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New Haven, CT
June 10, 2019

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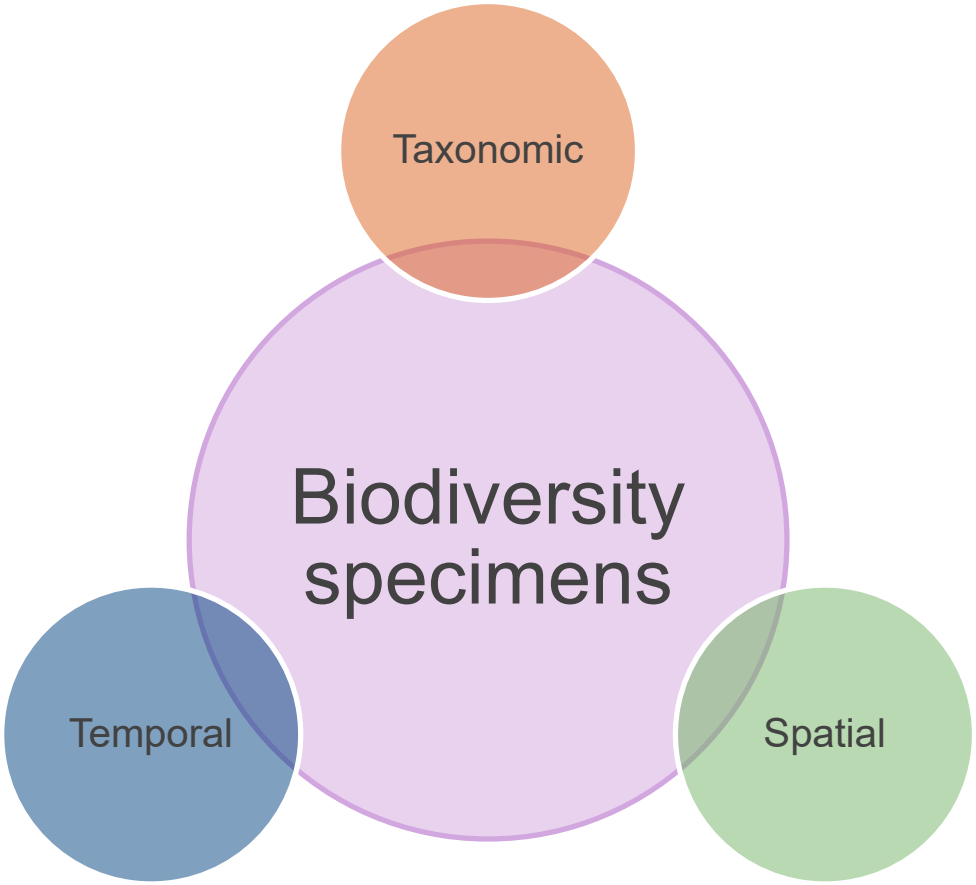
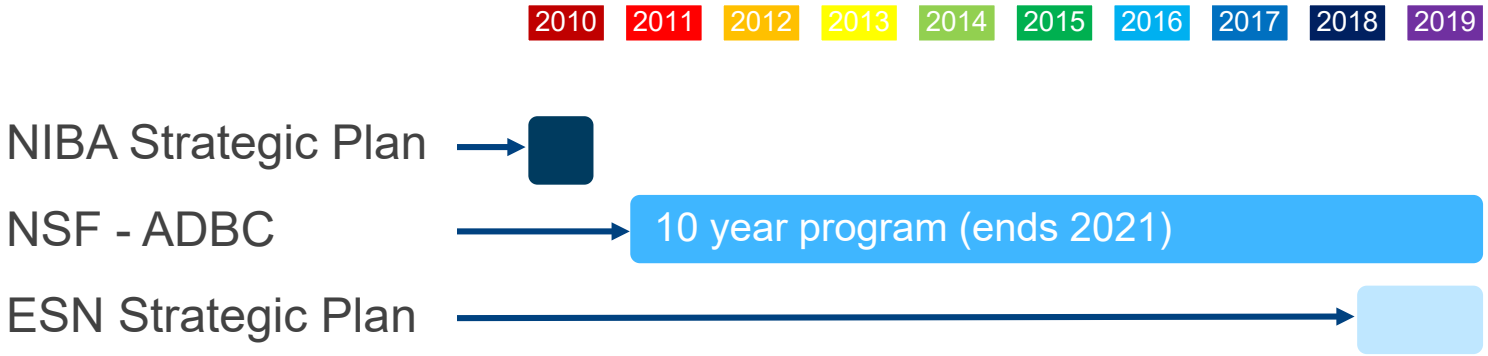
NEON and the Extended Specimen Paradigm

This material is based upon work supported by NSF's National Ecological Observatory Network which is a major facility fully funded by the National Science Foundation

