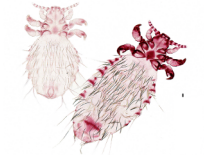
Jennifer M. Zaspel
Associate Curator and Head of Zoology Milwaukee Public Museum
Stephen Cameron
Head and Professor of Entomology Purdue University

- **Project Title:** Collaborative Research: Digitization TCN: Digitizing collections to trace parasite-host associations and predict the spread of vector-borne disease
- **Project Start Date:** September 1st 2019
- **Project Period:** 3 years
- **Participating Institutions:** 27 + 1 New PEN 2020 (Yale Peabody)
- **Co-PIs/Leads on Subs:** 34 (*12/18)
- **Participants:** 57+ (2019), 110+ (2020)

PARASITE TRACKER

DOCUMENTING ARTHROPOD VERTEBRATE PARASITES



Lice
(Phthiraptera)
~500 Species

Fleas
(Siphonaptera)
~325 Species

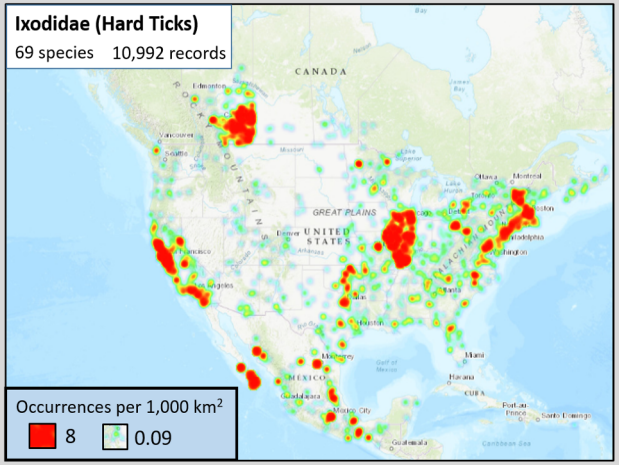
Ticks & Mites
(Acari)
~1330 Species

Biting True Bugs
(Hemiptera)
~30 Species

Biting Flies
(Diptera)
~1000 Species

Justification and Scope

- Parasitic arthropods inflict an enormous burden on the health of their hosts either directly, or through virulent pathogens that they vector
- Although parasites represent a substantial proportion of organismal diversity, their data are not readily accessible
- Arthropod parasite data are underrepresented among digitized specimen data



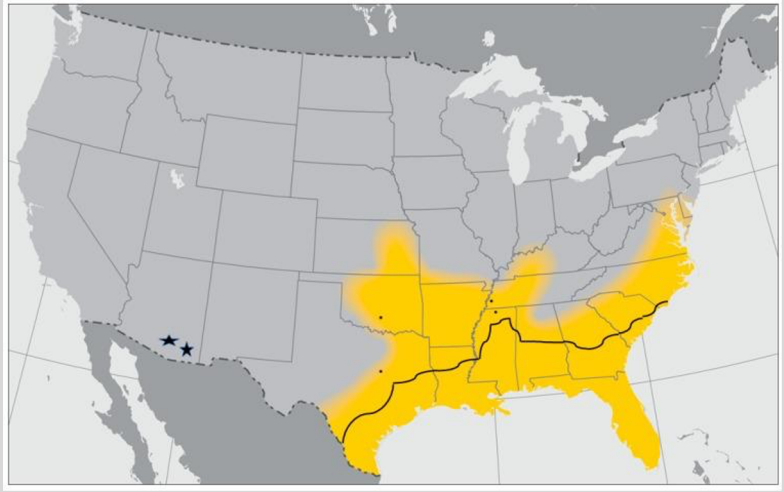
Occurrence records for Ixodidae available on *Symbiota Collections of Arthropods Network* (SCAN). Numbers are representative of all arthropod parasite groups in North America: low numbers, large gaps, and few collections that have contributed data to date. Heat maps are depicting areas with a maximum number of occurrences of 8 (red) and a minimum of 0.09 per 1,000 km^2.

