

The Current State of Arthropod Biodiversity Data: Addressing Impacts of Global Change

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Tri-Trophic Thematic Collection Network



SCAN
Southwest Collections of Arthropods Network

The Current State of Arthropod Biodiversity Data: Addressing Impacts of Global Change

- ❖ **How many species can we model future distributions under climate change? (n>30)**
- ❖ **Focus on North America – United States > Canada > Mexico**
- ❖ **Specimen estimates for North American museums (current & projected)**
- ❖ **Digitization in North American museums**
 - ❖ **Biogeography**
 - ❖ **Collection Timeline**
 - ❖ **Major taxonomic & functional groups**
- ❖ **Promoting Observable species**

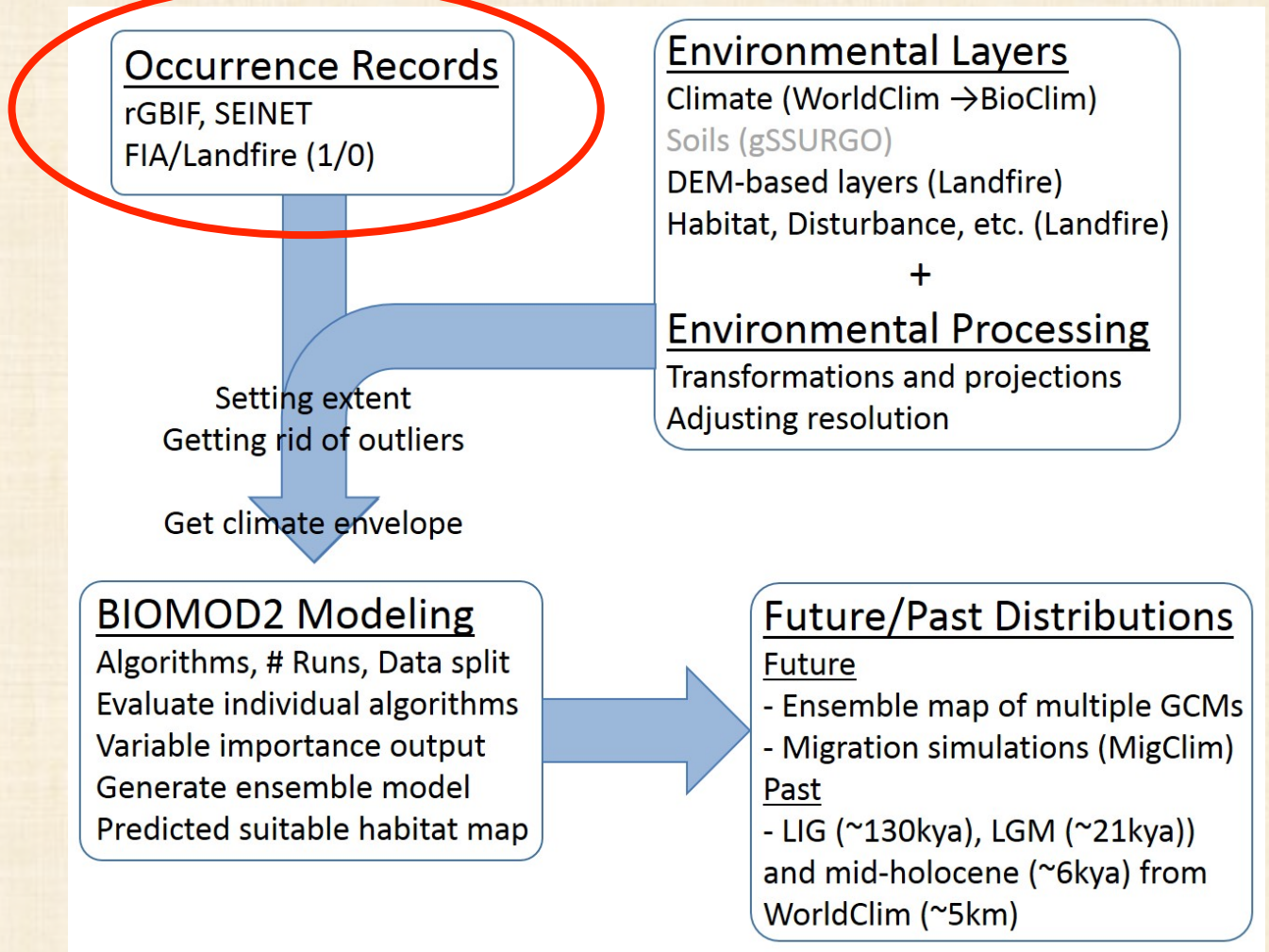
Race Against Time: A Few Key Observations