Specimens as Biological Integrators

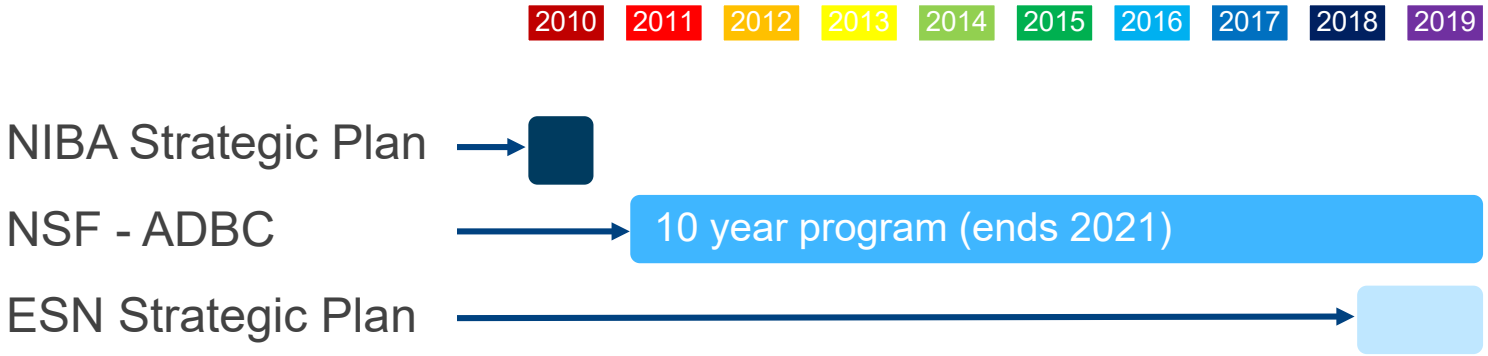


Recent digitization initiatives



- ADBC ($100 million program) funded:
  - 23 Thematic Collection Networks
  - 29 Partners to Existing Networks
  - Integrated Digitized BioCollections (iDigBio)
  - Digitization of 62 million specimens (915 collections; 317 institutions)
  - Provided training & work experience for thousands of students & early professionals

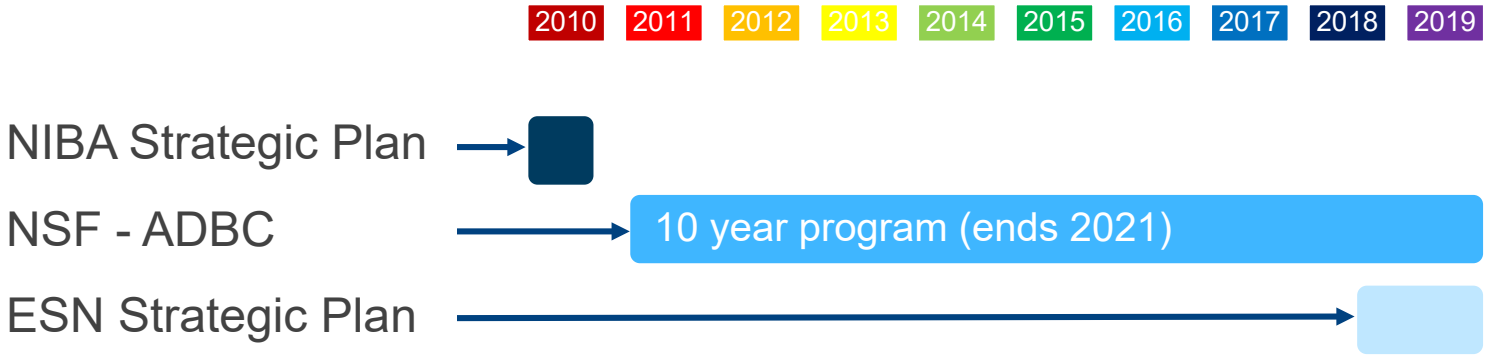
Recent digitization initiatives



Proportion of collections with some digitization:

- Mycology – 100%
- Fish - 43%
- Herbaria - 66% (represent 34% of specimens)
- Insects – 6%

Recent digitization initiatives



- 2021
  - ADBC will award its last grants
- 2023/2024
  - Funding expires on last awarded grands
  - Current iDigBio funding ends

What's next for collections?

