

Jennifer M. Zaspel

Associate Curator and Head of Zoology Milwaukee Public Museum

Stephen Cameron

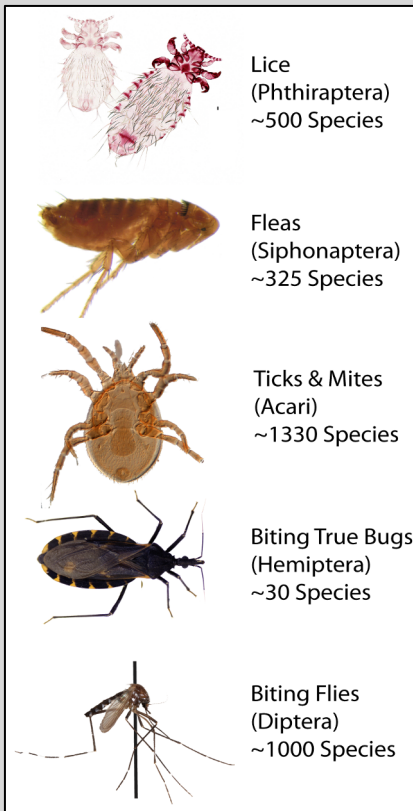
Head and Professor of Entomology Purdue University

- **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)



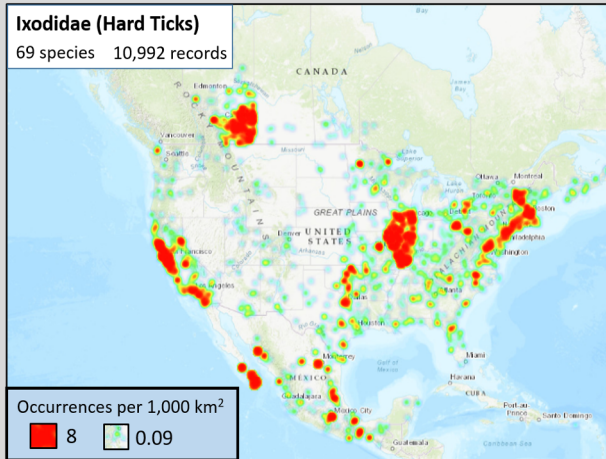
PARASITE TRACKER

DOCUMENTING ARTHROPOD VERTEBRATE PARASITES



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

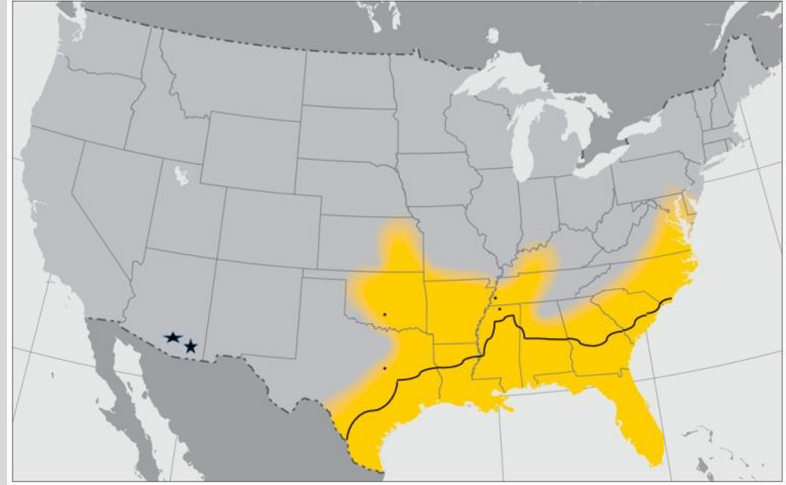


Occurrence records for Ixodidae available on *Symbiota Collections of Arthropods Network (SCAN)*. Numbers are representative of all arthropod parasite groups in North America: low numbers, large gaps, and few collections that have contributed data to date. Heat maps are depicting areas with a maximum number of occurrences of 8 (red) and a minimum of 0.09 per 1,000 km².



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.

