Lepidoptera of North America Network (LepNet)

$3.2 million over 4-Years
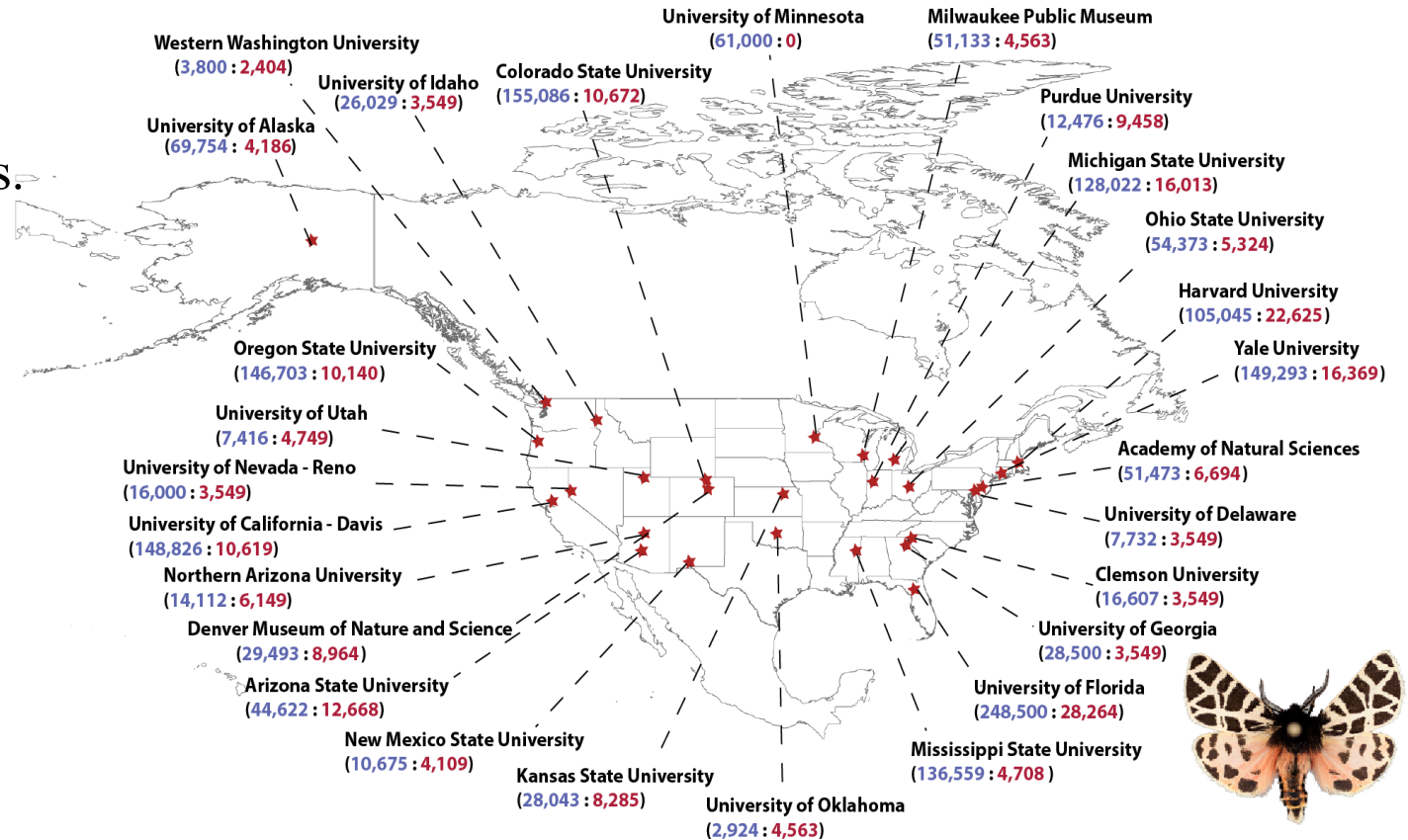
LepNet
Lepidoptera of North America Network

Project Goals – On Target!!

