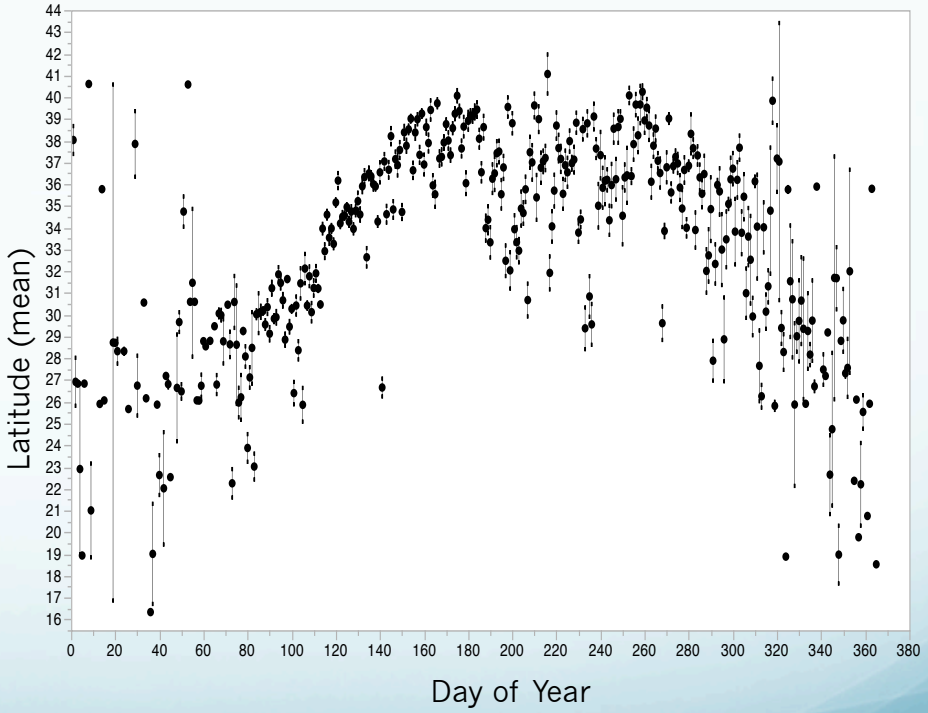
From Museum Specimen Database to Ecological Statement

Christine A. Johnson
Division of Invertebrate Zoology



Tri-trophic Digitization Team

Thematic Collections Network

Toby Schuh (Lead PI), Christine Johnson, ***Charles Bartlett***, John Heraty, Bob Magill, Rob Naczi, Benjamin Normark, ***Rich Rabeler,*** Melissa Tulig, Kim Watson, Christiane Weirauch, ***Katja Seltmann (Project Manager)***, Collaborating Institutions, *Digitizers!*

Funding & Support

NSF-ADBC
iDigBio
Barbara Thiers (NYBG Herbarium)
John Pickering (Discover Life)

Tri-trophic Digitization

Thematic Collections Network

Photo: S. Bauer

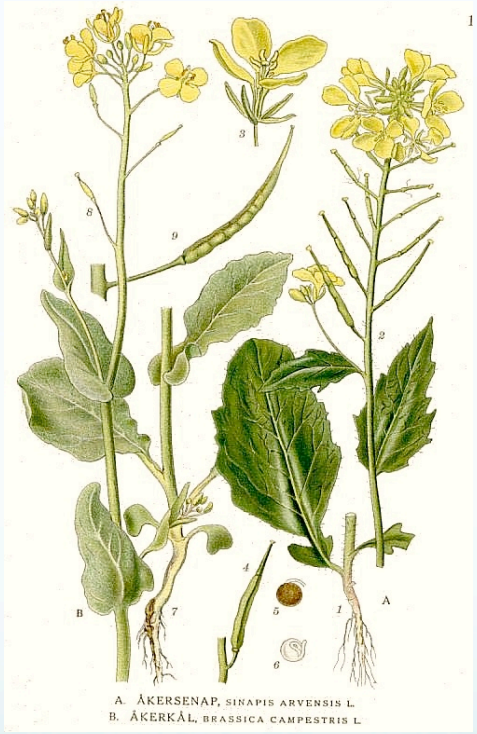


Illustration: W. J. Hooker

Photo: C. A. Johnson

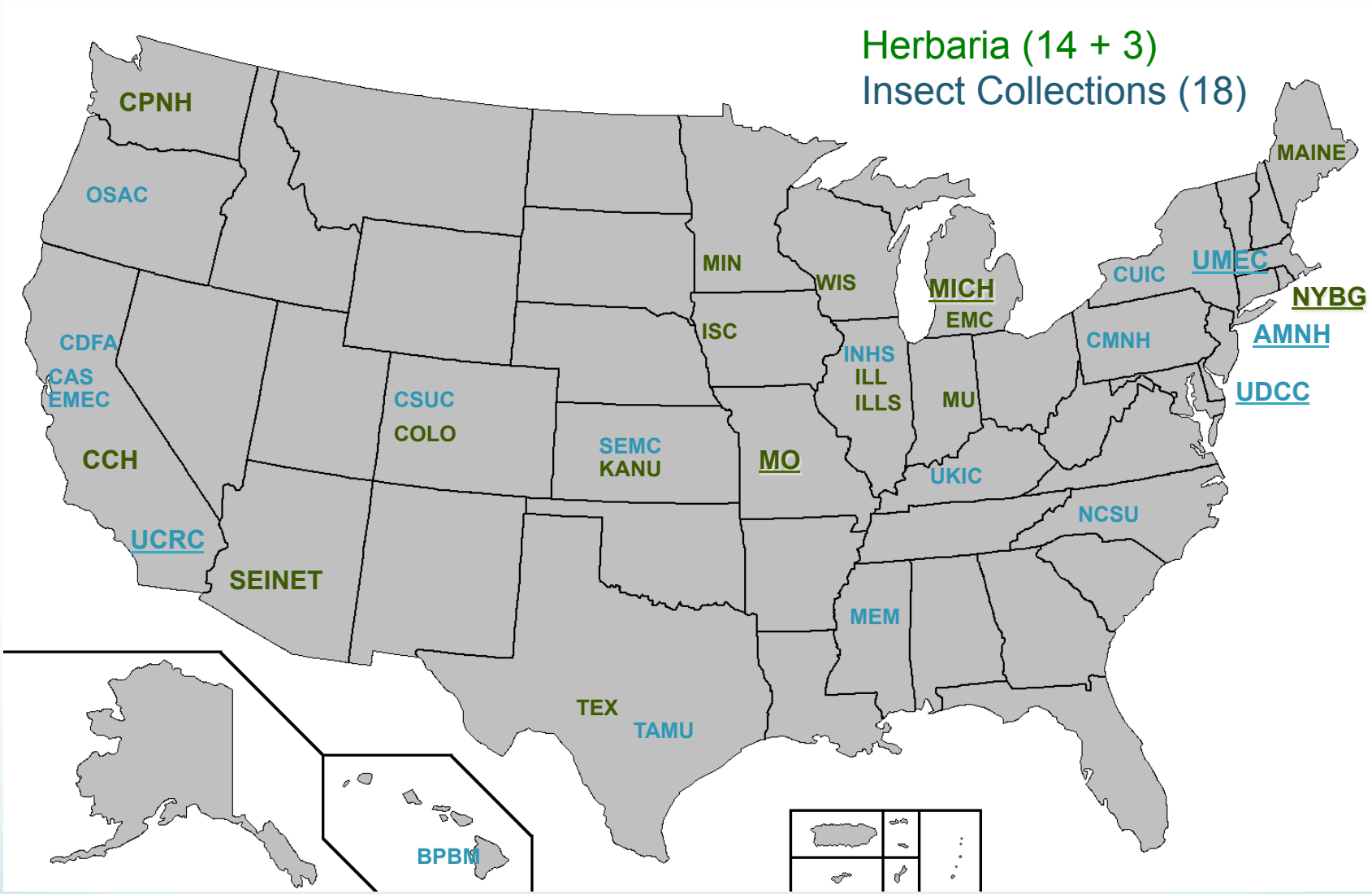


Image: Rich Rabeler

Tri-trophic Digitization

Thematic Collections Network

Tri-trophic Digitization Progress
Thematic Collections Network

- **Specimens Digitized**
  - Insects: 1,211,000 (cps = $1.33)
  - Plants: 63,513 (complete); 424,747 ("skeletal") (cps = .47)
- **Specimens Imaged**
  - Insects: ~10K
  - Plants: 1,019,764
- **Localities Georeferenced**
  - Insects: 54%
  - Plants: 16%
- **Submitted to iDigBio Aggregator**
  - Insects: 785,320
  - Plants: 281,127

From Museum Specimen Database to Ecological Statement:

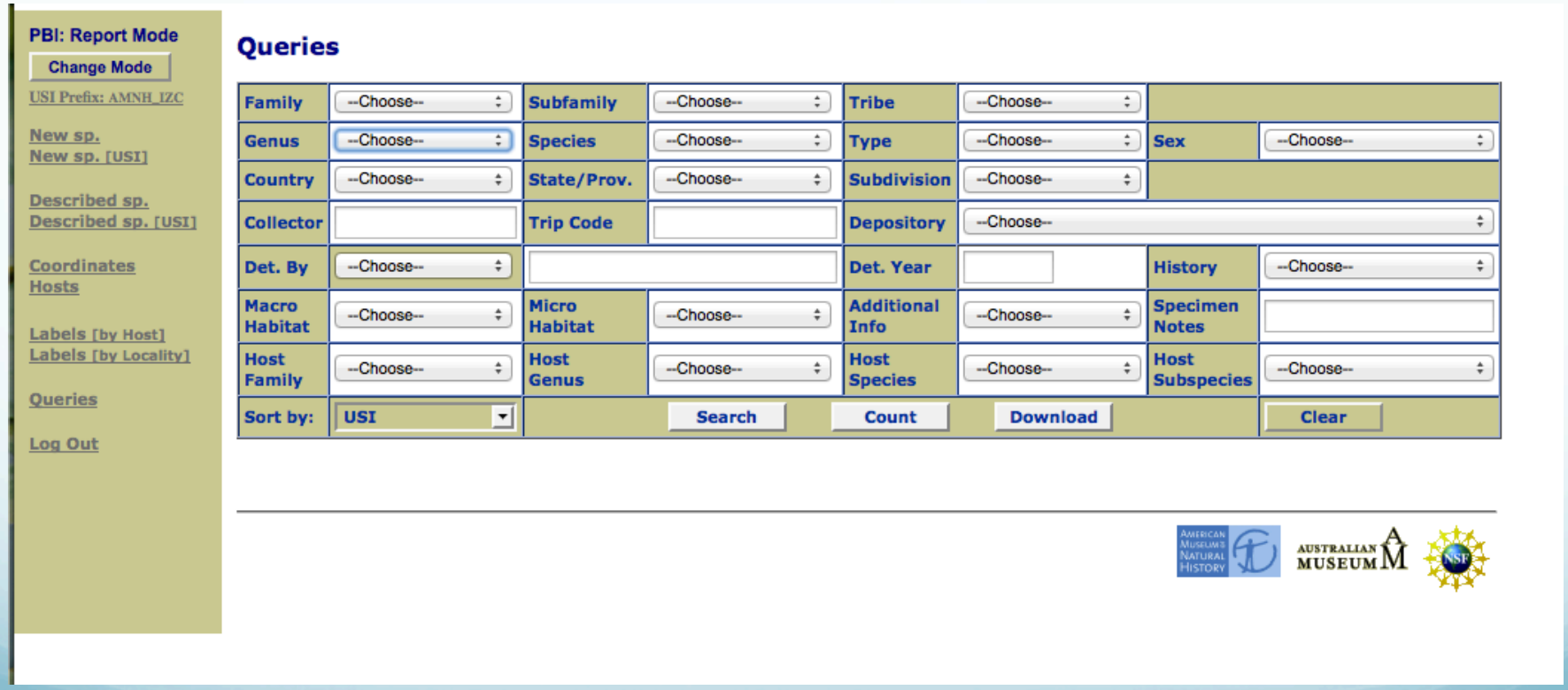
Climate change has an effect on the timing of bug “emergence”

