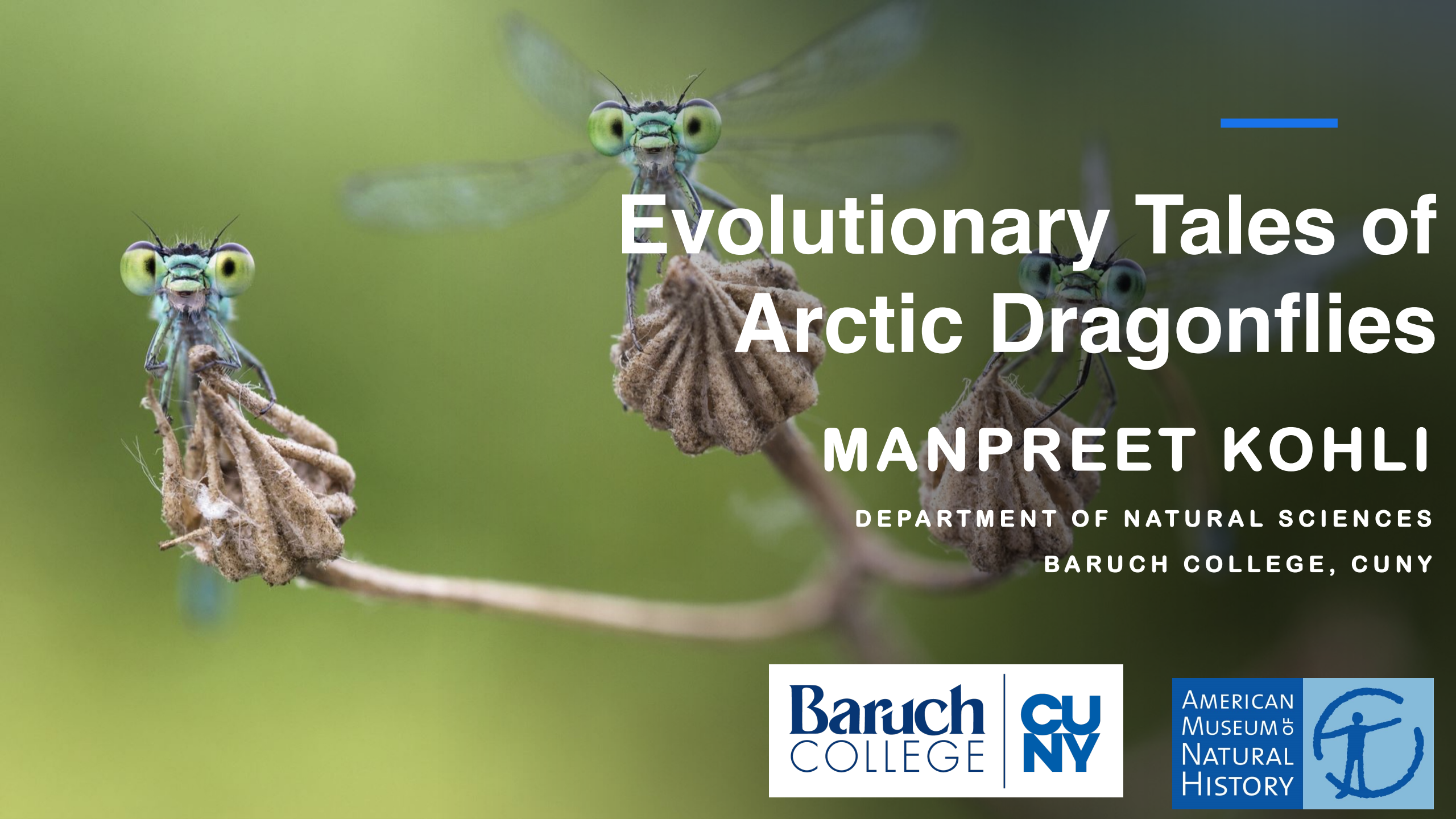


A photograph of three Arctic dragonflies perched on mud structures. The dragonflies have large, prominent eyes and a greenish-blue body. The mud structures are brown and have a textured, ribbed appearance. The background is a soft, out-of-focus green.