Extended Specimen Network Strategic Plan

NEON as a case study of holistic metadata

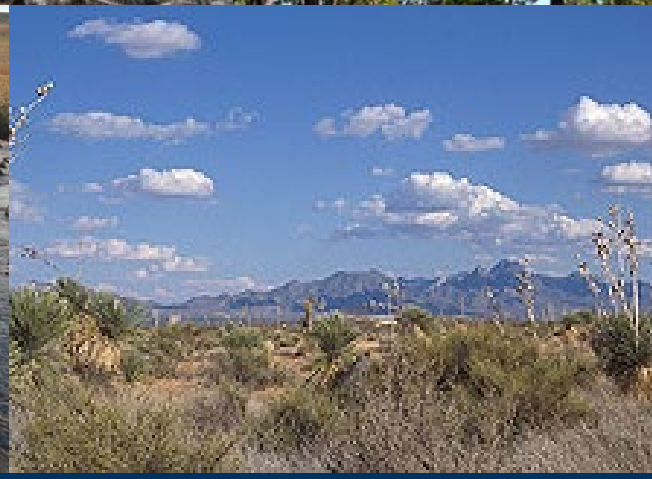
NEON: A continental-scale observatory









Diverse datatypes collected @ NEON sites

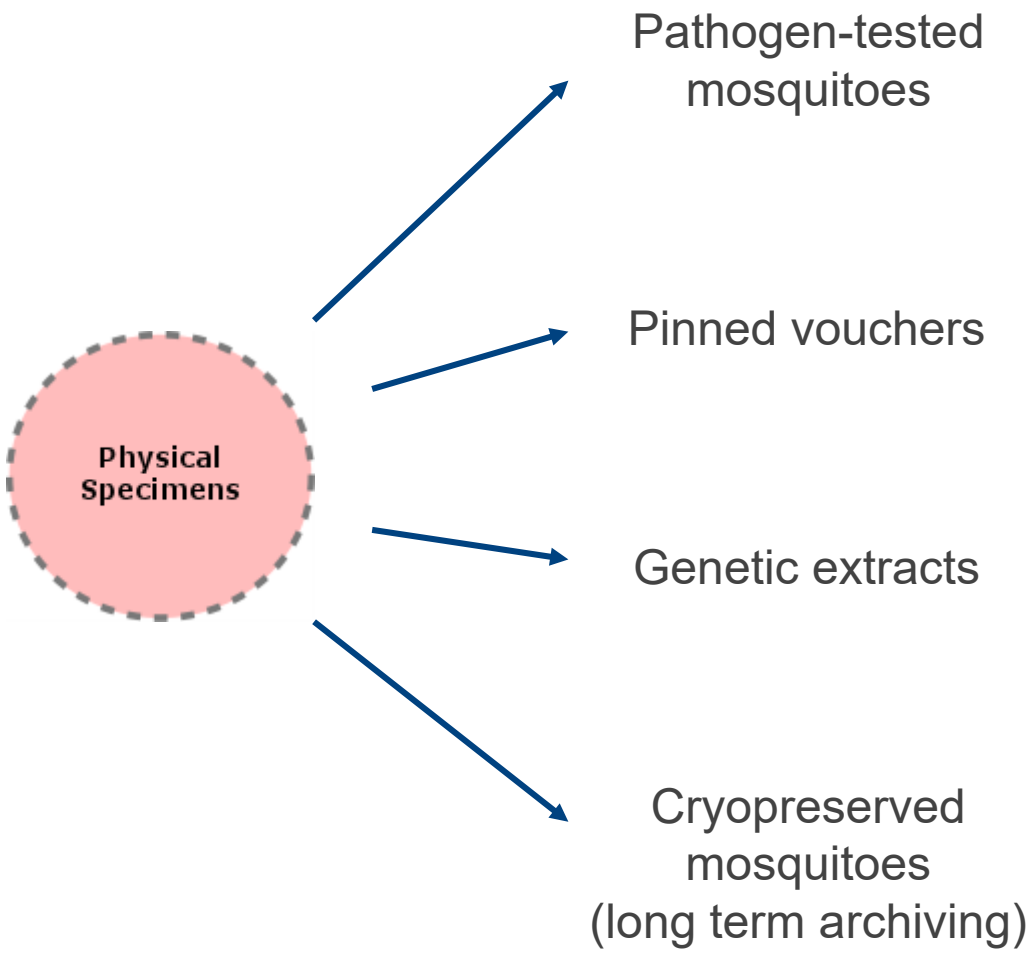
Annual archival of specimens @ the NEON Biorepository

- Small mammals*
- Fish*
- Ground beetles* & bycatch
- Mosquitos*
- Ticks*
- Zooplankton
- Benthic macroinvertebrates*
- Vascular plants, algae, bryophytes and lichens
- Soil microbes*
- Soil
- Dust
- Wet deposition