- ✦ **Arthropods comprise ~70% of described species, only 15% of climate impact studies**
- ✦ **460-600 million specimens worldwide?, <50,000,000 digitized (~10%)**
- ✦ **~10% of North American arthropod species have “enough” occurrence data (n=30)**
- ✦ **Cannot predict global change impacts without knowing existing species distributions**
- ✦ **Arthropod occurrence data resides primarily in museum collections**

Predicting Impacts of Climate Change on Species Distributions

- ❖ 30-100 occurrence localities
- ❖ Distributed over entire range

BIOMOD2+ Modeling Workflow

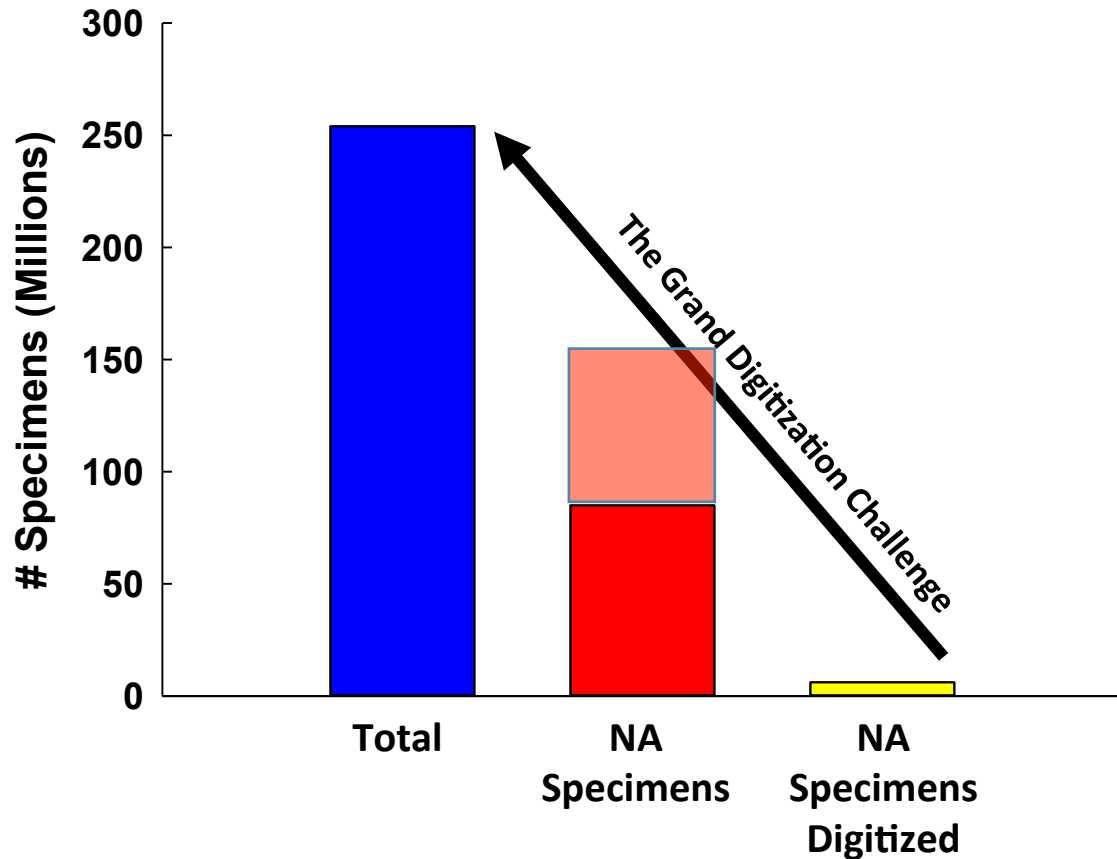


Understanding Climate Change Impacts on Arthropods

Ecological Niche Modeling



North American Arthropod Collections (USA-Canada-Mexico)



Key Estimates

Current Holdings

237 million specimens accounted for¹

>17 million not accounted for²

254 million Total specimens in NA collections

85 million Total North American specimens (?)