Evolutionary Tales of Arctic Dragonflies

MANPREET KOHLI

DEPARTMENT OF NATURAL SCIENCES

BARUCH COLLEGE, CUNY

Baruch
COLLEGE | **CU**
NY

AMERICAN
MUSEUM OF
NATURAL
HISTORY



Acknowledgments

Collaborators

Jessica Ware, AMNH, New York

Göran Sahlén, Halmstad University, Sweden

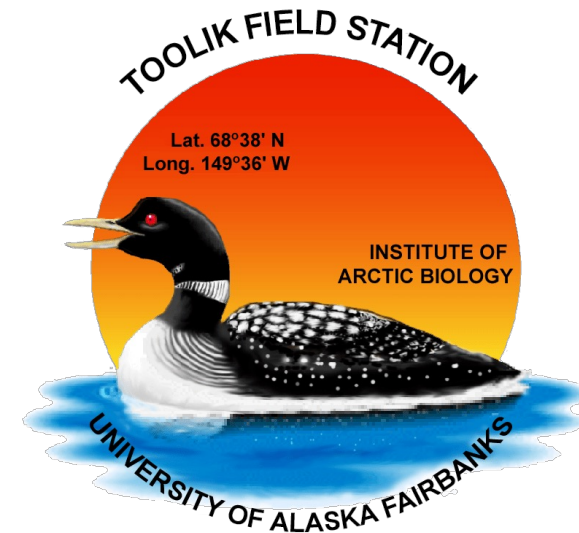
Anna Eichert, AMNH, New York

Rhema Uche-Dicke, CUNY, New York

Ethan Tolman, Virginia Tech, USA

Patrick Hulick

Toolik staff



Tundra award



Odonata



Dragonflies
Anisoptera



Anisozygoptera



Damselflies
Zygoptera

6000 recorded species globally



Dragonfly Life cycle

Adult



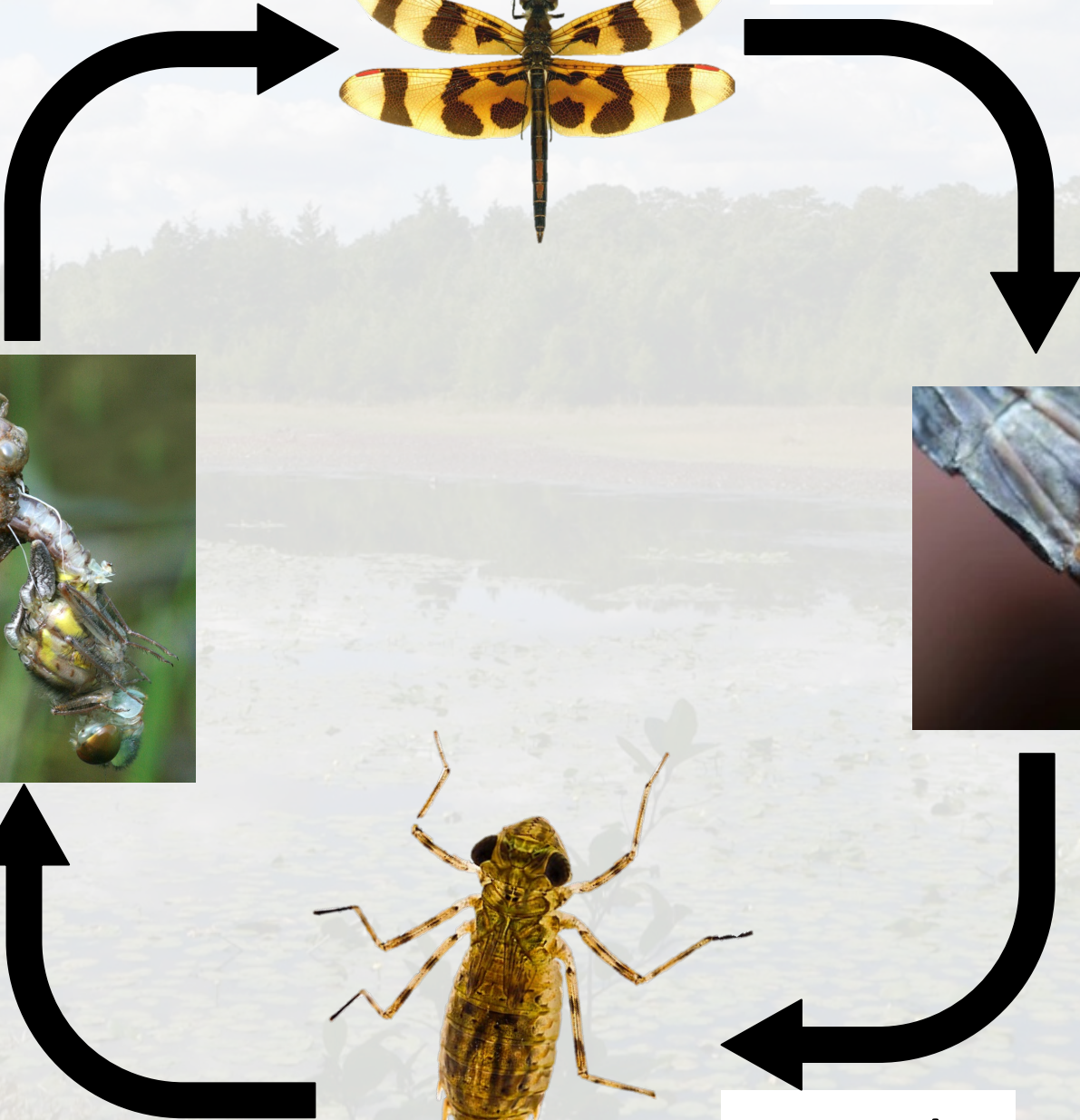
Eggs

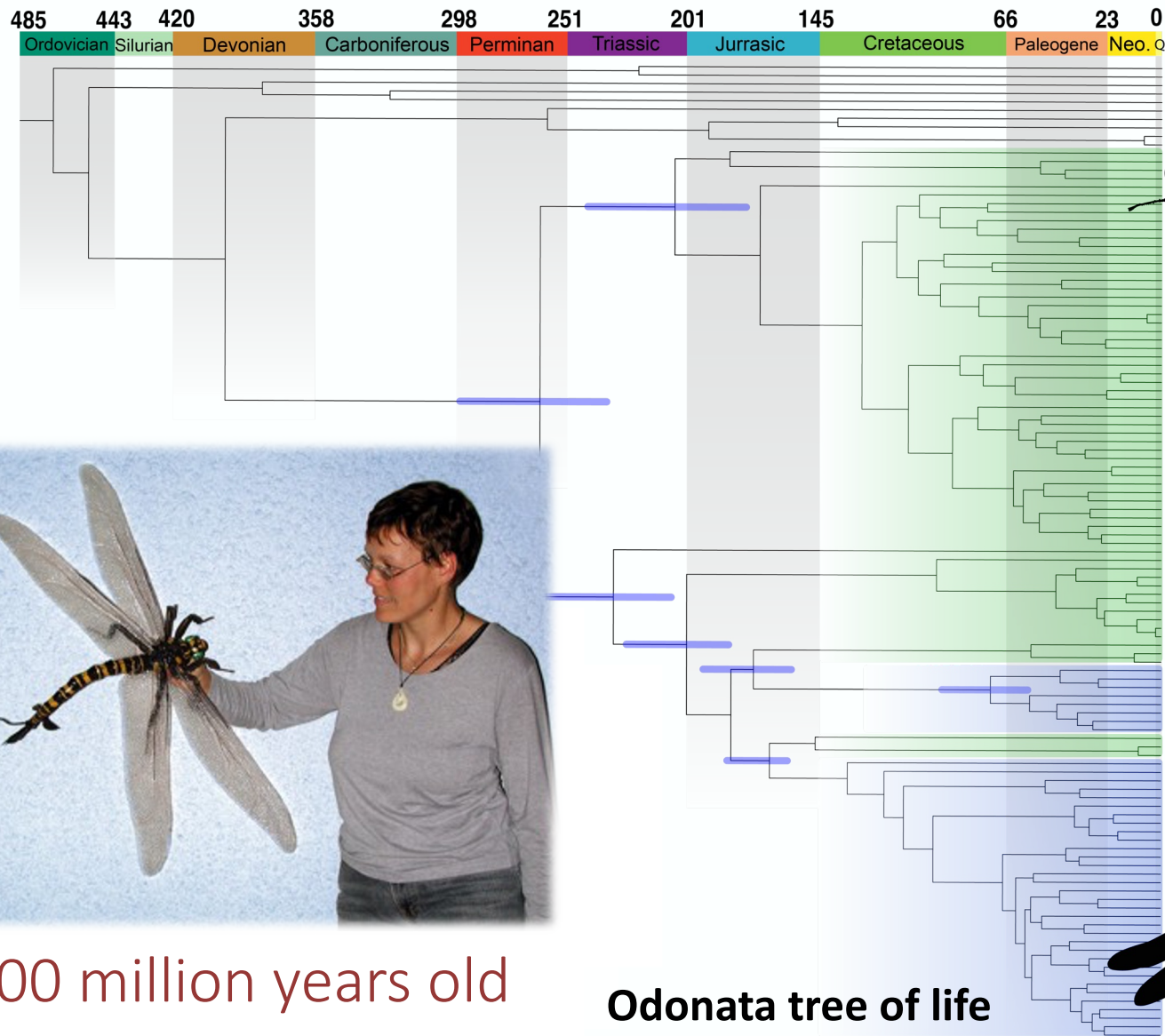


Nymph



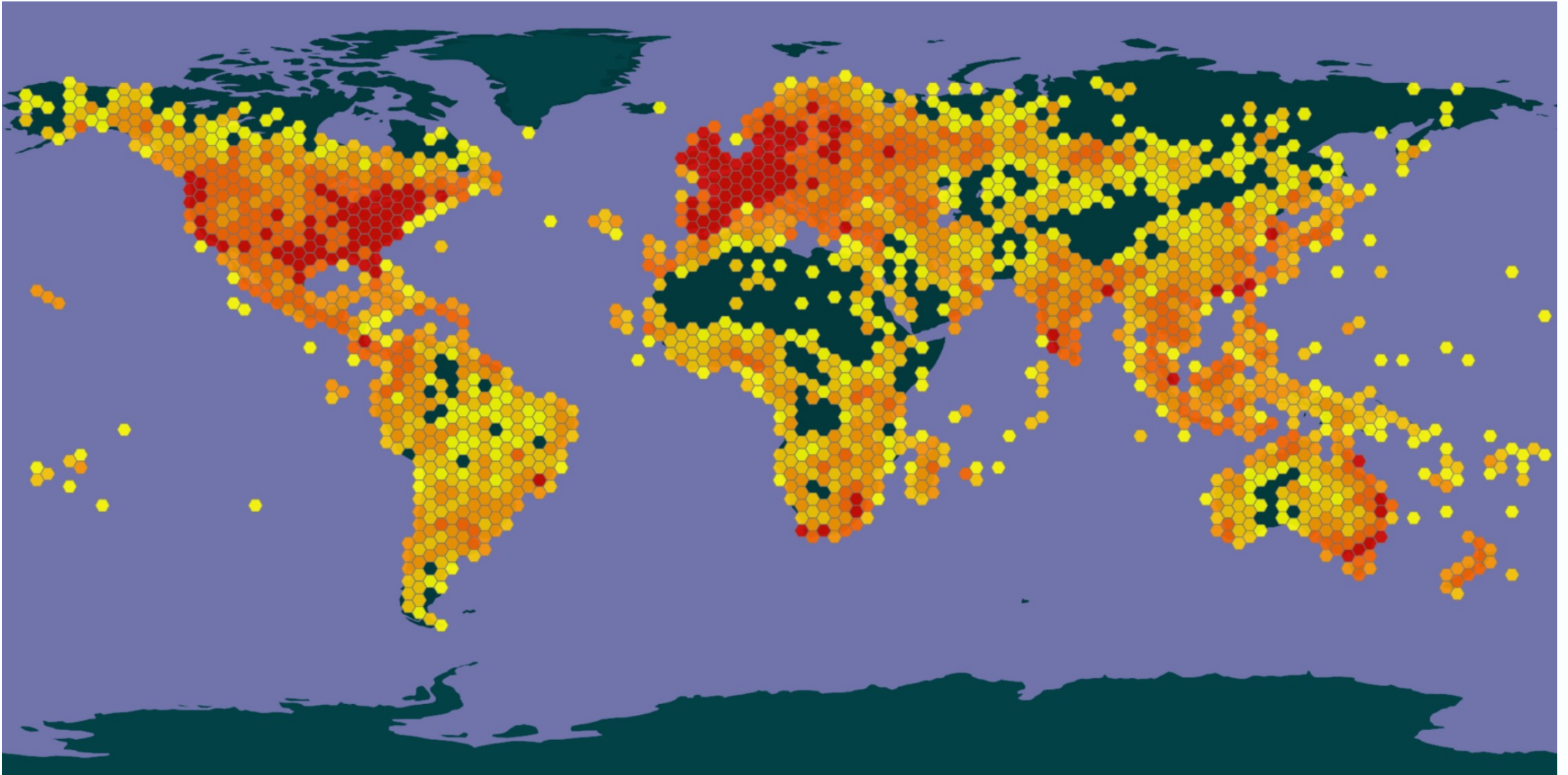
Incomplete
Metamorphosis
larvae - Adult





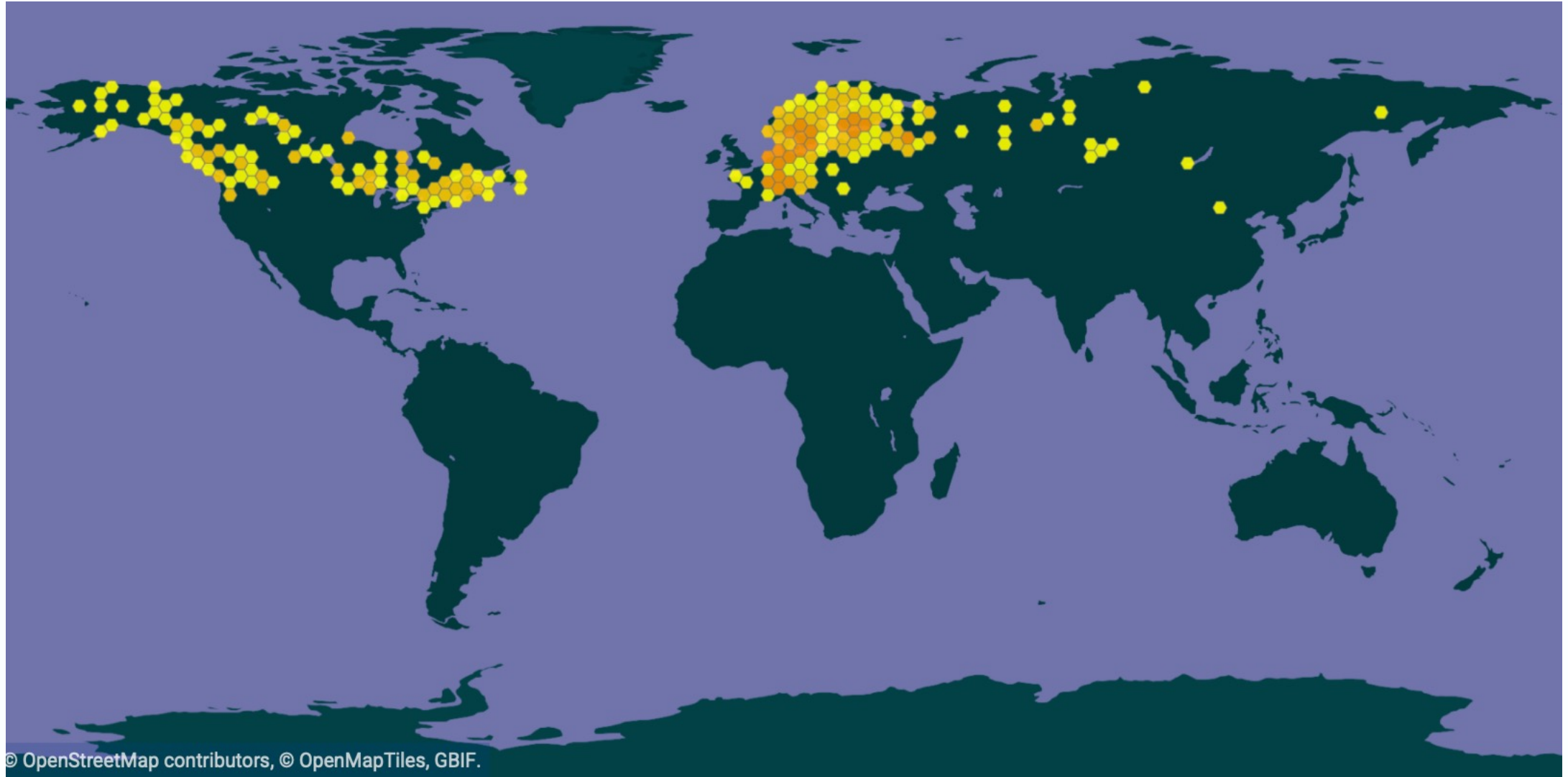
Kohli et al. 2021 *iScience*

Global Distribution



Map from GBIF based on “human observation” recorded between 2014-2024

Dragonflies of the Arctic



Map from GBIF based on “human observation” recorded between 2014-2024 for *Aeshna subarctica*