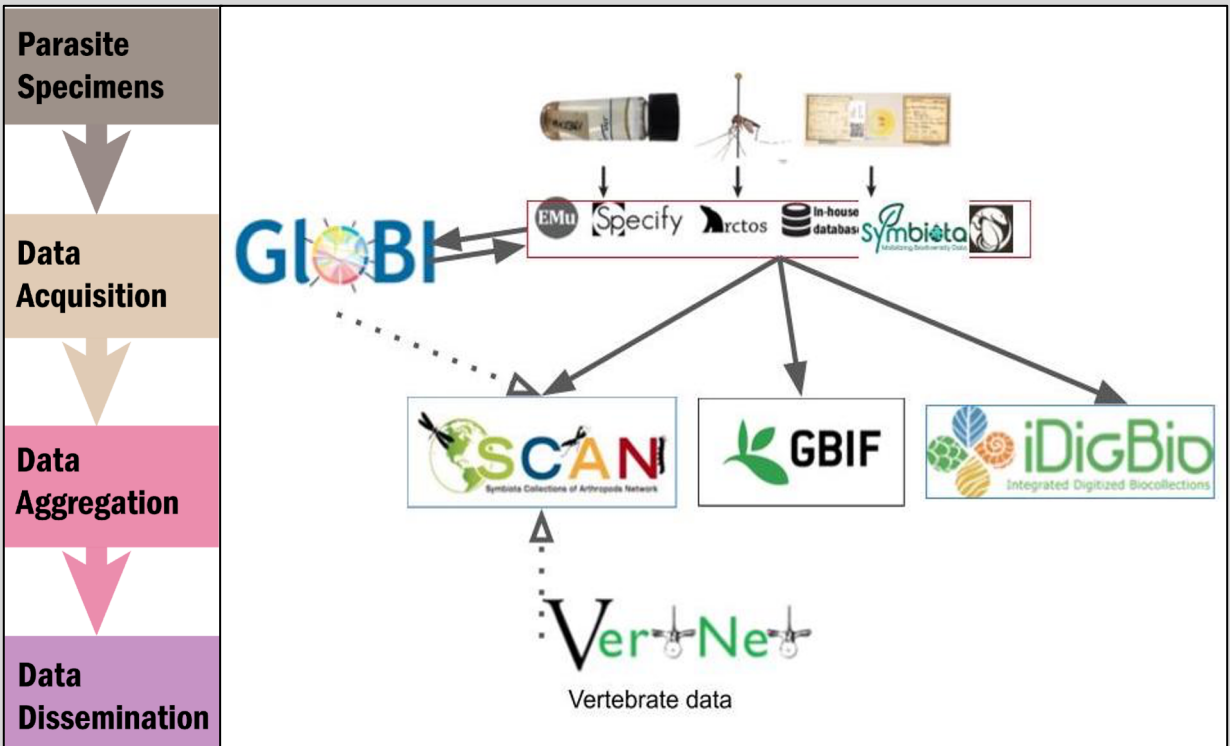
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DOCUMENTING ARTHROPOD VERTEBRATE PARASITES