*including genomic extracts

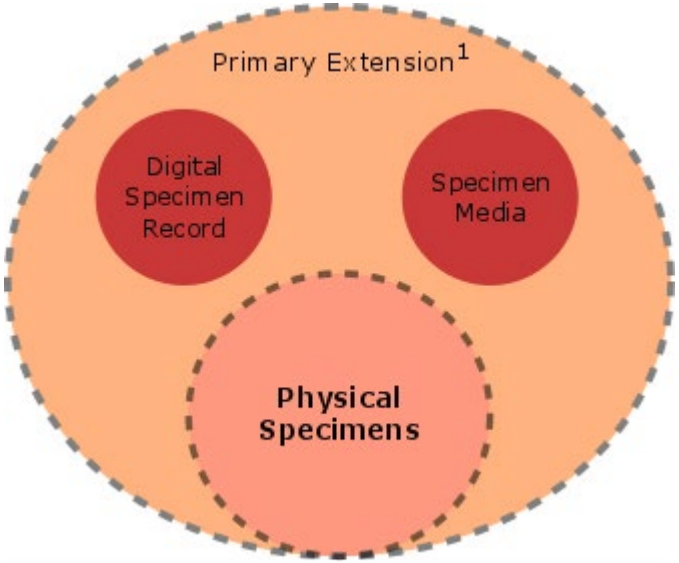
Case study: NEON Mosquito Collections

Physical Specimens

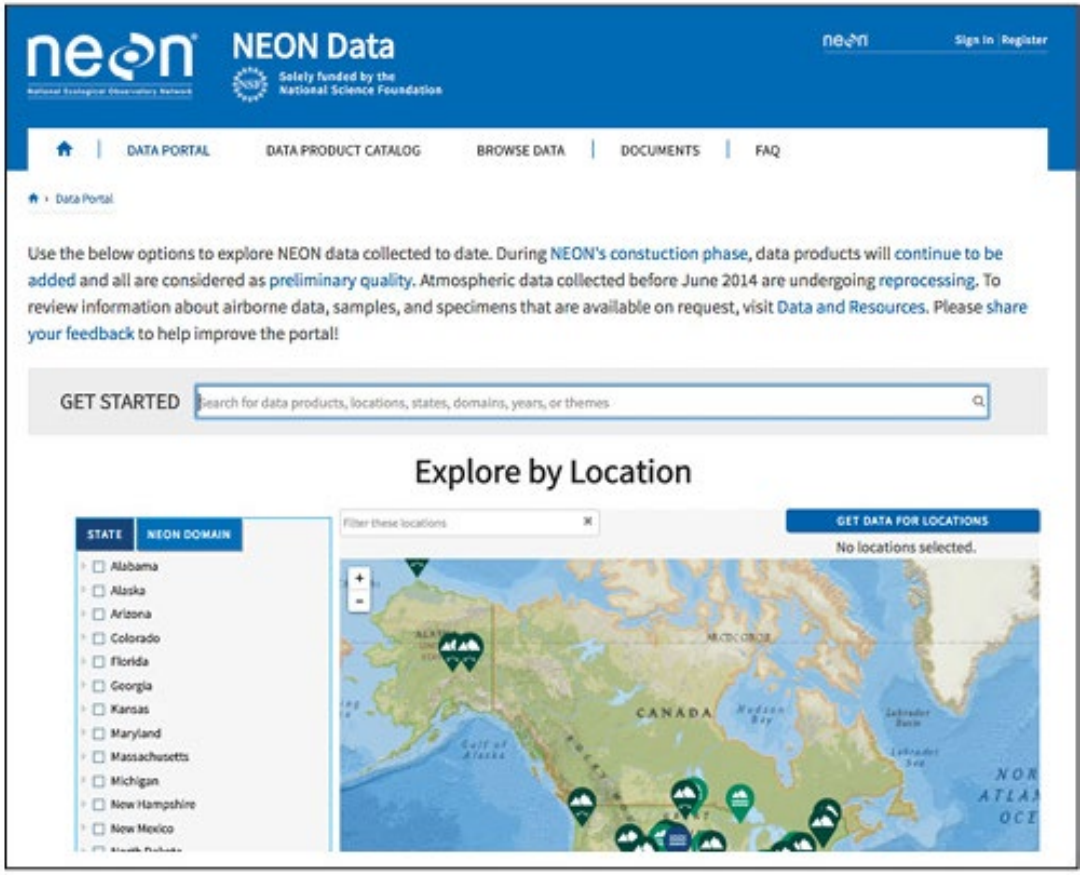


Case study: NEON Mosquito Collections

Primary Extension

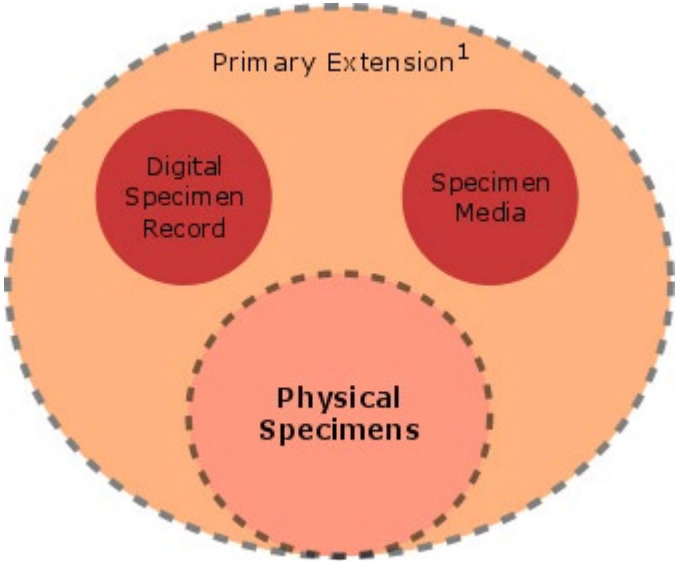


data.neonscience.org

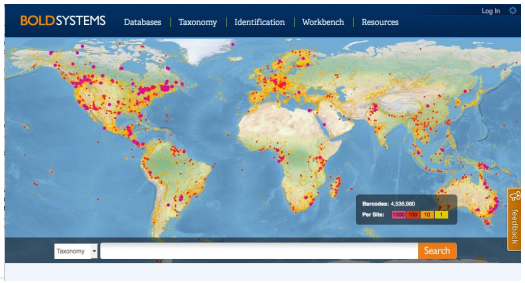


Case study: NEON Mosquito Collections

Primary Extension

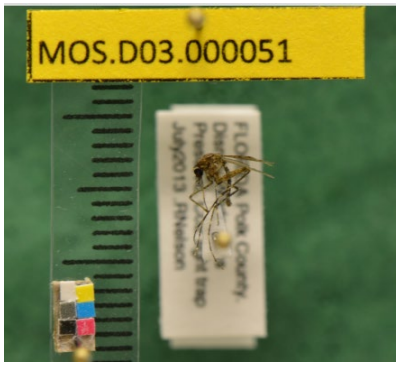


Barcode of Life (BOLD)



Taxonomy

Phylum:	Arthropoda
Class:	Insecta
Order:	Diptera
Family:	Culicidae
Subfamily:	Culicinae
Tribe:	Mansoniini
Genus:	Coquillettidia
Species:	Coquillettidia perturbans