@ Will Kuhn

Yukon Territory, Canada



Finland

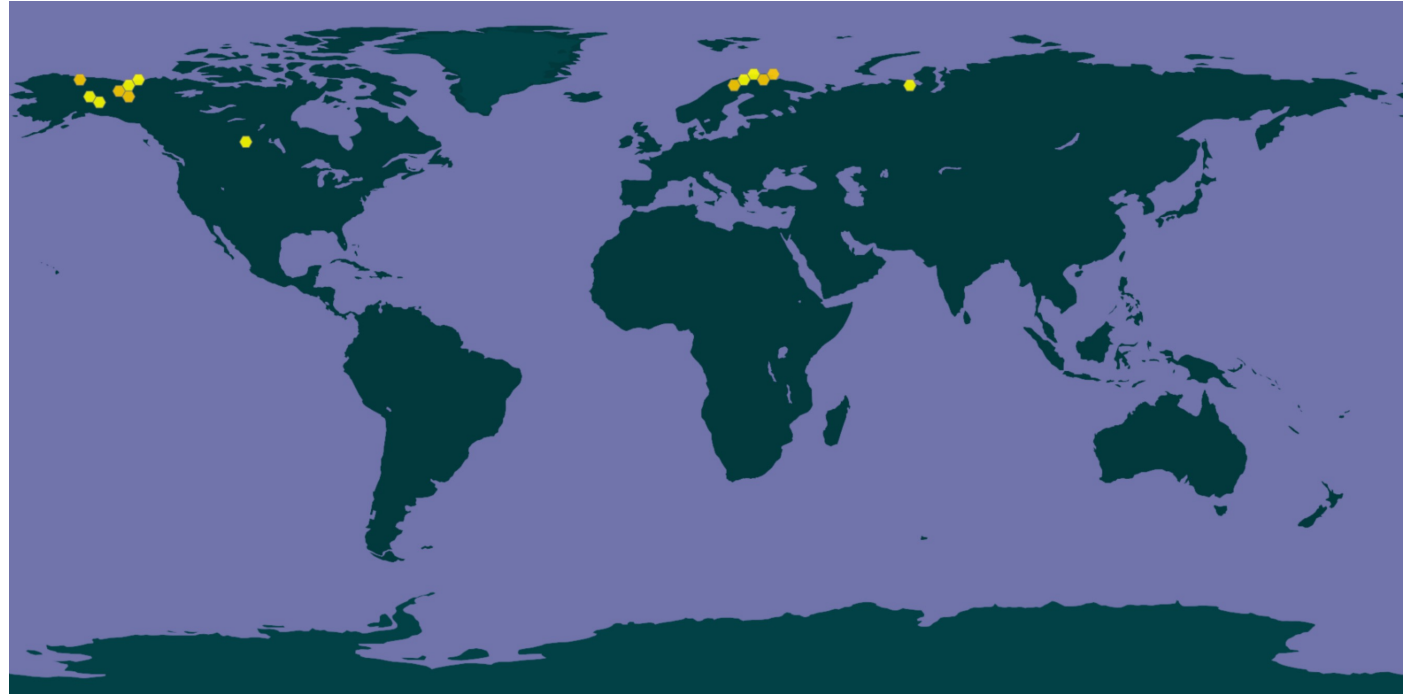
@ Göran Sahlén

Somatochlora sahlbergi – Tree-line emerald

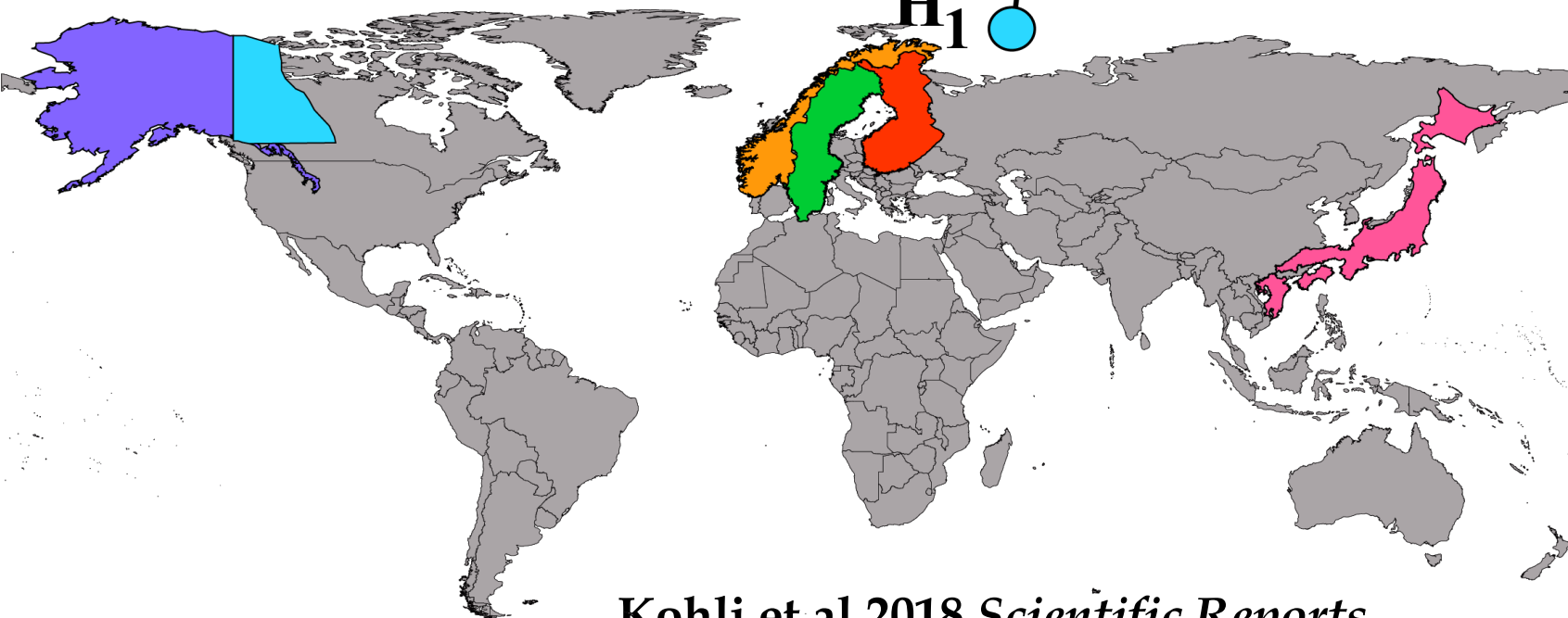
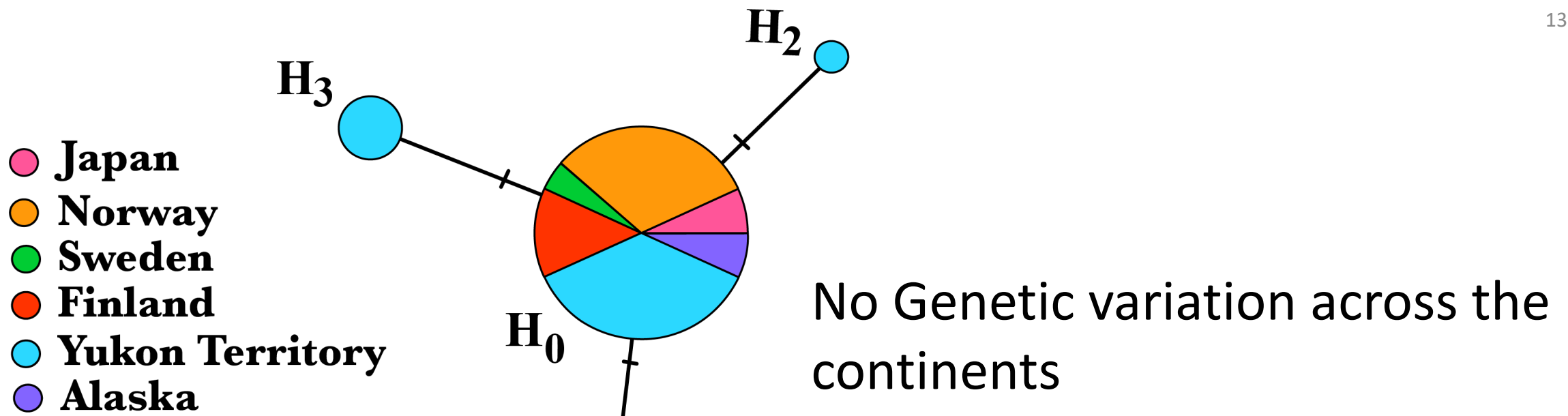


- Genetic structure across the geographic range?
- Are the populations on the two continents different?

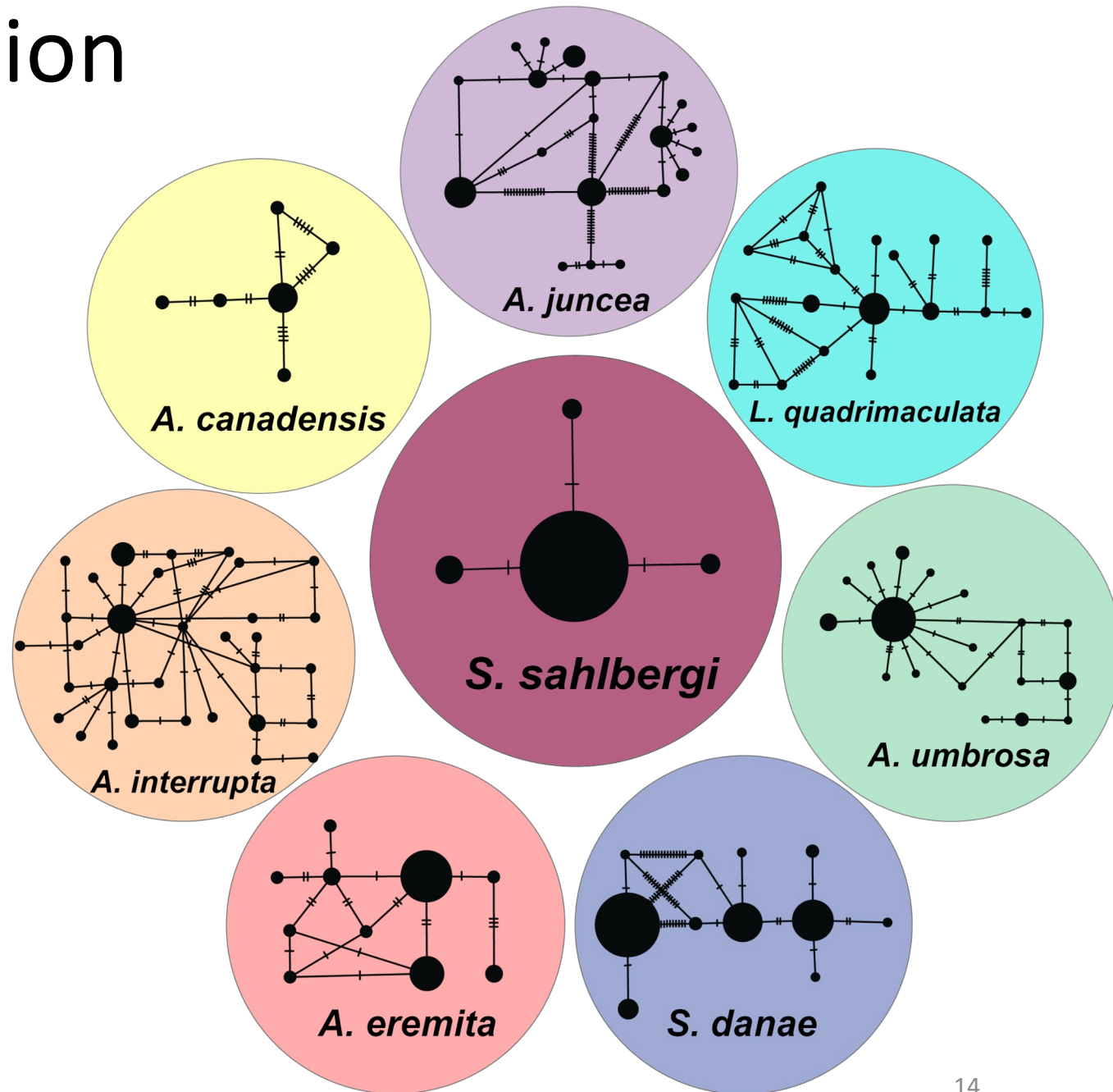
Considered to be the northern most breeding dragonfly species.