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



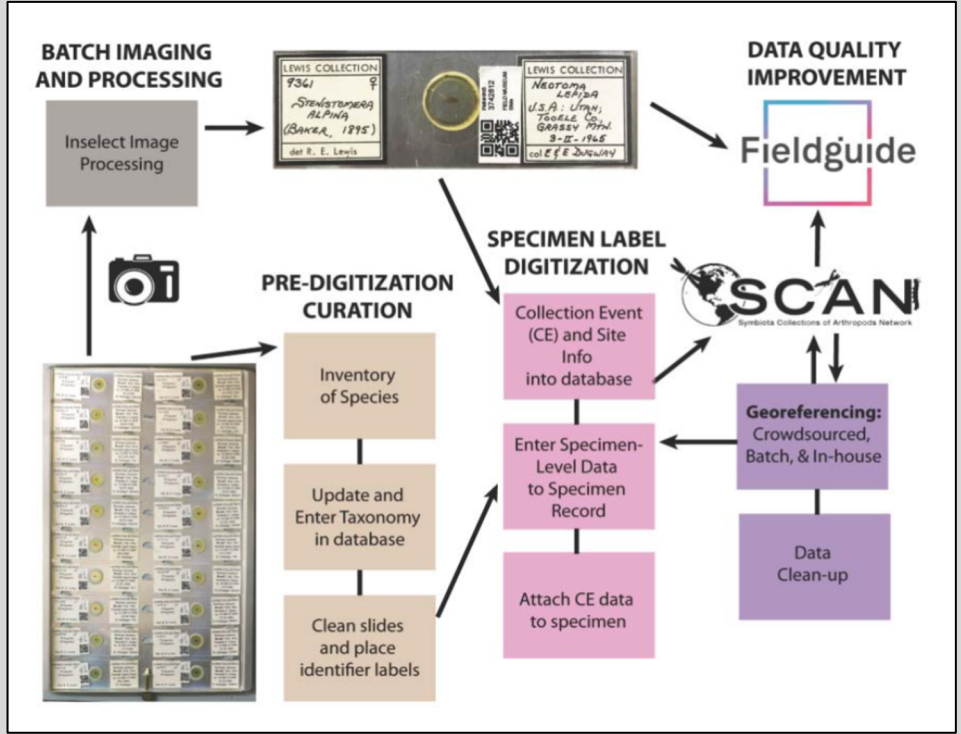


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DOCUMENTING ARTHROPOD VERTEBRATE PARASITES



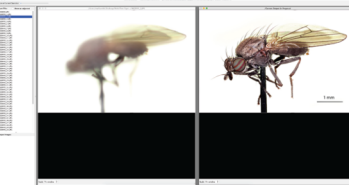
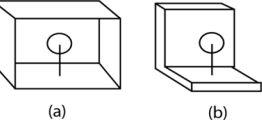
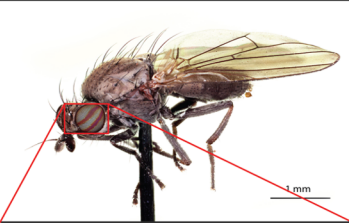
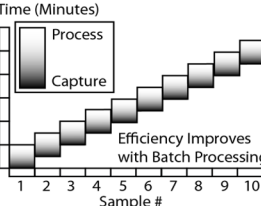
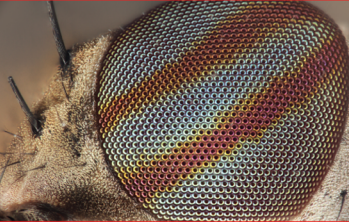


- Produce **140,000+** High Throughput (HTP) scans of fluid-stored and **450,000+** HTP scans of slide-mounted parasite specimens



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

A. Preparation & Setup	B. Automated Image Capture	C. Post-Processing and Analysis
<p>1. Configure system to image pinned specimens.</p>	<p>5. Focus on the back of the pinned specimen and select start point.</p>	<p>10. Open images in stacking software to align and stack.</p>
 <p>2. Select magnification according to specimen size.</p> <p>4cm 1 mm 1 μm</p> <p>1x — 5x 10x 20x 50x 100x</p>	<p>6. Focus on the front of the pinned specimen and select end point.</p> 	
<p>3. Position specimen on X, Y stage in insect box (a) or L bracket (b).</p> 	<p>7. Start automated image capture of 65-200 photographs according to specimen size.</p> <p>8. Repeat 3 through 7 using the next specimen in queue before proceeding to 9 for a faster workflow (see 11).</p>	<p>11. Save output image.</p> 
<p>4. Set camera settings according to magnification.</p> <p>Exposure: 1/200 Aperture: f4.0 at <5x f 2.8> 5x ISO: 100 Flash: 1/64 - 1/2</p>	<p>9. Hypothetical capture time for 10 specimens provided below.</p>  <p>Time (Minutes)</p> <p>Process</p> <p>Capture</p> <p>Efficiency Improves with Batch Processing</p> <p>Sample #</p>	

PARASITE TRACKER

DOCUMENTING ARTHROPOD VERTEBRATE PARASITES

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.



GloBI

[about](#) [blog](#) [browse](#) [contribute](#) [data](#) [search](#) [references](#) [status](#) [日本語](#) [Español](#)

Example query: [What do sea otters \(*Enhydra lutris*\) eat?](#) or [What do honey bees \(*Apis*\) pollinate?](#)

What kind of do interacts with according to ?

organisms
Interacts with... plenty of things!



Eider
(Somateria)

...

has parasite



flea
(Siphonaptera)

...

