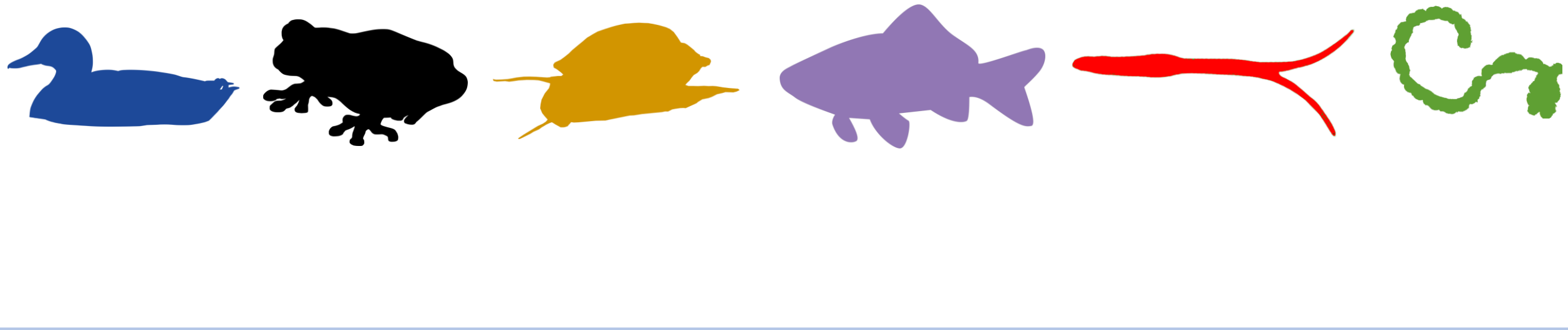
Using eDNA to monitor for invasive species

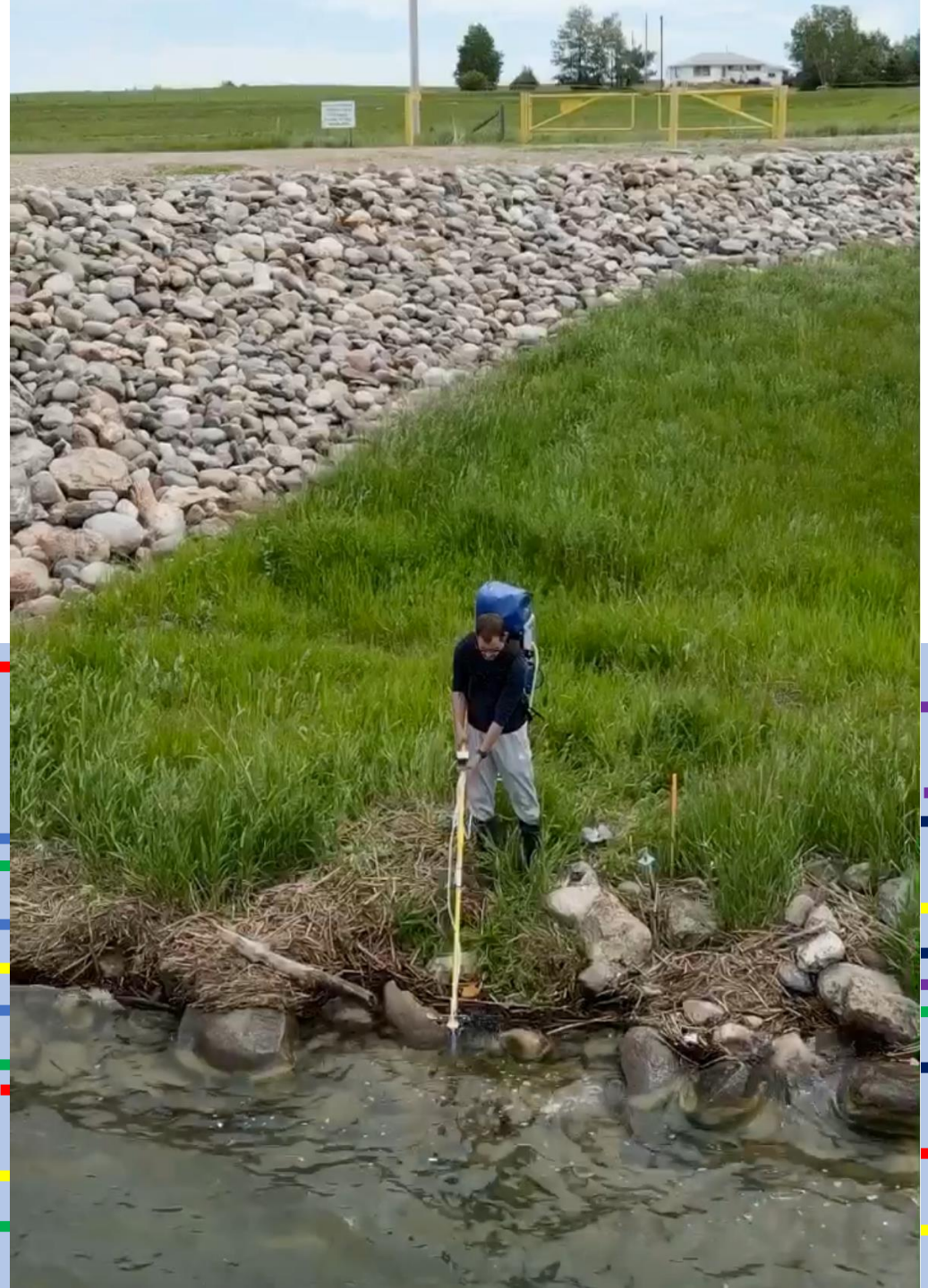
Patrick Hanington

What is environmental DNA?

Organisms leave transient biological signatures in their environments. Feces, mucus, or tissues can be deposited into aquatic environments. Or the organisms can be collected directly.

