A regional DNA barcode library for landscape-scale monitoring of multi-taxa assemblages

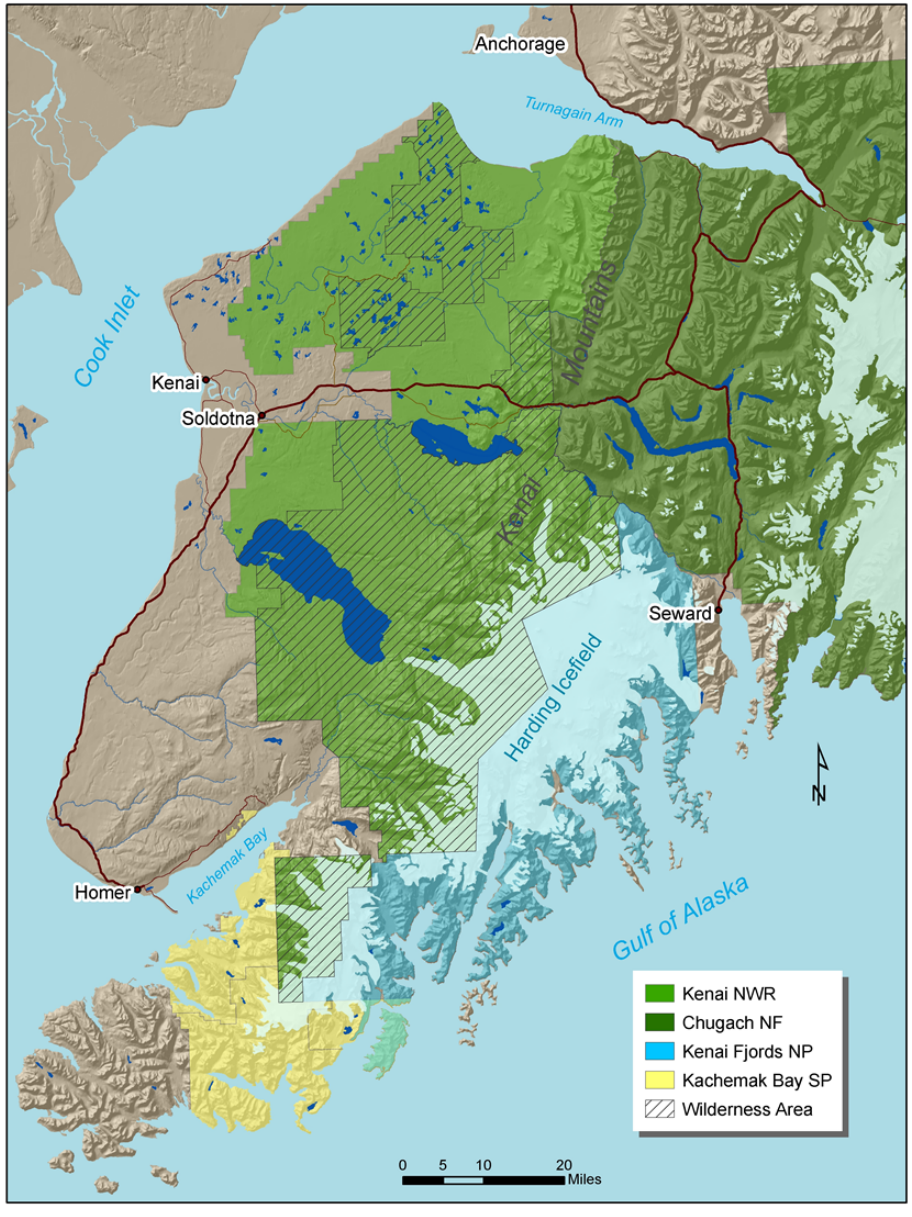
Matt Bowser[1], Derek S. Sikes[2], John M. Morton[1], and Sarah Meierotto[2]