PARASITE TRACKER

DOCUMENTING ARTHROPOD VERTEBRATE PARASITES

Intellectual Merit

- *Biological Associations*- index parasite-host associations
- *Disease Ecology*- create digital records for organisms that spread disease to better understand their ecological interactions
- *Changing Species Distributions*- use precise georeferenced specimen data to create distribution maps and identify areas of threatened parasite diversity
- *Systematics, Taxonomy, and Species Trait Analyses*- facilitate comprehensive systematic approaches and alpha-taxonomic studies

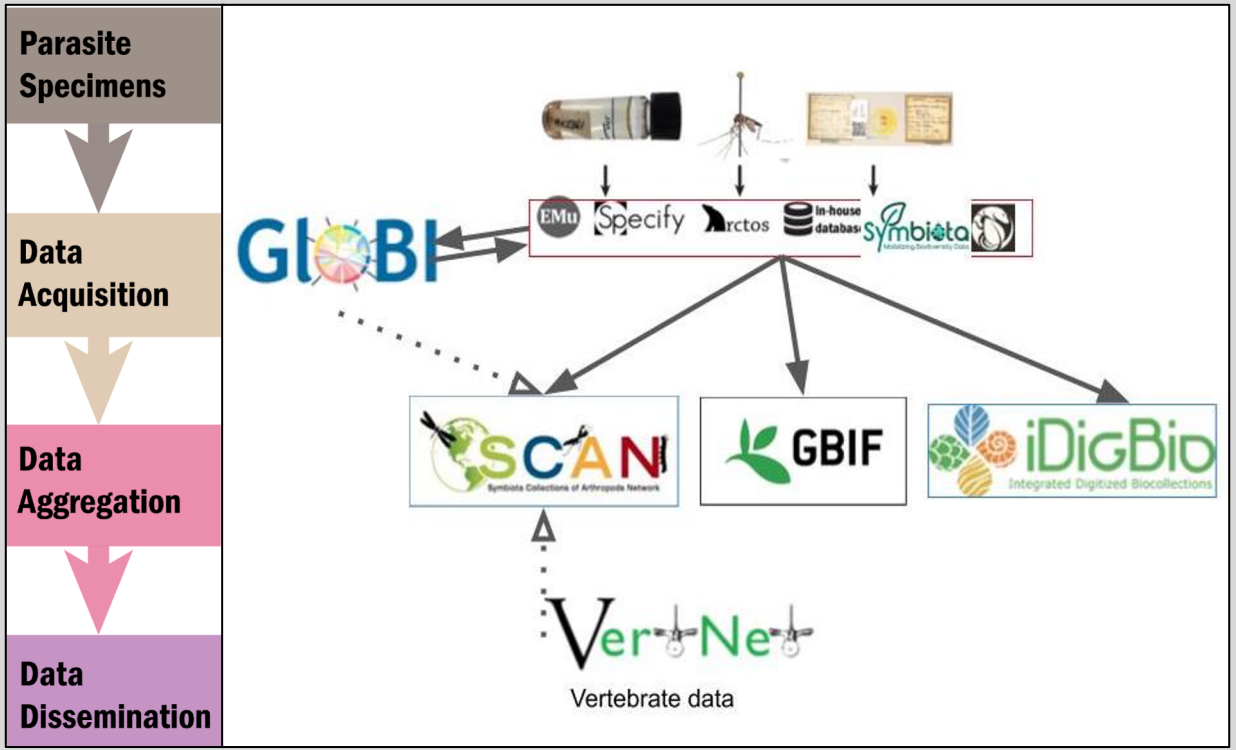


Map showing the current versus the historic geographic distribution of the Gulf Coast Tick, *Amblyomma maculatum*. Dark black line and the four isolated black dots indicate the historic distribution based on Bishop and Trembley. Asterisks in southeastern Arizona indicate new established populations as reported by Allerdice et al. Photo credit Dr. R. Ryan Lash, Traveler's Health Branch, DGMQ, Centers for Disease Control and Prevention, Atlanta, GA.