6 million digitized North American specimens

¹ 87 collections

² 201 collections

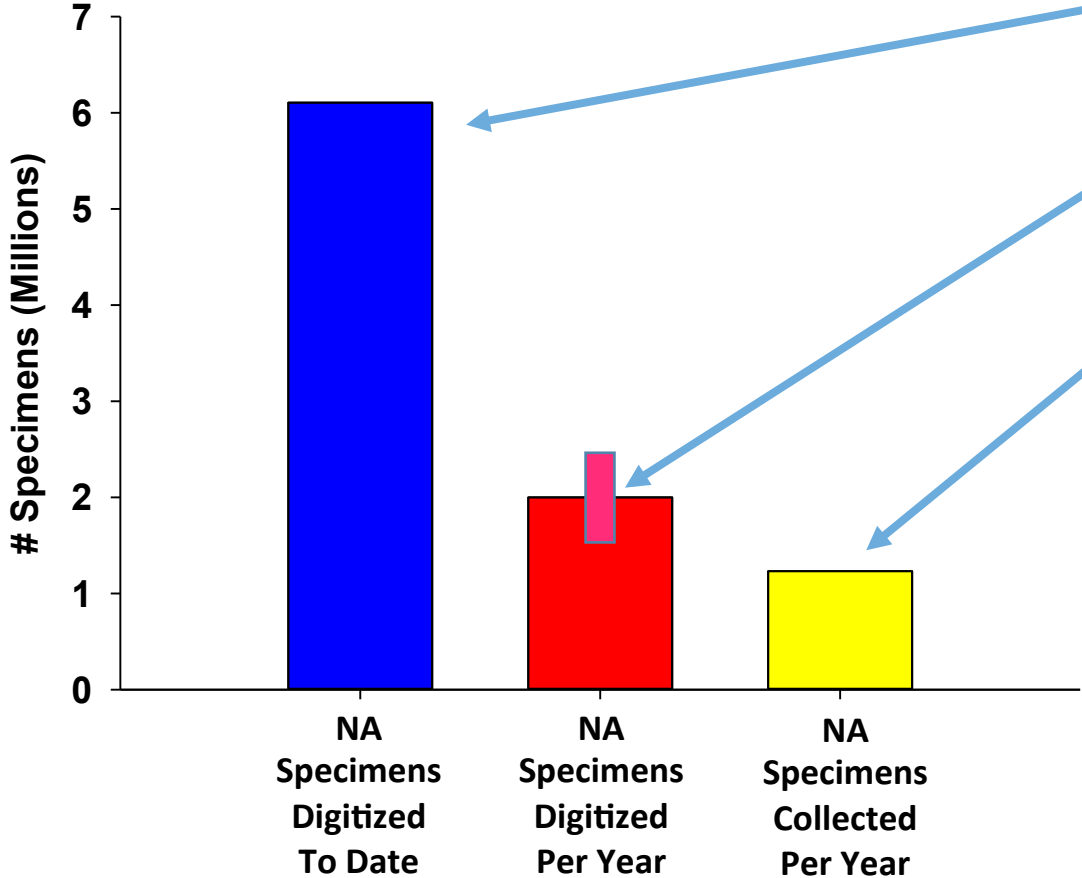
North American Arthropod Collections (USA-Canada-Mexico)