Photo: Prud’homme et al. 2011

Photo: UFAL Campus – Maceió Michal Hoskovec

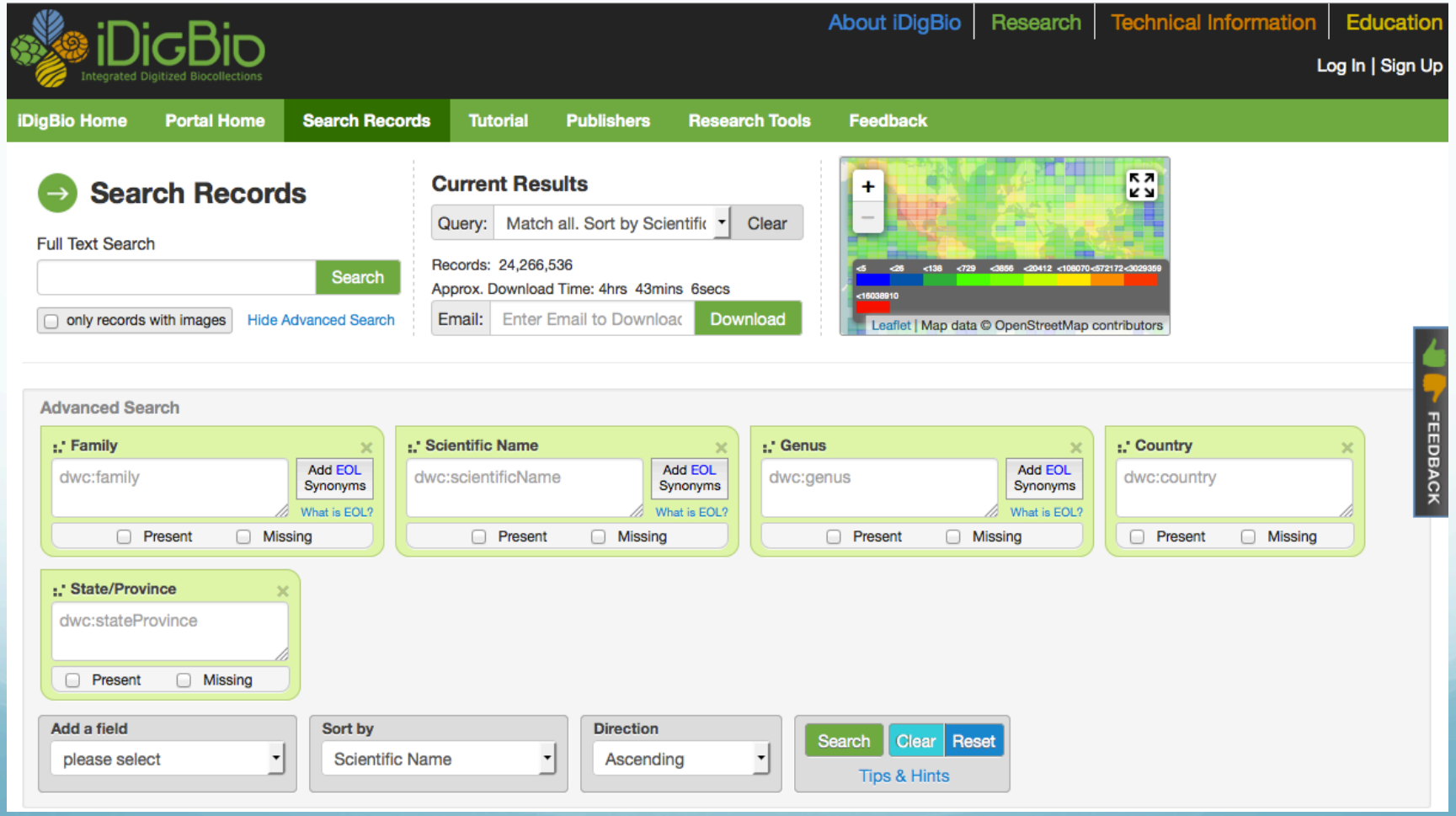
From Museum Specimen Database to Ecological Statement:

Arthropod Easy Capture Database



From Museum Specimen Database to Ecological Statement:

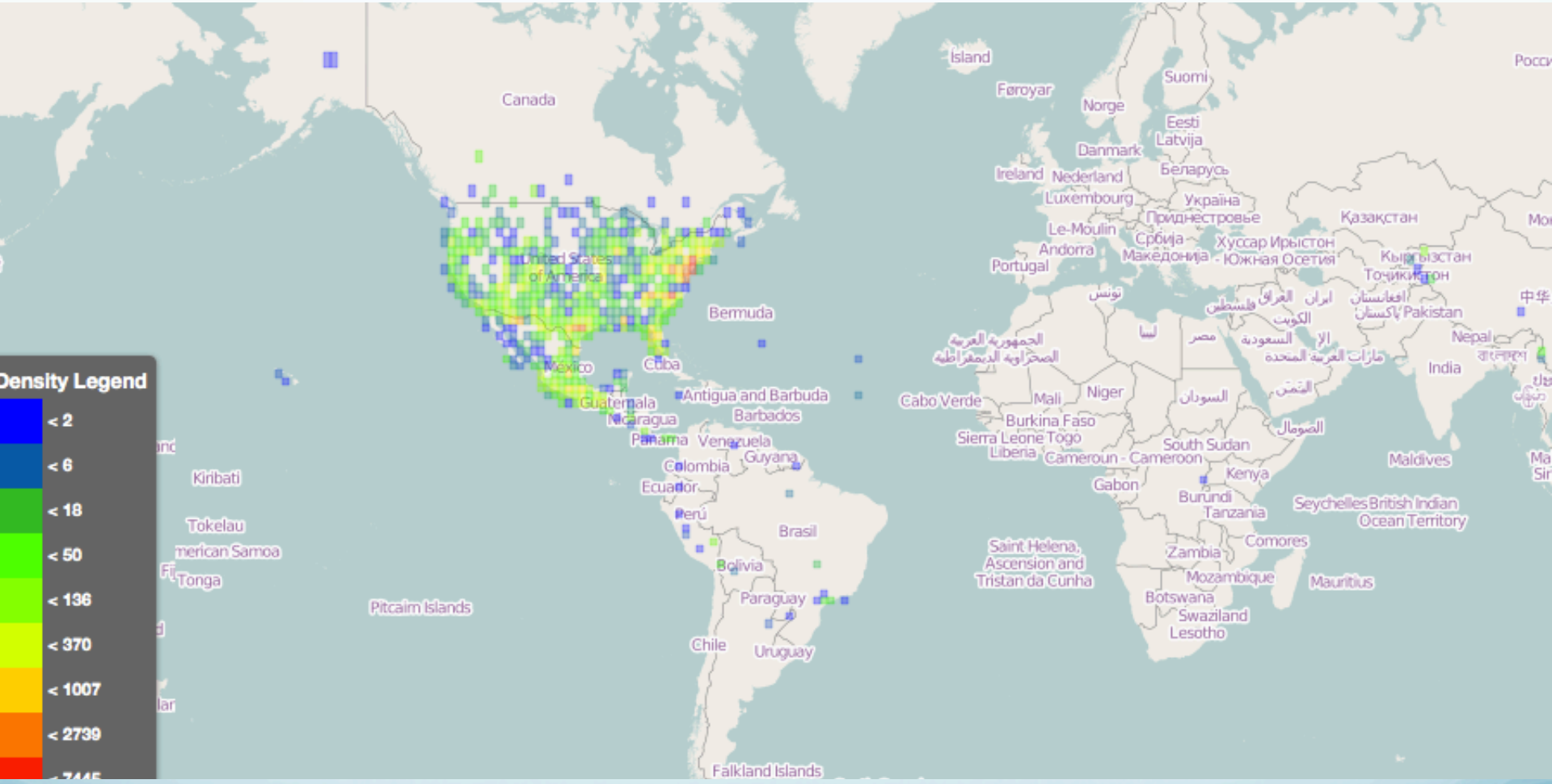
iDigBio Aggregator

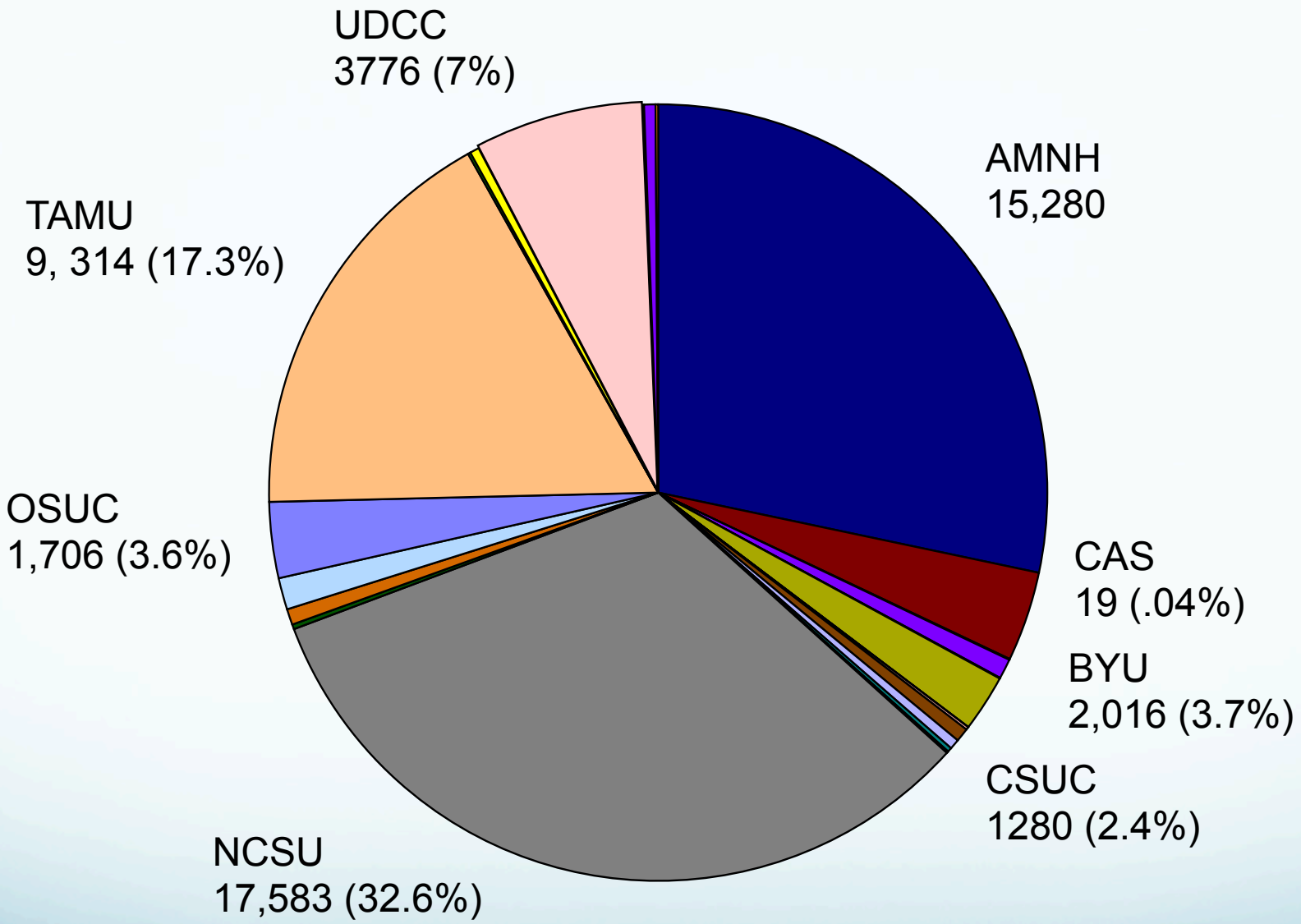


From Museum Specimen Database to Ecological Statement:

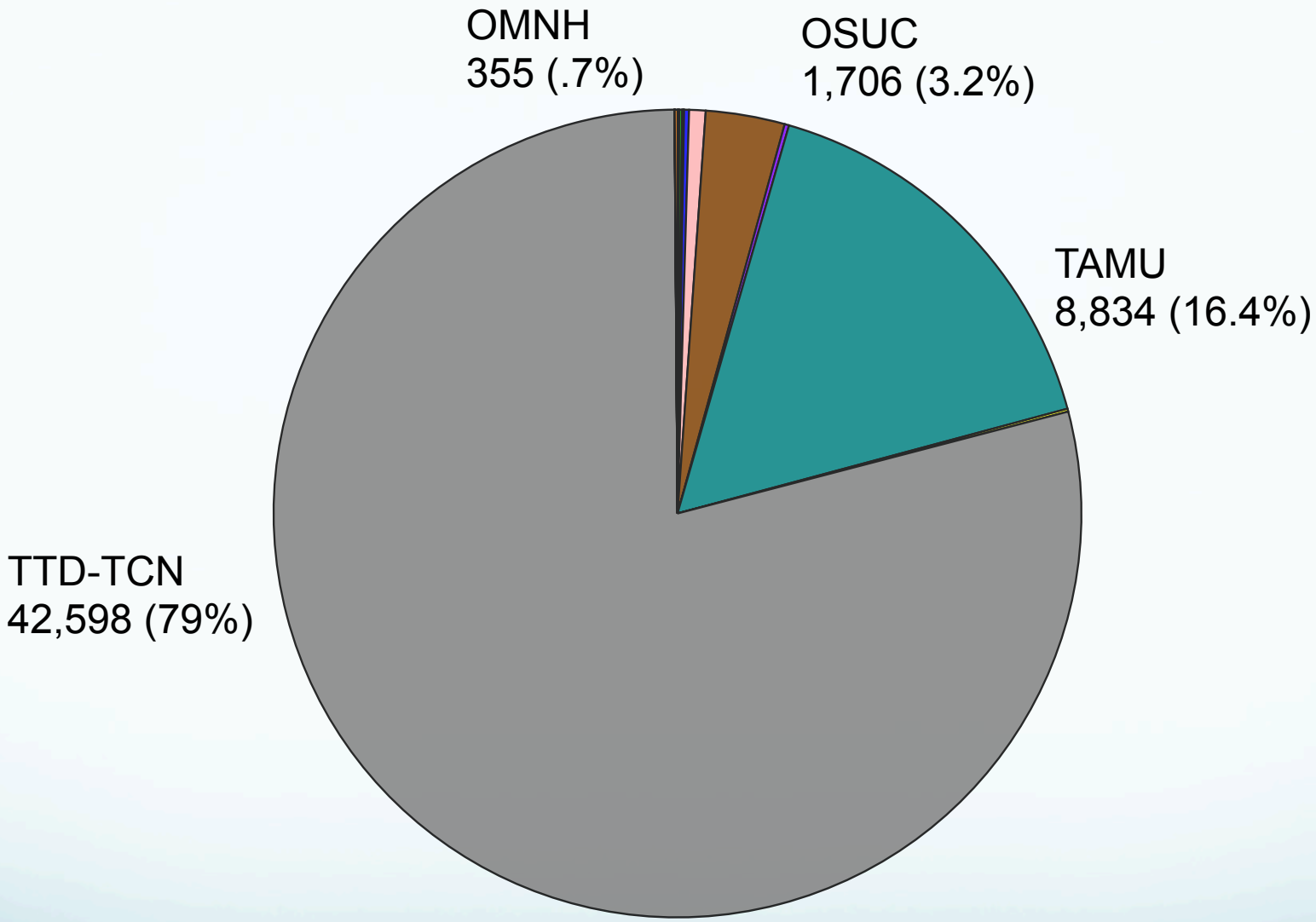
Climate change has an effect on the timing of bug "emergence"

- Downloaded Membracidae from iDigBio Portal (N = 53,959, no duplicate GUID/UUID)


Density Legend
< 2
< 6
< 18
< 50
< 136
< 370
< 1007
< 2739
Canada
United States of America
Mexico
Cuba
Bermuda
Guatemala
Nicaragua
Panama
Antigua and Barbuda
Barbados
Venezuela
Guyana
Colombia
Ecuador
Perú
Brasil
Bolivia
Paraguay
Chile
Uruguay
Falkland Islands
Pitcairn Islands
Kiribati
Tokelau
Tonga
Island
Føroyar
Norge
Suomi
Eesti
Latvija
Danmark
Ireland
Nederland
Беларусь
Luxembourg
Україна
Приднестровье
Le-Moulin
Andorra
Portugal
Србија
Македонија
Хуссар Ирыстон - Южная Осетия
Қазақстан
Кыргызстан
Тоҷикистон
Pakistan
Nepal
India
Cabo Verde
Mali
Niger
Burkina Faso
Sierra Leone
Togo
Liberia
Cameroun - Cameroon
South Sudan
Kenya
Gabon
Burundi
Tanzania
Comores
Zambia
Mozambique
Botswana
Swaziland
Lesotho
Saint Helena, Ascension and Tristan da Cunha
Seychelles
British Indian Ocean Territory
Maldives
Mauritius



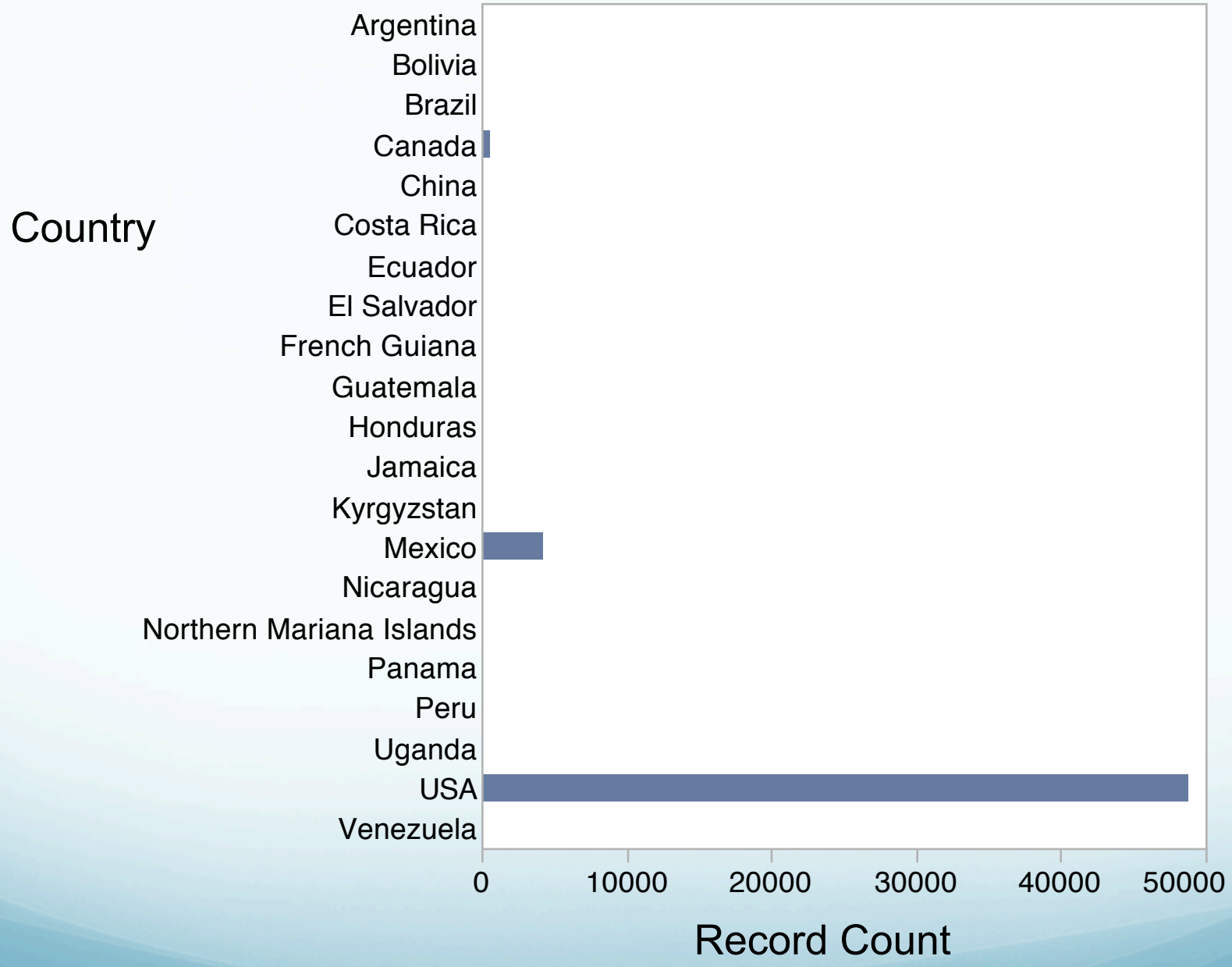
Membracids Data Records Submitted to iDigBio Aggregator By Institution

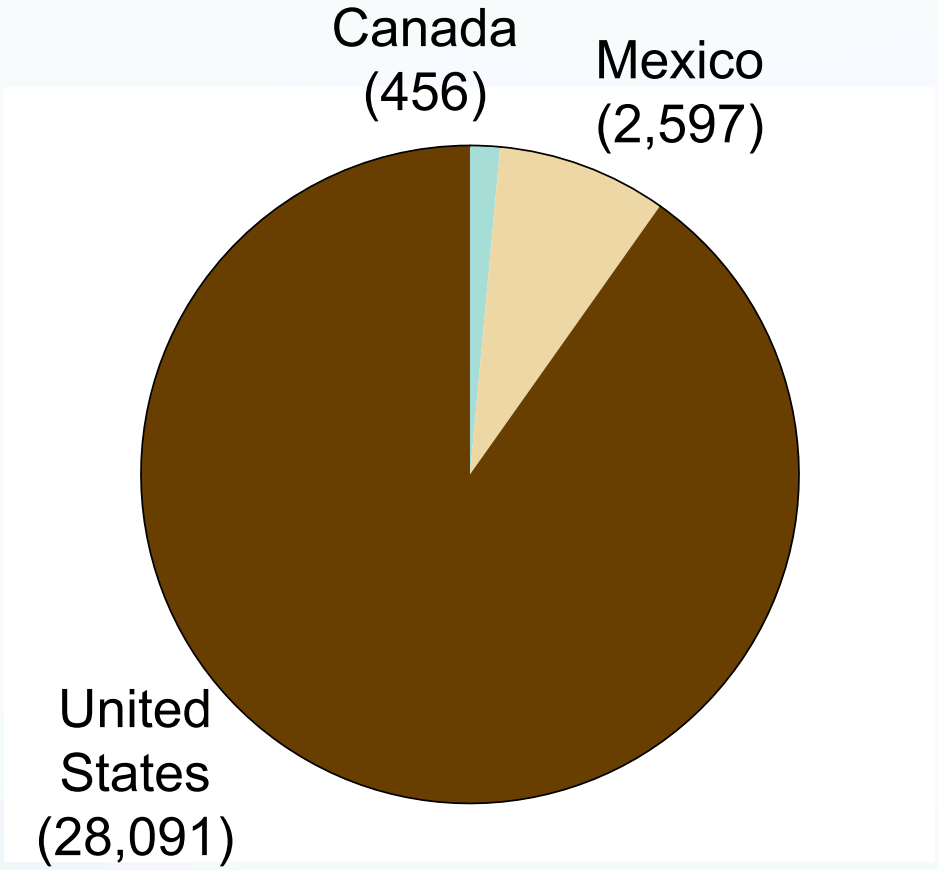


Membracidae Databased & Submitted to iDigBio By “Project” Name

Data “Problems”

- No locality information
- Localities not georeferenced
- Skeletal taxonomy records - no information below subfamily or tribe level
- Duplicate information in different fields
- Some outdated taxonomy
- Little info about the host
- Outdated/error in host taxonomy also


Country
Argentina
Bolivia
Brazil
Canada
China
Costa Rica
Ecuador
El Salvador
French Guiana
Guatemala
Honduras
Jamaica
Kyrgyzstan
Mexico
Nicaragua
Northern Mariana Islands
Panama
Peru
Uganda
USA
Venezuela
0
10000
20000
30000
40000
50000
Record Count



“Complete” North American Records of Membracidae

Subfamily: Tribe: Genus species

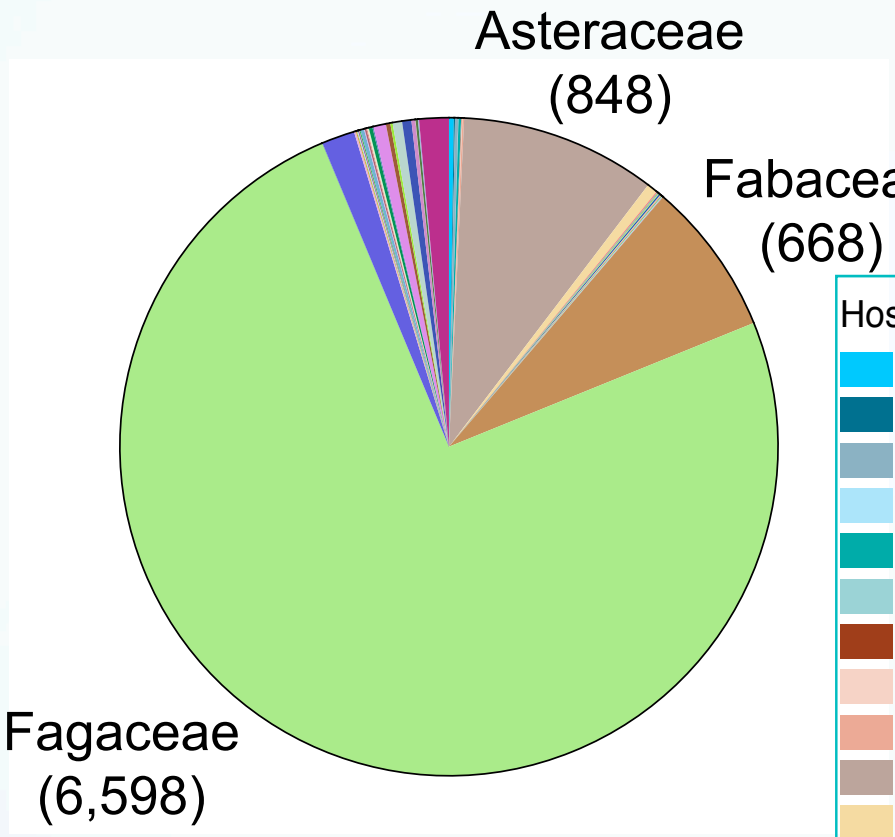
Number of Host Plants per Membracid Species