20.August.2015
Guelph, Ontario

6th International Barcode of Life Conference

[1]U.S. Fish & Wildlife Service, Kenai National Wildlife Refuge
[2]University of Alaska Museum

Setting: Kenai National Wildlife Refuge



Setting: Kenai National Wildlife Refuge

A broad conservation mandate

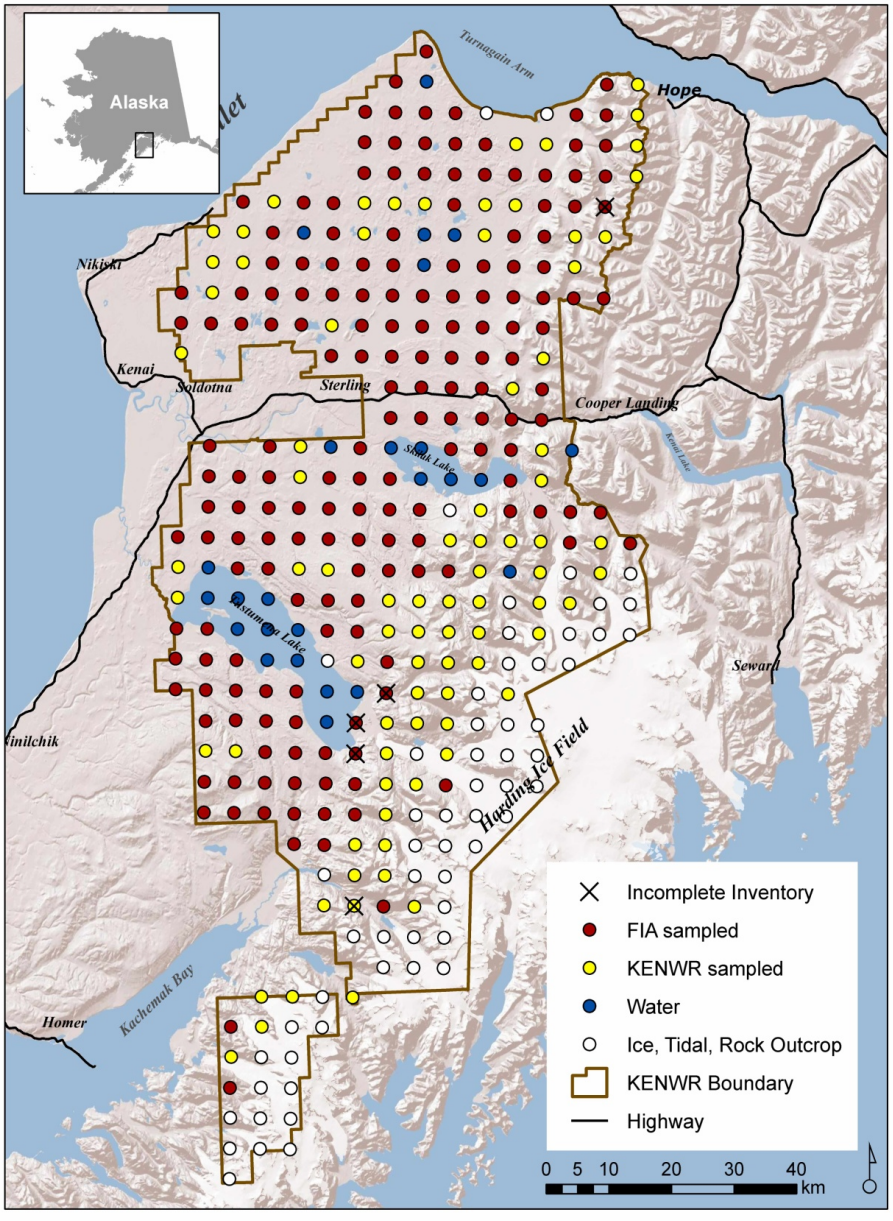
to conserve fish and wildlife populations and habitats in their natural diversity...

fish and wildlife = any member of the animal kingdom including without limitation any mammal, fish, bird, amphibian, reptile, mollusk, crustacean, arthropod or other invertebrate