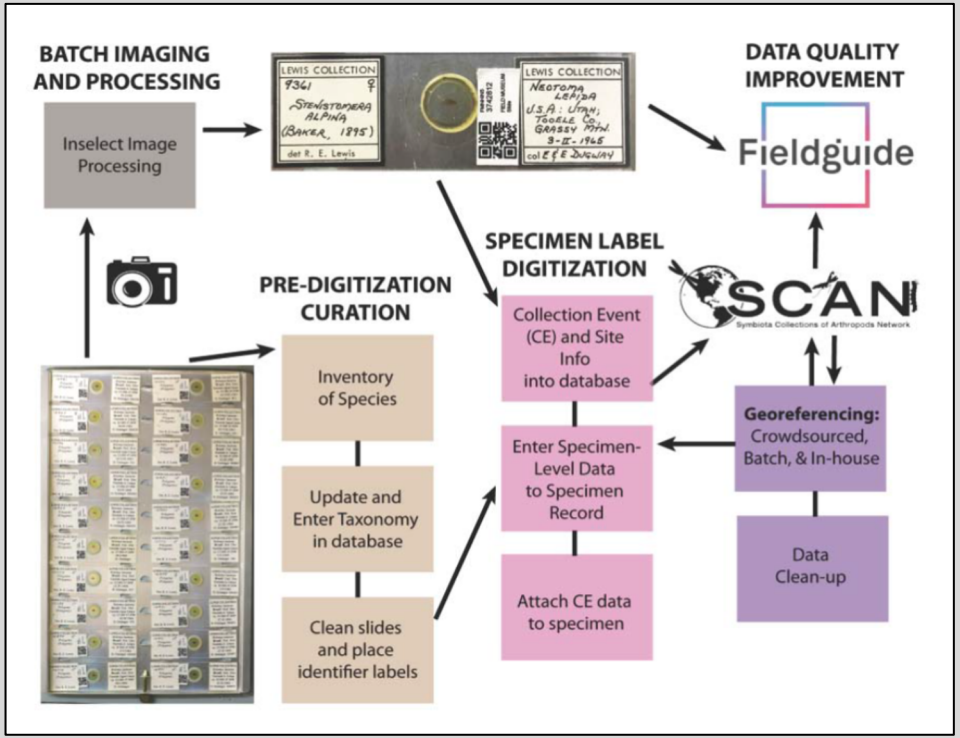
Fig. from Sonenshine, D.E. 2018. Range expansion of tick disease vectors in North America: implications for spread of tick-borne disease. International Journal of Environmental Research and Public Health 15: 478 doi: 10.3390/ijerph15030478.

Digitization Objectives

- Transcribe and georeference label data from **1.2+** million arthropod parasite specimens from 22 collections across North America (U.S. and territories) including ~55,000 specimens from biotic-association collections