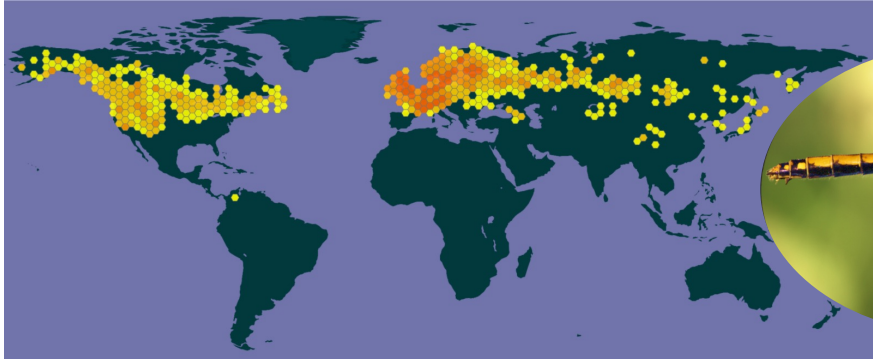
Circumboreal distribution



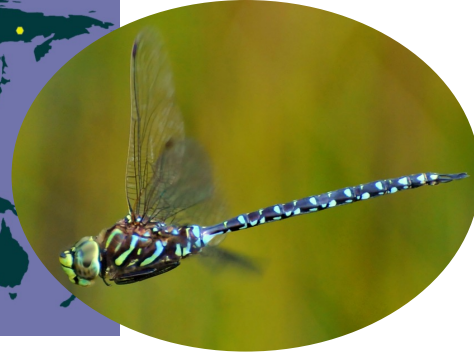
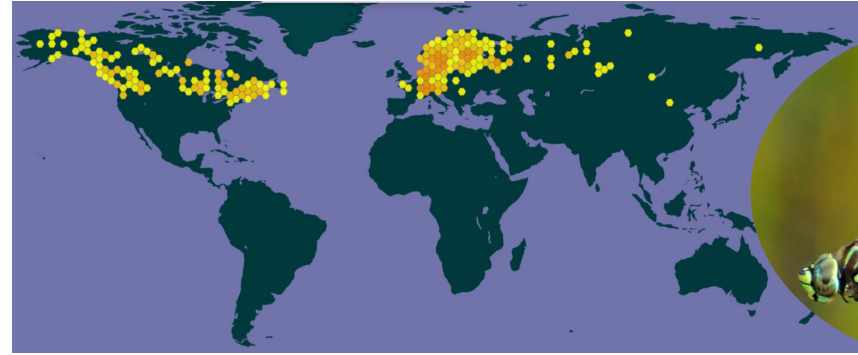
Is lack of genetic variation seen in other northern dragonfly species?



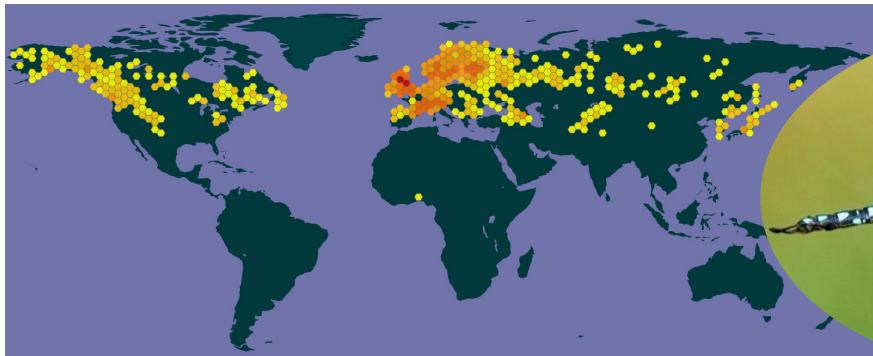
Holarctic dragonflies



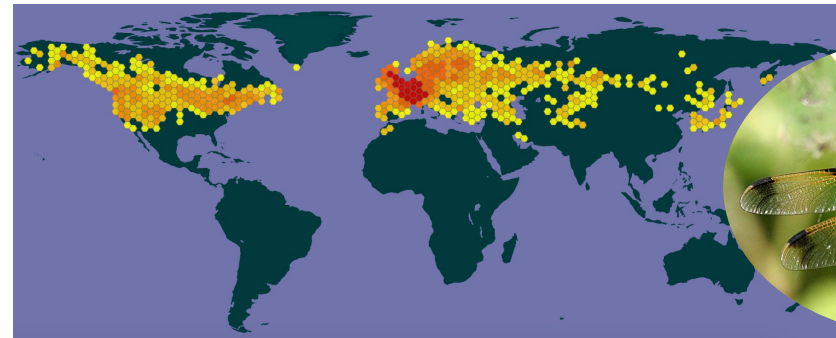
Sympetrum danae



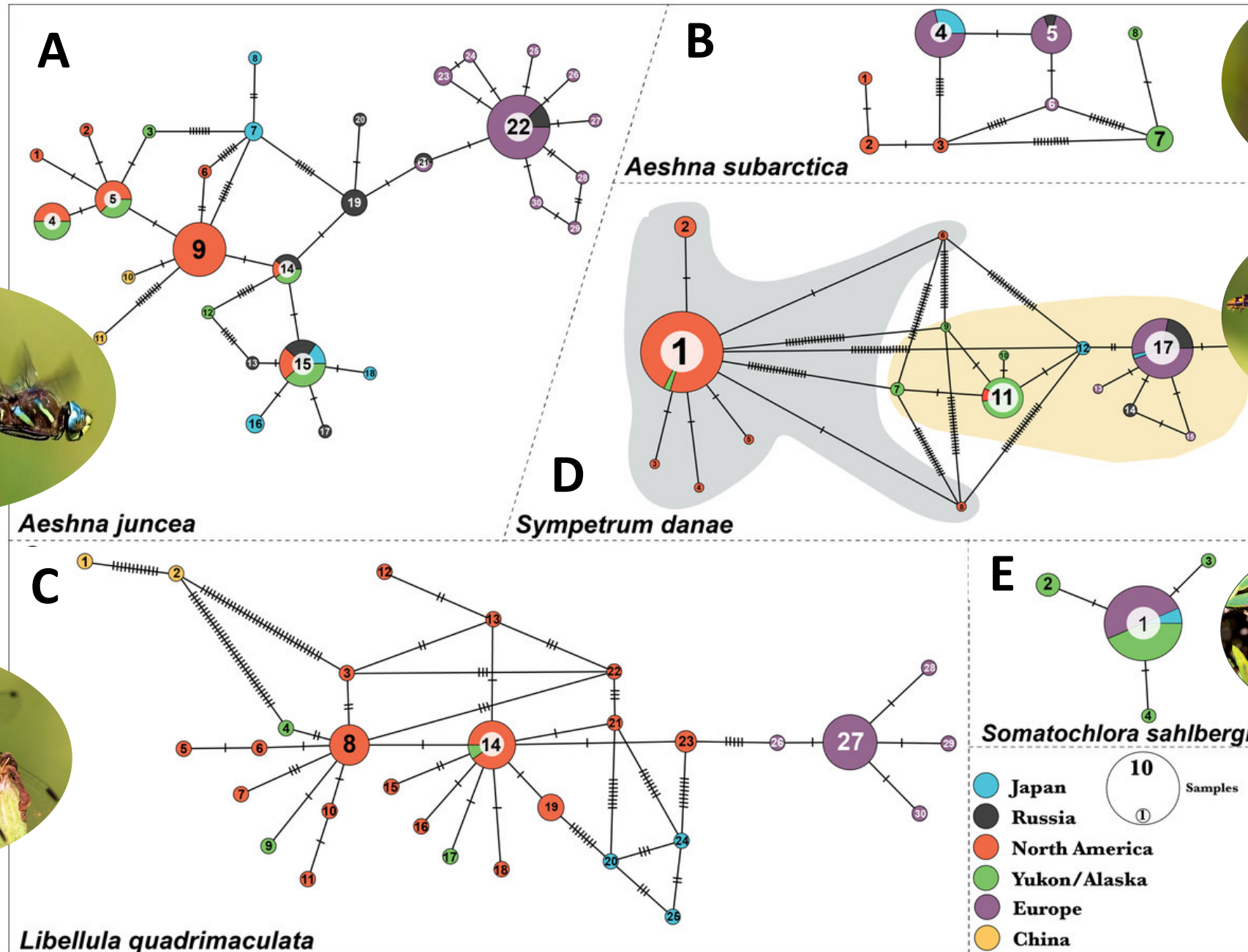
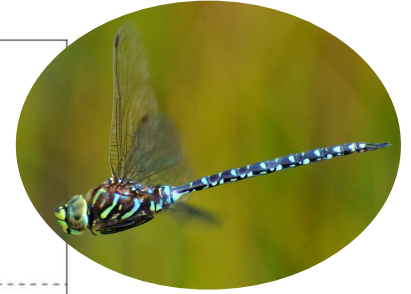
Aeshna subarctica