Stressors: climate, development, exotic species

→ novel species assemblages,
trophic mismatch,
and potential extinctions

Long Term Ecological Monitoring Program, t_1

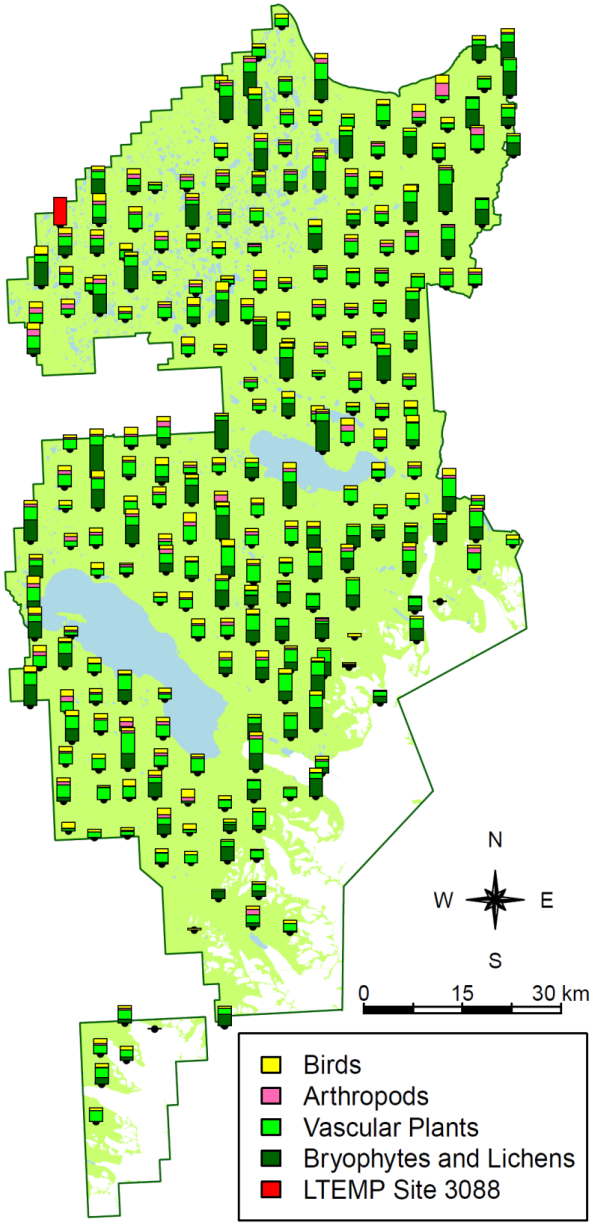


- Collaborative effort with USDA FIA program
- 259 permanent plots at 5-km intervals
- Sampled 2004, 2006, 2008
- Plants, birds, and arthropods inventoried

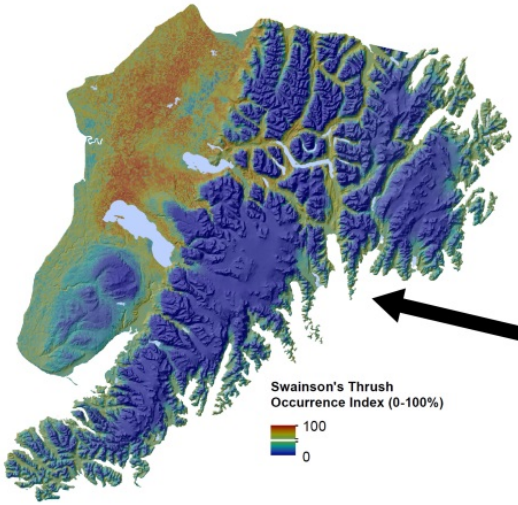
Long Term Ecological Monitoring Program, t_1

1,106 species:

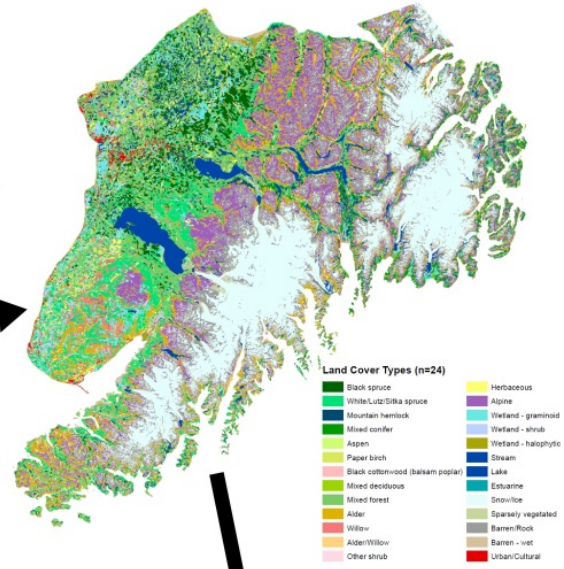
- 80 birds
- 256 invertebrates (15,136 specimens!)
- 324 vascular plants
- 297 lichens
- 149 bryophytes

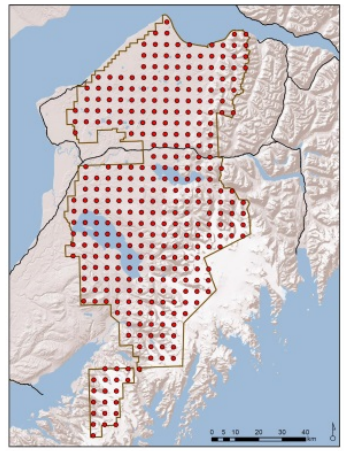


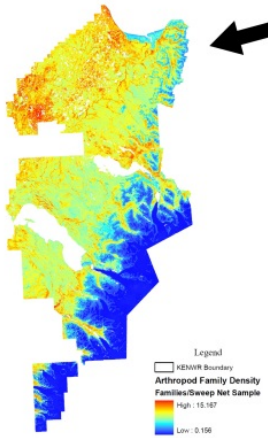
Predictive Models of
Single Species Distributions