These signatures can be detected and using modern molecular techniques like DNA sequencing or qPCR, we can detect these transient signals and infer the presence of an array of species



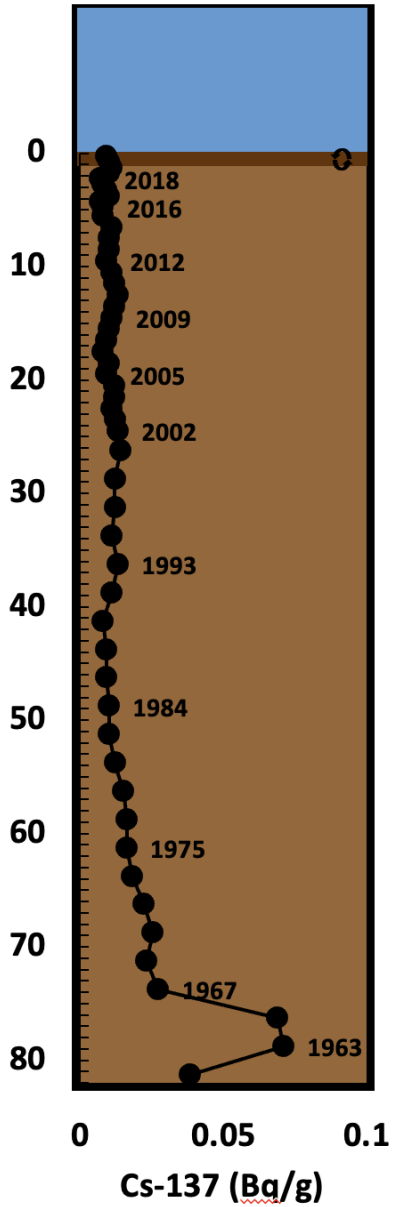


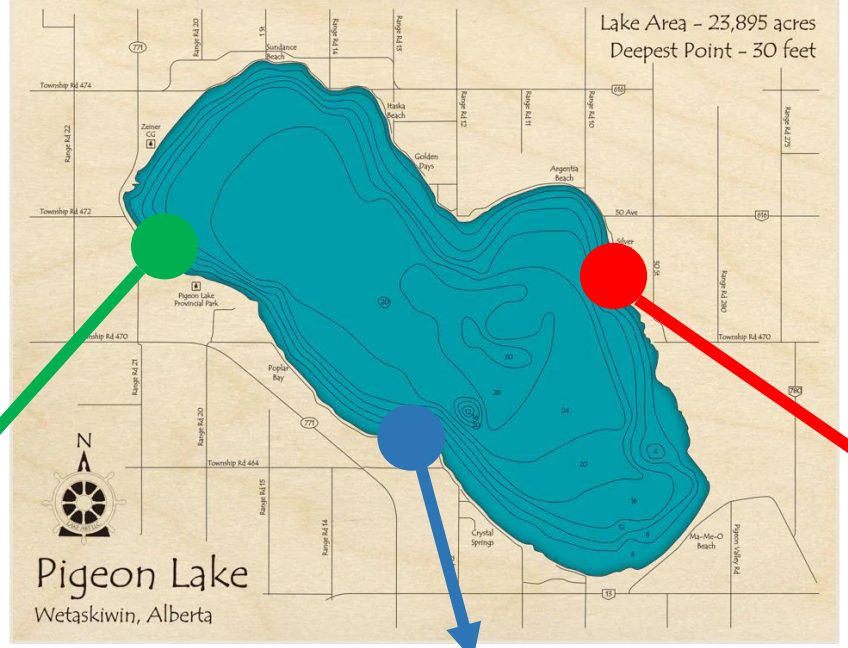
Ways we currently use eDNA

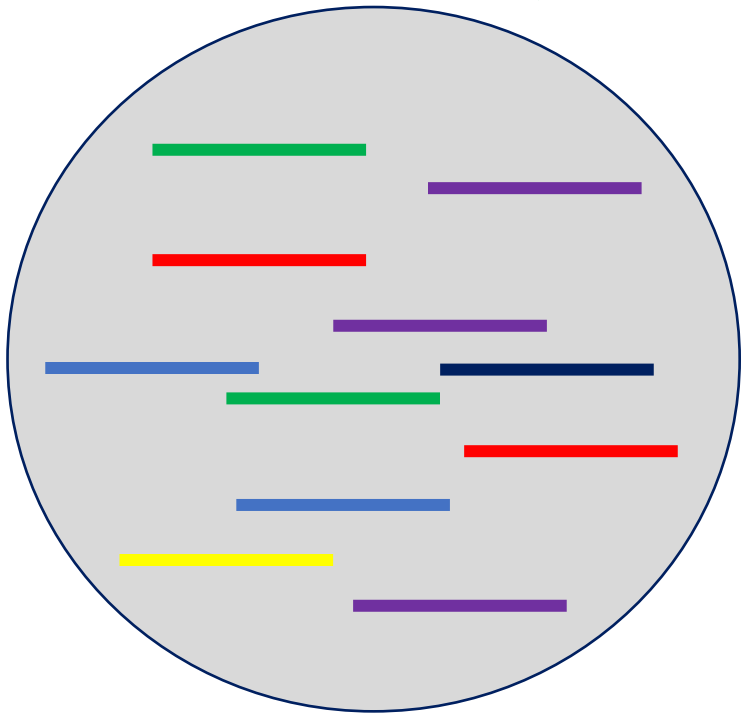
EDUCATION

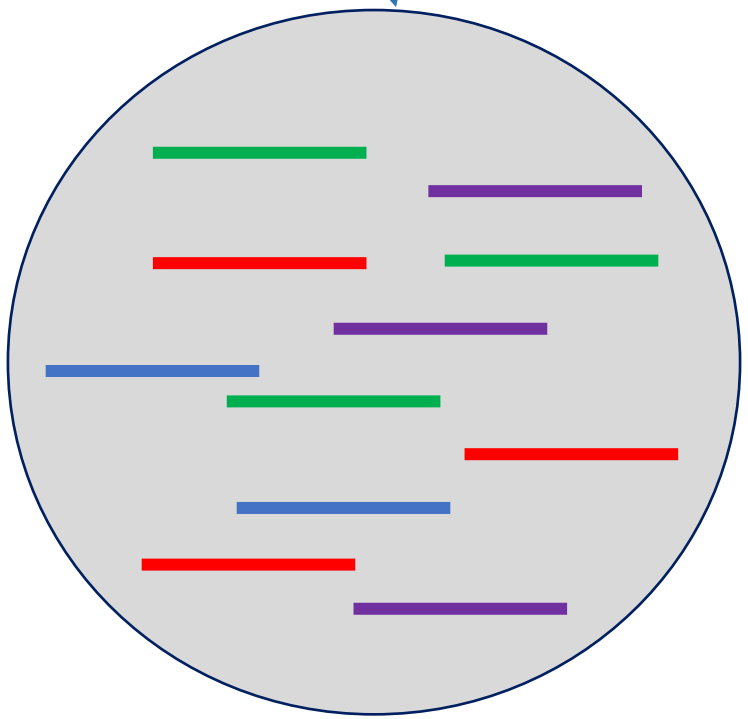