(1) Transcribe **1.7 million** specimens labels, integrate >1 million existing lepidopteran records, totaling **2.7 million** occurrence records.

(2) Produce **81,000** high-resolution images and >**160,000** smartphone images **(LepSnap)** for **240,000 total,** representing at least **60%** of the 14,300+ North American Lepidoptera species.

(3) Computer vision taxonomic identification available via smartphone apps & Laptop biodiversity portal (**Fieldguide**)

(4) **LepXlor** – Education-Outreach program
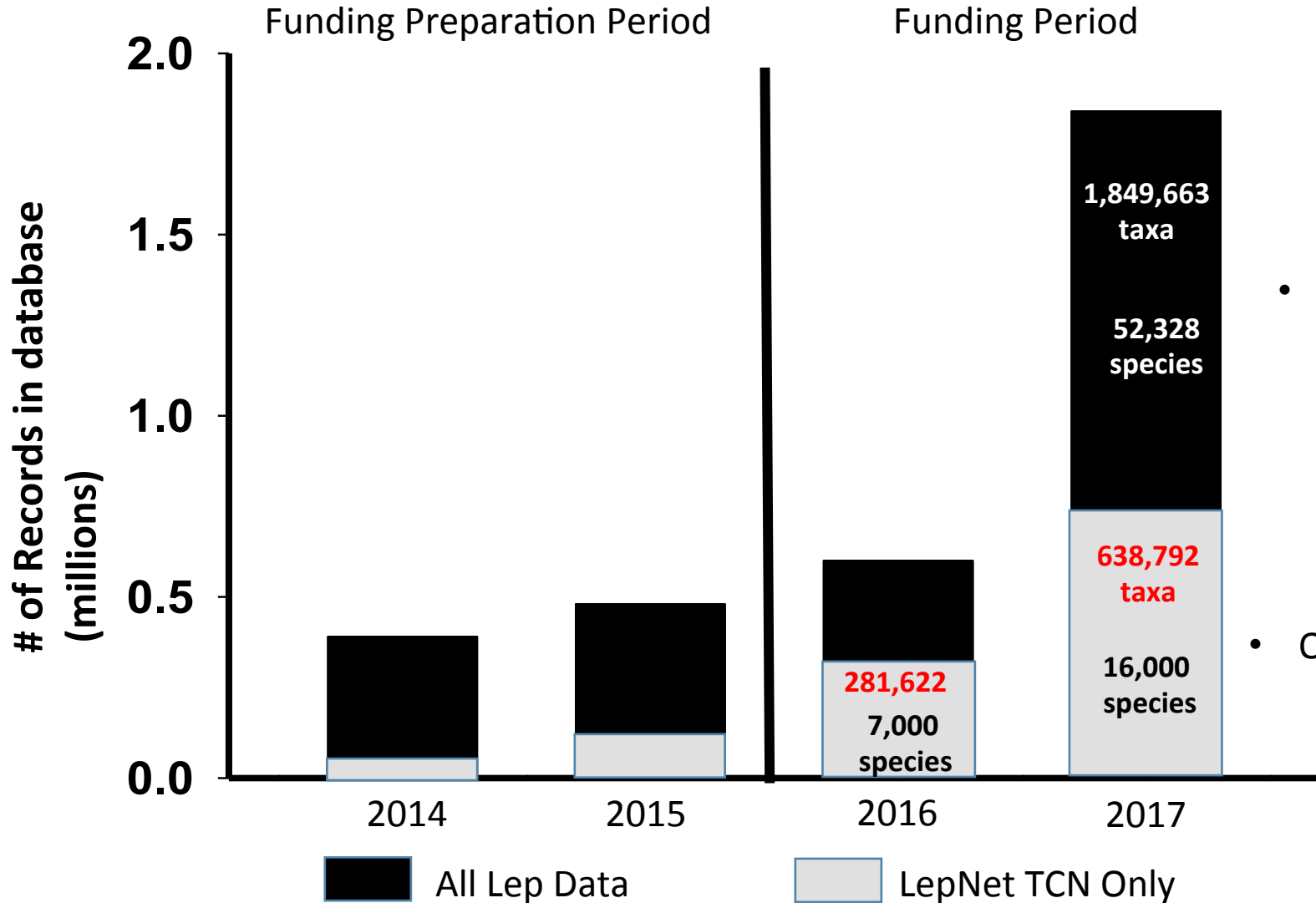
LepNet Research Collections
www.lep-net.org