Centrodontinae: Centrodontini: Multareis cornutus
Centrodontinae: Centrodontini: Multareoides digitatus
Centrotinae: Platycentrini: Platycentrus brevicornis
Centrotinae: Platycentrini: Tylocentrus reticulatus
Darninae: Darnini: Stictopelta nova
Membracinae: Hoplophorionini: Platycotis vittata
Membracinae: Hypsoprorini: Hypsoprora nogolata
Membracinae: Membracini: Campylenchia latipes
Membracinae: Membracini: Enchenopa permutata
Membracinae: Membracini: Leioscyta ferruginipennis
Smiliinae: Acutalini: Acutalis tartarea
Smiliinae: Amastrini: Vanduzea arquata
Smiliinae: Amastrini: Vanduzea triguttata
Smiliinae: Ceresini: Ceresa taurina
Smiliinae: Ceresini: Hadrophallus bubalus
Smiliinae: Ceresini: Spissistilus festinus
Smiliinae: Ceresini: Stictocephala basalis
Smiliinae: Ceresini: Stictocephala brevicornis
Smiliinae: Ceresini: Stictocephala diceros
Smiliinae: Ceresini: Stictocephala militaris
Smiliinae: Ceresini: Stictocephala stimulea
Smiliinae: Ceresini: Tortistilus inermis
Smiliinae: Micrutalini: Micrutalis calva
Smiliinae: Micrutalini: Micrutalis occidentalis
Smiliinae: Polyglyptini: Entylia carinata
Smiliinae: Polyglyptini: Publilia erecta
Smiliinae: Polyglyptini: Publilia reticulata
Smiliinae: Smiliini: Atymna castaneae
Smiliinae: Smiliini: Atymna inornata
Smiliinae: Smiliini: Cyrtolobus acutus
Smiliinae: Smiliini: Cyrtolobus auroreus
Smiliinae: Smiliini: Cyrtolobus clarus
Smiliinae: Smiliini: Cyrtolobus dixianus
Smiliinae: Smiliini: Cyrtolobus flavolatus
Smiliinae: Smiliini: Cyrtolobus funkhouseri
Smiliinae: Smiliini: Cyrtolobus gramatanus
Smiliinae: Smiliini: Cyrtolobus griseus
Smiliinae: Smiliini: Cyrtolobus limus
Smiliinae: Smiliini: Cyrtolobus oblongatus
Smiliinae: Smiliini: Cyrtolobus pallidifrontis
Smiliinae: Smiliini: Cyrtolobus pulchellus
Smiliinae: Smiliini: Cyrtolobus rufulus
Smiliinae: Smiliini: Cyrtolobus tuberosus
Smiliinae: Smiliini: Grandolobus grandis
Smiliinae: Smiliini: Ophiderma evelyna
Smiliinae: Smiliini: Ophiderma flavicephala
Smiliinae: Smiliini: Ophiderma pubescens
Smiliinae: Smiliini: Smilia camelus
Smiliinae: Smiliini: Telamonanthe pulchella
Smiliinae: Smiliini: Xantholobus inflatus
Smiliinae: Smiliini: Xantholobus lateralis
Smiliinae: Smiliini: Xantholobus nigrocinctus
Smiliinae: Telamonini: Archasia auriculata
Smiliinae: Telamonini: Carynota marmorata
Smiliinae: Telamonini: Carynota stupida
Smiliinae: Telamonini: Glossonotus crataegi
Smiliinae: Telamonini: Glossonotus turriculatus
Smiliinae: Telamonini: Heliria cristata
Smiliinae: Telamonini: Heliria scalaris
Smiliinae: Telamonini: Palonica portola
Smiliinae: Telamonini: Telamona ampelopsidis
Smiliinae: Telamonini: Telamona concava
Smiliinae: Telamonini: Telamona dubiosa
Smiliinae: Telamonini: Telamona gibbera
Smiliinae: Telamonini: Telamona monticola
Smiliinae: Telamonini: Telamona salvini
Smiliinae: Telamonini: Telamona tristis
Smiliinae: Telamonini: Telamona vestita
Smiliinae: Telamonini: Thelia uhleri
Stegaspidinae: Microcentrini: Microcentrus perditus

0 5 10 15 20 25 30 35 40 45

Platycotis vittata (37)
Photo: E. Gofreed

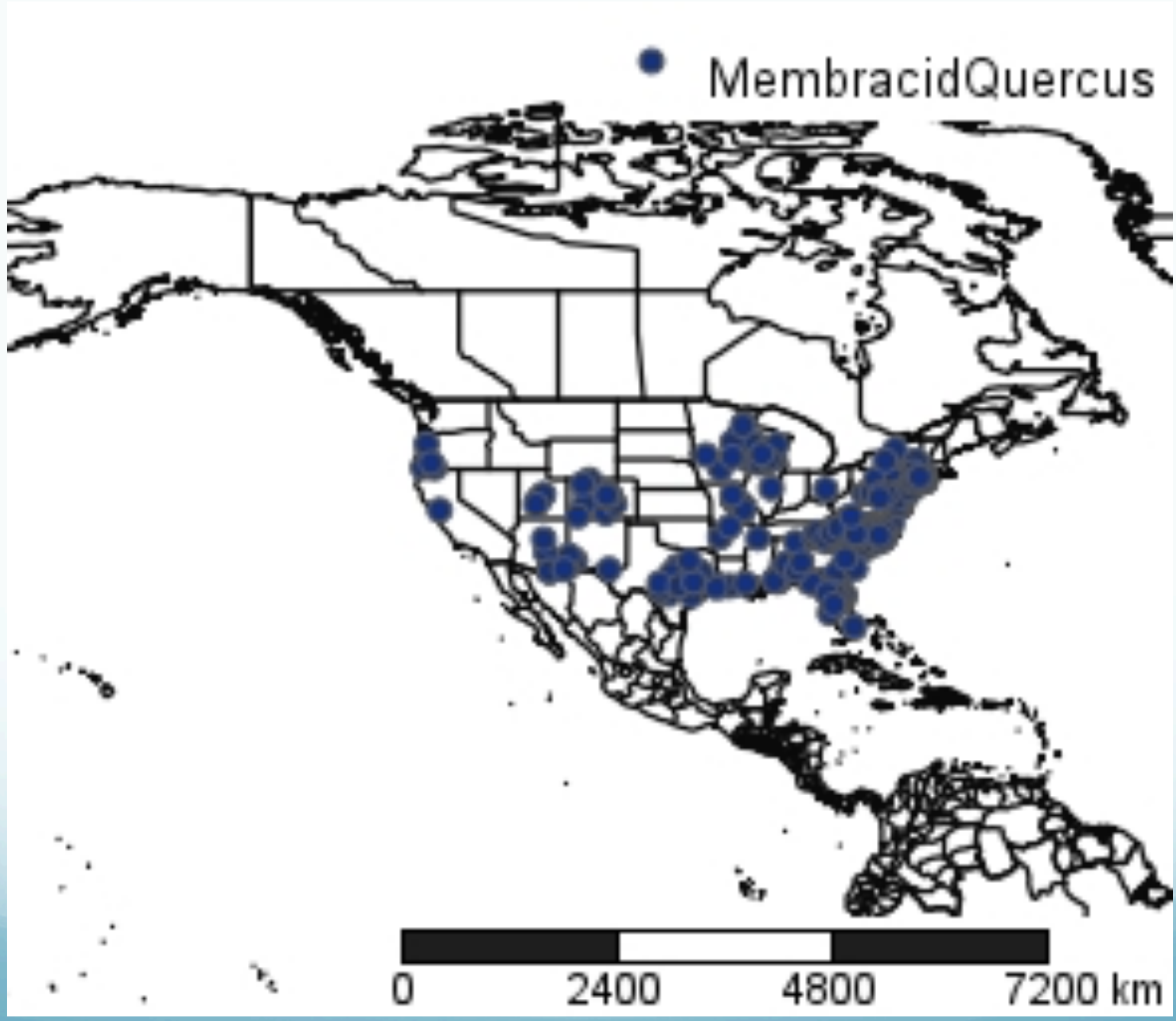
Entylia carinata (43)
Photo: metrioptera