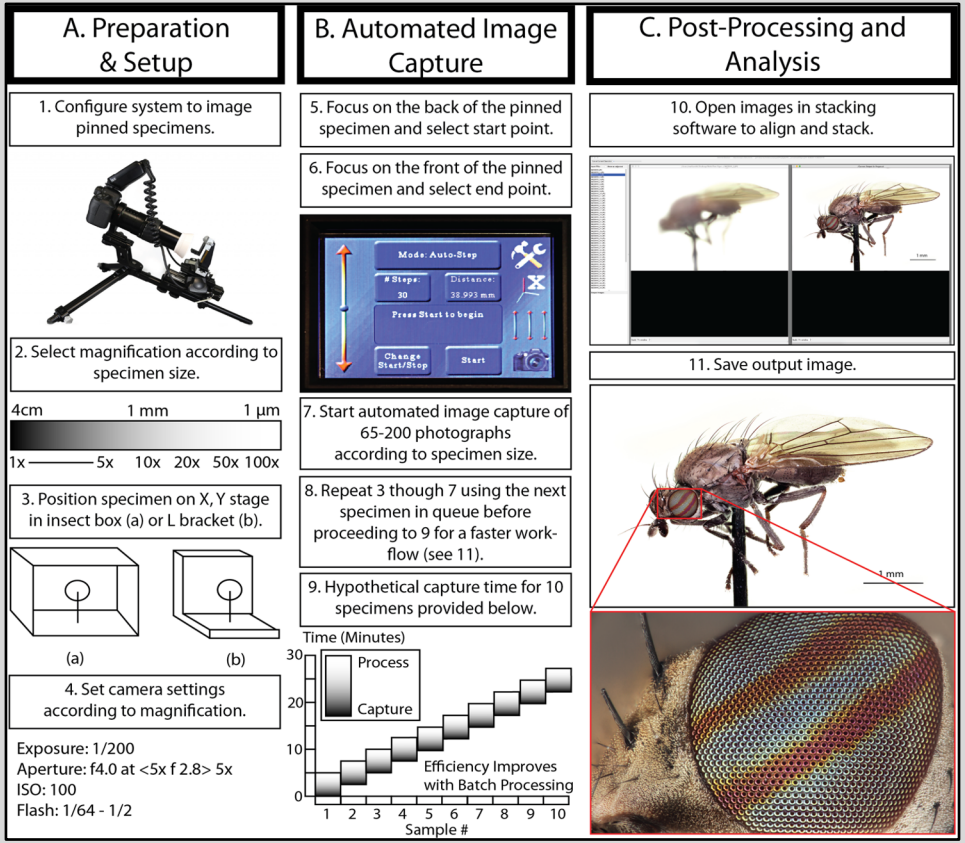


- Produce **140,000+** High Throughput (HTP) scans of fluid-stored and **450,000+** HTP scans of slide-mounted parasite specimens



Specimen Digitization

- Produce **20,000+** research-grade images of pinned specimen for exemplar parasite species and **200,000+** research-grade images of slide-mounted microparasite specimens