Key Estimates

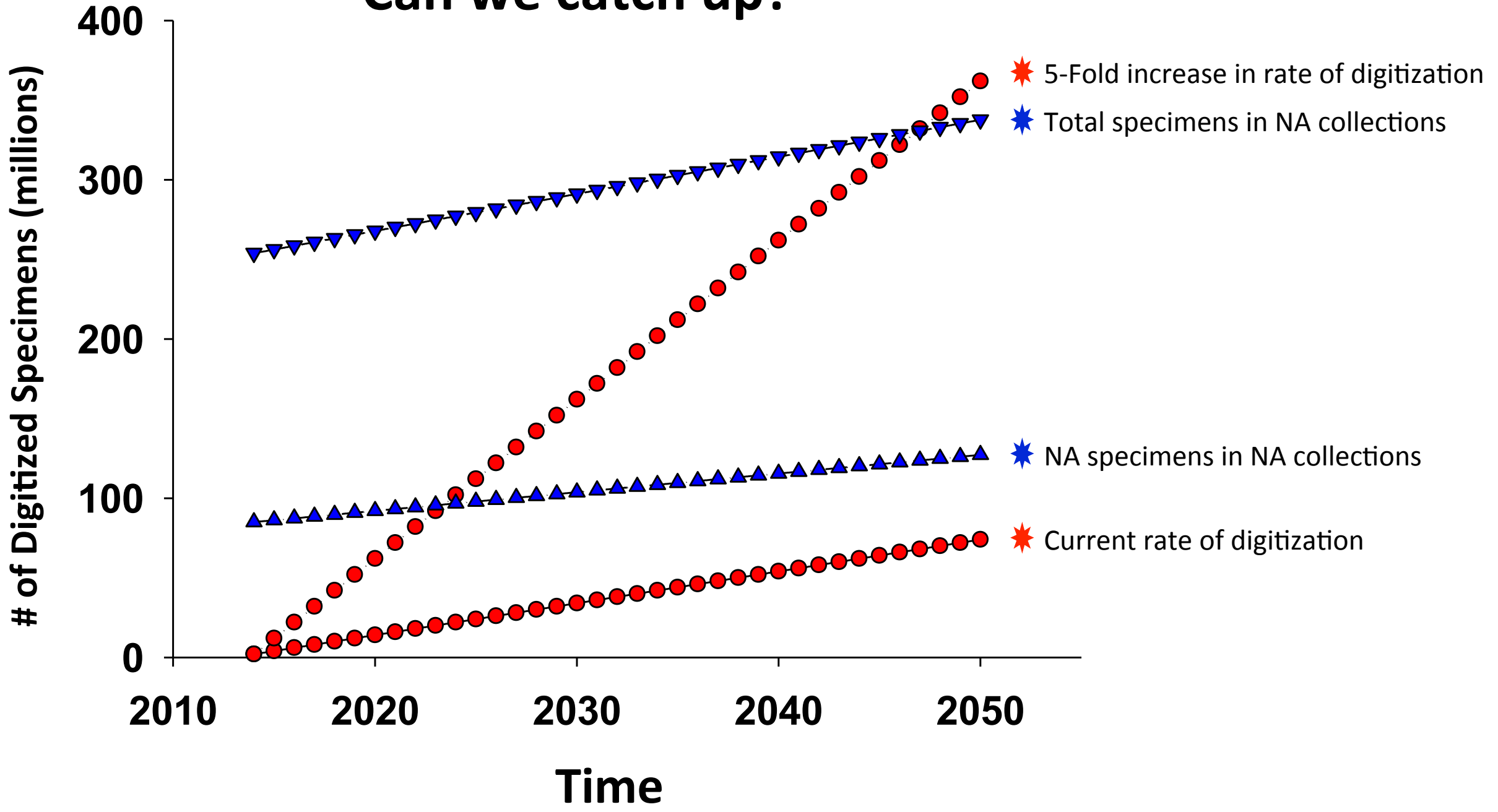
Annual Additions

- 6 million total specimens digitized
- 2 million total specimens digitized per year ?
- 3.5 million new specimens per year
- 1.1 million new North American specimens per year

Can we catch up?



Can we catch up?



The Data

❖ Museum Occurrence Records for United States & Canada

❖ Three sources of data accessed March, 2014

Southwest Collections of Arthropods TCN



(500k)



Tri-Trophic TCN



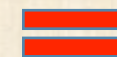
(900k)



GBIF



(3.2 million)



4,606,160



Methods

The “Seltmann model 865B”
Biodiversity Cluster Array

1. Compile raw data
2. Clean data
3. Format data
4. Compile & run scripts

❖ Museum Occurrence Records for United States & Canada

2,166 Families

20,153 Genera

80,161 Species (105,000 total in NA [?])

61,305 Species (Georeferenced)