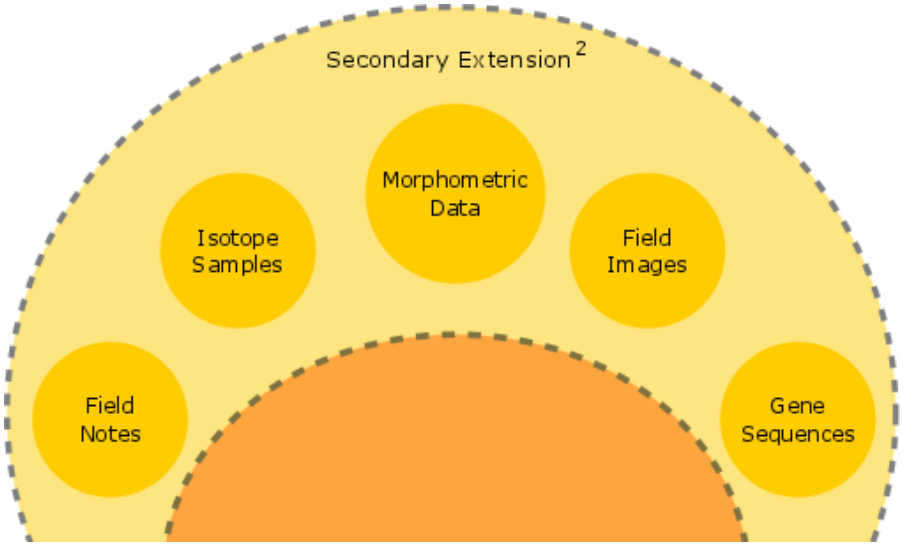


Collection Data

Country:	United States	**Collector:**	NEON Technician
Province/State:	Florida	**Date Collected:**	17-Aug-2013
Region/County:	Osceola	**Date Accuracy:**	+/- 38 day(s)
Sector:	Domain 03	**Time Collected:**	
Exact Site:	Disney Wilderness Preserve Site, RELOCATABLE	**Site Code:**	DSNY
		Habitat:	
Lat/Lon:	28.125, -81.436	**Sampling Protocol:**	CO2 trapping
Elevation:		**Coord. Source:**	Trimble GeoXH

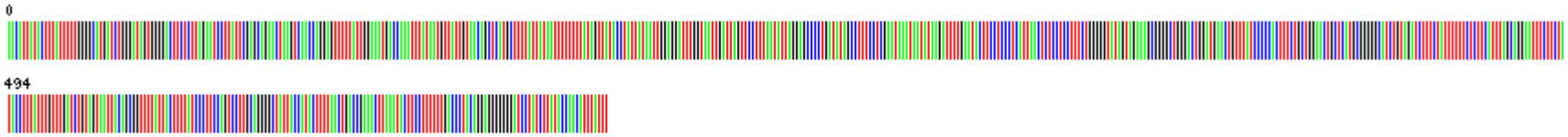
Case study: NEON Mosquito Collections

Secondary Extension



Phenocam – Harvard Forest canopy

Illustrative Barcode



Nucleotide Sequence

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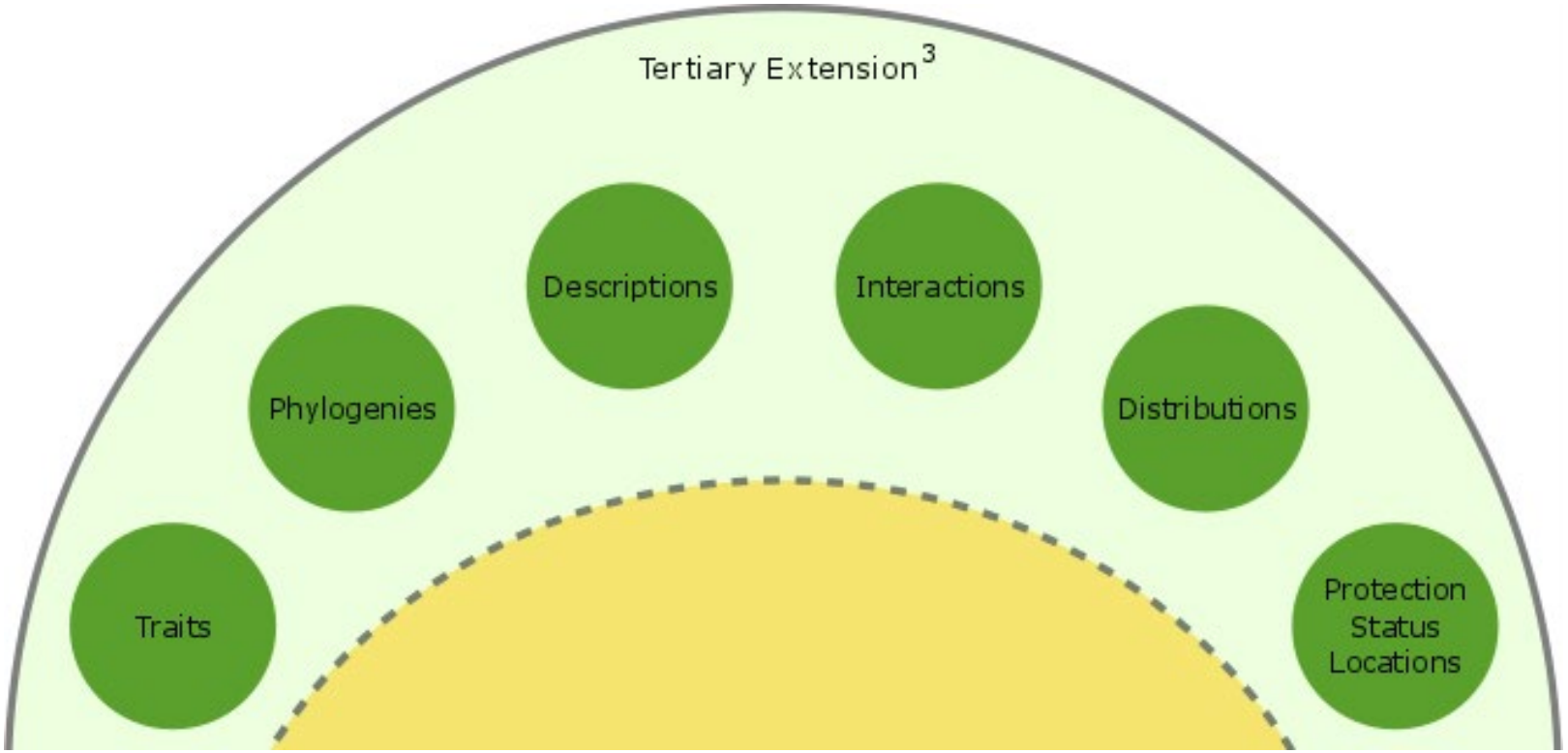
TACCTATTATAATTGGAGGATTTGGTAATTGATTAGTTCCTTTAATATTAGGAGCCCCTGATATAGCCTTTCCTCGAATAAATAATATAAGATTTTGAATACTTCCTCCCTCATTAACTCTCCTCCTTTCTGGGGGTATAGTAGAAAGCGGGGCTGGGACTGGA
TGAACTGTTTATCCCCCACTTTCTGCTGGAACTGCTCATGCGGGGGCATCTGTAGATCTTTCTATTTTTTCTCTTCATTTAGCAGGAATTTCTTCTATTTTAGGAGCAGTAAACTTTATTACTACAGTAATTAATATACGAACTTCTGGTATTACTTTAGATCG
TTTACCTTTATTTGTTTGATCTGTAGTAATTACAGCGGTTTTATTACTTTTATCCCTTCCAGTCCTTGCAGGGGCTATTACCATACTTTTAACTGACCGAAACTTAAATACTTCCTTTTTTGACCCTACAGGAGGGGGGGATCCTATCTTATACCAACATTTAT
TT