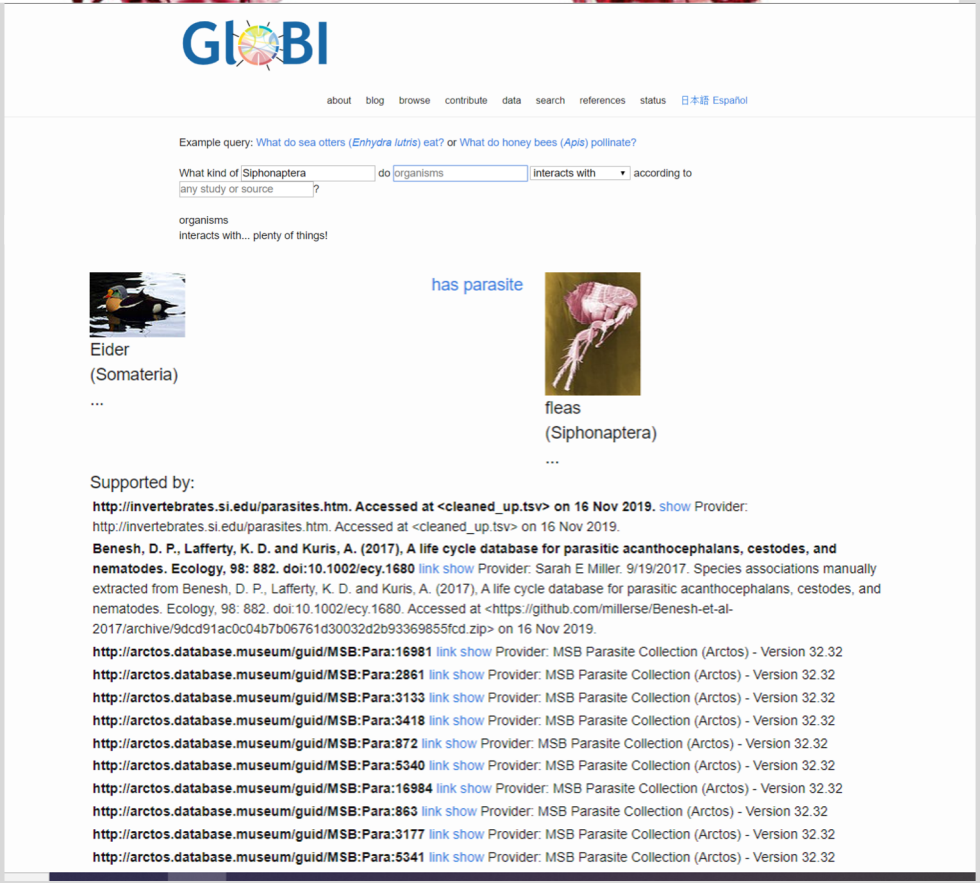


Data Integration

Global Biotic Interactions (GloBI) is a data integration tool that indexes existing species interaction datasets, literature, and specimen records in collections.

https://www.globalbioticinteractions.org/

Specimen data transcribed for the TPT project will generate 500,000 new parasite-host association records in GloBI.



2020 TPT Personnel Organizational Chart

Terrestrial Parasite Tracker

Research Advisory Board

Julie Allen
Jen Zaspel
Jessica Light
Rob Guralnick
Nate Lemoine
Anna Monfils
Sarah Bush
Jason Weckstein
Others TBD

Bioinformatics Teams

Project Leads

Jen Zaspel
Stephen Cameron

Project Manager

Kat Sullivan

Project communications, goals, and tracking

Data Providers

PU-Stephen Cameron/Jen Zaspel
TAMU-Jessica Light/Karen Wright
UH-Dan Rubinoff
UM-Barry OConnor/Erika Tucker
UMSP-Robin Thomson
UNL-Scott Gardner
UNH-Istvan Miko
UU-Sarah Bush
UNM-Mariel Campbell/Joe Cook
UWM-Dan Young/ Craig Brabant
UWSP-Sarah Orlofske

ANSP-Jason Weckstein
BPBM-Jim Boone
BYU-Mike Whiting
CAS-Chris Grinter
CU-Michael Caterino
FMNH-Petra Sierwald/Maureen Turcatel
INHS-Dmitry Dmitriev
MSU-Anthony Cognato
MPM-Julia Colby/Jen Zaspel
OSU-Hans Klompen
PSU-Andy Deans

Data Integration

GLOBI

Jorrit Poelen
Katja Seltmann
Jen Zaspel

Taxonomy

TaxonWorks-
Matt Yoder
Management, curation, and file formatting

Kat Sullivan
Jen Zaspel
Taxonomy file aggregation

VertNet

David Bloom
Vertebrate taxonomy

Digitization

Mark Smith
Pinned and slides
Alyssa Caywood
Pinned

MacroscopicSolutions

Image/Label Data Aggregation

Symbiota
SCAN

Katja Seltmann Neil Cobb

Broader Impacts

Anna Monfils Julie Allen
Jen Zaspel Emily Graslie
Rob Guralnick Katja Seltmann

Scanning

Kat Sullivan
Trays
Julia Colby
Slides and vials; barcodes
Jen Zaspel

Machine Learning Species Identification

Fg

Fieldguide-Andre Poremski

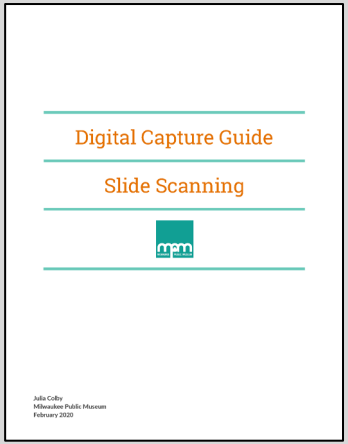
Inselect-Julia Colby,
Kat Sullivan
Jen Zaspel