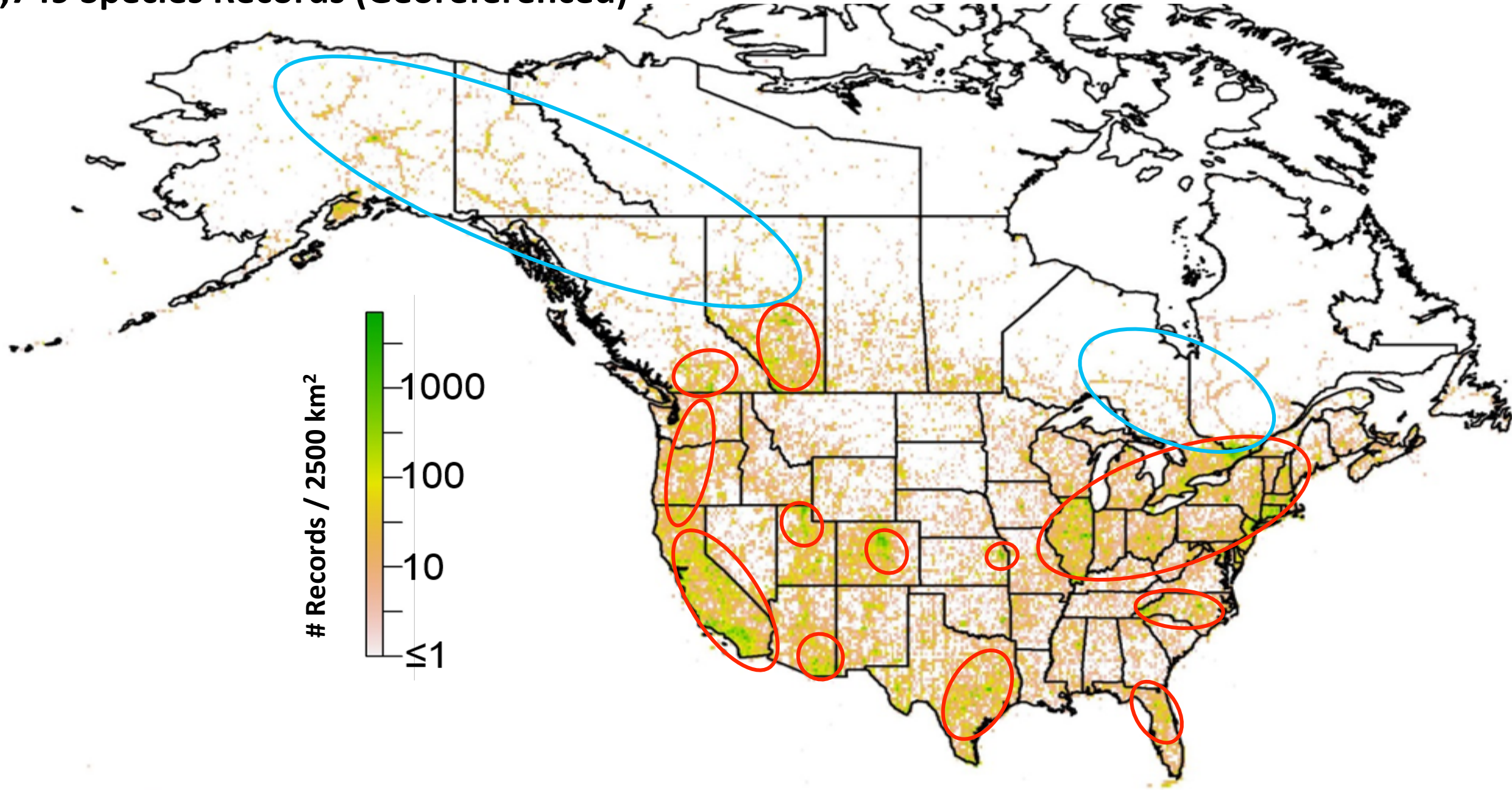
4,606,160 Specimen Records

3,733,257 Georeferenced Records (81%)

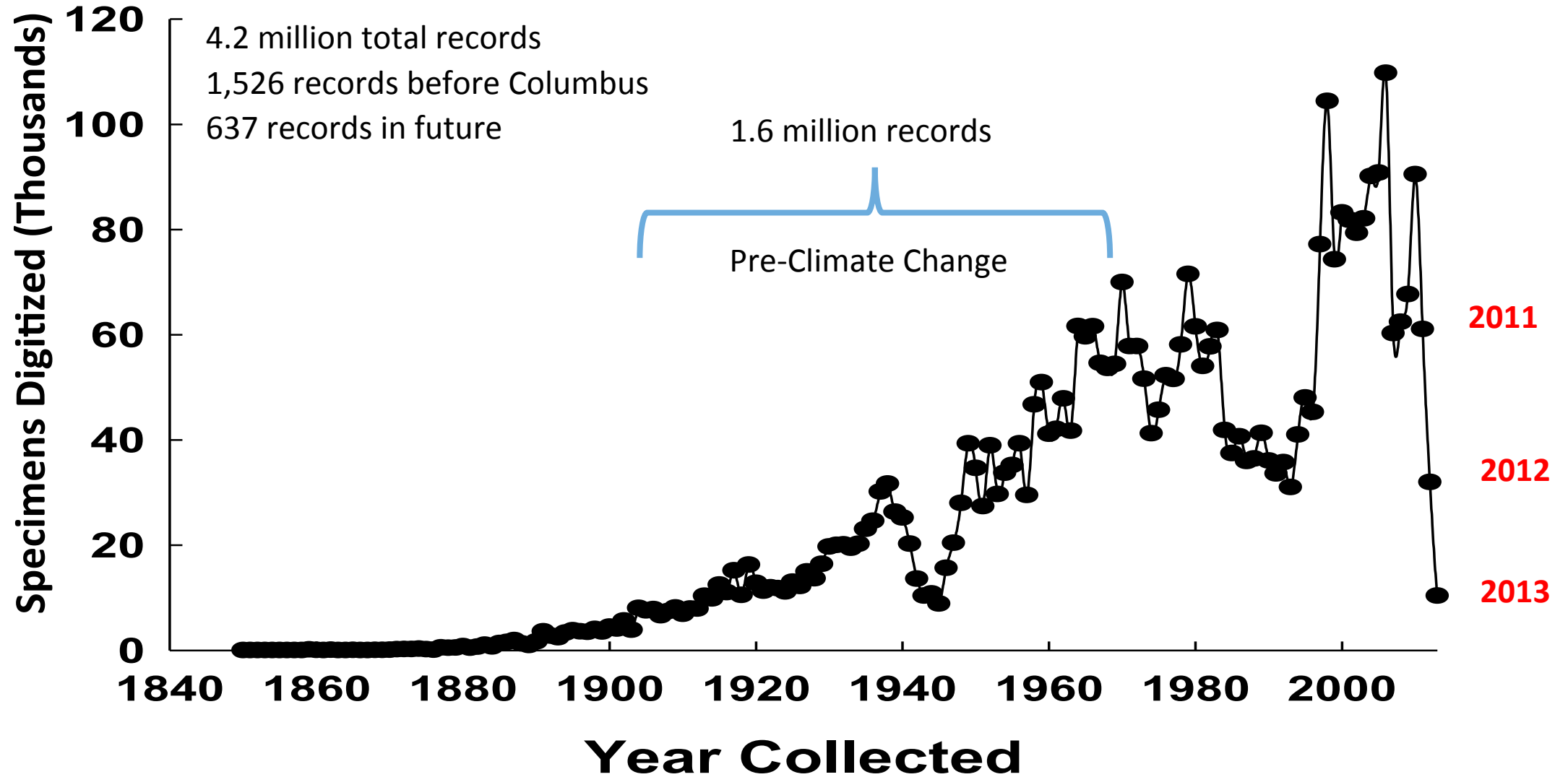
2,803,956 Identified to Species (60%)