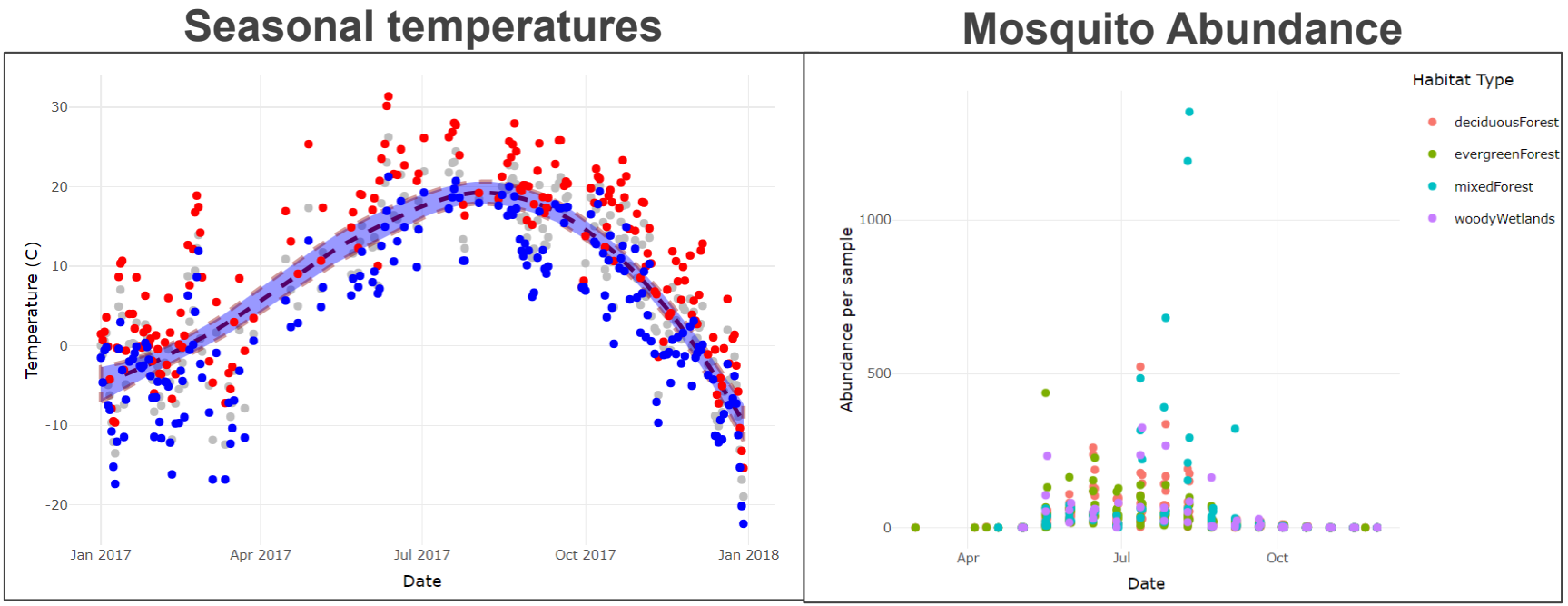
Case study: NEON Mosquito Collections

Tertiary Extension



Case study: NEON Mosquito Collections

Ecological forecasts from holistic data sources

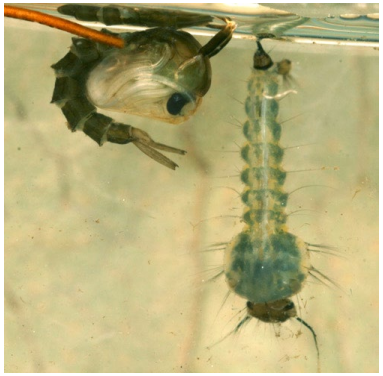


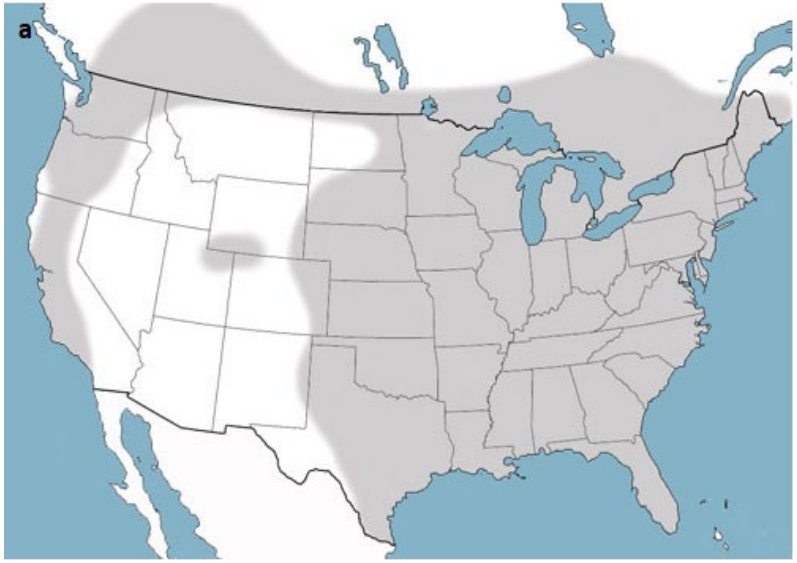
Temperature is an important predictor of activity