WHAT'S IN OUR WATER?

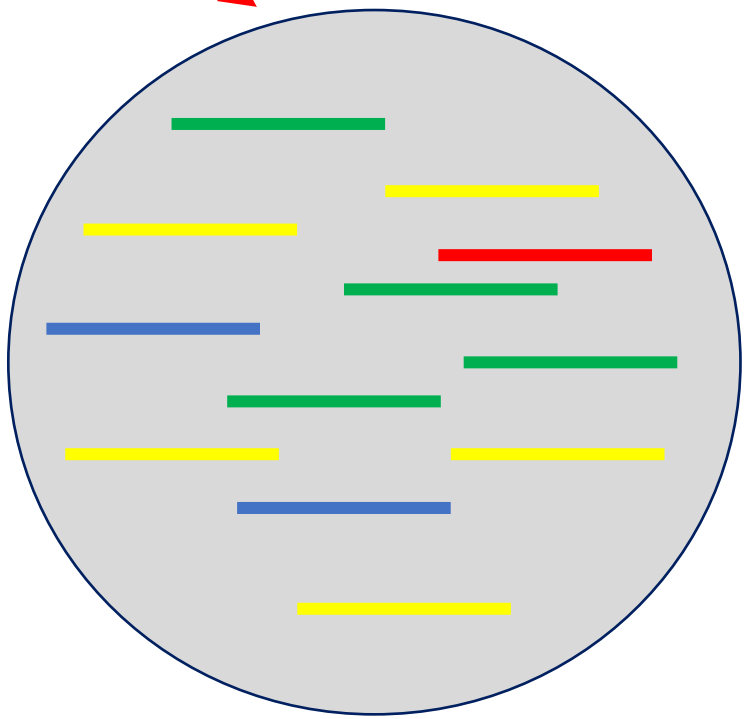
WHAT WAS IN OUR WATER?




Lake Area - 23,895 acres
Deepest Point - 30 feet
Pigeon Lake
Wetaskiwin, Alberta
N
Sundance Beach
Itaska Beach
Golden Days
Argentia Beach
Silver
Pigeon Lake Provincial Park
Poplar Bay
Crystal Springs
Ma-Me-O Beach
Township Rd 474
Township Rd 472
Township Rd 470
Township Rd 464
50 Ave