692,749 Unique Occurrences

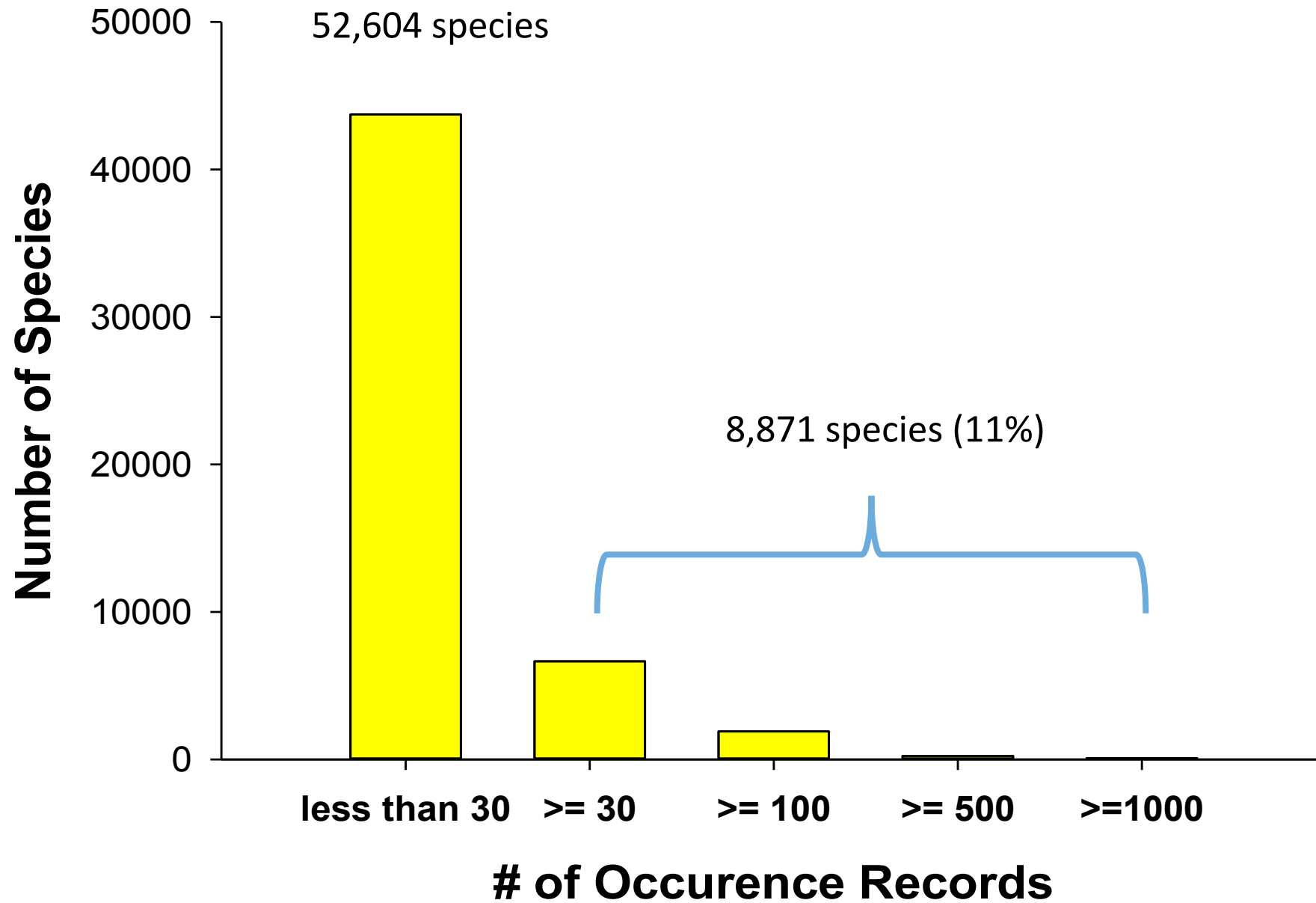
Biogeography of NA Arthropod Collections 692,749 Species Records (Georeferenced)