1,704,161 **Total specimen records**
214,705 **Total specimens imaged**

University of Minnesota (61,000 : 0)
Milwaukee Public Museum (51,133 : 4,563)
Western Washington University (3,800 : 2,404)
University of Idaho (26,029 : 3,549)
Colorado State University (155,086 : 10,672)
University of Alaska (69,754 : 4,186)
Purdue University (12,476 : 9,458)
Michigan State University (128,022 : 16,013)
Ohio State University (54,373 : 5,324)
Harvard University (105,045 : 22,625)
Oregon State University (146,703 : 10,140)
Yale University (149,293 : 16,369)
University of Utah (7,416 : 4,749)
Academy of Natural Sciences (51,473 : 6,694)
University of Nevada - Reno (16,000 : 3,549)
University of California - Davis (148,826 : 10,619)
University of Delaware (7,732 : 3,549)
Northern Arizona University (14,112 : 6,149)
Clemson University (16,607 : 3,549)
Denver Museum of Nature and Science (29,493 : 8,964)
University of Georgia (28,500 : 3,549)
Arizona State University (44,622 : 12,668)
University of Florida (248,500 : 28,264)
New Mexico State University (10,675 : 4,109)
Mississippi State University (136,559 : 4,708)
Kansas State University (28,043 : 8,285)
University of Oklahoma (2,924 : 4,563)

TCN vs Broader Impact Goals

Funding Preparation Period

Funding Period

# of Records in database (millions)

- 2.0
- 1.5
- 1.0
- 0.5
- 0.0

2014 **2015** **2016** **2017**

- 2016: **281,622** / **7,000 species**
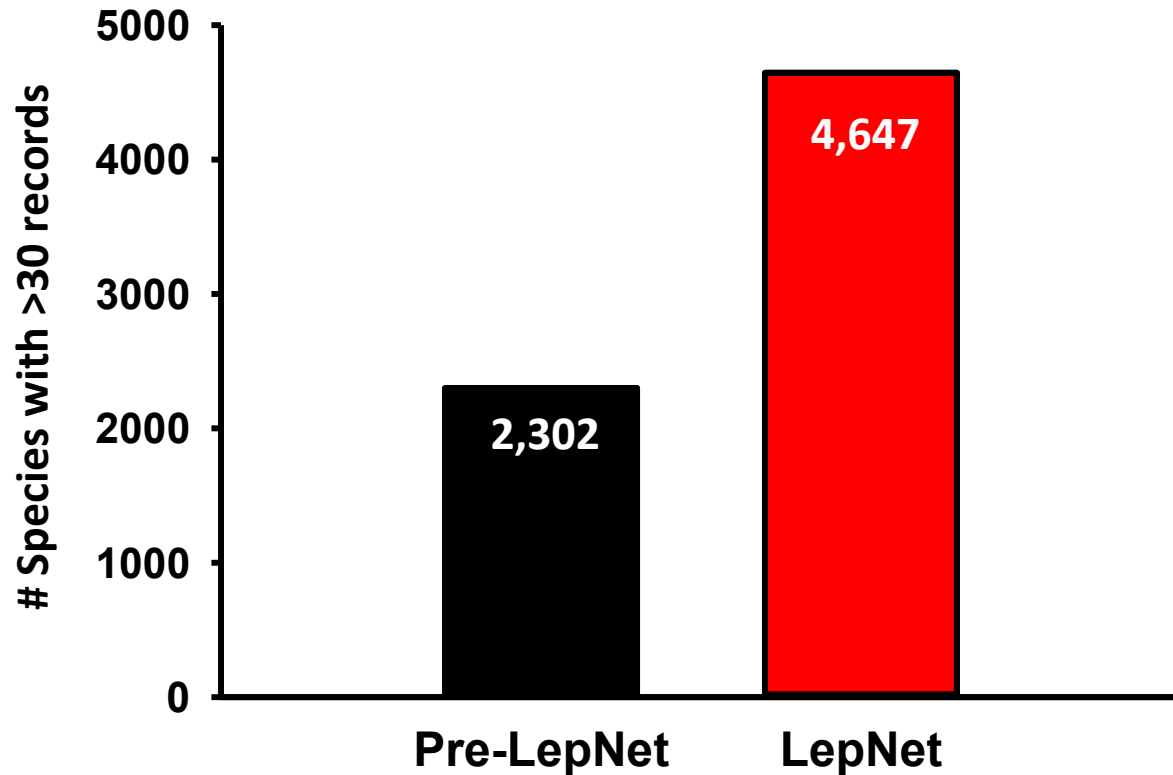- 2017: **1,849,663 taxa** / **52,328 species** / **638,792 taxa** / **16,000 species**