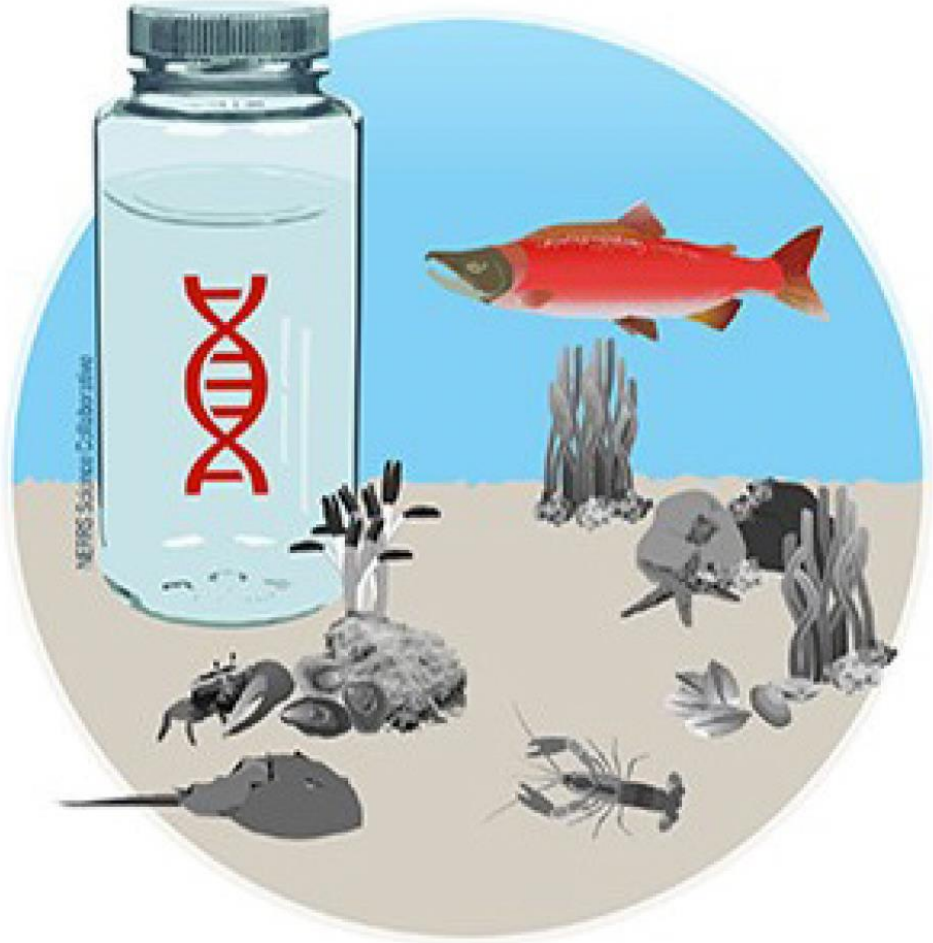






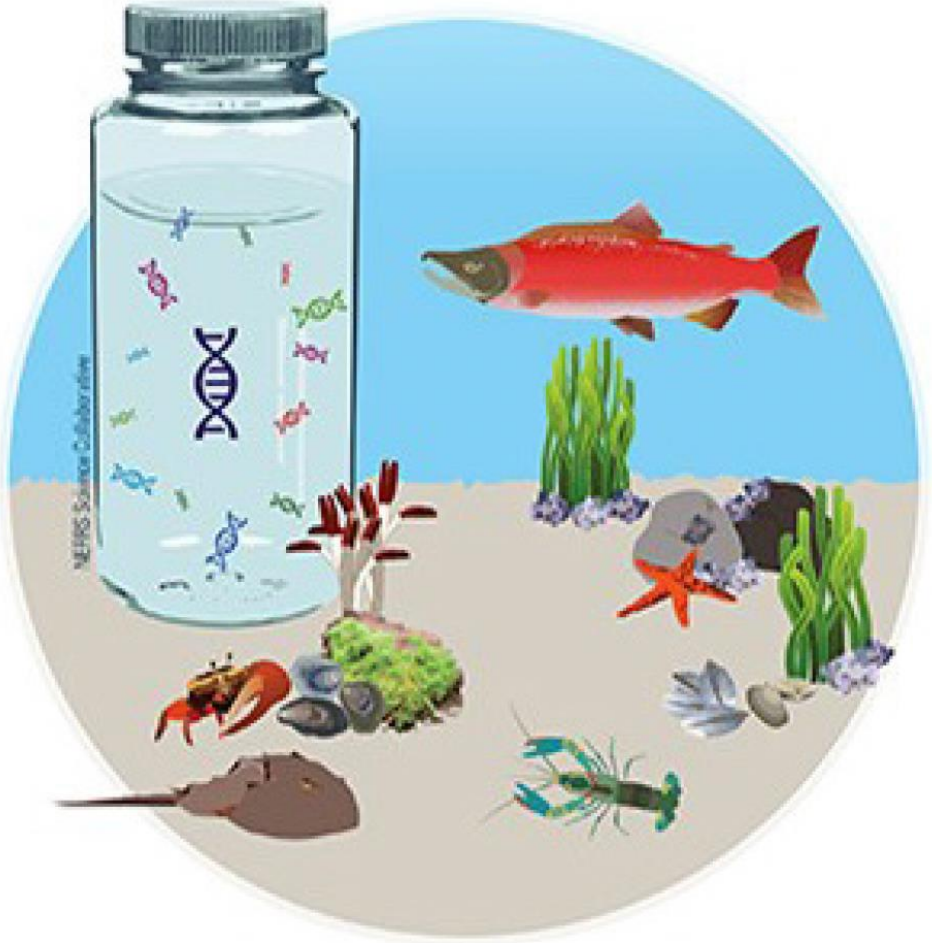
eDNA methods can answer many questions about aquatic ecosystem biodiversity

Well characterized
High sensitivity and specificity



Single Species PCR

Emerging
Incredible potential



Metabarcoding

Watts and Peter, 2020

Well characterized
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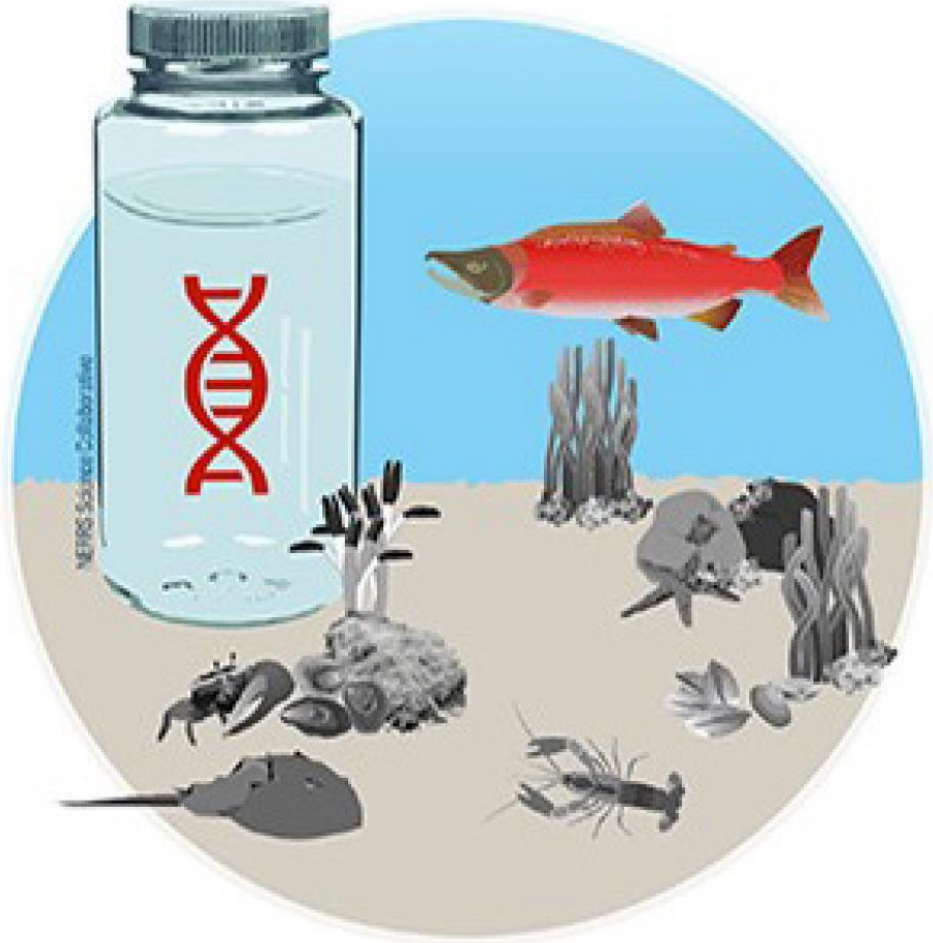