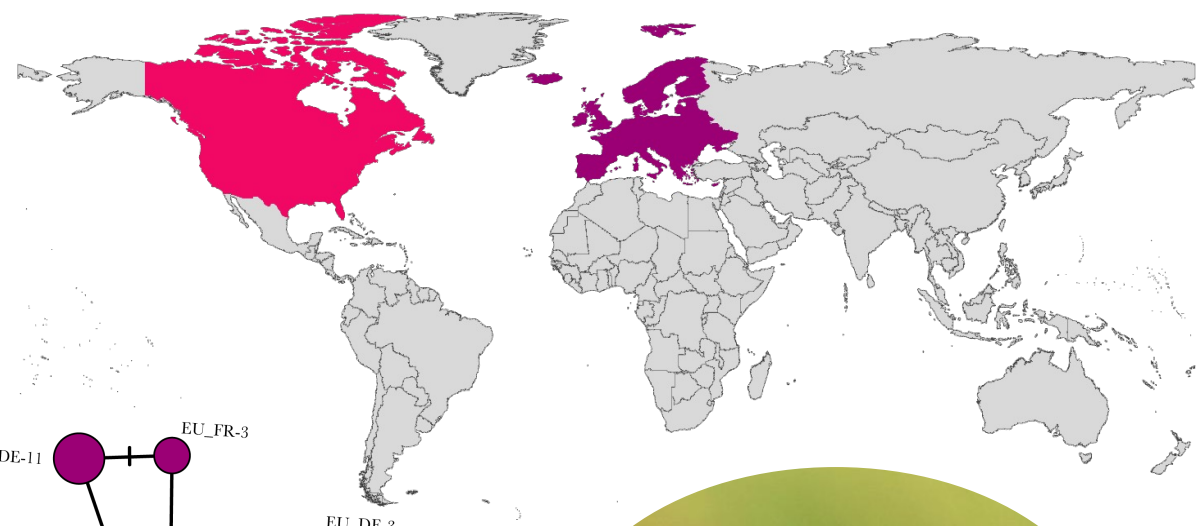
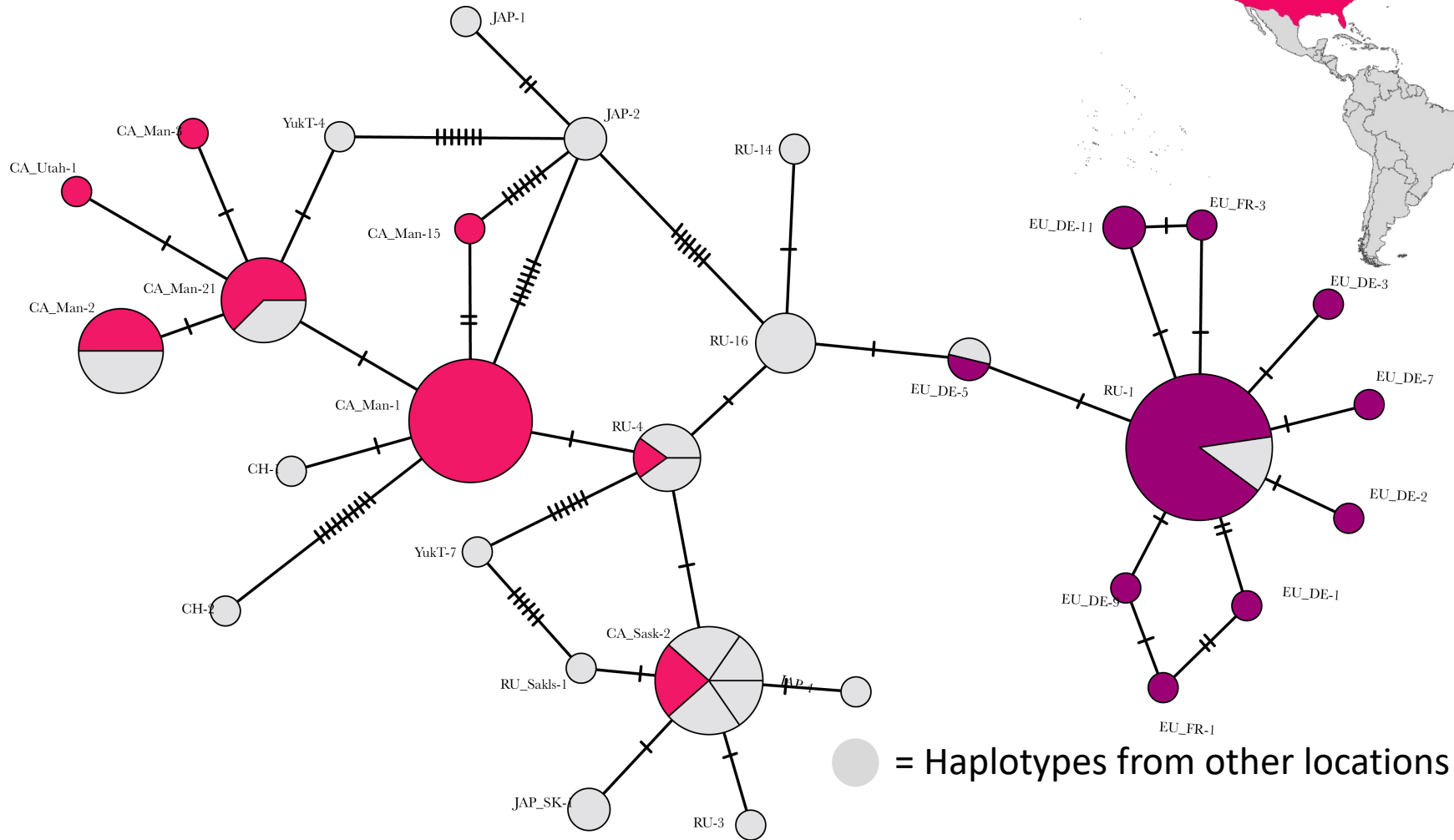
Aeshna juncea



Libellula quadrimaculata



The Atlantic Divide



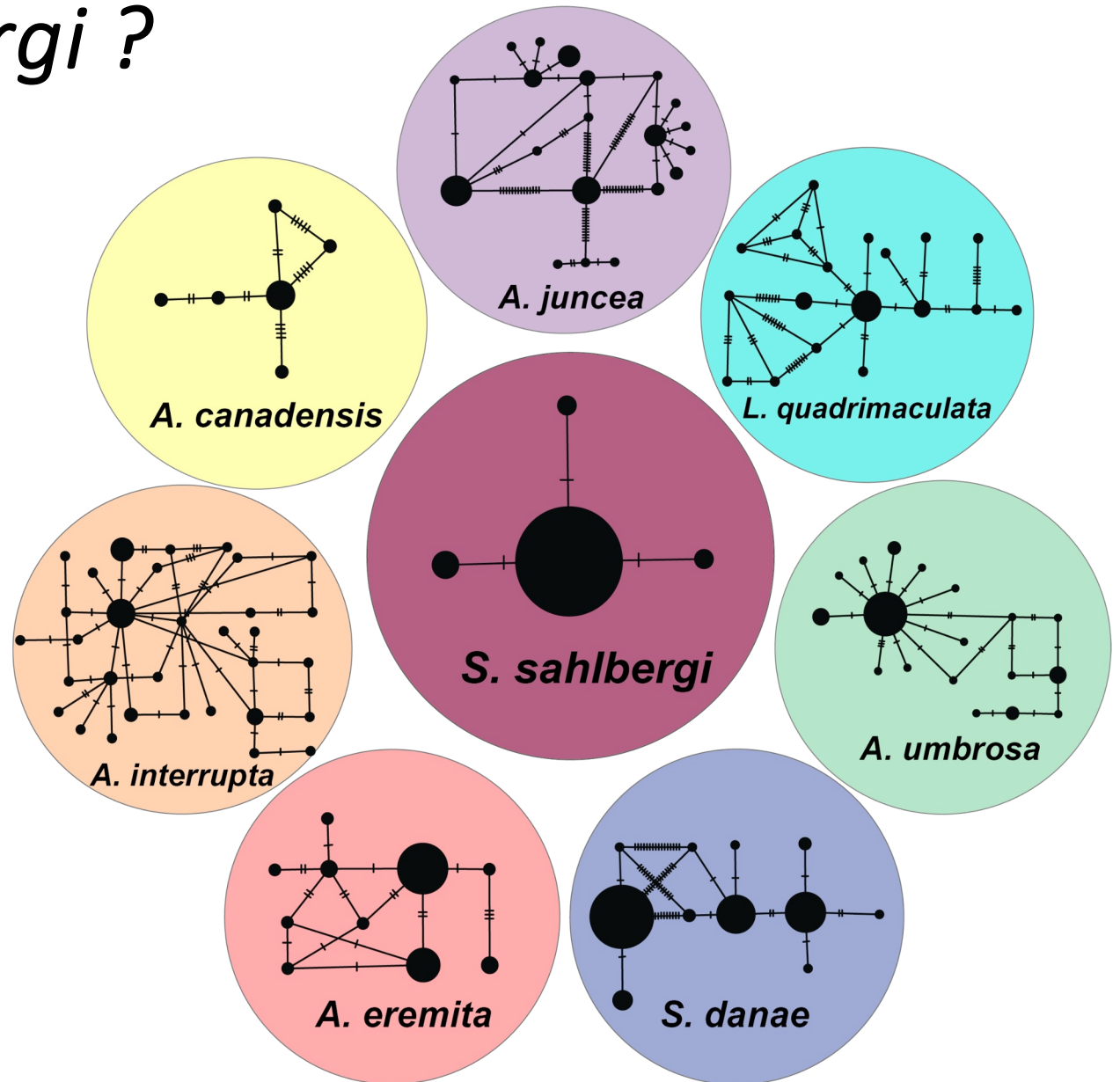
Aeshna juncea

In all the species accept *Somatochlora sahlbergi*

What's up with *S. sahlbergi* ?



Why do we see lack of genetic variation in *S. sahlbergi* ?



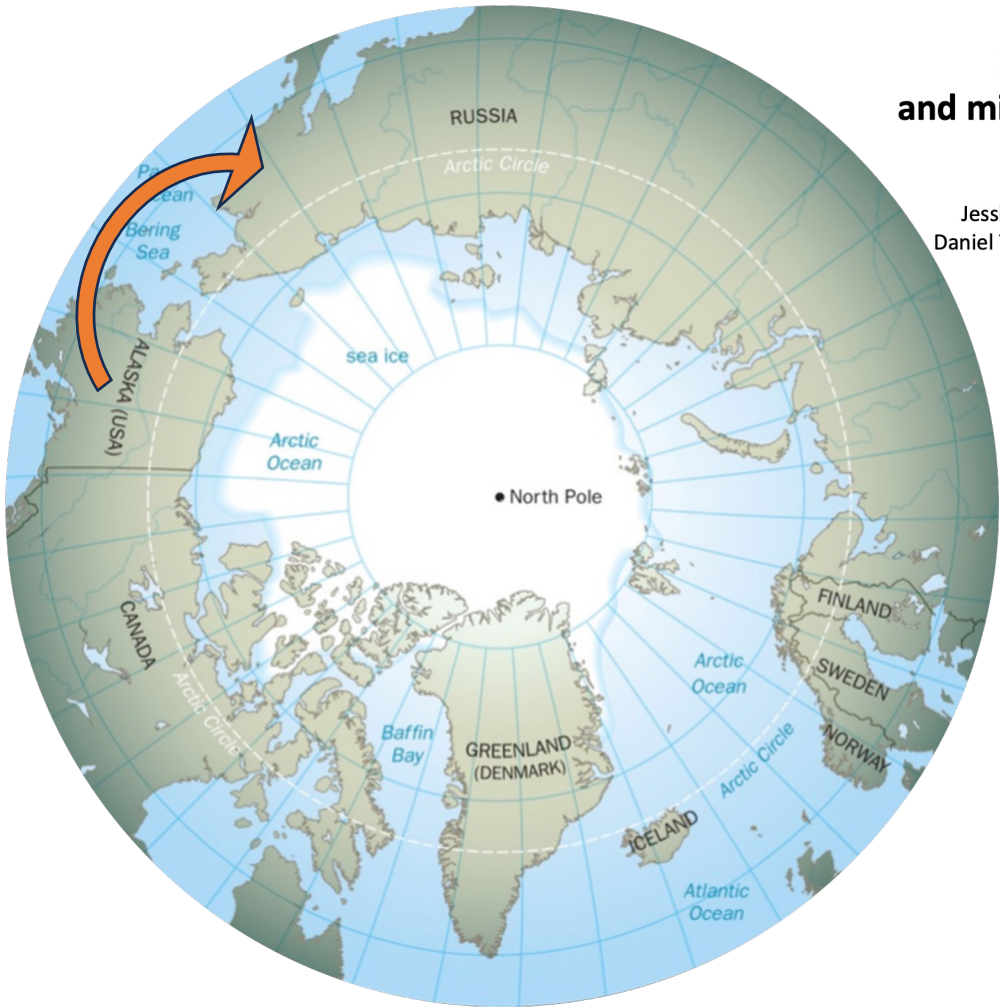
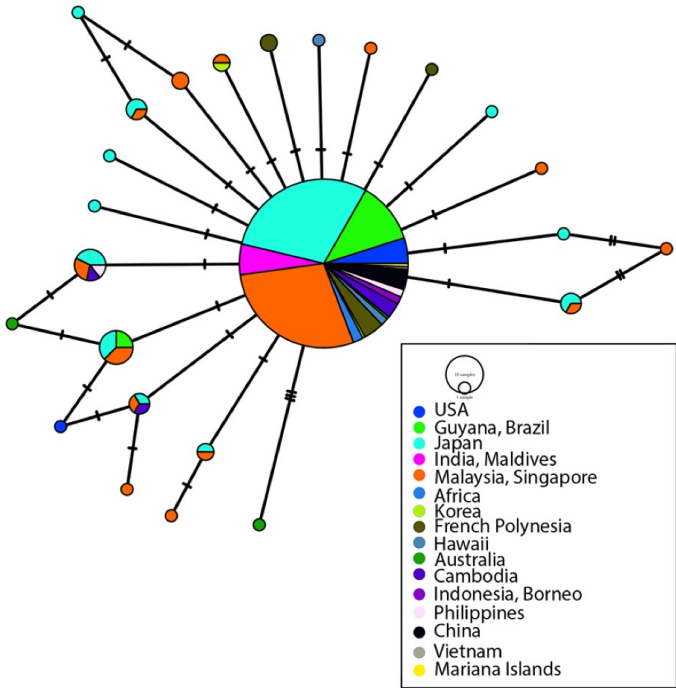
A Panmictic population?