- ADBC Digitization increases **unfunded efforts** and mobilizes **dark data** (51 Broader Impact collections)
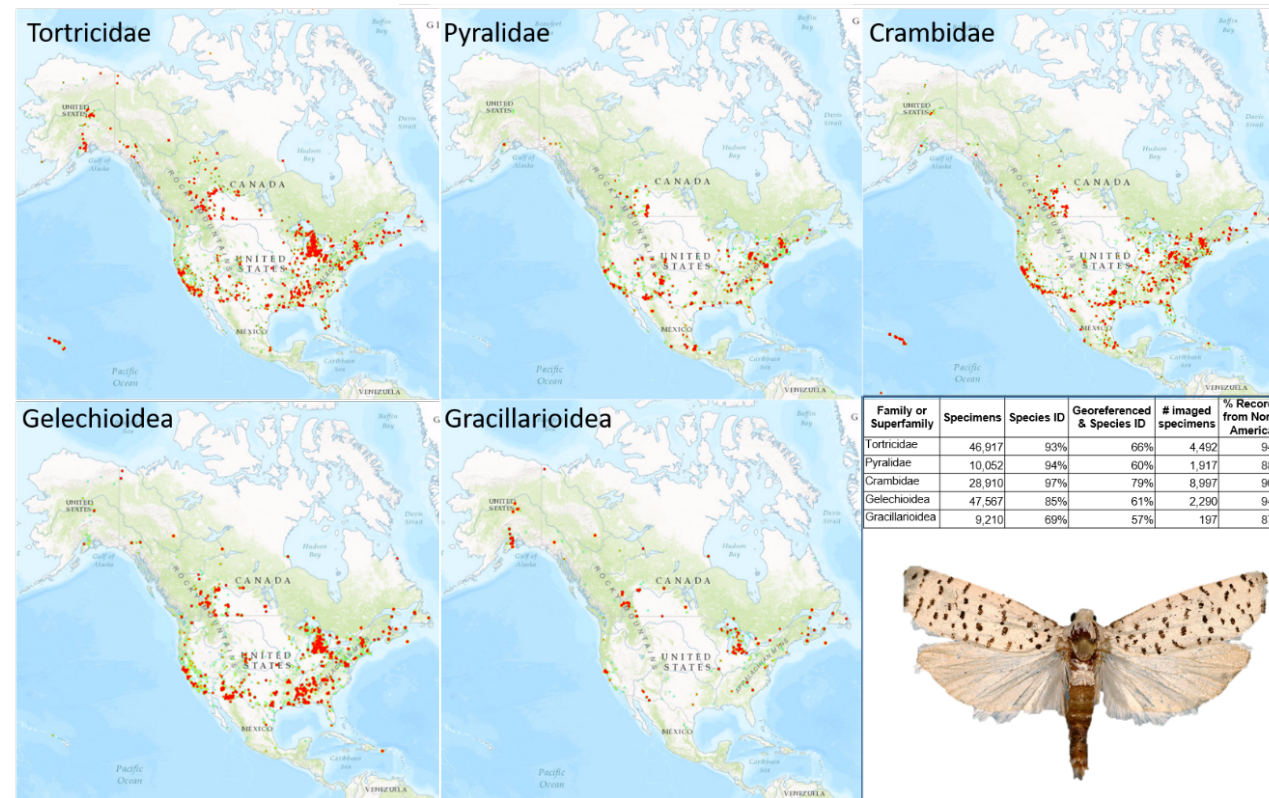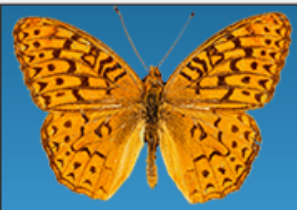
- On track to reach goal (26 TCN collections)