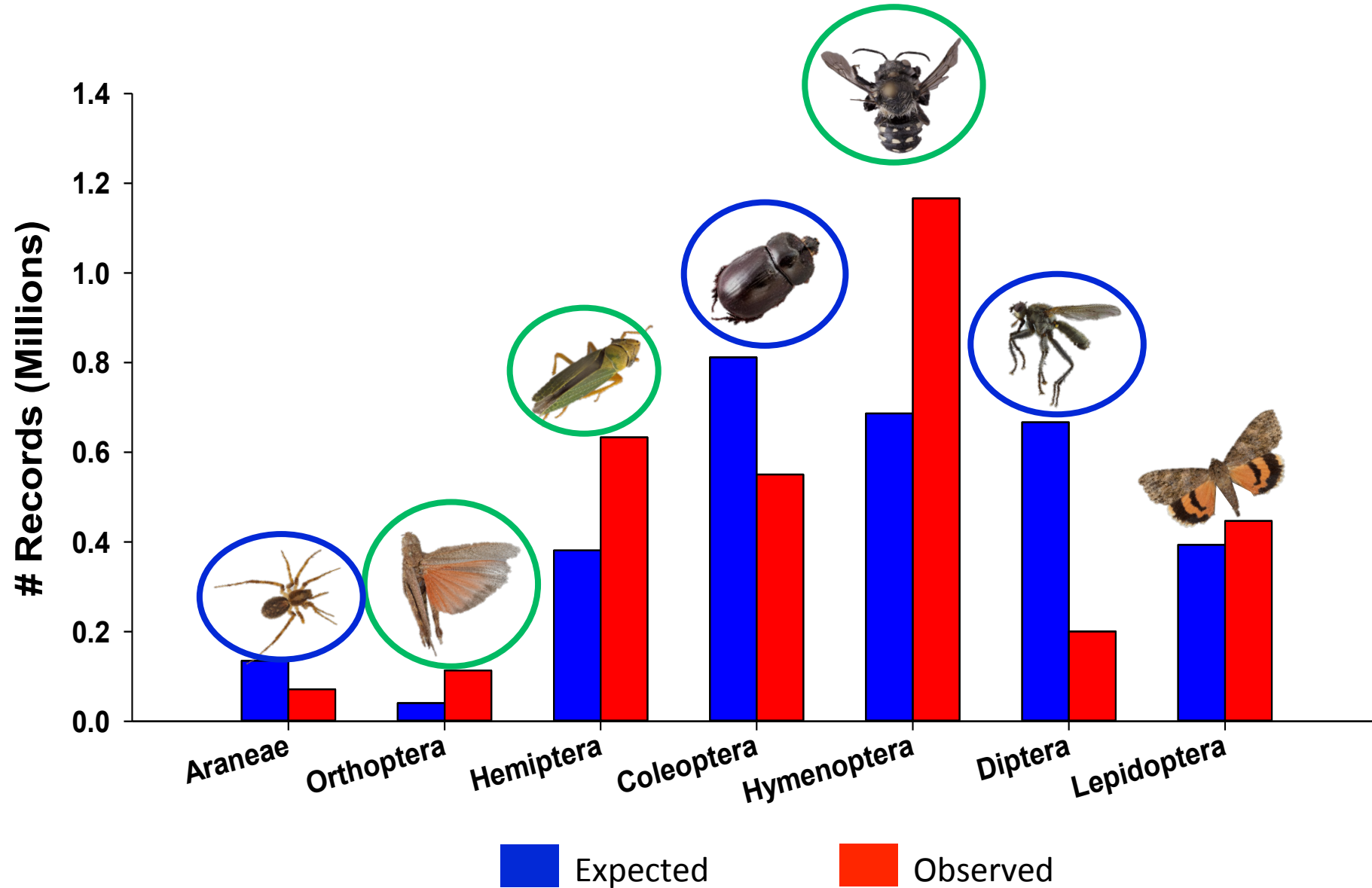
Timeline of Arthropod Collecting?