International Journal of Odonatology
2022, Vol. 25, pp. 43–55
[doi:10.48156/1388.2022.1917166](https://doi.org/10.48156/1388.2022.1917166)

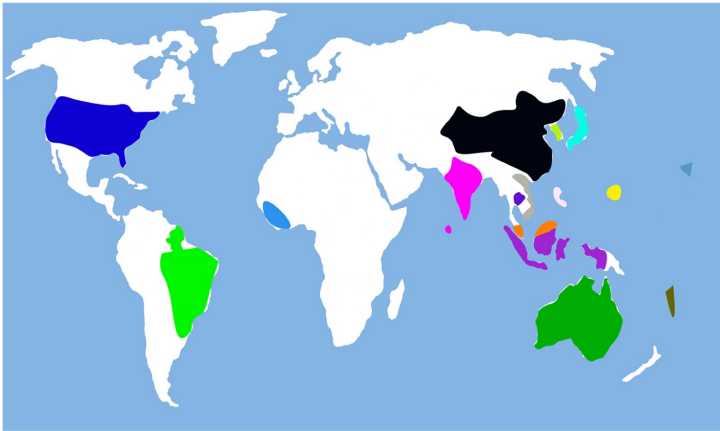


Evidence for widespread gene flow and migration in the Globe Skimmer dragonfly *Pantala flavescens*

Jessica Ware^{1*}, Manpreet Kaur Kohli¹, Ciara Mae Mendoza², Daniel Troast³, Hiroshi Jinguji⁴, Keith A. Hobson⁵, Göran Sahlén⁶, R. Charles Anderson⁷ & Frank Suhling⁸

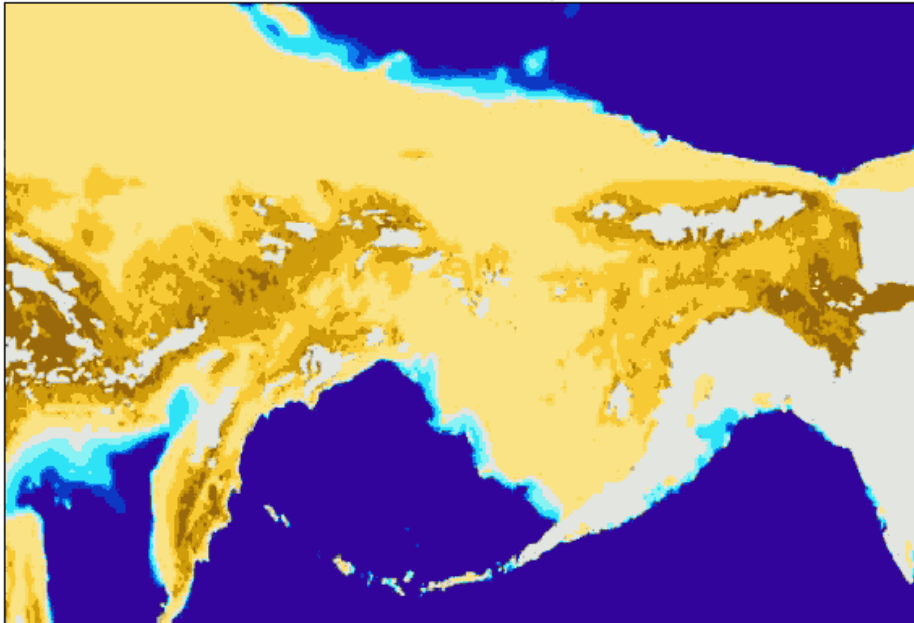


Pantala flavescens
The Global wanderer



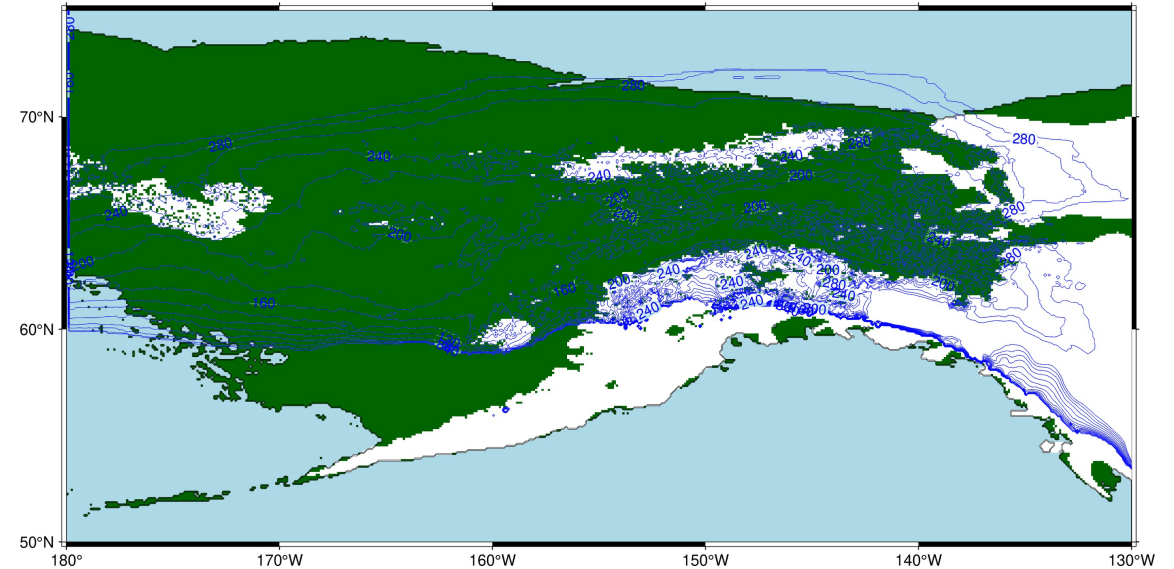
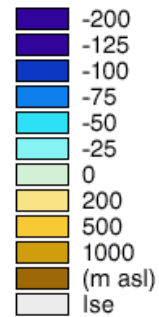
Divergence time since separation?

PALE Paleoenvironmental Atlas of Beringia
Coastline 21,000 Cal years BP



Wikimedia commons

Beringia 20000 years ago Duration of snow cover in days



Existed only in the Beringian refugia??

Long generation time?



Molecular Phylogenetics and Evolution

Volume 200, November 2024, 108185



Journal of Biogeography (J. Biogeogr.) (2014) 41, 1291–1300

ORIGINAL
ARTICLE

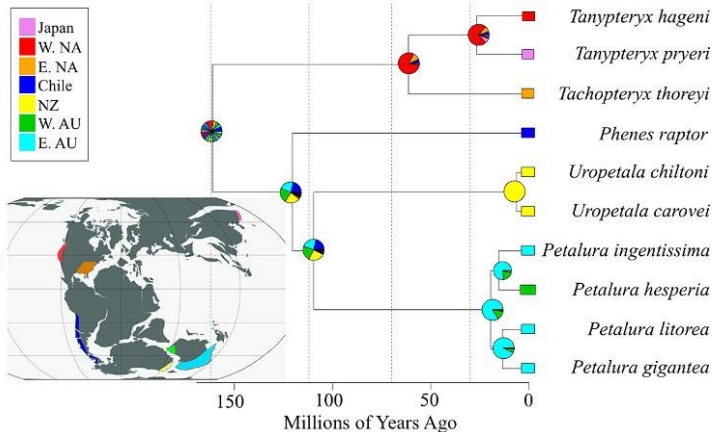
The petaltail dragonflies (Odonata: Petaluridae): Mesozoic habitat specialists that survive to the modern day

Jessica L. Ware^{1,*†}, Christopher D. Beatty^{2,*†}, Melissa Sánchez Herrera¹, Steve Valley³, Jim Johnson⁴, Cary Kerst⁵, Michael L. May⁶ and Gunther Theischinger⁷



A molecular phylogeny of the Petaluridae (Odonata: Anisoptera): A 160-Million-Year-Old story of drift and extinction

Ethan R. Tolman^{a b c}  , Christopher D. Beatty^{a d}, Manpreet K. Kohli^{a c e}, John Abbott^f, Seth M. Bybee^g, Paul B. Frandsen^h, J. Stephen Gosnell^{e k}, Robert Guralnick^l, V.J. Kalkman^j, Lacie G. Newton^a, Anton Suvorov^b, Jessica L. Ware^a



Story so far...

S. sahlbergi -dragonfly with potentially an interesting evolutionary history.

- Panmictic population?
- Divergence time since separation?
- Long generation time?