■ All Lep Data   ▢ LepNet TCN Only

Research Ready Data
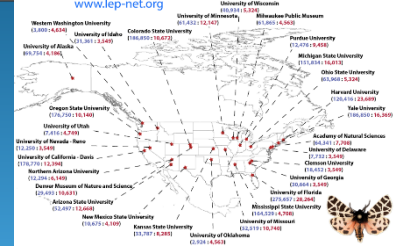
Ecological Niche Modeling (≥ 30 records per species)

Goal: 5,000 more species for modeling

Microlepidoptera

Family or Superfamily	Specimens	Species ID	Georeferenced & Species ID	# imaged specimens	% Records from North America
Tortricidae	46,917	93%	66%	4,492	94%
Pyralidae	10,052	94%	60%	1,917	88%
Crambidae	28,910	97%	79%	8,997	96%
Gelechioidea	47,567	85%	61%	2,290	94%
Gracillarioidea	9,210	69%	57%	197	87%

Huge Potential for Identification from Images

6,870 North American species (40%) can be identified to species through images

Smartphone + Computer Vision

LepSnap

Geographic Filter

Arctia opulenta

Arctia caja

Phenology Filter

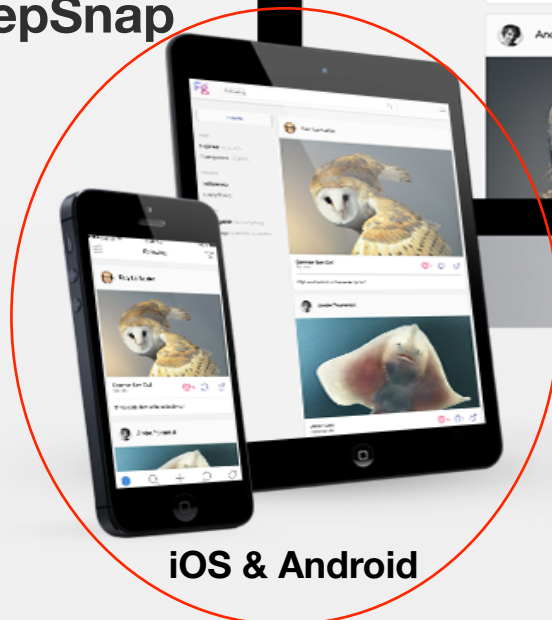Phenology Calculator
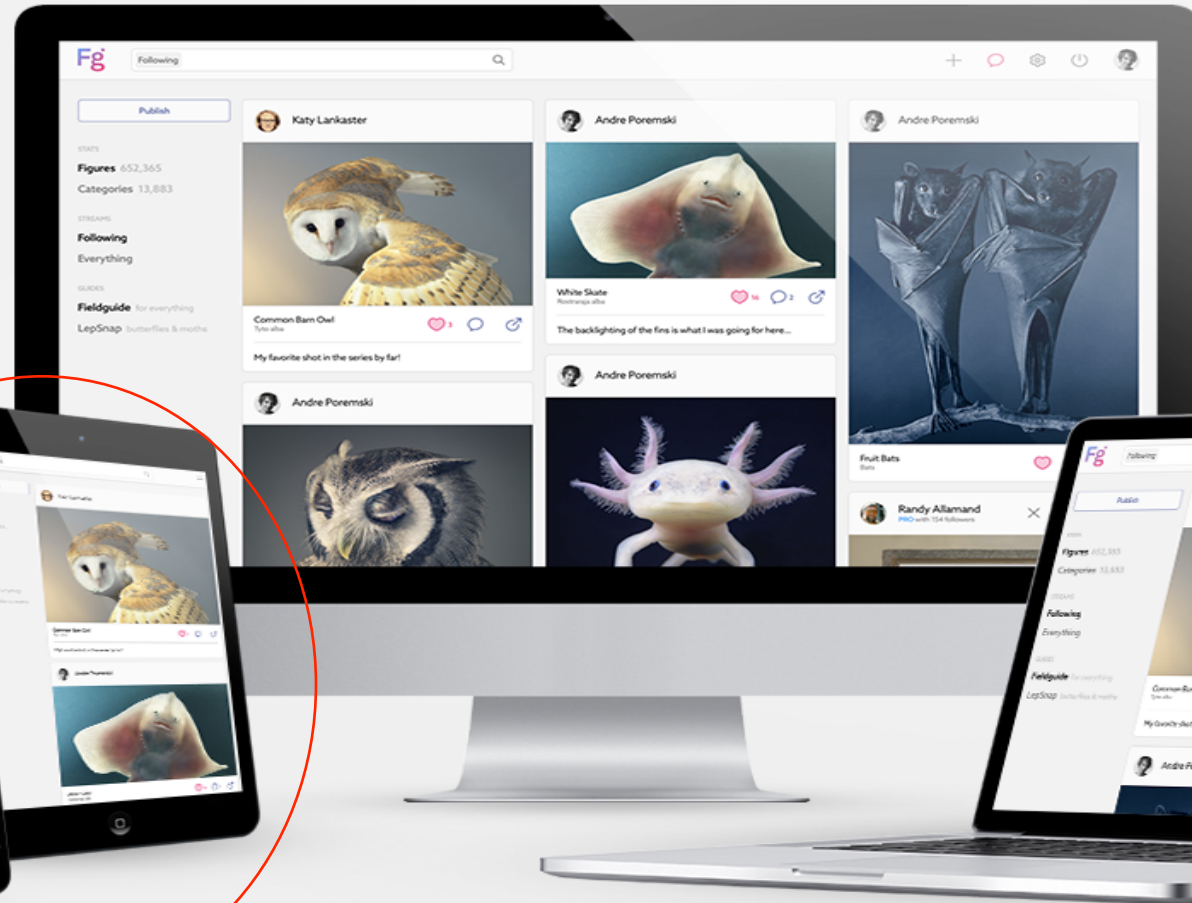
100   150   200   250
Day of Year