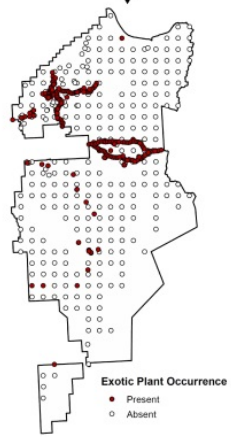
Remote Sensing
Classification



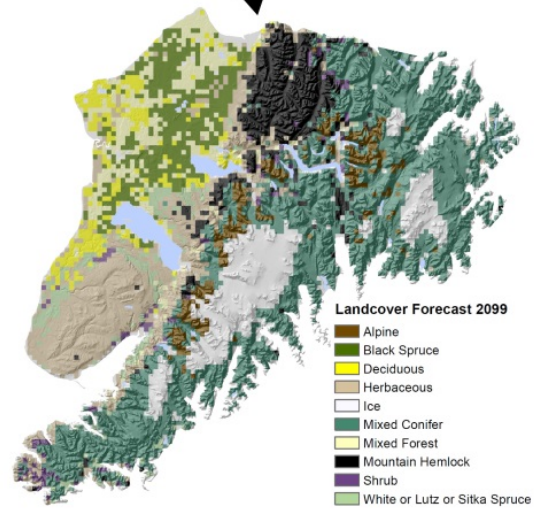




Explanatory Models of
Family Richness



Monitoring for
Adaptive Management



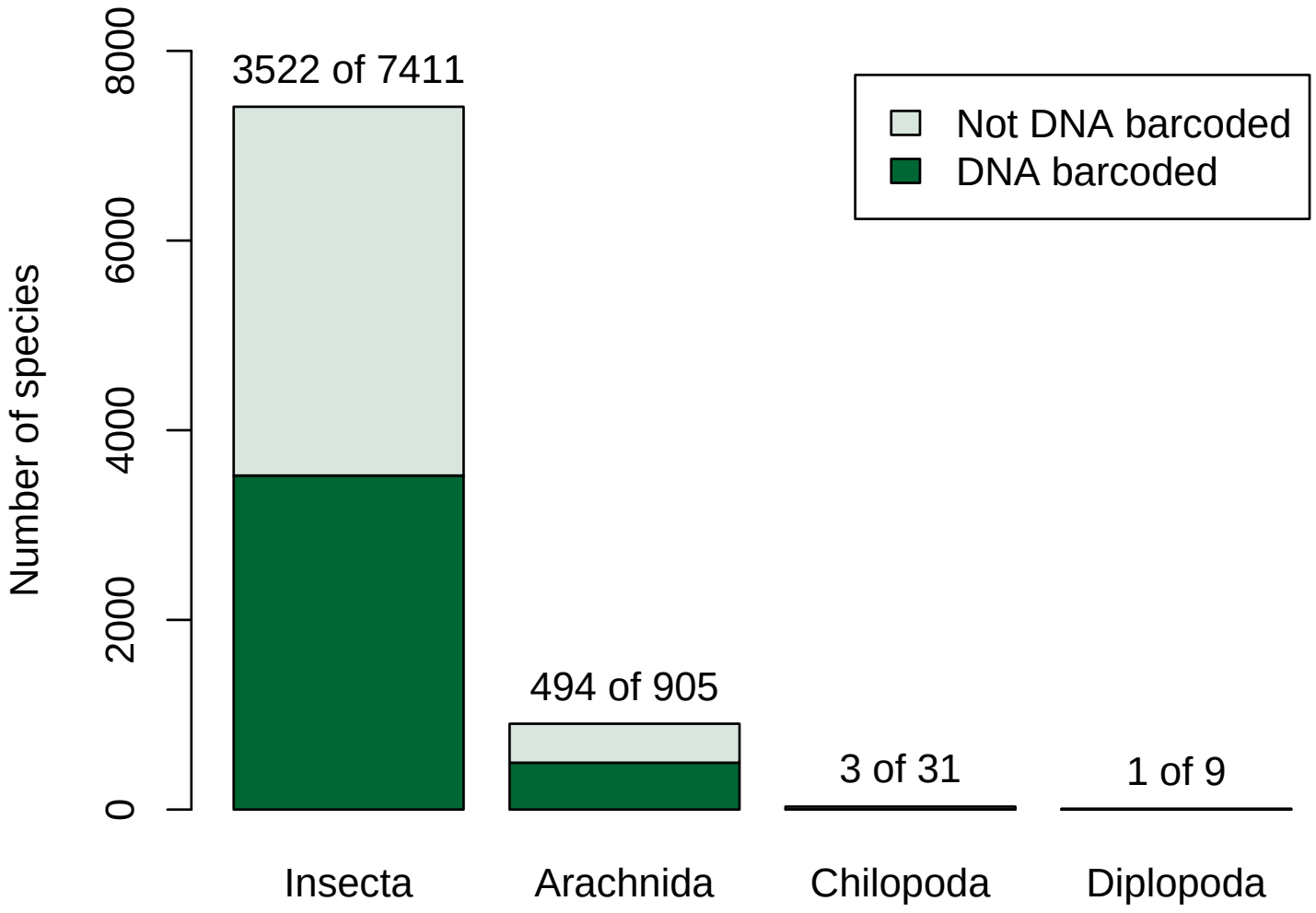
Climate Envelope Models
of Future Conditions

Problem: the Taxonomic Impediment

Morphological identification is impractical for *monitoring*.