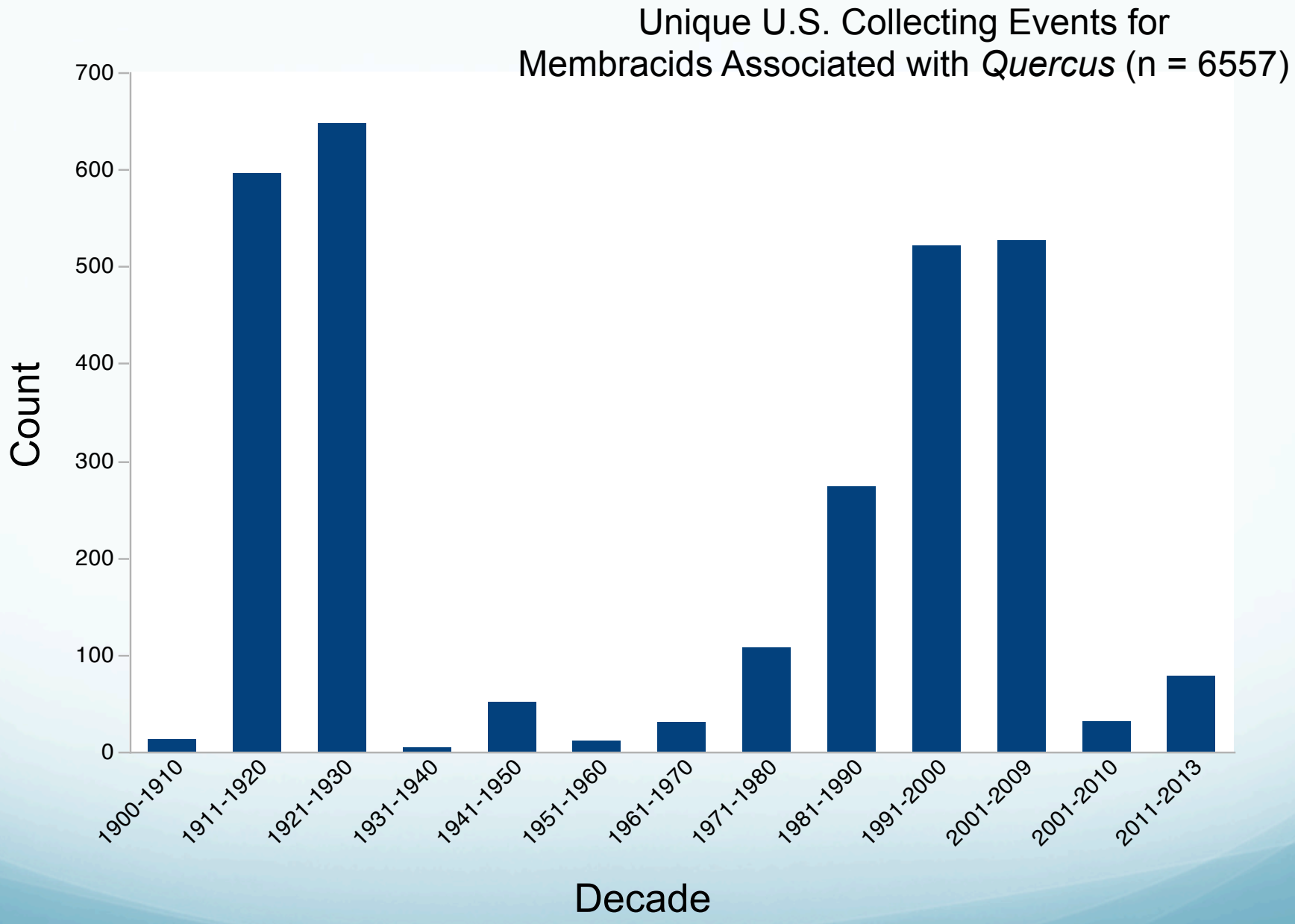
HostFamily

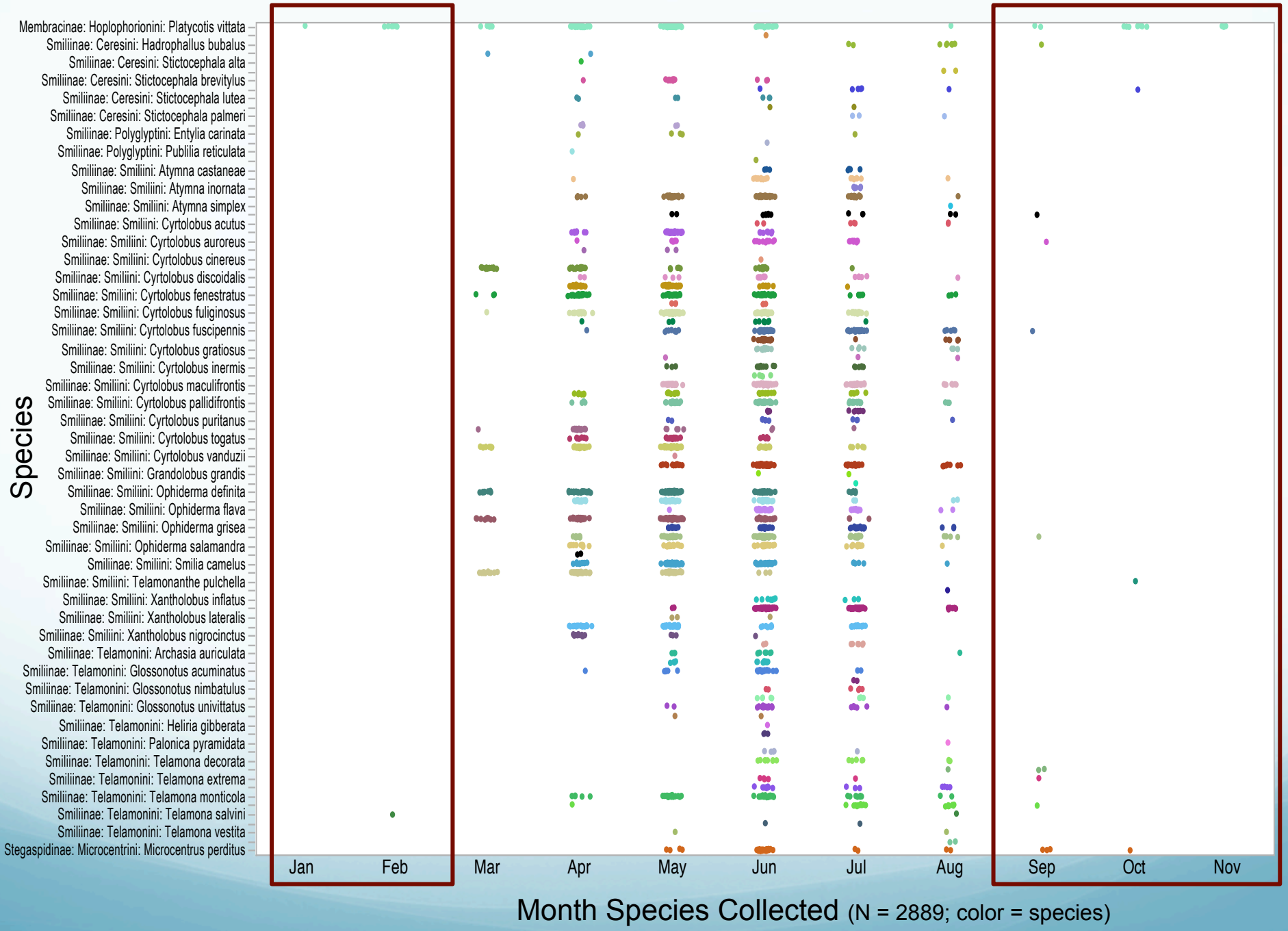
- Adoxaceae
- Altingiaceae
- Amaranthaceae
- Anacardiaceae
- Apiaceae
- Apocynaceae
- Araceae
- Araliaceae
- Arecaceae
- Asteraceae
- Betulaceae
- Brassicaceae
- Bromeliaceae
- Cannabaceae
- Celastraceae
- Chenopodiaceae
- Cleomaceae
- Compositae
- Convolvulaceae
- Cornaceae
- Cupressaceae
- Euphorbiaceae
- Fabaceae
- Fagaceae
- Grossulariaceae
- Juglandaceae
- Lauraceae
- Magnoliaceae
- Malvaceae
- Moraceae
- Myracaceae
- Oleaceae
- Phytolaccaceae
- Pinacaeae
- Pinaceae
- Plantanaceae
- Platanaceae
- Poaceae
- Polygonaceae
- Ranunculaceae
- Rhamnaceae
- Rosaceae
- Salicaceae
- Sapindaceae
- Sarcobataceae
- Smilacaceae
- Solanaceae
- Ulmaceae
- Unplaced
- Urticaceae
- Vitaceae
- Zygophyllaceae

Host Families in U.S. Membracid Records

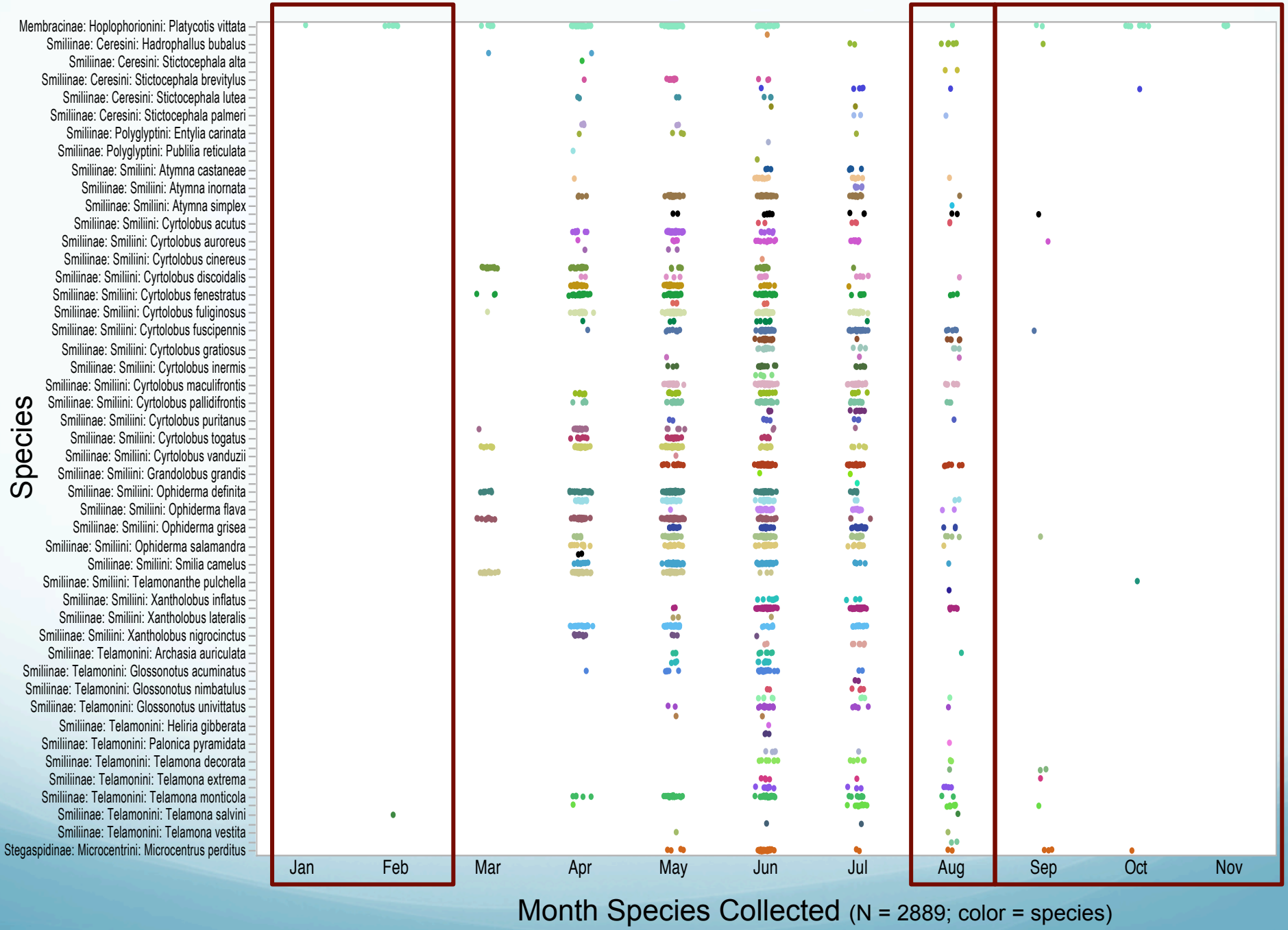

MembracidQuercus
0
2400
4800
7200 km


© 2009 by Paul Hueber

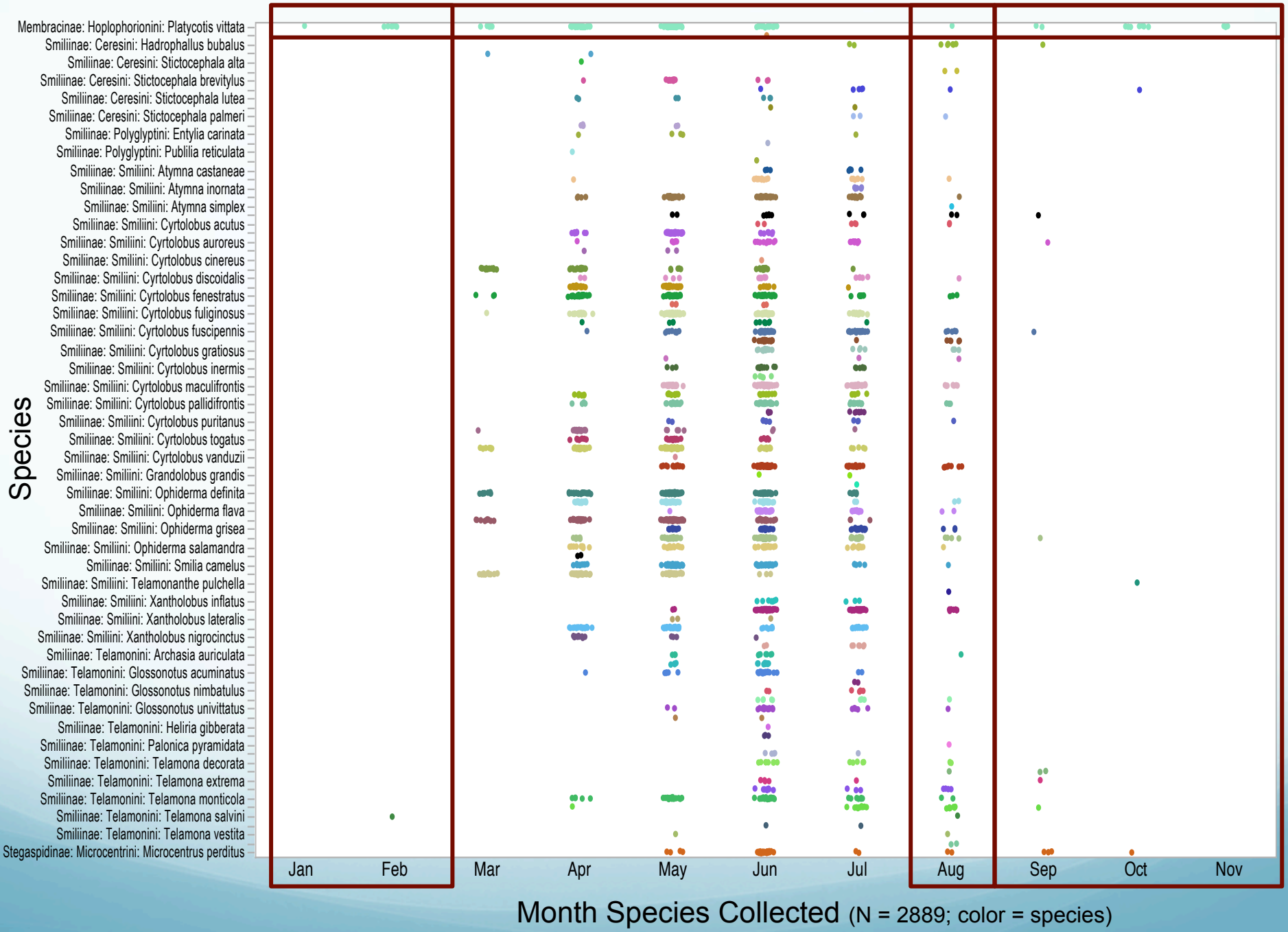

Unique U.S. Collecting Events for
Membracids Associated with *Quercus* (n = 6557)
Count
700
600
500
400
300
200
100
0
1900-1910
1911-1920
1921-1930
1931-1940
1941-1950
1951-1960
1961-1970
1971-1980
1981-1990
1991-2000
2001-2009
2001-2010
2011-2013
Decade