Supported by:

<http://invertebrates.si.edu/parasites.htm>. Accessed at <cleaned_up.tsv> on 16 Nov 2019. [show](#) Provider: <http://invertebrates.si.edu/parasites.htm>. Accessed at <cleaned_up.tsv> on 16 Nov 2019.

Benesh, D. P., Lafferty, K. D. and Kuris, A. (2017), **A life cycle database for parasitic acanthocephalans, cestodes, and nematodes**. *Ecology*, 98: 882. doi:10.1002/ecy.1680 [link](#) [show](#) Provider: Sarah E Miller. 9/19/2017. Species associations manually extracted from Benesh, D. P., Lafferty, K. D. and Kuris, A. (2017), A life cycle database for parasitic acanthocephalans, cestodes, and nematodes. *Ecology*, 98: 882. doi:10.1002/ecy.1680. Accessed at <<https://github.com/millirse/Benesh-et-al-2017/archive/9dc091ac0c4b7b06761d30032d2b93369855fcd.zip>> on 16 Nov 2019.

<http://arctos.database.museum/guid/MSB:Para:16981> [link](#) [show](#) Provider: MSB Parasite Collection (Arctos) - Version 32.32

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<http://arctos.database.museum/guid/MSB:Para:5341> [link](#) [show](#) Provider: MSB Parasite Collection (Arctos) - Version 32.32

PARASITE TRACKER

DOCUMENTING ARTHROPOD VERTEBRATE PARASITES



2020 TPT Personnel Organizational Chart

Research Advisory Board

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

Bioinformatics Teams

Data Integration



Jorrit Poelen
Katja Seltmann
Jen Zaspel

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

Taxonomy



TaxonWorks-
Matt Yoder
Management,
curation, and file
formatting



Kat Sullivan
Jen Zaspel
Taxonomy file
aggregation



David Bloom
Vertebrate
taxonomy

Digitization

Mark Smith
Pinned and slides
Alyssa Caywood
Pinned



Image/Label Data Aggregation



Katja Seltmann Neil Cobb

Broader Impacts

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

Machine Learning Species Identification



Fieldguide-Andre Poremski

Scanning

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



Insect-Julia Colby,
Kat Sullivan
Jen Zaspel

NOTES FROM NATURE

Julie Allen
Michael Denslow
Rob Guralnick

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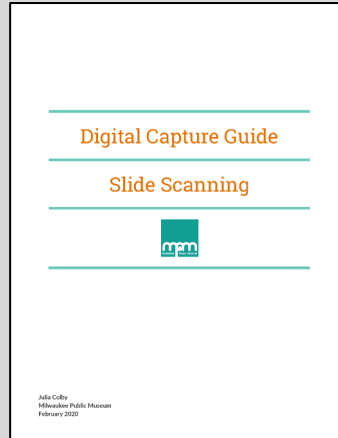
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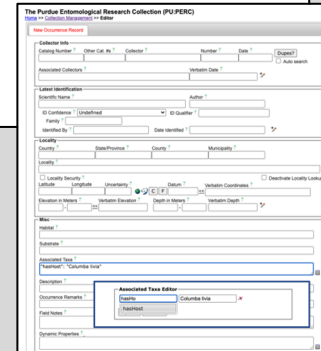
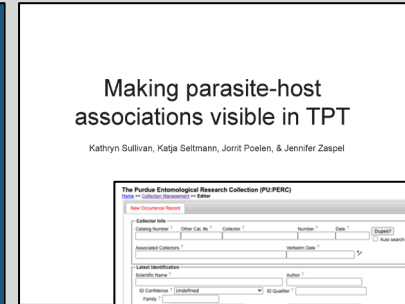
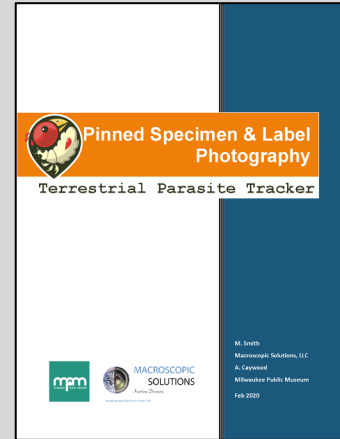
Highlights from Year 1