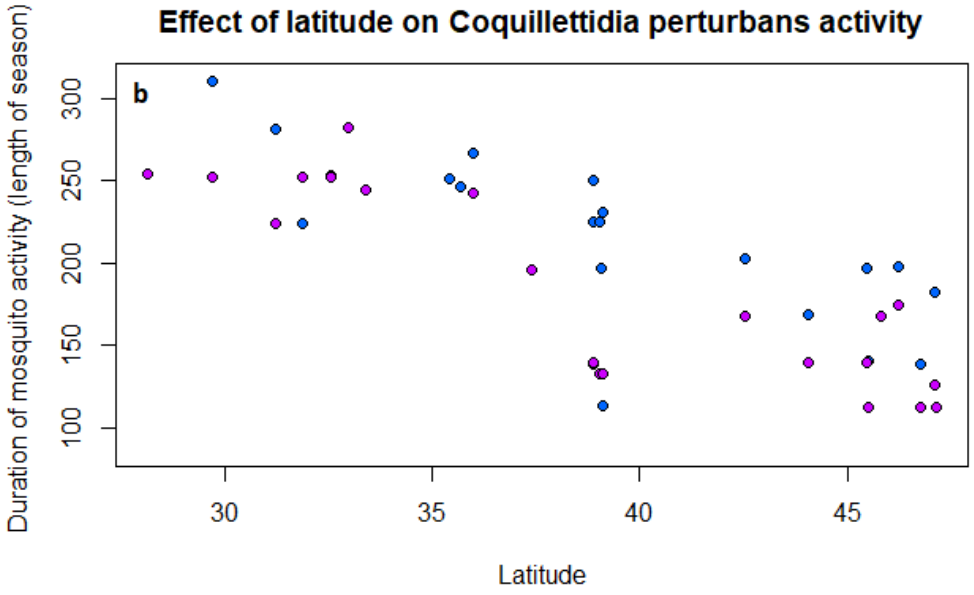
Data from Harvard Forest 2017

Case study: NEON Mosquito Collections

Detecting changes in distribution and ranges







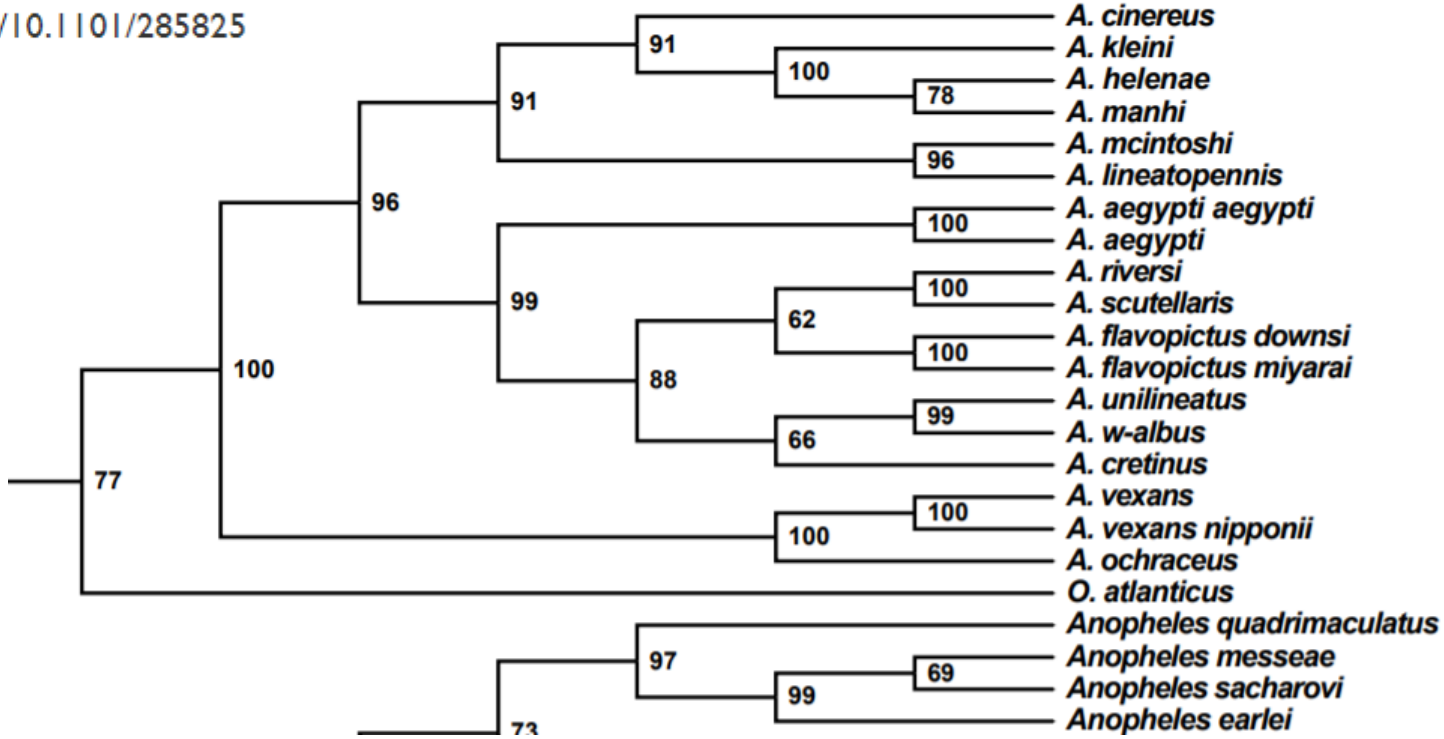
Case study: NEON Mosquito Collections

Phylogenies & updated taxonomy

A barcoding approach to phylogenetic classification of Aedini mosquitoes (*Aedes*, *Ochlerotatus*)

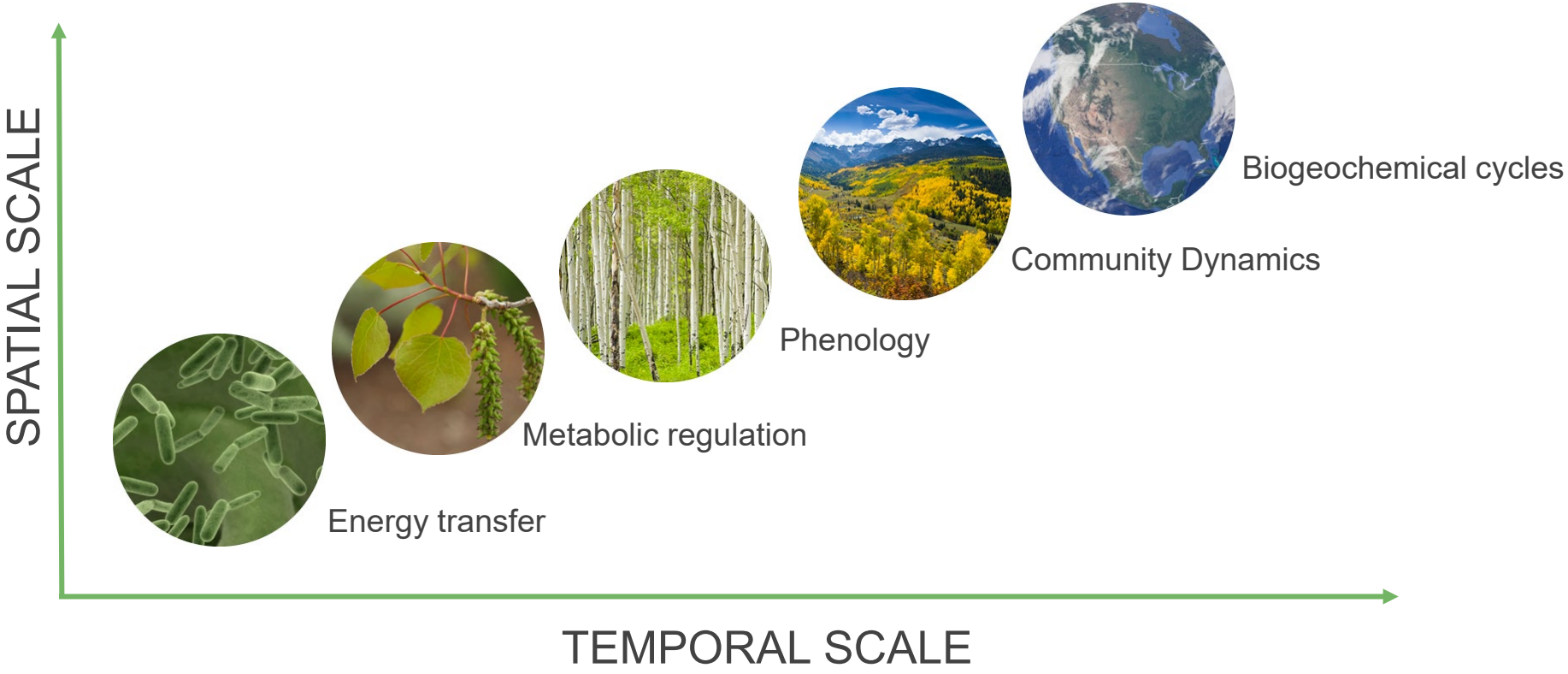
Haley Glass, Emma Carroll, Doug Curley, Hannah Kienzle, Donald A. Yee, Steven Vamosi

doi: https://doi.org/10.1101/285825



Biodiversity specimens:

Integrate ecological observations across multiple scales



Modified after Schaepman, et al. 2009

NEON as a case study of holistic metadata

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Acknowledgements

ESN White Paper

Extending U.S. Biodiversity Collections to Promote Research and Education

Thiers, Barbara, Anna Monfils, Jennifer Zaspel, Elizabeth Ellwood, Andrew Bentley, Katherine Levan, John Bates, David Jennings, Dori Contreras, Laura Lagomarsino, Paula Mabee, Linda Ford, Robert Guralnick, Robert Gropp, Marcy Revelez, Neil Cobb, James Lendemer, Katja Seltmann and Mary Catherine Aime.

BIODIVERSITY
COLLECTIONS NETWORK

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NEON can be used to:

Enable environmental forecasting