+   +
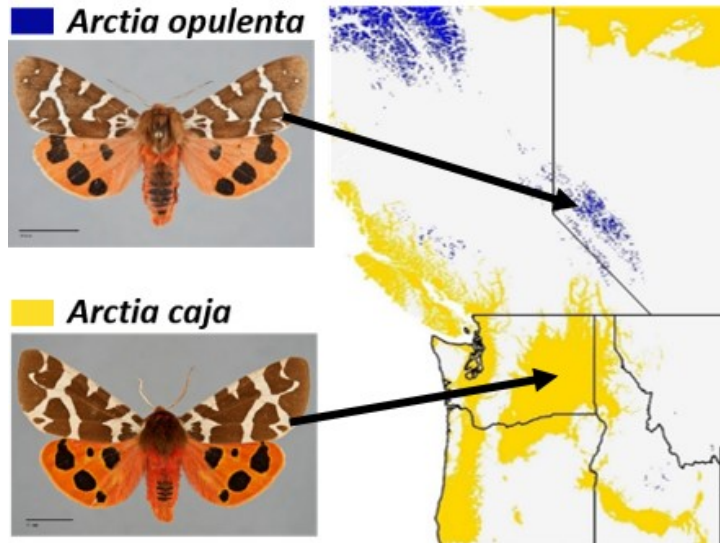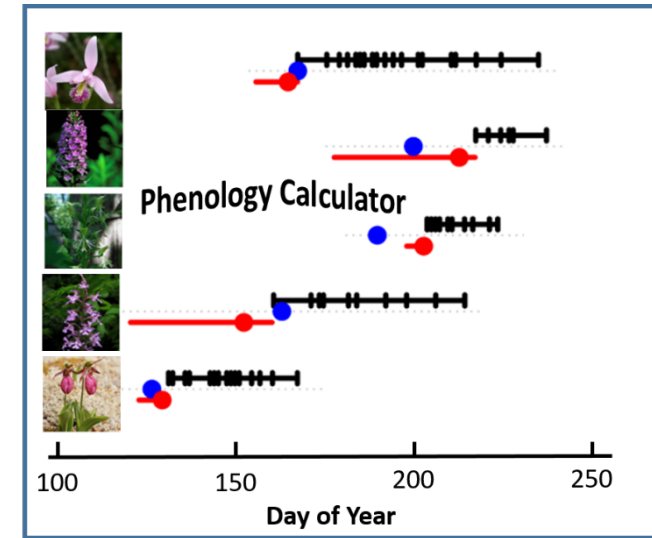
Fieldguide
Computer vision for biodiversity

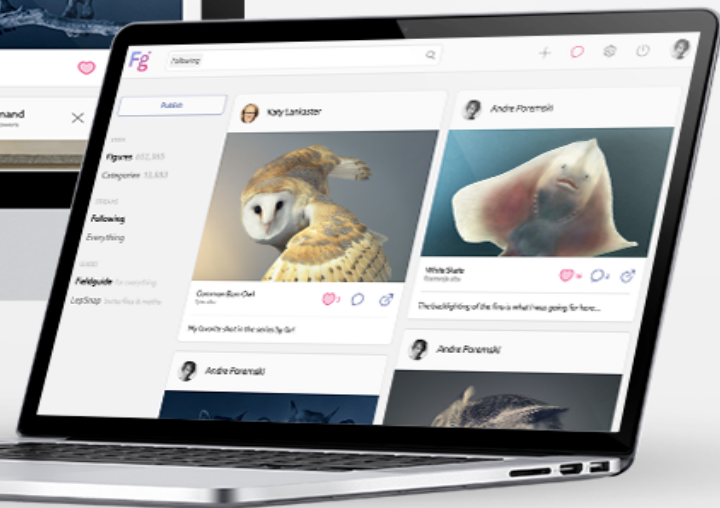Andre Poremski overview in Symbiota Meeting Nov 2, 3:30PM, Harn Chandler Auditorium

CV-Batch API processes all Images on Symbiota portal

Image Search (CV-Widget)

LepSnap

iOS & Android

Paper Models of Lepidoptera

*Anne Basham, Project Director LepXplor

Papered Benefits

- 2D nature of leps allows for creation of life-like models.

- Handled and manipulated in K-12 classrooms.

- Linked with databases and applications.