TPT Workshop I
Field Museum of Natural
History, February 2020

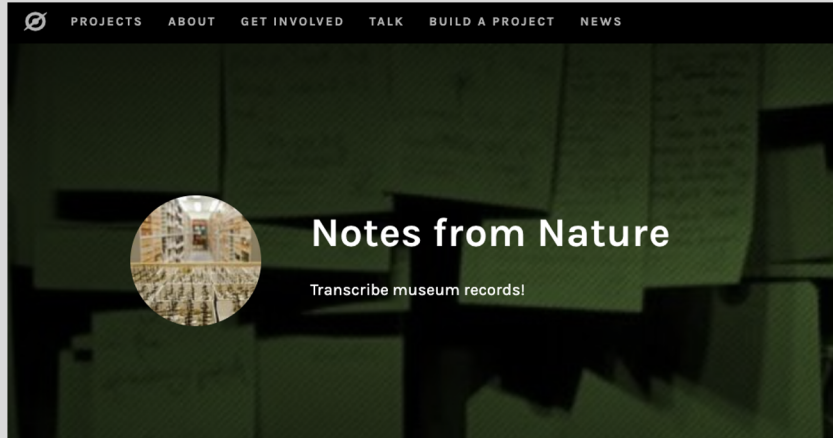


Workflow Development



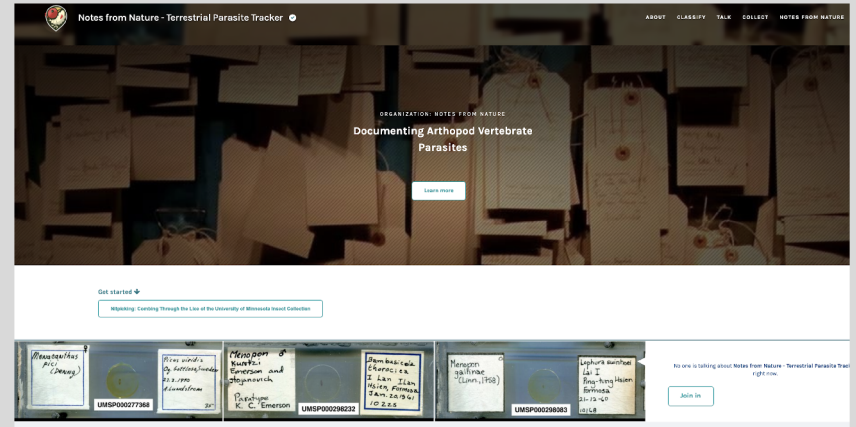
Associations Data

Highlights from Year 1



PROJECTS ABOUT GET INVOLVED TALK BUILD A PROJECT NEWS

 **Notes from Nature**
Transcribe museum records!

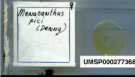
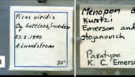
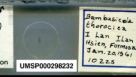
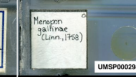