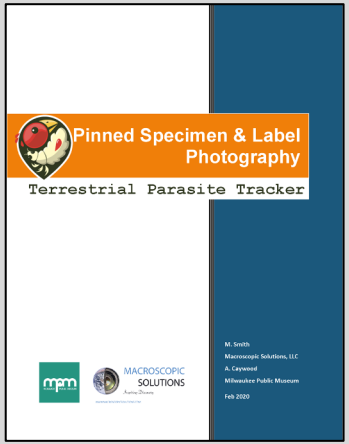
NOTES FROM NATURE

Julie Allen
Michael Denslow
Rob Guralnick

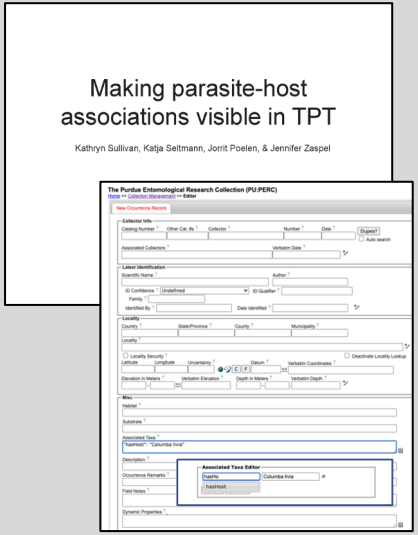
Highlights from Year 1

TPT Workshop I
Field Museum of Natural History, February 2020



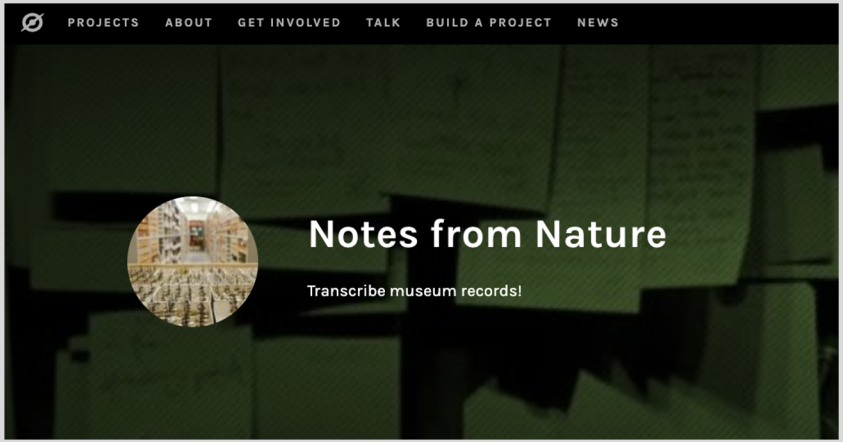


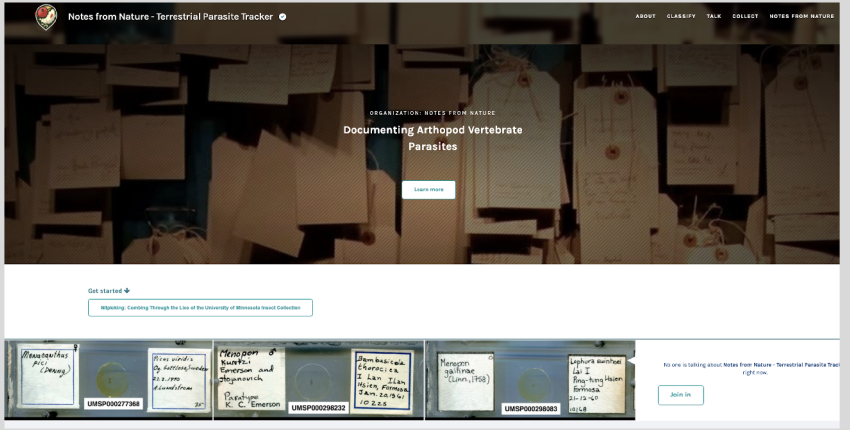
Workflow Development

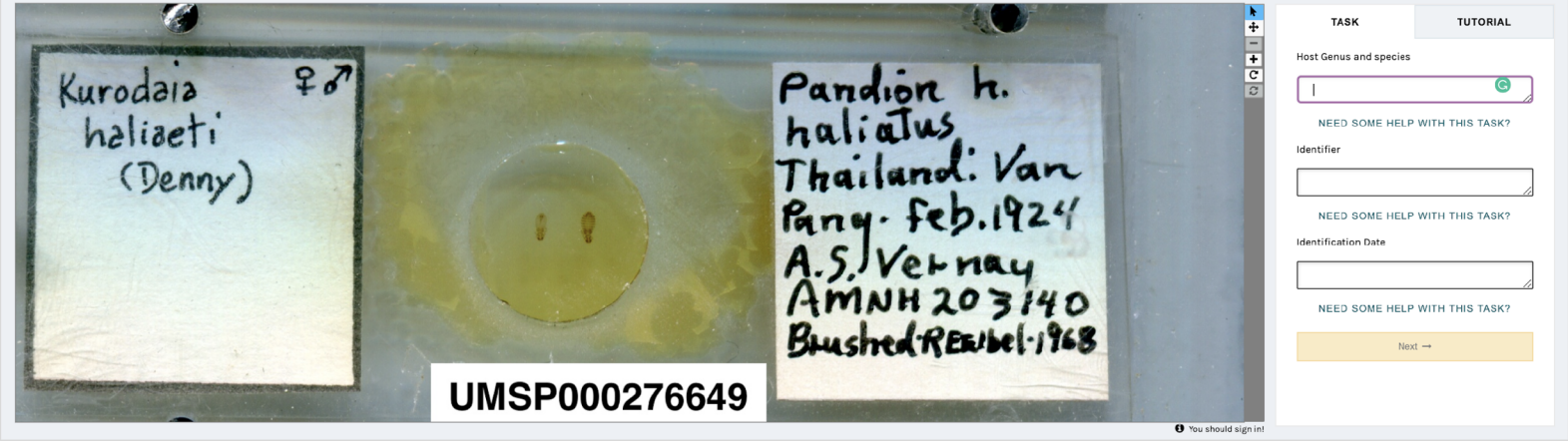


Associations Data

Highlights from Year 1







Lessons Learned and Staying Connected in 2020!

Terrestrial Parasite Tracker

April 17, 2020

Dear TPT Network,

Welcome Dr. Vijay Barve!

Vijay Barve will be one of the new postdoctoral researchers to join the TPT Network. In the coming weeks, Vijay will be providing members of our network with taxonomy for terrestrial vertebrate hosts. The next phase of his project will be focused on developing a comprehensive list of names for the taxa we are digitizing for TPT. Vijay has a master's degree in Computer science from India where he developed an interest in Biodiversity Informatics. His doctoral research at the University of Kansas focused on harvesting biodiversity information from social networking sites. Upon completion of his PhD, he joined the Florida Museum of Natural History as a post-doctoral researcher where he continues his work on Biodiversity Informatics. His main role is to integrate heterogeneous biodiversity data sources to create data products to be consumed by researchers and projects like ButterflyNet and Map of Life and also building data handling tools. His recent research has dealt with Citizen Science in Biodiversity and he has several research publications in that area. Vijay is the recipient of the GBIF Young Researcher award and has also received two GBIF Ebbe Nielsen awards. He has trained staff and students from several countries in Africa, Asia and the Americas in Biodiversity Informatics and mentored students through Google Summer of Code projects.

Crowdsourcing and Notes from Nature

The community transcription event WeDigBioUte is happening now April 16-19! We have two expeditions up from TPT: The Lousy Expedition III and See No See Ums: Hawaii from BPBM. This is a great opportunity to get a lot of data transcribed as there are many people online helping with these kinds of projects. If you have a set of images ready please email Julie Allen (jallen23@unr.edu).