Holarctic dragonflies

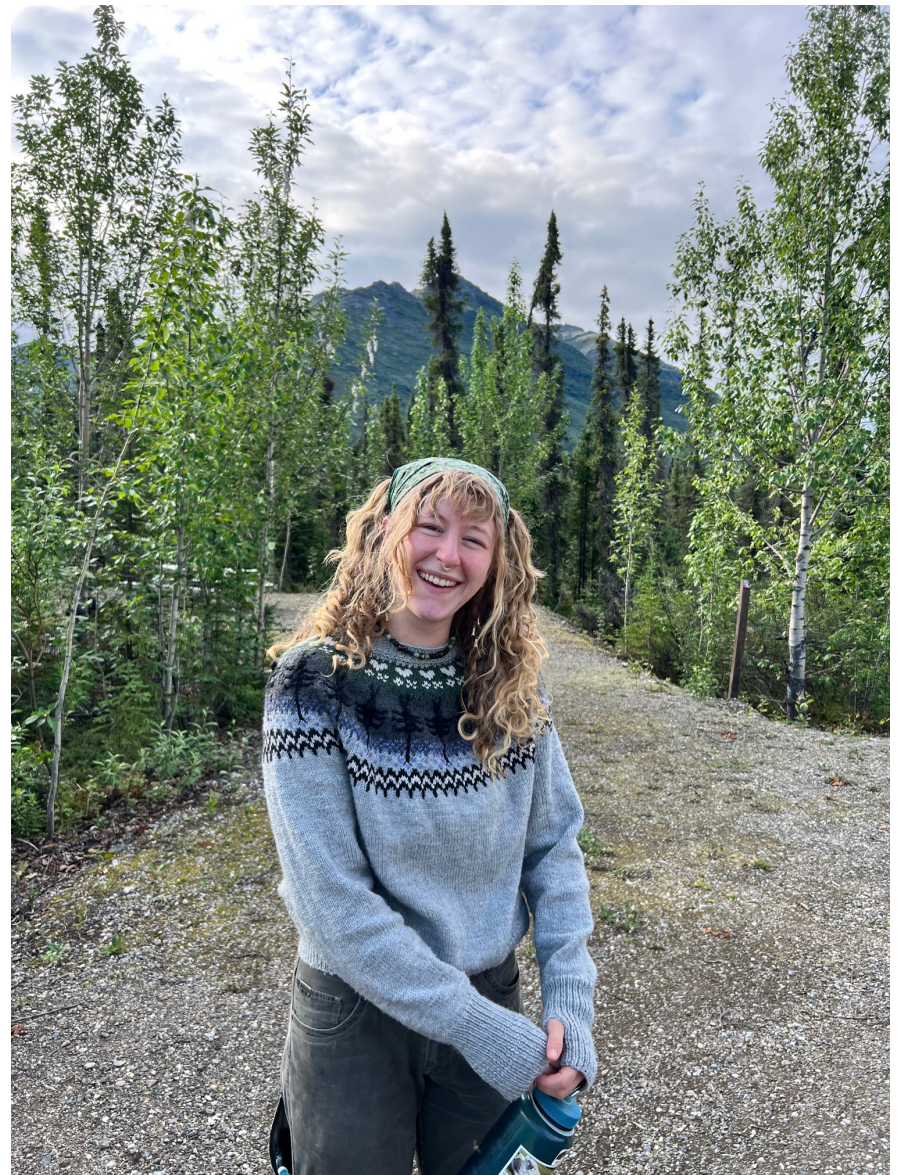
- Large Holarctic ranges?
- how are they surviving the extreme weather?

Next steps...