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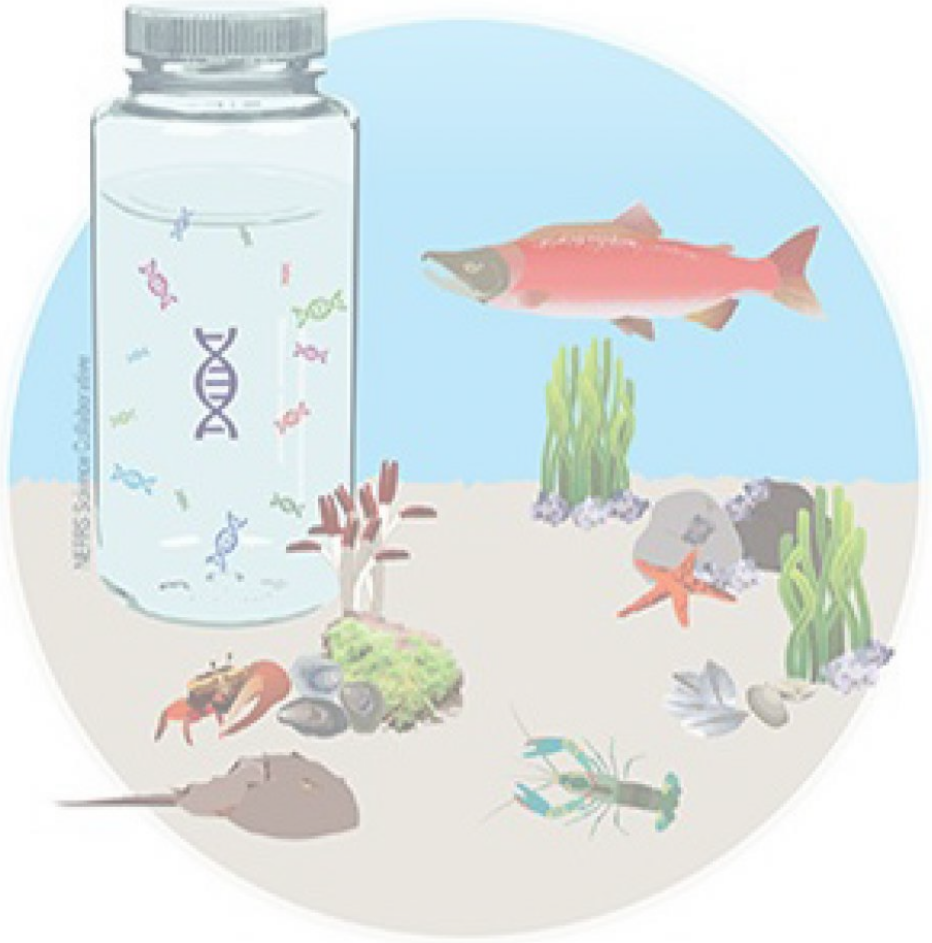

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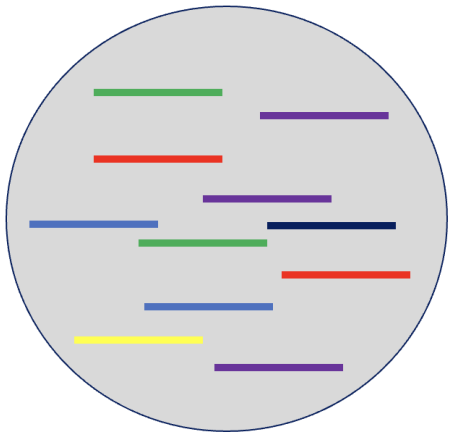
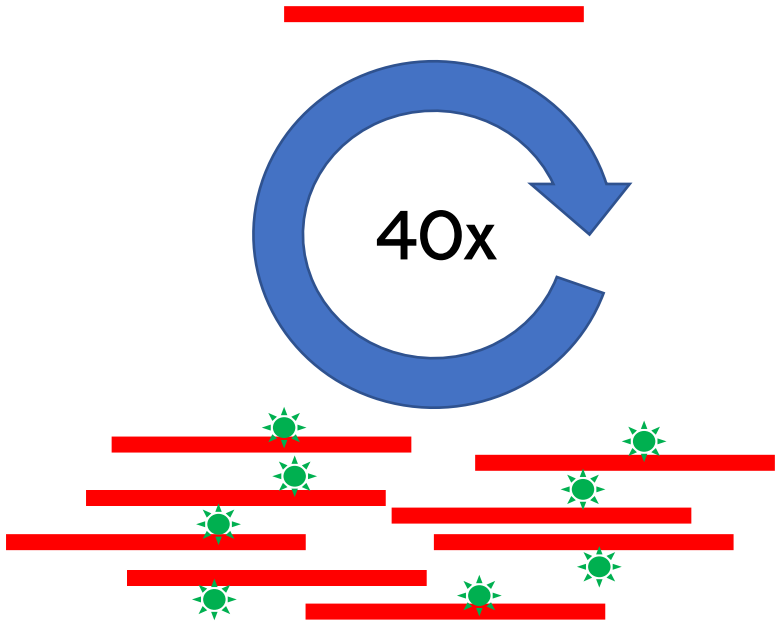