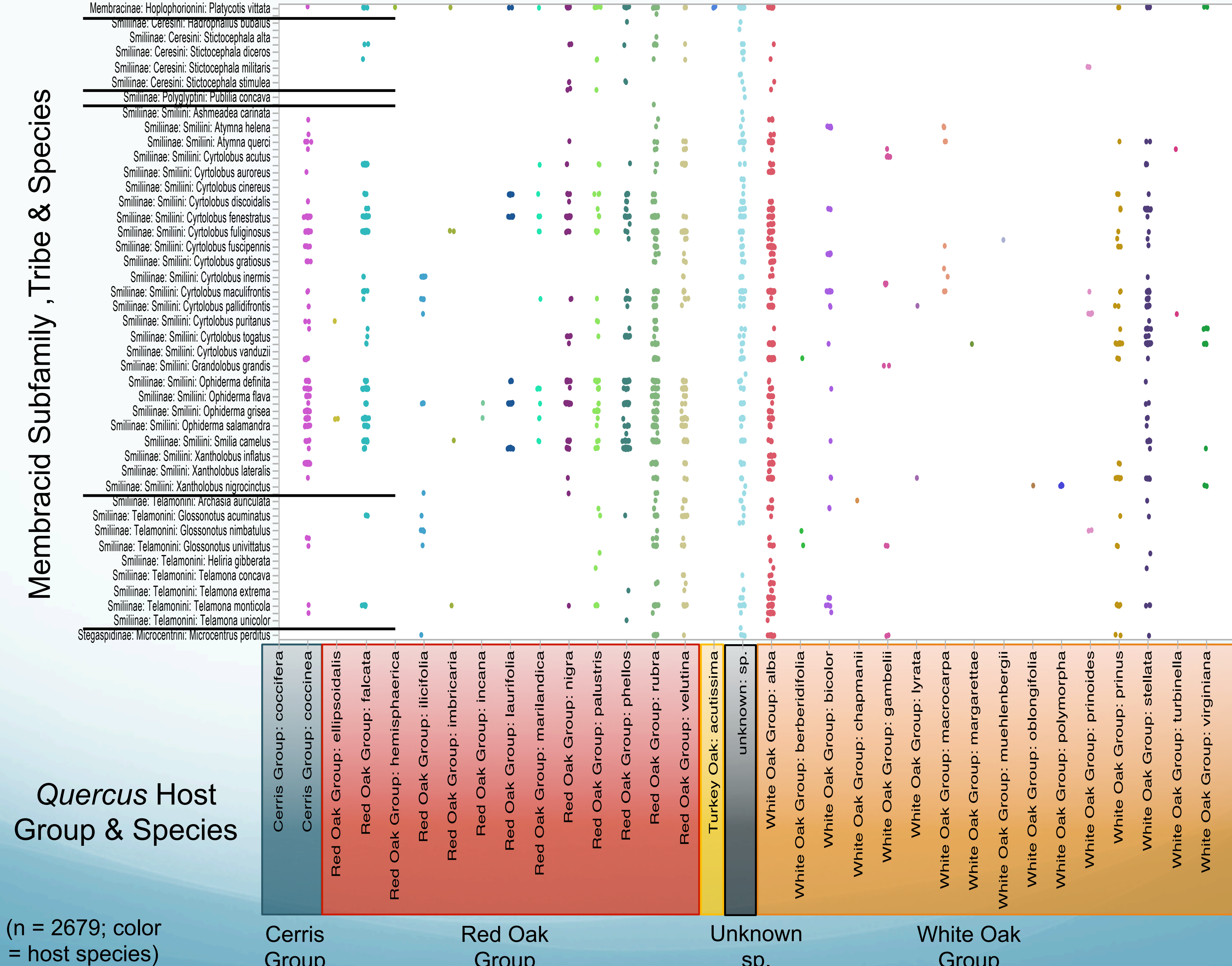
11/17/14 AEC *Quercus* data CJohnson



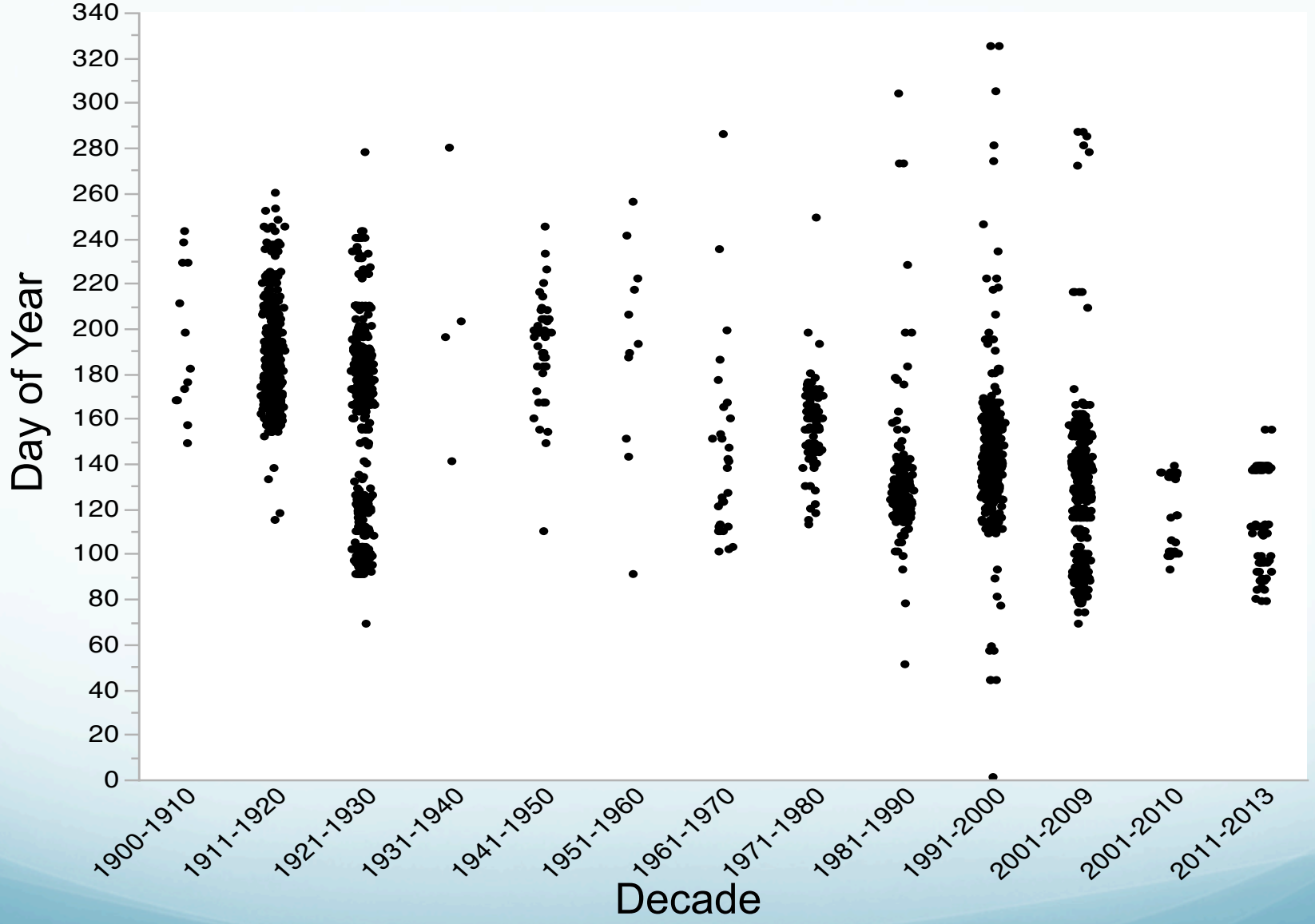
11/17/14 iDigBio *Quercus* data CJohnson