- Can represent holotypes or rare species not normally used in education & outreach.

- Parks & education centers can order reference collection from checklist and place on public display.

*Presentation at Symbiota Meeting, Nov 2 3:45 Harn Auditorium

Thanks to LepNet Collaborators!

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Casting a LEP-NET

HI-RES IMAGES OF BUTTERFLIES AND MOTHS COMING TO A COMPUTER NEAR YOU

Butterflies and moths can't take selfies — at least not yet. But pictures of them can be incredibly compelling and insightful, which is why the National Science Foundation has awarded nearly $4 million to 24 institutions, including Colorado State University, to capture hi-resolution images of Lepidoptera, the order of insects that includes butterflies and moths. The project, Lep-Net, will take place over four years, with the ultimate goal of digitizing more than 1.7 million specimen records and integrating those images with the more than 1 million records already in place.

Paul Opler, a professor in CSU's Department of Bioagricultural Sciences and Pest Management and associate director of CSU's C.P. Gillette Museum of Arthropod Diversity, will spearhead the University's contribution to the image database, which will account for 10 percent of the total number of images. The primary focus of the project is databasing almost 160,000 butterfly and moth specimens in the museum's holdings, which are estimated to be about a half million.

The NSF funding allowed the team to purchase a high-resolution sophisticated camera system, dubbed "The Little Kahuna," which captures images at six times the resolution of those previously cataloged.

Arctia caja subsp. utahensis, taken from Roan Plateau, Garfield County, Colo., cir. 1996. Donated by C.P. Staler.

"Images of North American butterflies and moths have never before been cataloged in this way," said Opler. "Importantly, this image database will not simply be a resource for scientists, but we fully expect the database to be used for community outreach, since the images will be available for teachers, educators, and the general public."

An additional component of the project is Lep-Snap where users of an app designed for mobile phones can take pictures of butterflies and moths, upload them, and have them identified. The identification is not done by experts but rather by the program itself, which uses the vast array of images collected to compare and analyze new pictures uploaded by individuals.

The project is relying heavily on the work of research associates drawn from the local community. Chuck Harp, an acknowledged expert on butterflies and moths, serves as a full-time research associate for the project, and he leads the day-to-day work of 11 or more students and citizen scientists who do most of the databasing work.

"The Lep-Net project, funded through the NSF grant and iDigBio, allows us to document and to preserve vital biological data from specimens housed in the C.P. Gillette Museum from several scientific pioneers from the past 100 years," said Harp. "I accepted this job to honor their efforts for the public and for further scientific studies. It has been my pleasure to be a part of this project to ensure the specimens and data contained on the labels are shared for all to use."

"Importantly, this image database will not simply be a resource for scientists, but we fully expect the database to be used for community outreach, since the images will be available for teachers, educators, and the general public."

Paul Opler, professor in CSU's Department of Bioagricultural Sciences and Pest Management and associate director of CSU's C.P. Gillette Museum of Arthropod Diversity

Pam Piombino is volunteer associate who is focused primarily on butterfly identification. "Many people describe Lepidoptera as the glamour insects because they are so beautiful, especially when viewed up close and at high resolution," said Piombino. "But Lepidoptera also perform many essential functions in nature including pollinating plants and serving as a protein source for predators."

The team is hopeful that the project may someday expand to other arthropods, but the immediate plans are to continue documenting Lepidoptera. The database currently has approximately 32,000 images with 1,500 uploaded onto the website, which can be accessed at:

http://symbiota4.acis.ufl.edu/scan/portal/index.php.

Papilio canadensis, taken from Yukon Territories, cir. 1969. Donated by R.E. Stanford.
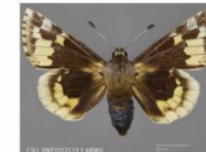
Megathymus yuccae subsp. reubeni, taken from nr. Carrizozo, N.M., cir. 2007. Donated by C.E. Harp.