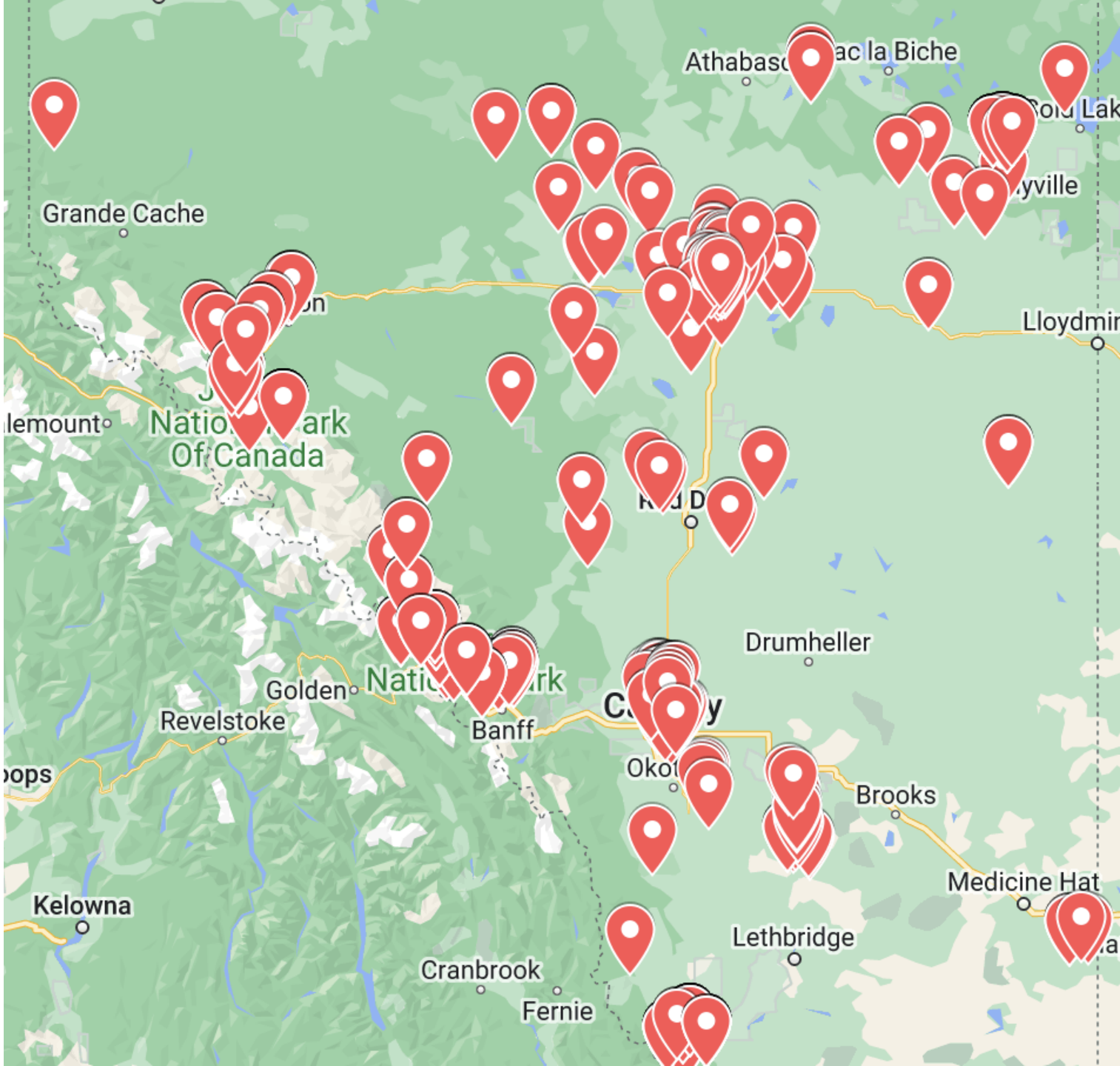


Early Detection – Rapid Response

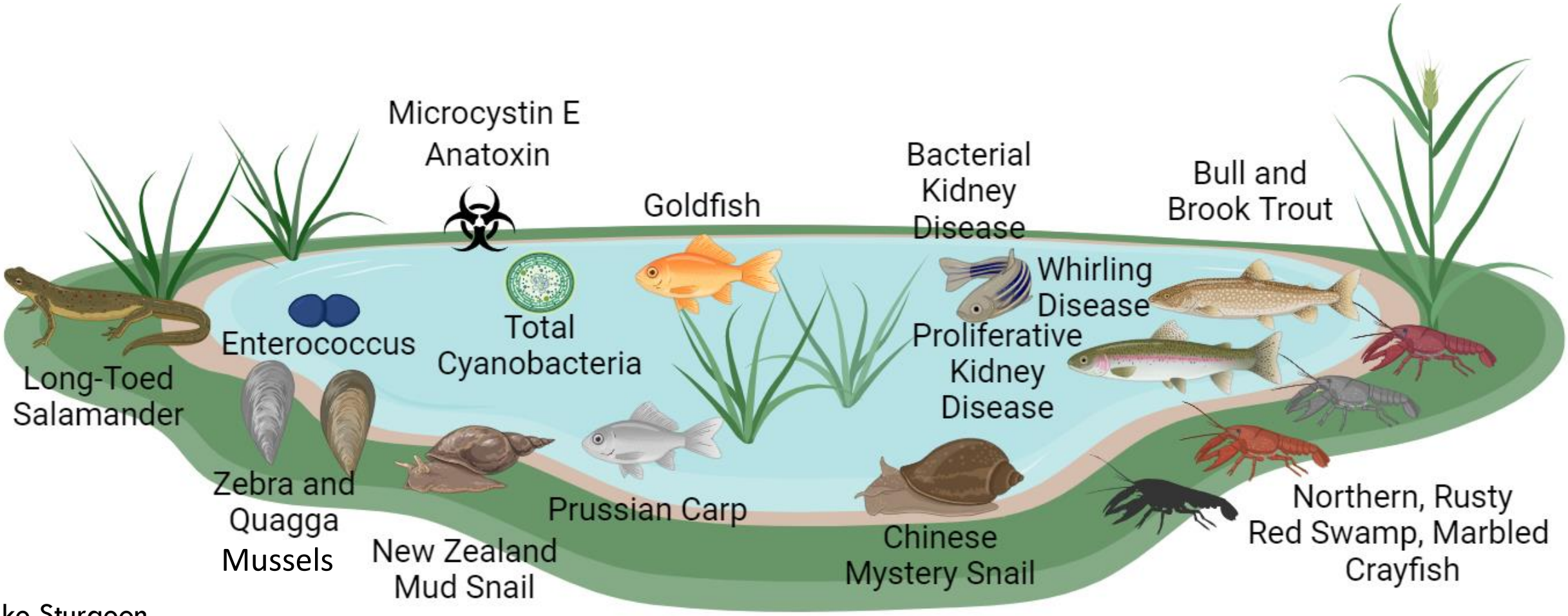
Aquatic eDNA monitoring for invasive species