An Alaska regional DNA barcode library

- 8,421 terrestrial arthropod species known from Alaska
- 4,020 (47%) of Alaska species now on BOLD
- 1,464 Alaska species sequenced by UAM & USFWS

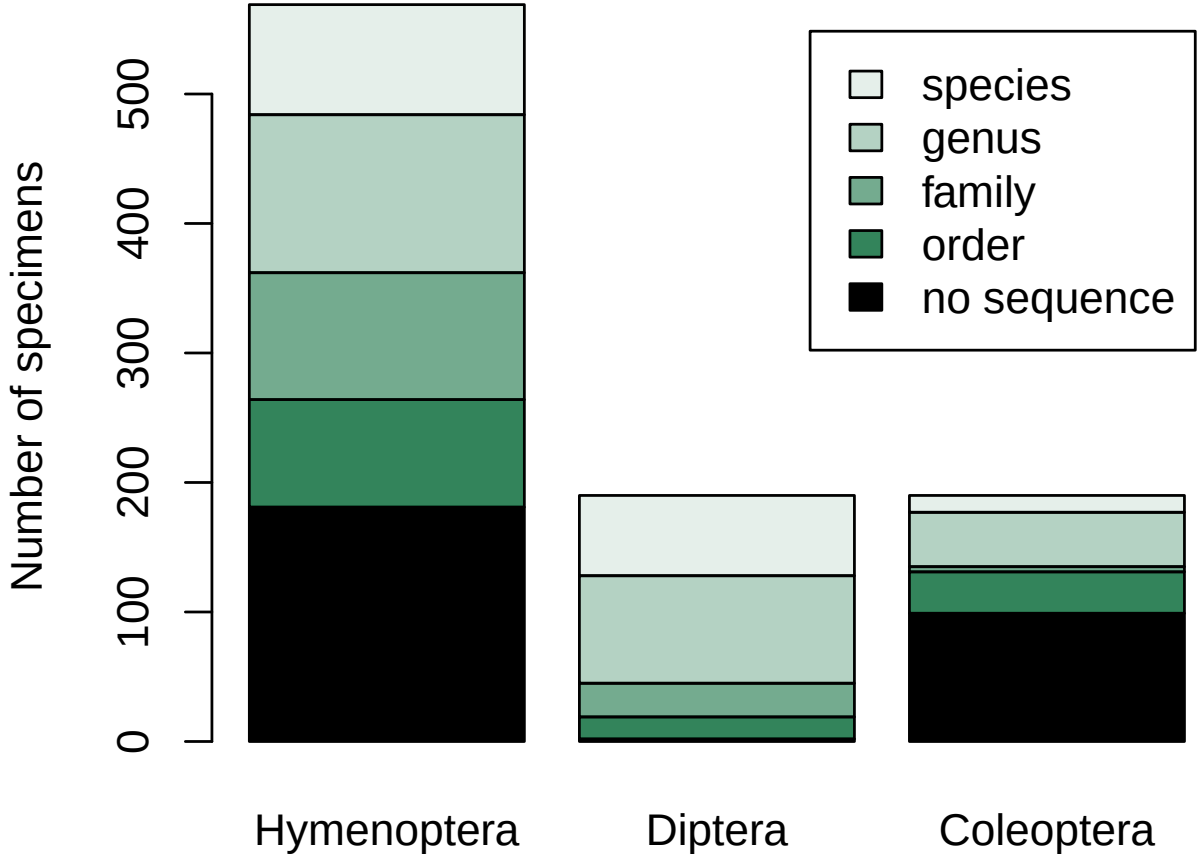


UAF UNIVERSITY OF ALASKA FAIRBANKS

U.S. FISH & WILDLIFE SERVICE
DEPARTMENT OF THE INTERIOR

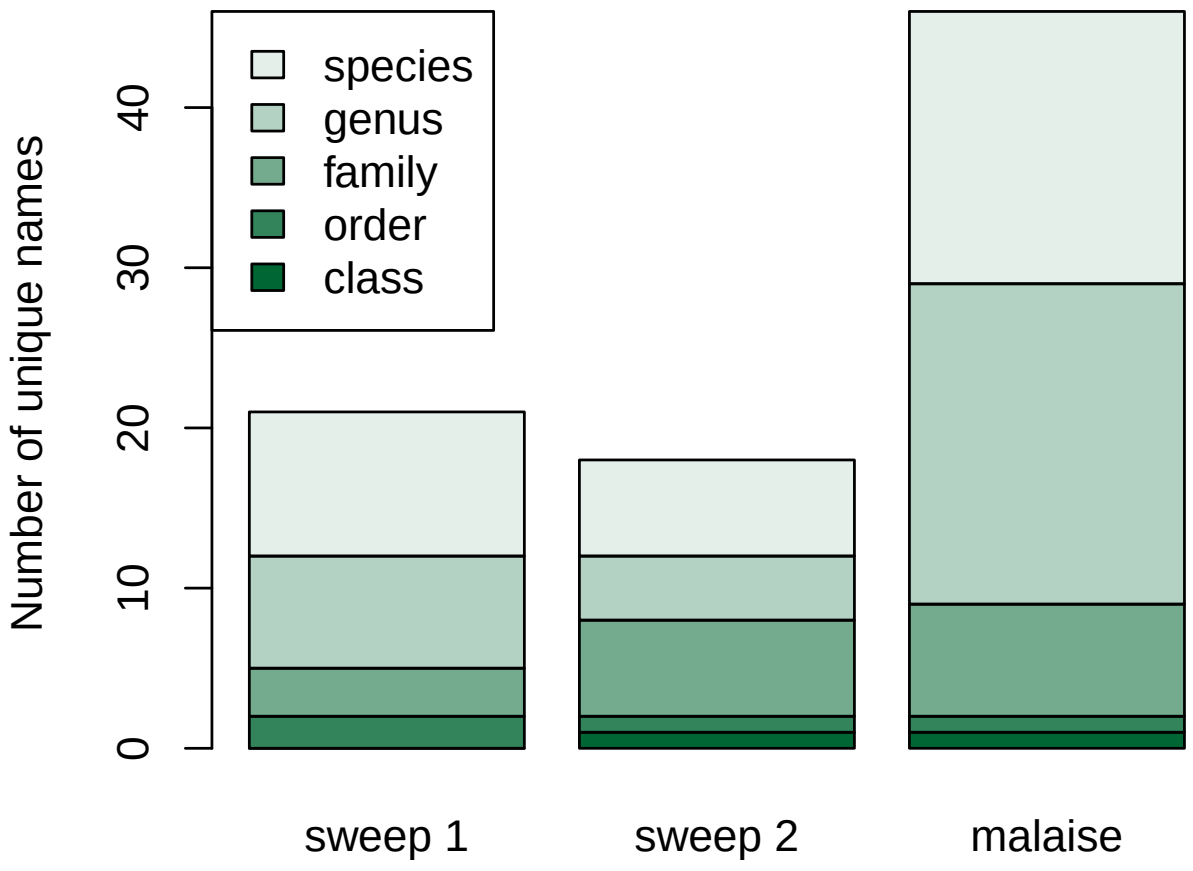
Sanger sequencing test: unknown *individuals*

- 950 specimens submitted to CCDB
- 17% overall success rate for species ID
- $71/species ID



NGS test 1: metabarcoding *assemblages*

- 2 sweep net samples and 1 malaise sample
- *ZBJ-ArtF1c* and *ZBJ-ArtR2c* primers → 157 bp sequence
- 6-17 species ID's/sample → \$6-\$16/species ID