In Progress:

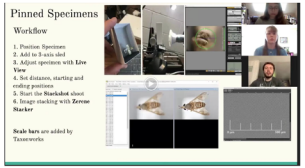
- Diptera families
- Vertebrate host list--mammals and reptiles

BioScience Publications and Podcast

A recent press release highlights publications and a podcast in BioScience about leveraging biodiversity science infrastructure in the COVID-19 era. Congrats to several of our TPT PIs and collaborators!
https://www.eurekalert.org/pub_releases/2020-06/aiob-lbs062320.php

Remote Digitization Highlights

Digital Data Presentation from University of New Hampshire on June 1, 2020
Developing the digitization practices of parasitic arthropod specimens from a university collection
Jenna O'Dell, University of New Hampshire; Isaac A. Bergfalk, University of New Hampshire; Holly A. Hoag, University of New Hampshire; István Mikó, University of New Hampshire



Watch the undergraduates in István Mikó's lab outline their TPT digitization workflows!
Presentation
Abstract

UWSP article

Sarah Orlofske was featured in this recent article for integrating digital specimens into her undergraduate lab course at the University of Wisconsin-Stevens Point.
https://wausaupilotandreview.com/2020/05/20/uwsp-students-use-virtual-museums-to-study-biology/

Please continue to send us updates you would like to share in the future. We will continue sending out monthly newsletters throughout the summer.

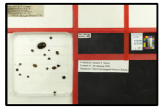
Hope you are all safe and healthy!

Remote Digitization Highlight

FridayNightLice!!! Data transcription of louse specimens is in full swing at the Frost Entomological Museum (PennState). So far they have transcribed data from >500 slides, scanned >15k slides, and imaged over >600 vials. Check out this awesome Walrus louse specimen, complete with label data, of course!

Walrus louse - *Antarctophthirus callorhini* (Osborn, 1899)
(Phthiraptera: Echinophthiriidae)
Collecting event:
Ex. *Callorhinus ursinus* (Carnivora: Otariidae)
St. Paul Island, Alaska
9. VII.1969

Staff at the Frost also discovered a batch of vials of ticks from Africa, collected off of various exotic animals. The image on the right is of ticks from a cheetah!?!



"This TPT funding has enabled us to retrieve samples from the darkest corners of our museum and to bring them into the realm of science. We had no idea what were in these vials..." Andy Deans, Professor and Director of the Frost Entomological Museum

Stay tuned for biweekly newsletters and *Please* send us updates you would like to share in the future.

Hope you are all safe and healthy!

Jen, Kat, and Julie

using his iPad as a second monitor. With a small dip, we were able to maintain work at about 75% capacity. However, with the shutdown lasting so long, the data entry was running out. River went to campus to take home a cabinet of slides to continue prepping and imaging slides. And just this week, one student who is interested in working full time through the summer was approved on the 'essential personnel' list. He is working on campus in a room by himself prepping and imaging more alcohol specimens. As needed, I will go in periodically to organize more ethanol specimens to be processed. Without these two employees, the remote work would soon run out. Summer plans include encouraging students to continue working remotely through the summer and repopulating the workplace as slowly as possible."

Above: River Martinez processing slides at home.

We plan to switch to a monthly newsletter model beginning in June. *Please* send us updates you would like to share in the future.

Hope you are all safe and healthy!

Jen, Kat, and Julie

NSF

Thank You!

MacroscopicSolutions
Portable, High Performance Imaging and Microscopy Systems

GEORGIA SOUTHERN UNIVERSITY

LepNet
Lepidoptera of North America Network

SCAN
Symbiota Collections of Arthropods Network

InvertNet

BIODIVERSITY COLLECTIONS NETWORK

PURDUE

WRBU
WALTER REED BIOSYSTEMATICS UNIT
Know the vector, know the threat

iDigBio
Integrated Digitized Biocollections

NSC ALLIANCE

VerNet

VectorBase
Bioinformatics Resource for
Invertebrate Vectors of Human Pathogens