Dr. Jacob Hambrook

- 592 samples collected in 2023
- 20 invasive species/species at risk and health-related targets assessed
- Repeated for two additional years

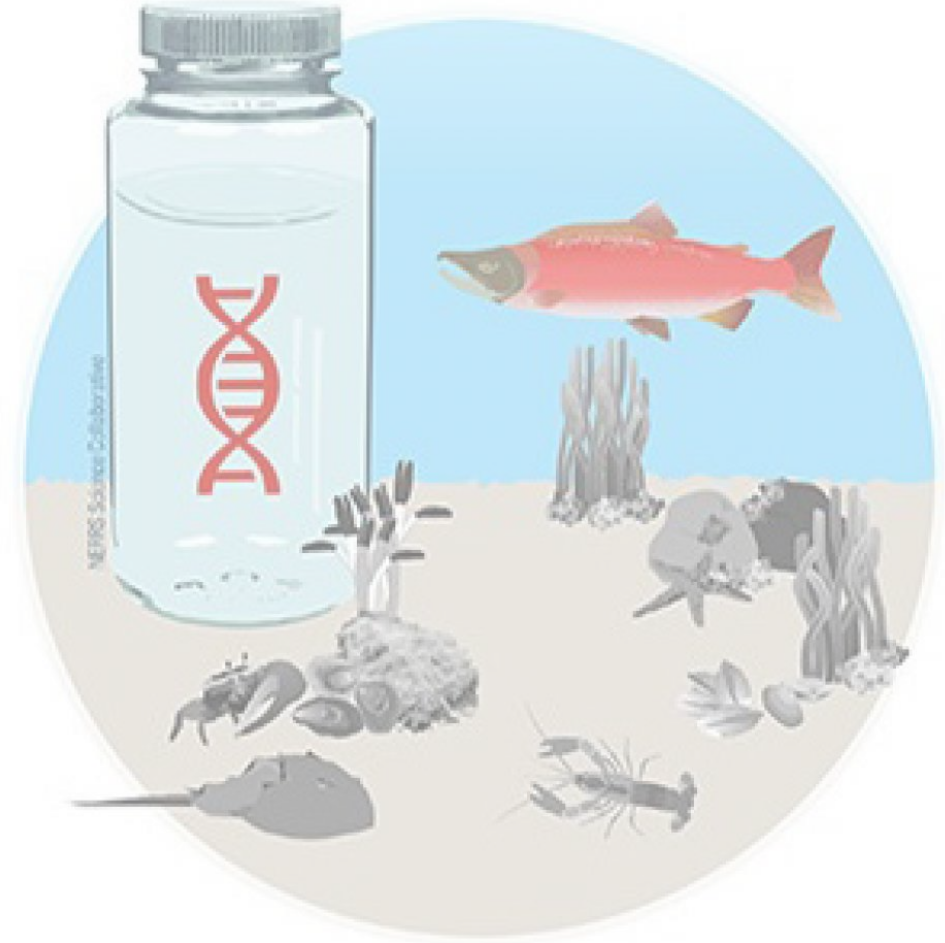


Targets we're testing for now



Lake Sturgeon
Arctic grayling
Athabasca Rainbow trout

Well characterized
High sensitivity and specificity



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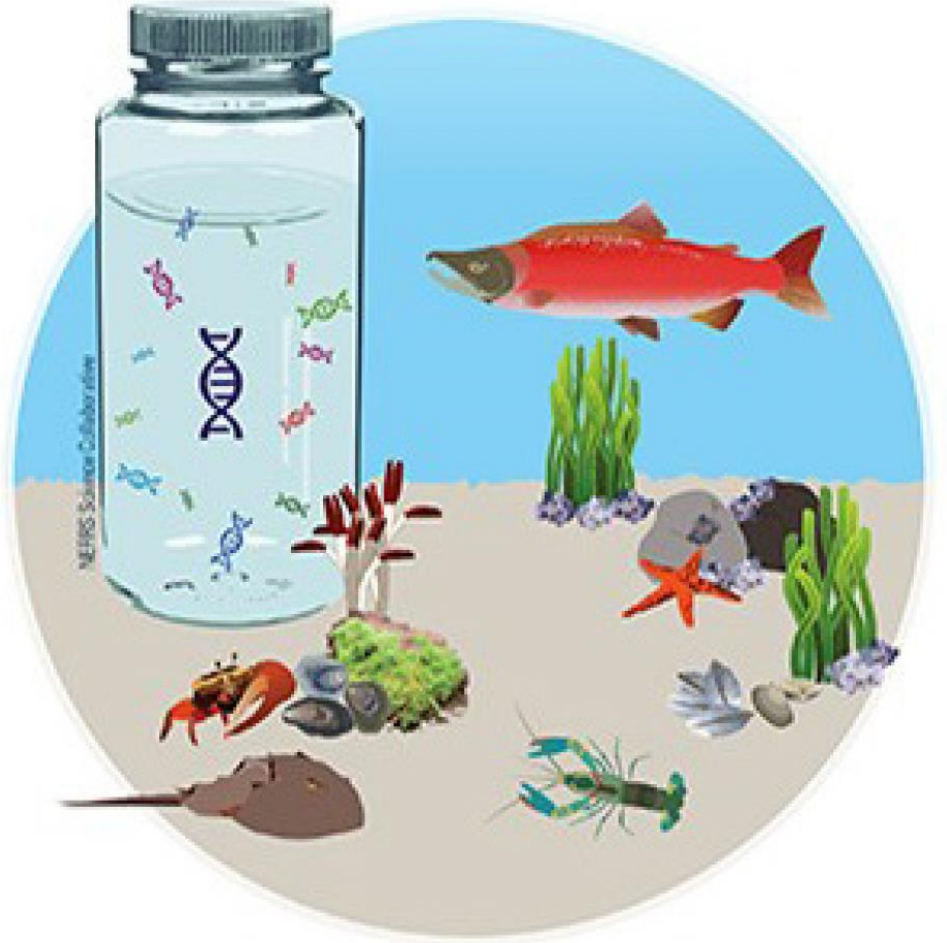