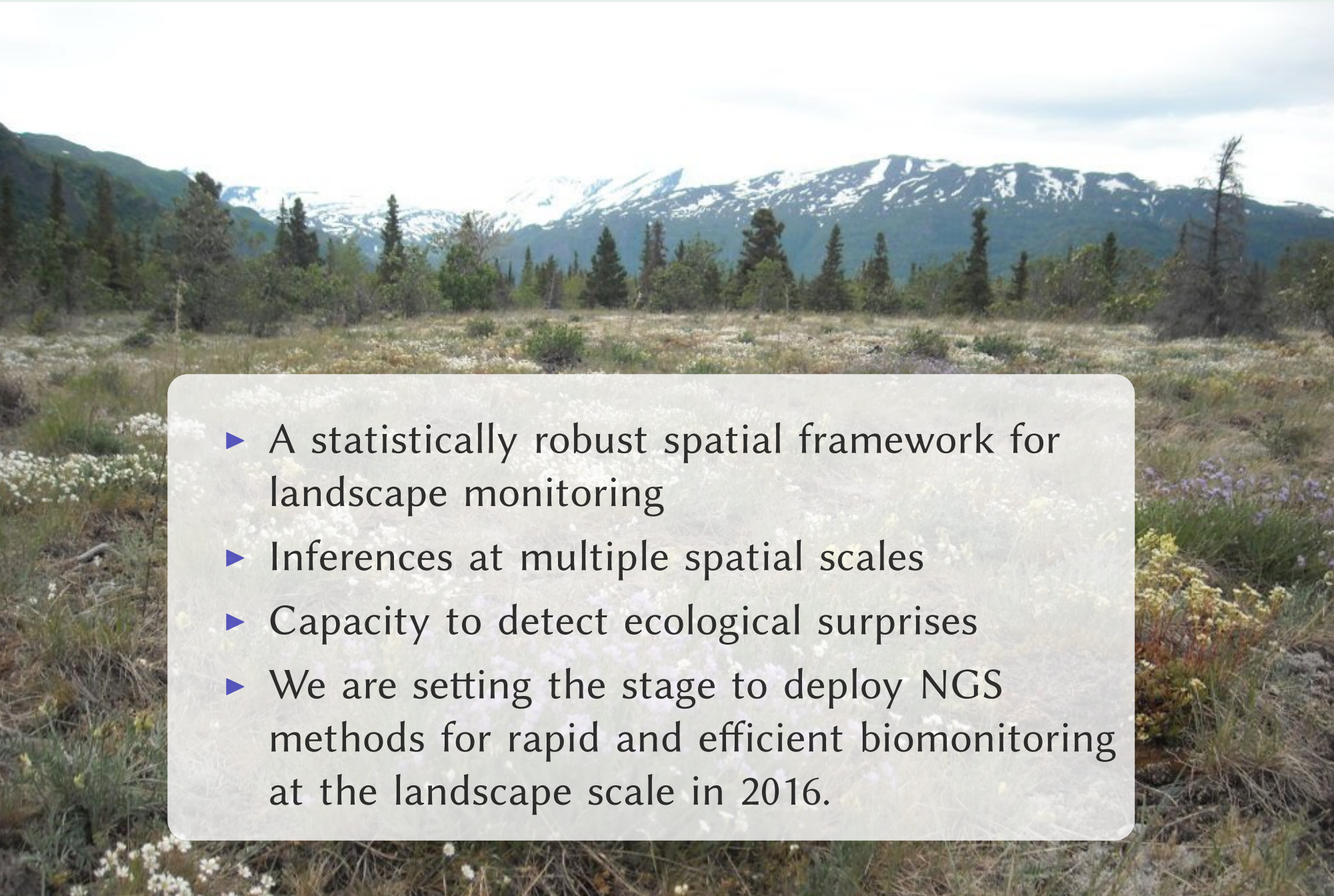


NGS barcoding ideal for *monitoring*

- Quick turn-around time
- Immatures, fragments, etc. can be identified.
- Identifications updated as libraries are improved.
- Repeatable
- $ Cost $

→ *Makes managing for biodiveristy feasible*

Long Term Ecological Monitoring Program, t_2



- A statistically robust spatial framework for landscape monitoring
- Inferences at multiple spatial scales
- Capacity to detect ecological surprises
- We are setting the stage to deploy NGS methods for rapid and efficient biomonitoring at the landscape scale in 2016.

Acknowledgments