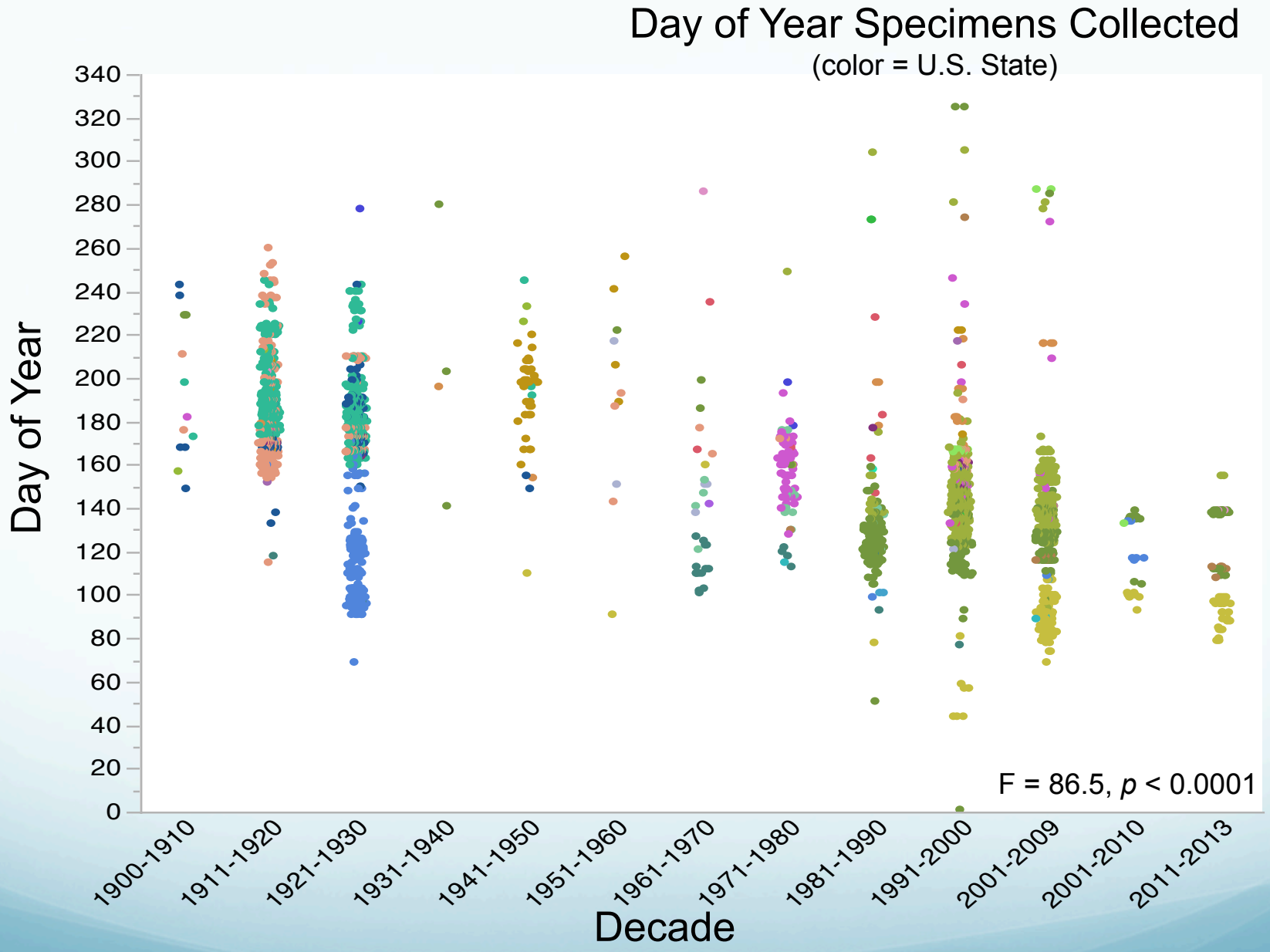


11/17/14 iDigBio *Quercus* data CJohnson


Membracid Subfamily ,Tribe & Species
Membracinae: Hoplophorionini: Platycotis vittata
Smiliinae: Ceresini: Hadrophallus bubalus
Smiliinae: Ceresini: Stictocephala alta
Smiliinae: Ceresini: Stictocephala diceros
Smiliinae: Ceresini: Stictocephala militaris
Smiliinae: Ceresini: Stictocephala stimulea
Smiliinae: Polyglyptini: Publilia concava
Smiliinae: Smiliini: Ashmeadea carinata
Smiliinae: Smiliini: Atymna helena
Smiliinae: Smiliini: Atymna querci
Smiliinae: Smiliini: Cyrtolobus acutus
Smiliinae: Smiliini: Cyrtolobus auroreus
Smiliinae: Smiliini: Cyrtolobus cinereus
Smiliinae: Smiliini: Cyrtolobus discoidalis
Smiliinae: Smiliini: Cyrtolobus fenestratus
Smiliinae: Smiliini: Cyrtolobus fuliginosus
Smiliinae: Smiliini: Cyrtolobus fuscipennis
Smiliinae: Smiliini: Cyrtolobus gratiosus
Smiliinae: Smiliini: Cyrtolobus inermis
Smiliinae: Smiliini: Cyrtolobus maculifrontis
Smiliinae: Smiliini: Cyrtolobus pallidifrontis
Smiliinae: Smiliini: Cyrtolobus puritanus
Smiliinae: Smiliini: Cyrtolobus togatus
Smiliinae: Smiliini: Cyrtolobus vanduzii
Smiliinae: Smiliini: Grandolobus grandis
Smiliinae: Smiliini: Ophiderma definita
Smiliinae: Smiliini: Ophiderma flava
Smiliinae: Smiliini: Ophiderma grisea
Smiliinae: Smiliini: Ophiderma salamandra
Smiliinae: Smiliini: Smilia camelus
Smiliinae: Smiliini: Xantholobus inflatus
Smiliinae: Smiliini: Xantholobus lateralis
Smiliinae: Smiliini: Xantholobus nigrocinctus
Smiliinae: Telamonini: Archasia auriculata
Smiliinae: Telamonini: Glossonotus acuminatus
Smiliinae: Telamonini: Glossonotus nimbatulus
Smiliinae: Telamonini: Glossonotus univittatus
Smiliinae: Telamonini: Heliria gibberata
Smiliinae: Telamonini: Telamona concava
Smiliinae: Telamonini: Telamona extrema
Smiliinae: Telamonini: Telamona monticola
Smiliinae: Telamonini: Telamona unicolor
Stegaspidinae: Microcentrini: Microcentrus perditus
Cerris Group: coccifera
Cerris Group: coccinea
Red Oak Group: ellipsoidalis
Red Oak Group: falcata
Red Oak Group: hemisphaerica
Red Oak Group: ilicifolia
Red Oak Group: imbricaria
Red Oak Group: incana
Red Oak Group: laurifolia
Red Oak Group: marilandica
Red Oak Group: nigra
Red Oak Group: palustris
Red Oak Group: phellos
Red Oak Group: rubra
Red Oak Group: velutina
Turkey Oak: acutissima
unknown: sp.
White Oak Group: alba
White Oak Group: berberidifolia
White Oak Group: bicolor
White Oak Group: chapmanii
White Oak Group: gambelii
White Oak Group: lyrata
White Oak Group: macrocarpa
White Oak Group: margarettae
White Oak Group: muehlenbergii
White Oak Group: oblongifolia
White Oak Group: polymorpha
White Oak Group: prinoides
White Oak Group: prinus
White Oak Group: stellata
White Oak Group: turbinella
White Oak Group: virginiana
Quercus Host Group & Species
(n = 2679; color = host species)
Cerris Group
Red Oak Group
Unknown sp.
White Oak Group

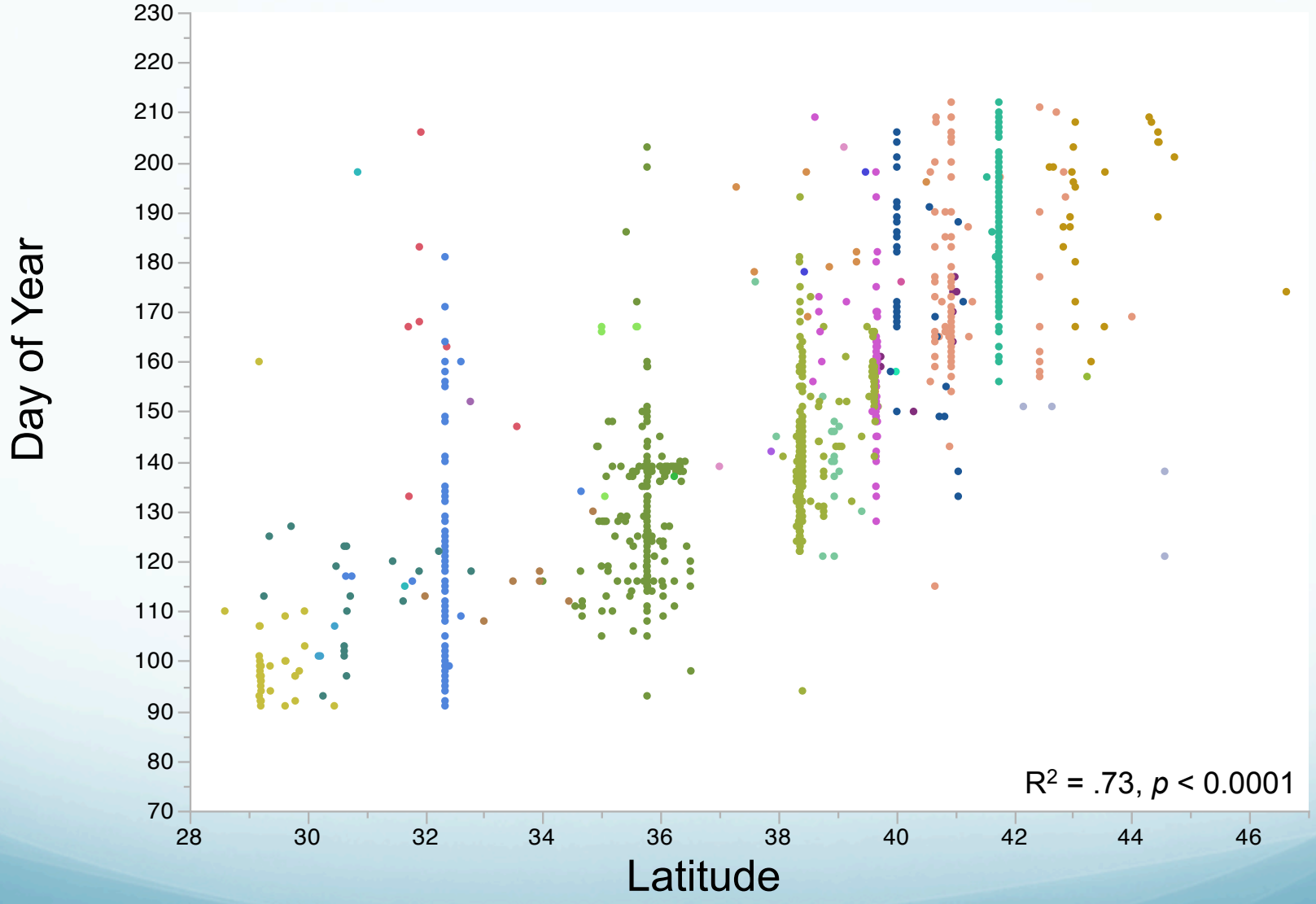
Day of Year Specimens Collected



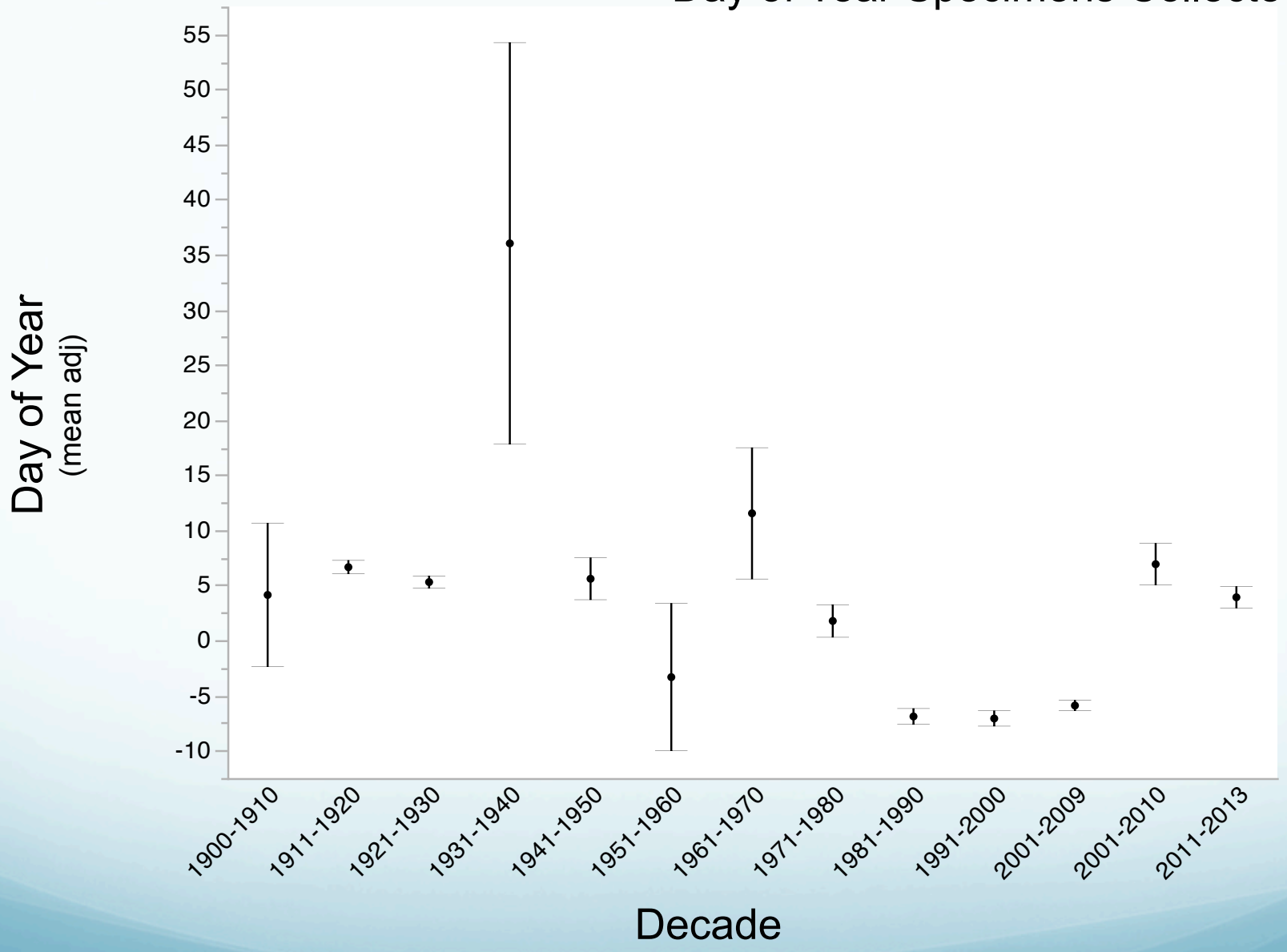

Day of Year Specimens Collected
(color = U.S. State)
Day of Year
340
320
300
280
260
240
220
200
180
160
140
120
100
80
60
40
20
0
F = 86.5, p < 0.0001
1900-1910
1911-1920
1921-1930
1931-1940
1941-1950
1951-1960
1961-1970
1971-1980
1981-1990
1991-2000
2001-2009
2001-2010
2011-2013
Decade

