Biomonitoring bugs by molecules: Slikok Creek

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3. Feb. 2018

Eleventh annual meeting of the Alaska Entomological Society, Anchorage, Alaska

a U.S. Fish & Wildlife Service, Kenai National Wildlife Refuge
Said the folks on the Hill
Keep that Great Land great still,
The fish and the wildlife
You must conserve
Stressors: climate, development, exotic species

In their natural diversity
Amid adversity
Every fish, bird and bug
On the Kenai reserve
(instrumental — Kenai Refuge landscape photos)
Plants, birds, and arthropods inventoried

In ’04 through ’06
We swept up insects
Long Term Ecological Monitoring Program, $t_1$

1,106 species documented

To enable monitoring
Of communities
Pinned and vialled all those bugs, 15,000+ bugs
TERRESTRIAL ARTHROPOD BIODIVERSITY
ON THE KENAI NATIONAL WILDLIFE REFUGE, ALASKA

A
THESIS

Presented to the Faculty
of the University of Alaska Fairbanks
in Partial Fulfillment of the Requirements
for the Degree of

MASTER OF SCIENCE

By

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Fairbanks, Alaska

May 2009

This guy did his best
By morphology
Conventional workflow

But No, it won't work
To monitor this way

Desitka.

2 espèces de Cychrus.
5 » de Feronta.
1 » de Patropus nov. planiusculus N.
1 . d’Amara, et 1 espèce de Nebria.
Metabarcoding workflow

So we have been trying Metabarcoding: Mushed bugs...
Metabarcoding are sequenced and identified.
A small test: Kenai grasslands, 2015

- 10 sites
- One 100 m\(^2\) sweep at each

We tried a small test
With pretty good success
Arthropod and oligochaete assemblages from grasslands of the southern Kenai Peninsula, Alaska

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Abstract

By the end of this century, the potential climate-biome of the southern Kenai Peninsula is forecasted to change from transitional boreal forest to prairie and grasslands, a scenario that may already be playing out in the Caribou Hills region. Here, spruce (Picea × glauca × sitchensis) forests were heavily thinned by an outbreak of the spruce bark beetle (Dendroctonus rufipennis (Kirby, 1837)) and replaced by the native but invasive grass species, Calamagrostis canadensis (Michx.) P. Beauv. As part of a project designed to delimit and characterize potentially expanding grasslands in this region, we sought to characterize the arthropod and earthworm communities of these grasslands. We also used this sampling effort as a trial of applying high-throughput sequencing metabarcoding methods to a real-world inventory of terrestrial arthropods.

Identifying things

From 10 samples we tried.

Photo: http://boldsystems.org/pics/BBHCN/10bbchem-0256%2B1291048108.jpg
And it seemed a lot better
To monitor this way
So in 2016 we tried monitoring on a grid of 40 places at Slikok Creek.
Slikok Creek 2016: field methods

We walked each place twice
Every time sweeping twice.

- Sampled:
  - birds
  - plants
  - lichens
  - earthworms
  - arthropods
Slikok Creek 2016: field methods

That's 160 samples — 4 sweeps each.
But we only processed 125 samples.

Multiple samples at each site. Remember that. It's important!
'Cause you really can't tell
If you missed something
Well, it might not have been there
Or you might just have missed it!
But with multiple samples and occupancy models, you can estimate the chance it was there and just missed.
(instrumental)
Slikok Creek 2016: results

For each and every bug of 401 species.

401 species

- Insecta: 358 species
- Arachnida: 34 species
- Collombola: 3 species
- Gastropoda: 6 species
Slikok Creek 2016: results

We figured out how likely if it’s there we would see.

Photo:  http://3.bp.blogspot.com/-SNah1hnap_U/T_A73ZHUILI/AAAAAAAASk/ISeGFA6knos/s1600/Midge+(female)+(Ablabesmyia+monilis).jpg
Slikok Creek 2016: results

Ablabesmyia monilis

Number of occurrences per day

So in short yes, it works
To metabarcode bugs

Photo: http://3.bp.blogspot.com/-SNah1hnnap_U/T_A73ZHUrI/AAAAAAAAA5k/lSeGFaY6kno/s1600/Midge+(female)+(Ablabesmyia+monilis).jpg.
Slikok Creek 2016: results

Number of species per plot

For monitoring insect Communities
Slikok Creek 2016: species

Photo: http://aesgsf.free.fr/V5/_media/img/medium/tetragnatha-extensa-pby-arno-s.jpg.

So yes, it's feasible.

Photo: https://diptera.info/images/photoalbum/album_38/pcampestris.jpg.

Photo: https://www.brc.ac.uk/schemes/barkfly/images/photos/Valenzuela%20flavidus_AO.jpg.
It's far more reasonable
And certainly more repeatable
Acknowledgments

- John Morton, Dawn Robin Magness, Todd Eskelin, Jennifer Peura, Rebekah Brassfield, Mariah McInnis, Joel Stone, Mallory Okuly, Tracy Melvin, Annie Dziergowski (Design, support, lab work, field work for Kenai grassland and Slikok creek projects)

- Derek Sikes and others, University of Alaska Museum (Alaska regional arthropod DNA barcode library)

- Research and Testing Laboratory (sequencing)