Notes from Nature - Terrestrial Parasite Tracker

ORGANIZATION: NOTES FROM NATURE
Documenting Arthropod Vertebrate Parasites

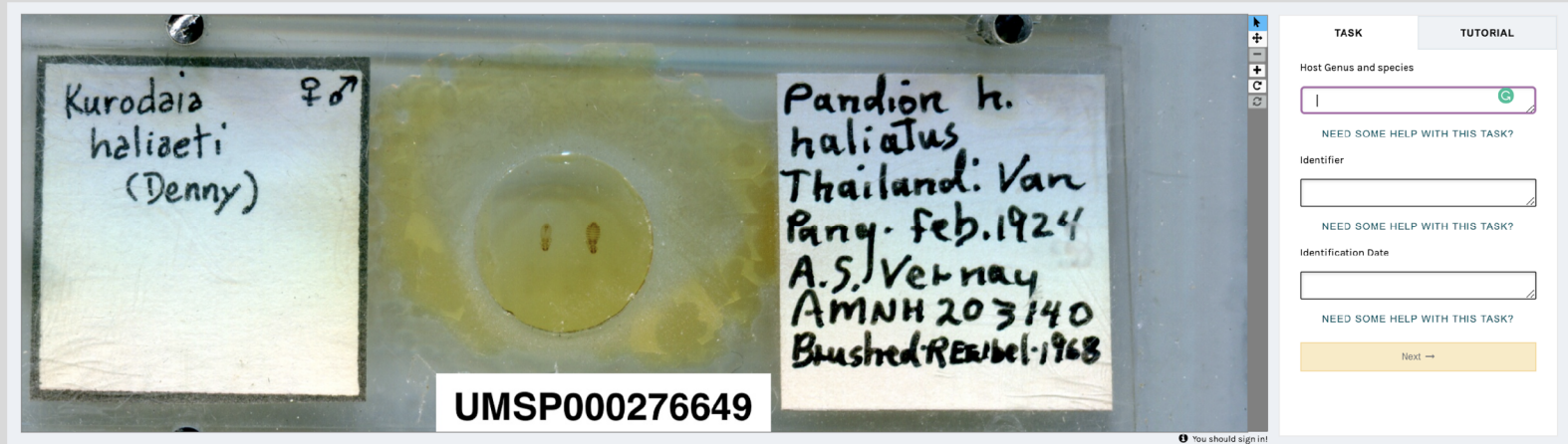
Get started

Warning: Content through the site of the University of Wisconsin-Madison Collection

 UMSP000277988	 UMSP00029232	 UMSP00029833	 UMSP00029833
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No one is talking about Notes from Nature - Terrestrial Parasite Tracker right now.

Join in



Kurodaia haliaeti (Denny) ♀♂

UMSP000276649

Pandion h. haliaetus
Thailand: Van Pary. Feb. 1924
A.S. Verrill
AMNH 203140
Brushed REEbel. 1968

TASK **TUTORIAL**

Host Genus and species

NEED SOME HELP WITH THIS TASK?

Identifier

NEED SOME HELP WITH THIS TASK?

Identification Date

NEED SOME HELP WITH THIS TASK?

Next →

🔒 You should sign in!

Lessons Learned and Staying Connected in 2020!



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 Einar Nilsson 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 [BirdNet](https://www.birdnet.org/) is happening now April 16-19! We have two expeditions up from TPT: The Lousy Expedition III and See No See Ums: Hawaii from BPM. 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 (allen23@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.sciencemag.org/podcasts/releases/2020/06/06/rob-ku060320r.pdf>

Remote Digitization Highlights

Digital Data Presentation from University of New Hampshire on June 1, 2020

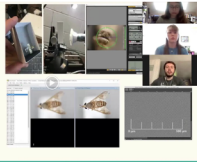
Developing the digitization practices of parasitic arthropod specimens from a university collection Jenna O'Neil, University of New Hampshire; Isaac A. Bengtson, University of New Hampshire; Holly A. Hoag, University of New Hampshire; Istvan Mikó, University of New Hampshire

Pinned Specimens

Workflow

1. Position Specimen
2. Add to Scan Area
3. Adjust specimen with Live View
4. Set distance, starting and ending positions
5. Start the Workflow about
6. Image tracking with Remote Marker

Media here are added by Transcribers



Watch the undergraduates in Istvan Mikó's lab outline their TPT digitization workflow!

[Presentation](#)

[Abstract](#)

[WUASP article](#)

Sarah Ortoftak was featured in this recent article for integrating digital specimens into her undergraduate lab course at the University of Wisconsin Stevens Point.

<https://www.sciencedirect.com/science/article/pii/S0304378920300005>

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

FridayNightLive!!! 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 >4000 vials. Check out this awesome Widesuse louse specimen, complete with libel data, of course!



Walrus louse - *Antarctophthirus californii* (Osborn, 1899) (Phthiraptera: Echinophthiridae)
Collecting event:
Ex. *Callorhinus ursinus* (Carnivora: Otariidae)
St. Paul Island, Alaska
5. VI. 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.

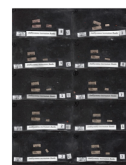
Hope you are all safe and healthy!

Jan, 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!

Jan, Kat, and Julie



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Thank You!

MacroscopicSolutions 

Portable, High Performance Imaging and Microscopy Systems



GEORGIA SOUTHERN UNIVERSITY



SCAN
Symbiota Collections of Arthropods Network



LepNet
Lepidoptera of North America Network



BIODIVERSITY COLLECTIONS NETWORK



InvertNet
Advancing Digitization of Biological Collections

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




iDigBio
Integrated Digitized Biocollections

NSC ALLIANCE

VerNe 



VectorBase
Bioinformatics Resource for Invertebrate Vectors of Human Pathogens