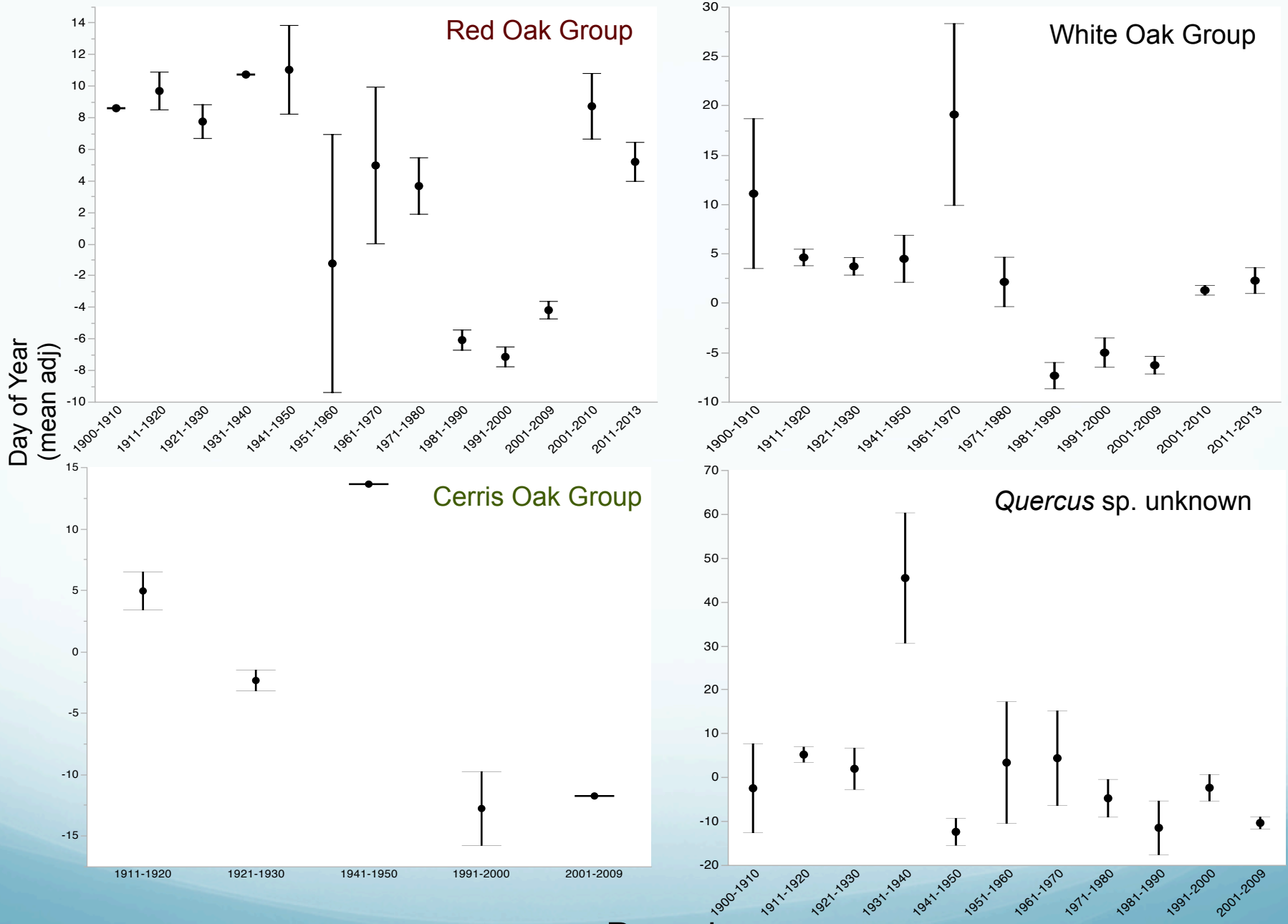
Day of Year Specimens Collected

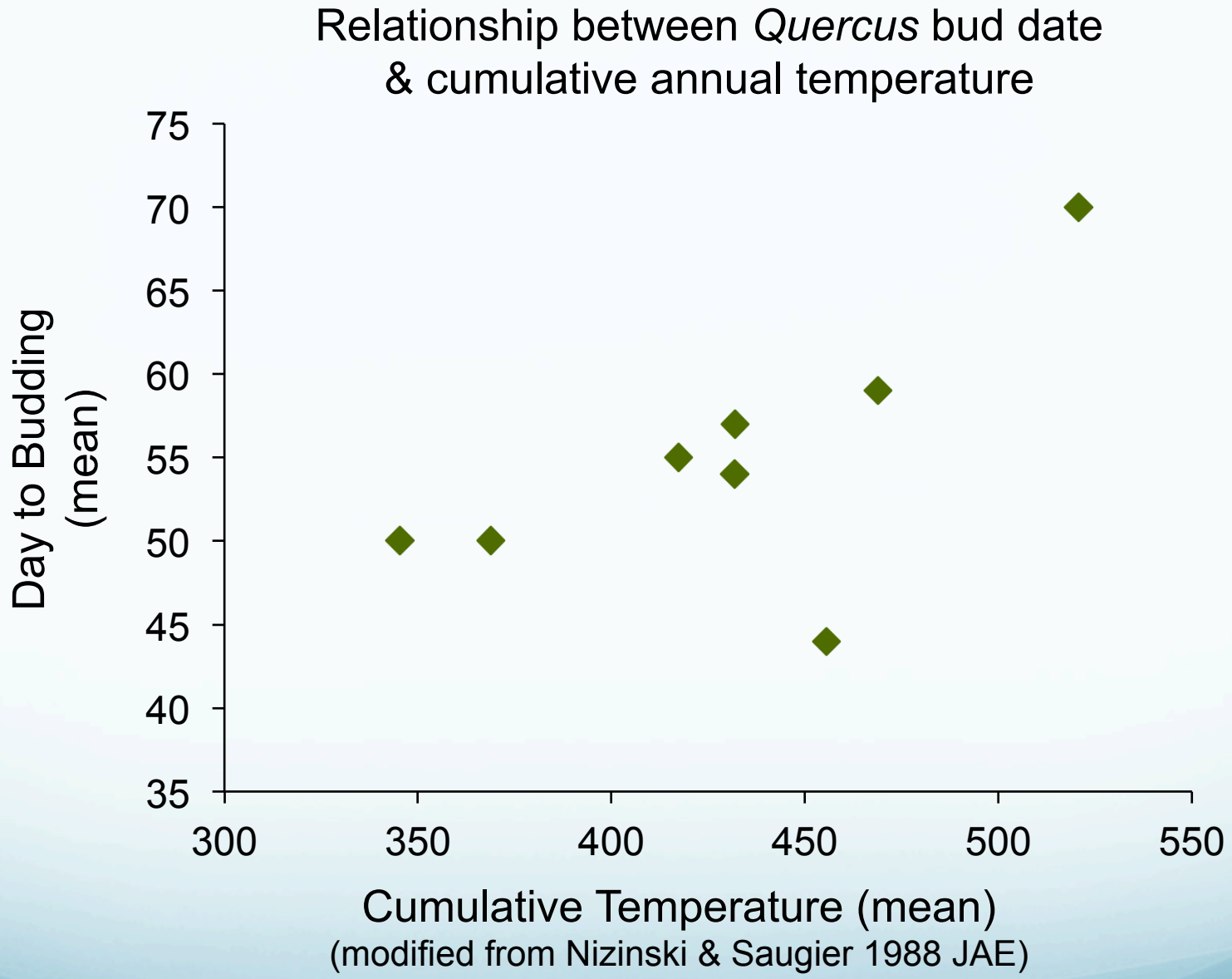
(color = U.S. State)



Day of Year Specimens Collected




Red Oak Group
White Oak Group
Cerris Oak Group
Quercus sp. unknown
Day of Year (mean adj)
Decade
1900-1910
1911-1920
1921-1930
1931-1940
1941-1950
1951-1960
1961-1970
1971-1980
1981-1990
1991-2000
2001-2009
2001-2010
2011-2013


Relationship between *Quercus* bud date & cumulative annual temperature
Day to Budding (mean)
75
70
65
60
55
50
45
40
35
300
350
400
450
500
550
Cumulative Temperature (mean)
(modified from Nizinski & Saugier 1988 JAE)

Conclusion:

- *Historical records can provide valuable information about ecological trends associated with specimens*
    - *Seems to be an association among warming trend, oak budding & treehopper emergence*
- *BUT more data records & more complete data records are needed to fill in gaps*
- *Need data from large AND small institutions/collections*
- *Approach conclusions with caution*
- *Data label standards!*
- *Encourage deposition of some/all data from ecological research?*

Photo: Alex Wild

ISSN 1948-6596 resources

data

Improving the use of information from museum specimens: Using Google Earth© to georeference Guiana Shield specimens in the US National Herbarium

Eduardo Garcia-Milagros and Vicki A. Funk

US National Herbarium, Department of Botany, National Museum of Natural History, Smithsonian Institution, Washington DC, 20013-7012 USA
e-mail: eduadogarmi@gmail.com; http://botany.si.edu/bdg/index.html

Abstract. Data found on labels of museum collections have been useful in a variety of biodiversity studies. However, the georeferenced data available are often hampered by poor interpretation of label information and as a result are not as accurate, and therefore useful, as they might be. We have used Google Earth© as a geographic information system to improve the georeferencing of the data. Its user interface allowed us to make use of all the label information and to represent the coordinates more accurately, thus producing a better quality and more reliable dataset to be used in our studies. The quality, defined as "fitness for use", of the species-occurrence data generated, which is mostly affected by the values of accuracy and uncertainty associated to the coordinates, shows that uncertainly can be reduced. This method also allows us to show the power of examining georeferenced data from the stand point of 'all collections from an expedition" rather than "all collections from a single area." Type specimens housed at U.S. National Herbarium from the Guiana Shield were used in this work.

Keywords. museum collections, georeferencing, data quality, Google Earth, type specimen

Introduction

The specimen collections housed in museums and

et al. 2000, Funk and Richardson 2002, Reddy and Davalos 2003). Although these studies suggest

Journal of Biogeography (J. Biogeogr.) (2005) **32**, 1883–1897

ORIGINAL ARTICLE

Elevational gradient analyses and the use of historical museum specimens: a cautionary tale

Rebecca J. Rowe*

Committee on Evolutionary Biology, University of Chicago, Chicago, IL, USA and Division of Mammals, The Field Museum, Chicago, IL, USA

ABSTRACT

Aim The value of biodiversity informatics rests upon the capacity to assess data quality. Yet as these methods have developed, investigating the quality of the underlying specimen data has largely been neglected. Using an exceptionally large, densely sampled specimen data set for non-flying small mammals of Utah, I evaluate measures of uncertainty associated with georeferenced localities and illustrate the implications of uncritical incorporation of data in the analysis of patterns of species richness and species range overlap along elevational gradients.

Location Utah, USA, with emphasis on the Uinta Mountains.

Methods Employing georeferenced specimen data from the Mammal Networked Information System (MaNIS), I converted estimates of areal uncertainty into elevational uncertainty using a geographic information system (GIS). Examining patterns in both areal and elevational uncertainty measures, I

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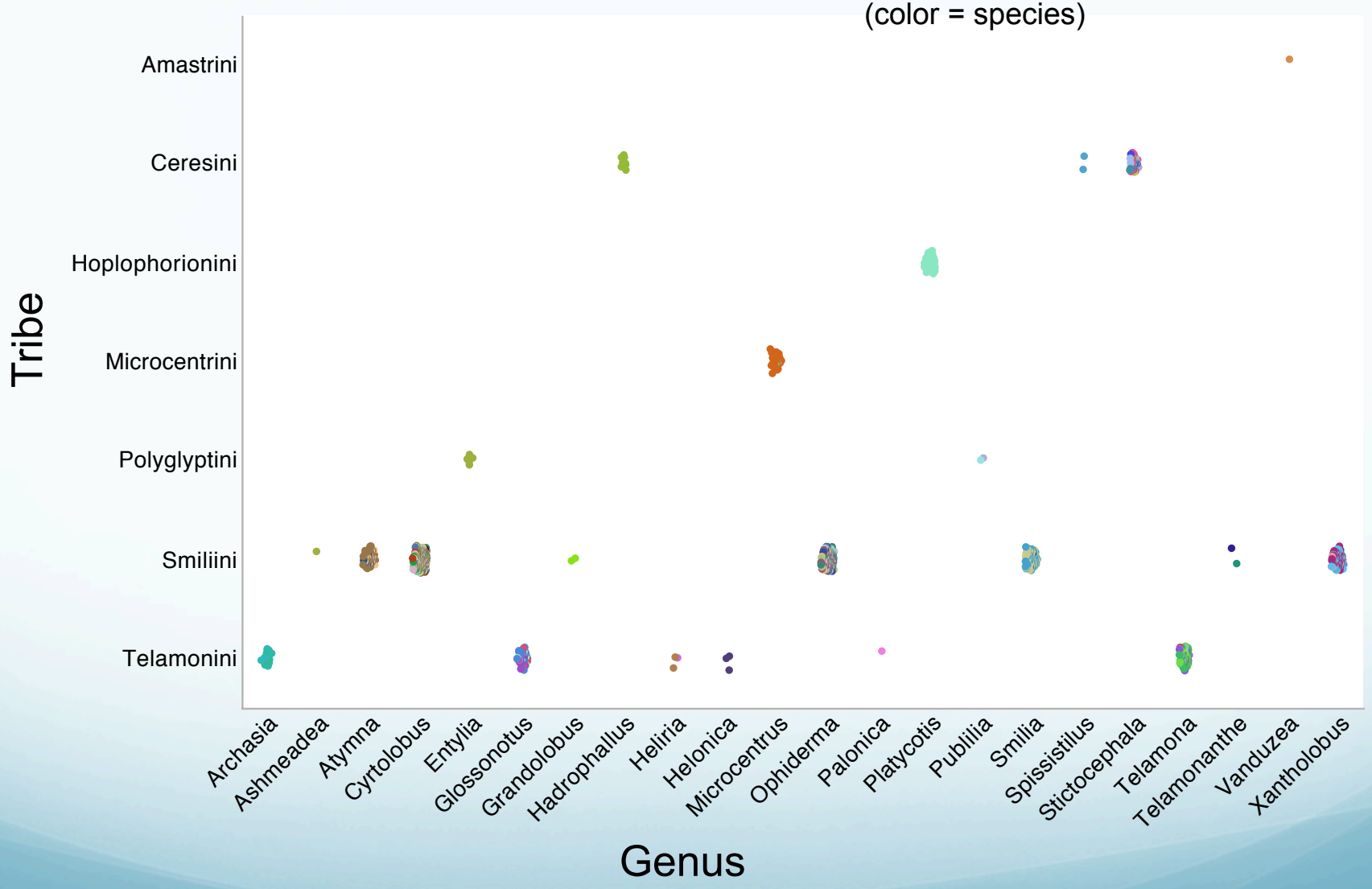
(color = species)



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