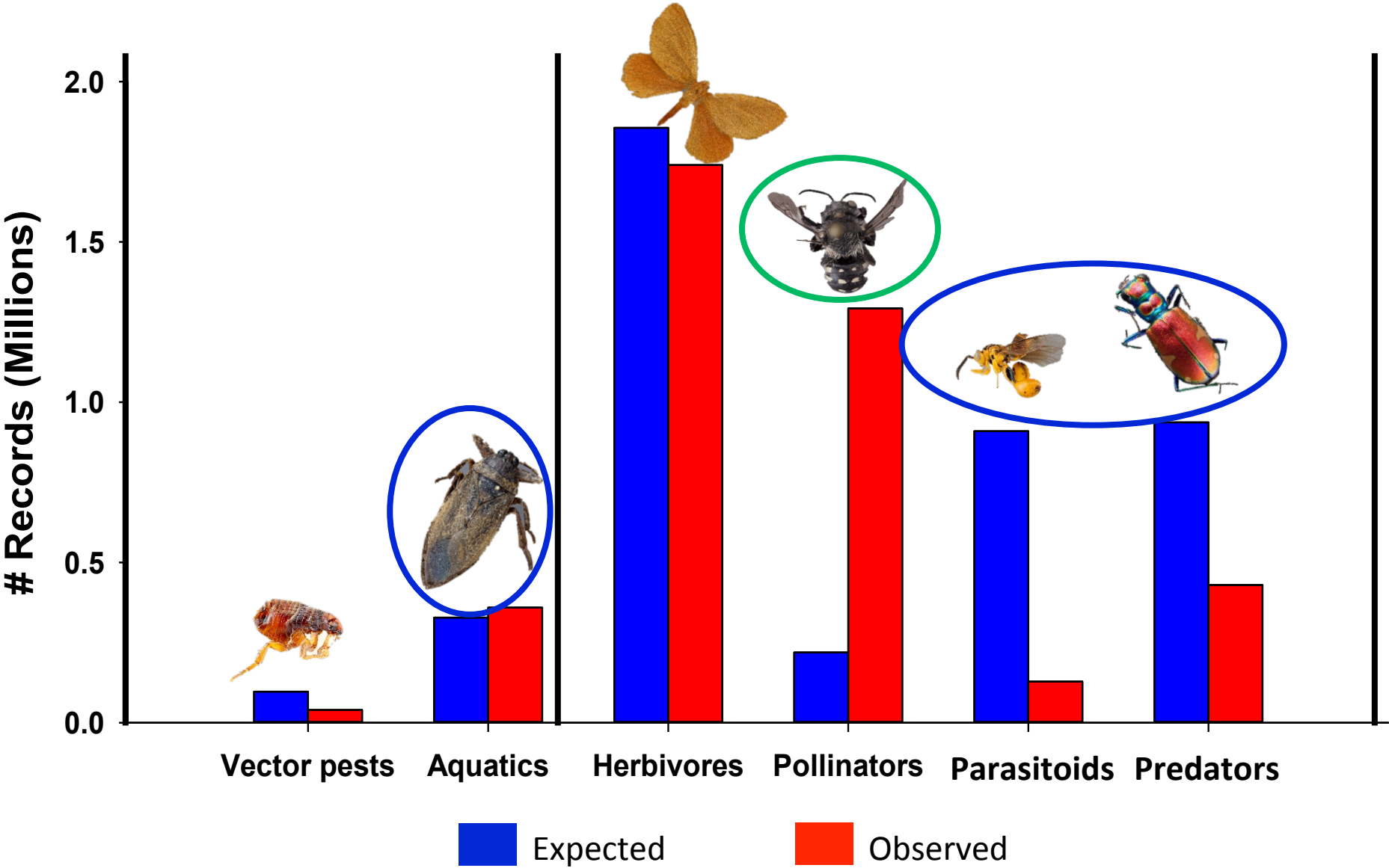
Research Ready Data (identified to species & georeferenced)



Taxonomic Distribution: Expected vs. Observed Records



Ecological Distribution: Expected vs. Observed Records



Status of *Research-Ready* Arthropod Biodiversity Data

- 1. Fraction of specimens digitized, but enough to model for climate change impacts.**
- 2. Biogeography of specimen records confirms geographic significant bias.**
- 3. Historical data indicate enough taxa can be tested for climate change responses NOW.**
- 4. Taxonomic breadth of data generally good (except Diptera & Coleoptera?).**
- 5. Ecological breadth of data generally good (except predators & parasitoids).**

Museums currently hold the vast majority of arthropod occurrence data!!

How many arthropod species are observable in the field?

Can we follow the V&Vers (Vascular plant and Vertebrate scientists?)

Field-observable arthropod taxa

- Dragonflies some damselflies
- Other aquatic groups
- Butterflies & Moths
- Ants
- Grasshoppers
- Crickets
- Cockroaches
- Earwigs
- Vespid Wasps
- Miscellaneous species

Projects that use observations

- Odonata Central
- Butterflies & Moths of NA
- Moth Photographers Group
- BugGuide
- Cricket Crawl
- Lost Ladybug
- Great Sunflower Project
- Discoverlife (Bee Hunt)
- Life on Loosestrife

of NA arthropod species that can be observed in field and/or images

- 9,000 non-lepidopteran species
- 6,800 lepidopteran species
- 15,800 total observable species?
- 84,200 total “unobservable” species?

Interim Conclusions

Lots to do



Lots to work with



Take Your Pick

TCN Collaboration



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