Genomic, physiological, ecological etc



July 2023

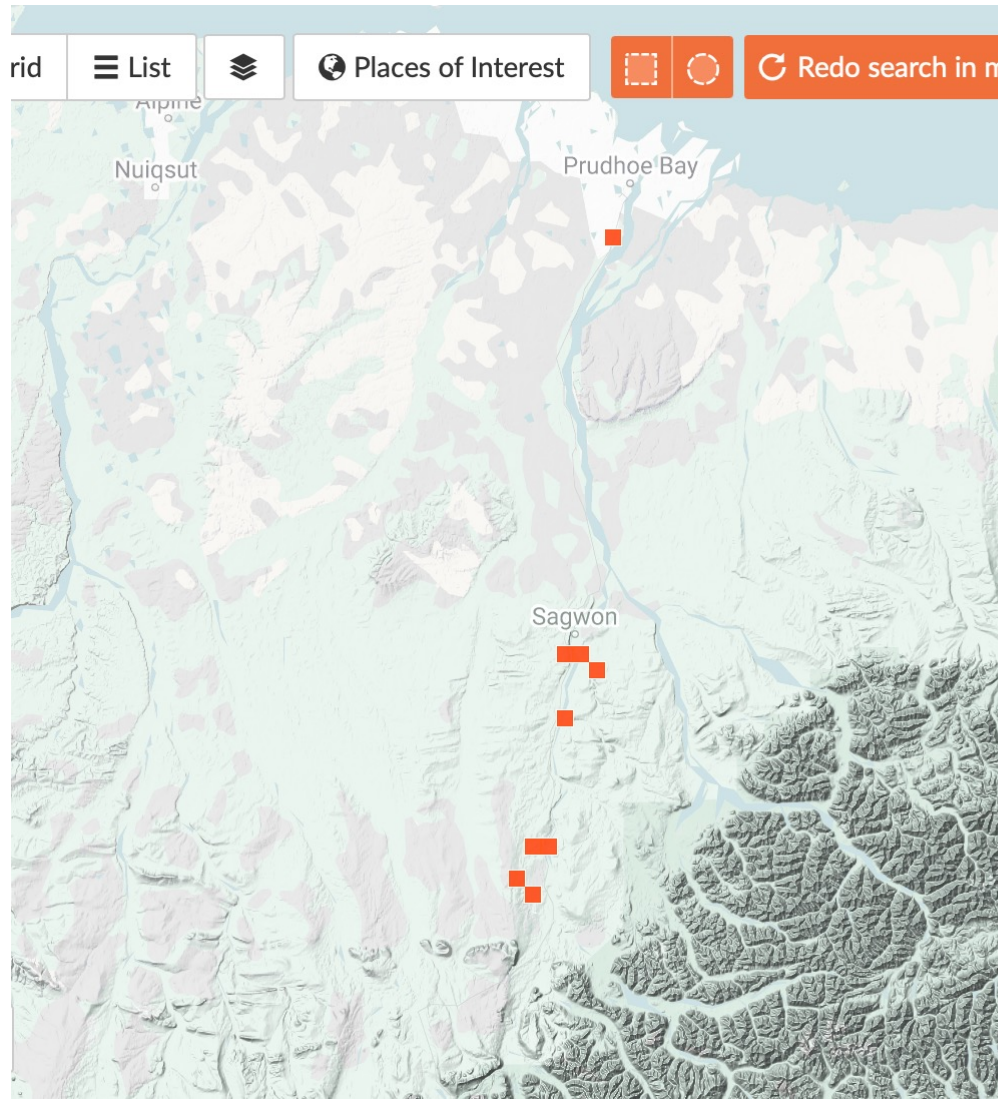


Anna Eichert

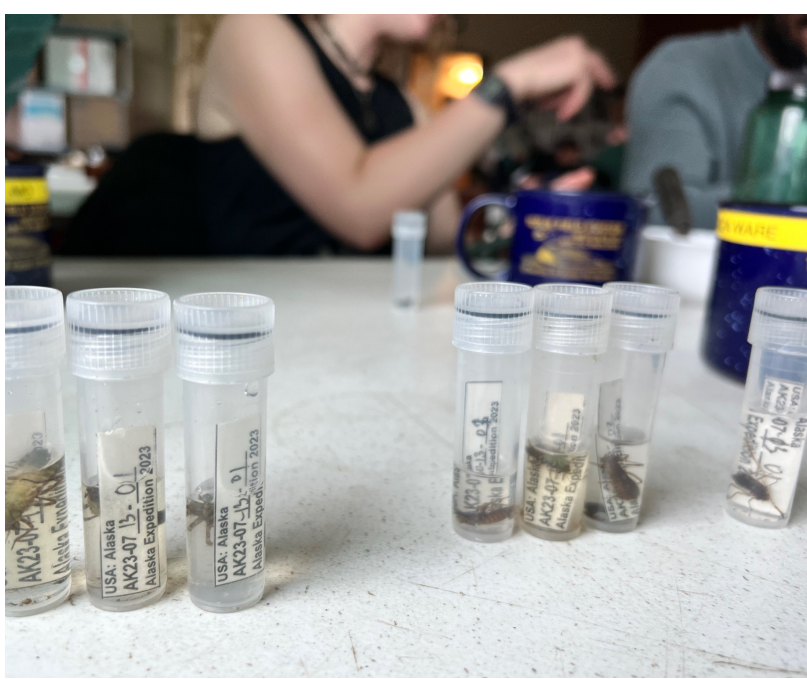












Bog 2 looking west

middle

shore2

shore

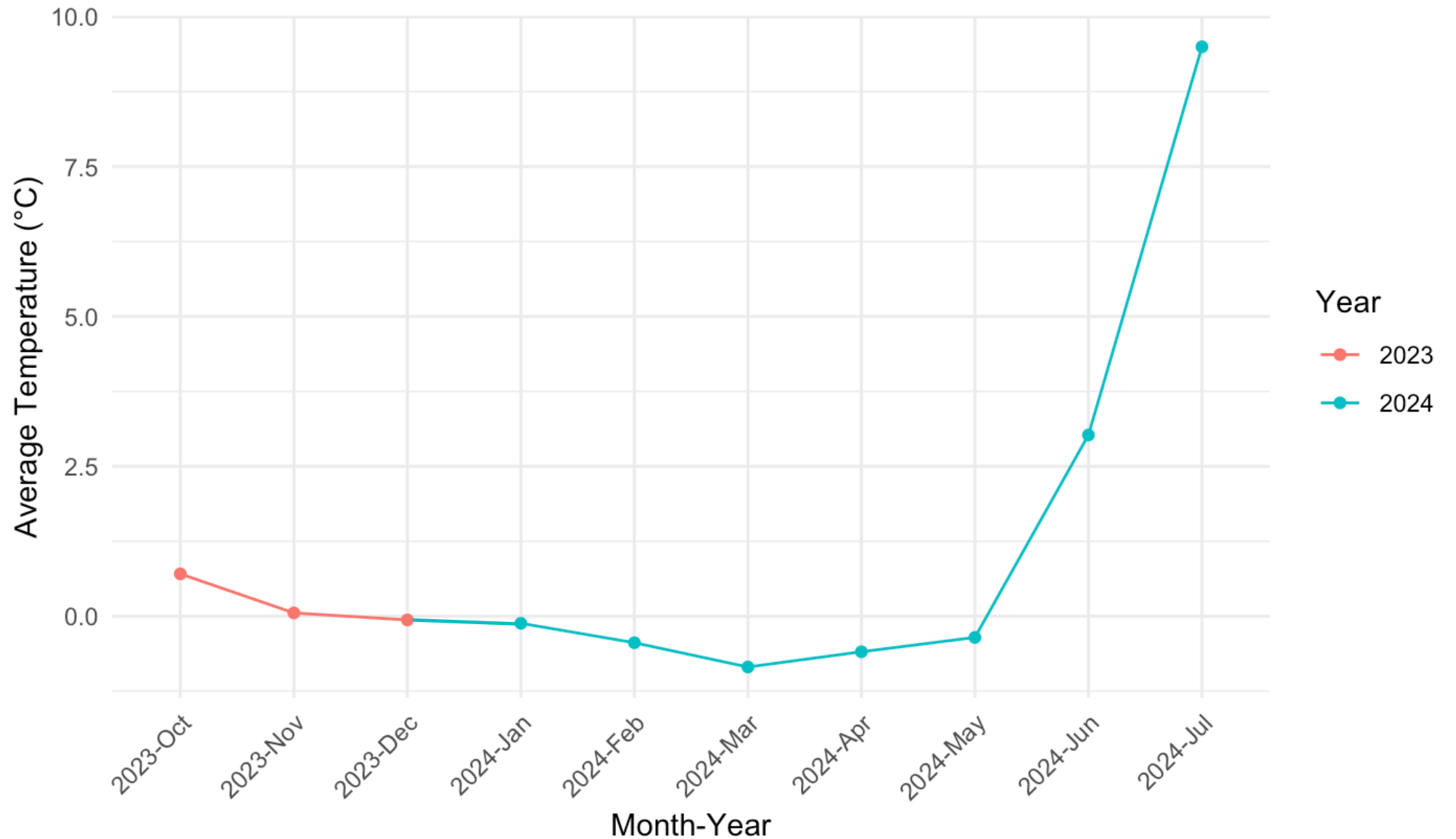
rebar



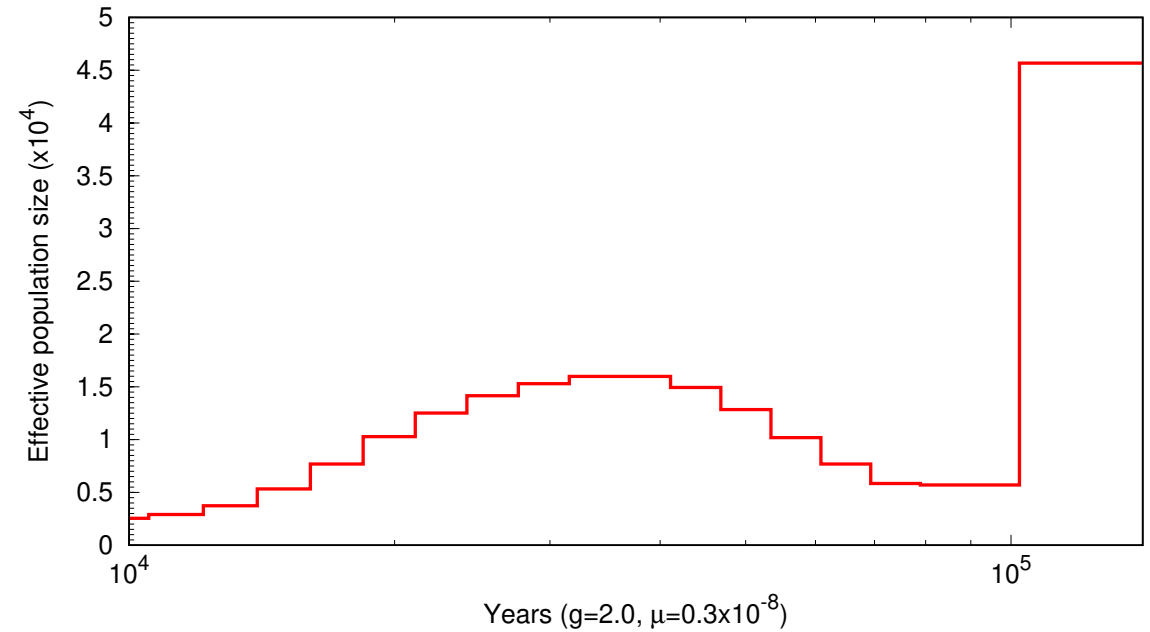
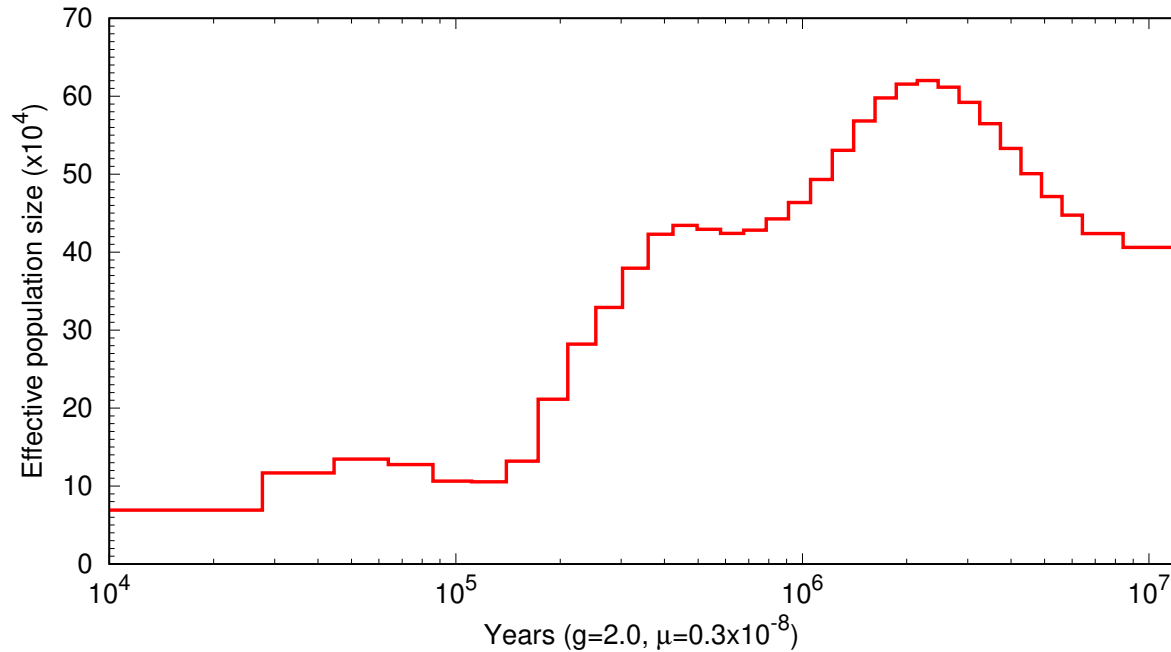
Abigail Jackson

Mayra Meléndez-González

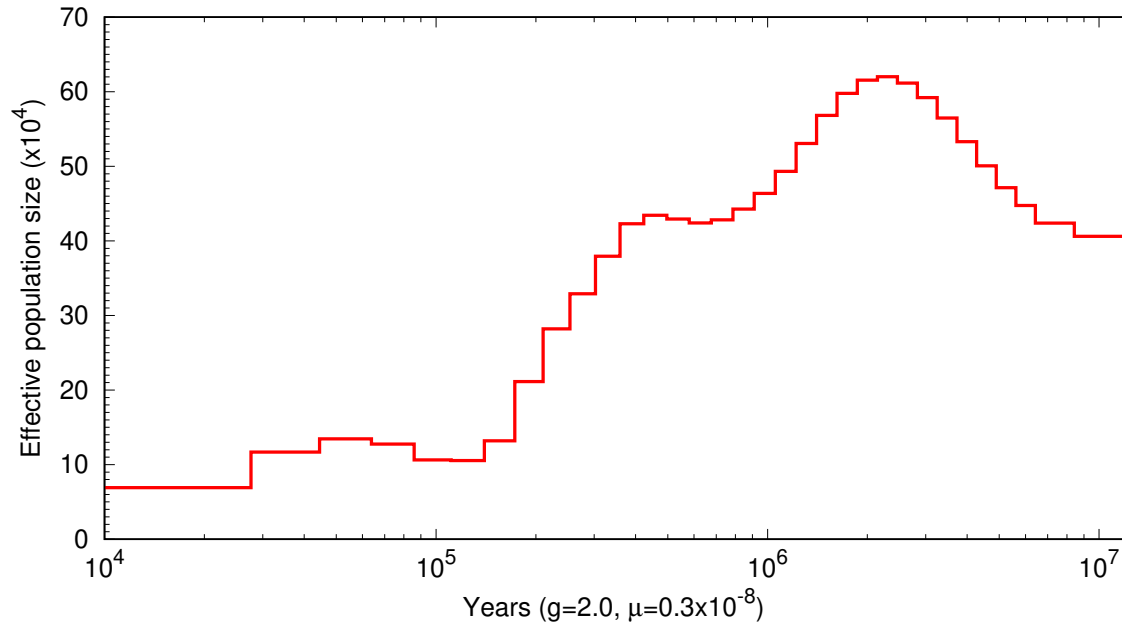
Monthly temperature trend Oct 2023- July 2024



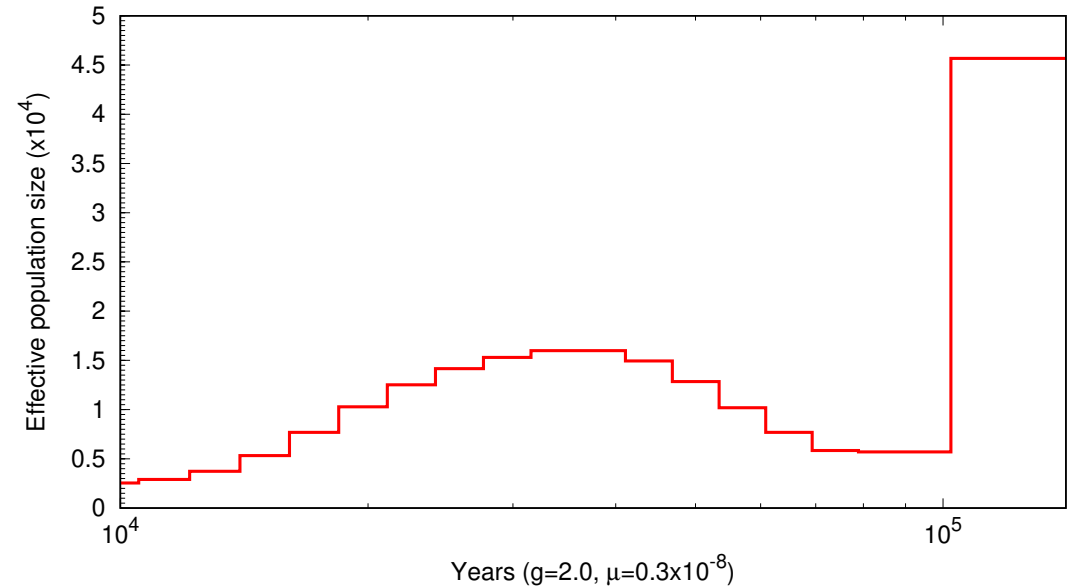
Whole genome sequencing – PSMC analysis



Whole genome sequencing



Aeshna juncea



Somatochlora sahlbergi



Northern Sweden – Oct 2023



Northern Sweden – June 2024



Next steps...

Genetic and physiological mechanism of cold tolerance and local adaptations across Holarctic



Next steps...

Genetic and physiological mechanism of cold tolerance and local adaptations across Holarctic

Thank you

