator
TCN - Microfungi Collections Consortium (MiCC)
VINCENMA@MIAMIOH.EDU

Mike currently serves as an Instructor of Biology and the Curator of Miami's Willard Sherman Turrell Herbarium, which is the largest herbarium in Ohio.

Brian Wee
Director of Strategic Alliances
NEON
BWEE@NEONINC.ORG

Brian is based in Washington, D.C. He is NEON, Inc.'s liaison to the US Congress, US federal agencies, and scientific organizations. He also represents the informatics needs of the large-scale environmental sciences before the computer science and federal data communities.
George Weiblen
Co-Principal Investigator
TCN - Macrofungi Collections Consortium (MaCC); TCN - Microfungi Collections Consortium (MiCC); PEN - North American Lichens and Bryophytes (LBCC)
GWEIBLEN@UMN.EDU

George is the Interim Scientific Director of the Bell Museum of Natural History at the University of Minnesota. He is a herbarium curator and professor with interests in collection-based research, plant and insect phylogenetics, tropical ecology and public engagement in science.

Alexander Weir
Collaborator
TCN - Microfungi Collections Consortium (MiCC)
AWEIR@ESF.EDU

Alex is an Associate Professor in Environmental and Forest Biology at SUNY [State University of New York] in Syracuse, New York.

James White
Principal Investigator
TCN - Microfungi Collections Consortium (MiCC)
JWHITE3728@GMAIL.COM

Jim is on the faculty at Rutgers University in New Brunswick, New Jersey. He is a Professor of Plant Biology and Director of the Mycological Collections. Jim teaches courses in mycology and conducts research on effects on non-pathogenic microbes on plants.

Zheping XU
Project Manager
China National Specimen Information Infrastructure (NSII)
XUZP@IBCAS.AC.CN

Zheping is based at the Institute of Botany, Chinese Academy of Sciences in Beijing, China. He manages the design and development of NSII [China National Specimen Information Infrastructure]. His interests include GIS, geology, biodiversity informatics and cultural diversity.

Tracy Barbaro
Learning + Education Project Coordinator
Encyclopedia of Life
TBARBARO@EOL.ORG

Tracy is based at the Harvard Museum of Comparative Zoology in Cambridge, MA. She coordinates educational projects for the Encyclopedia of Life and is a member of the iDigBio Education and Outreach Working Group.

Katelin Stanley
Graduate Student
iDigBio
JDS15E@MY.FSU.EDU

Katie is based at Florida State University in Tallahassee, FL. She works in the lab of Dr. Austin Mast to coordinate outreach events such as WeDigBio, build educational materials and investigate ways of improving the iDigBio database. Her research interests include using biological collections to test evolutionary hypotheses.
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