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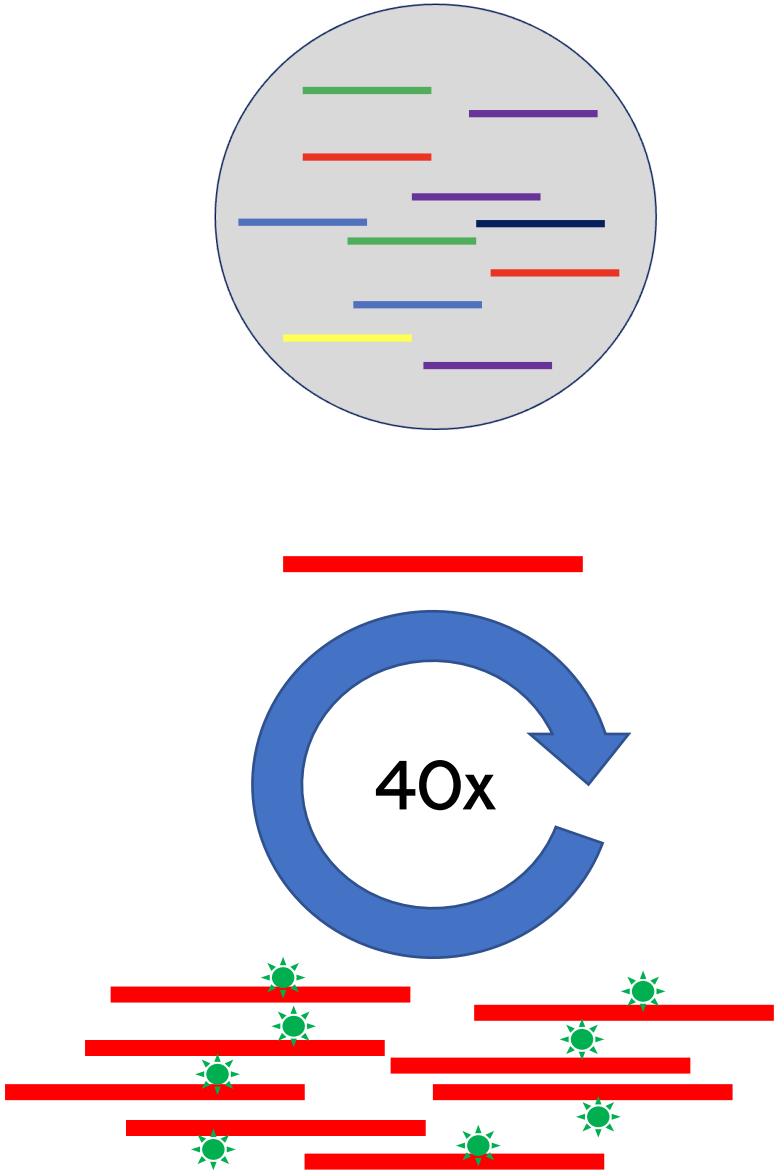
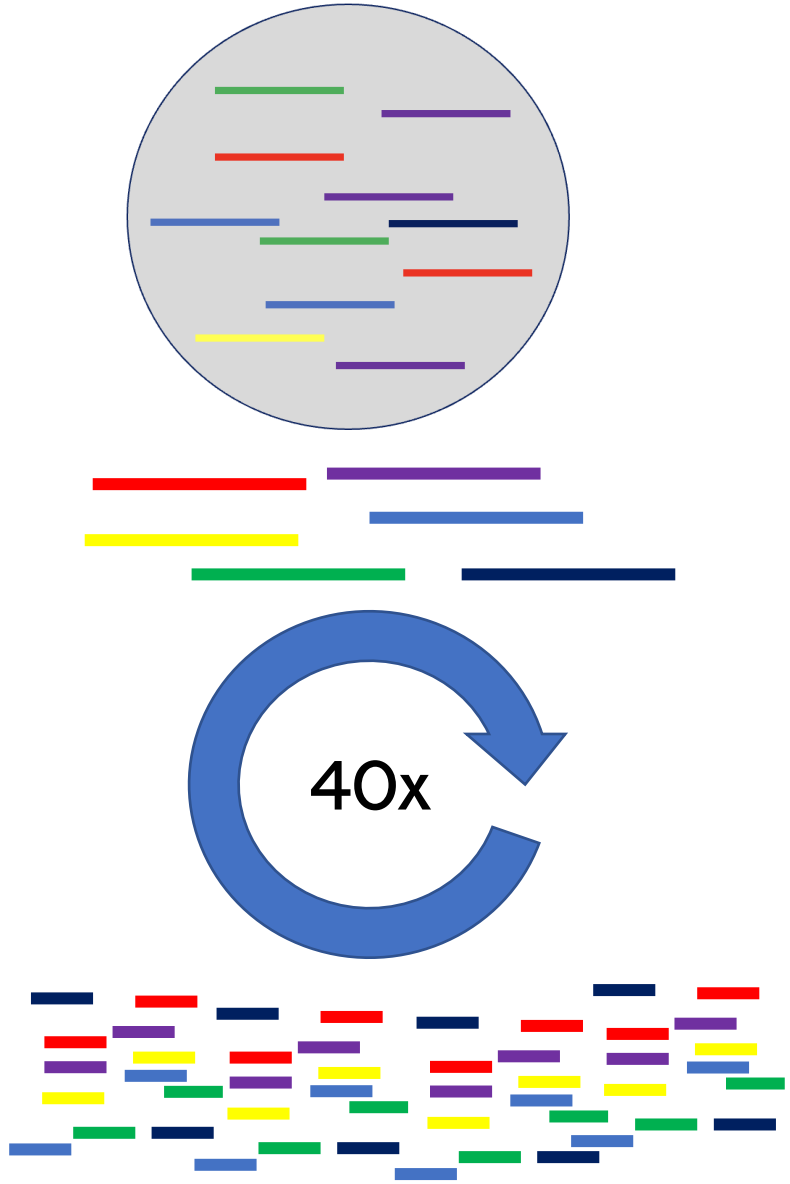
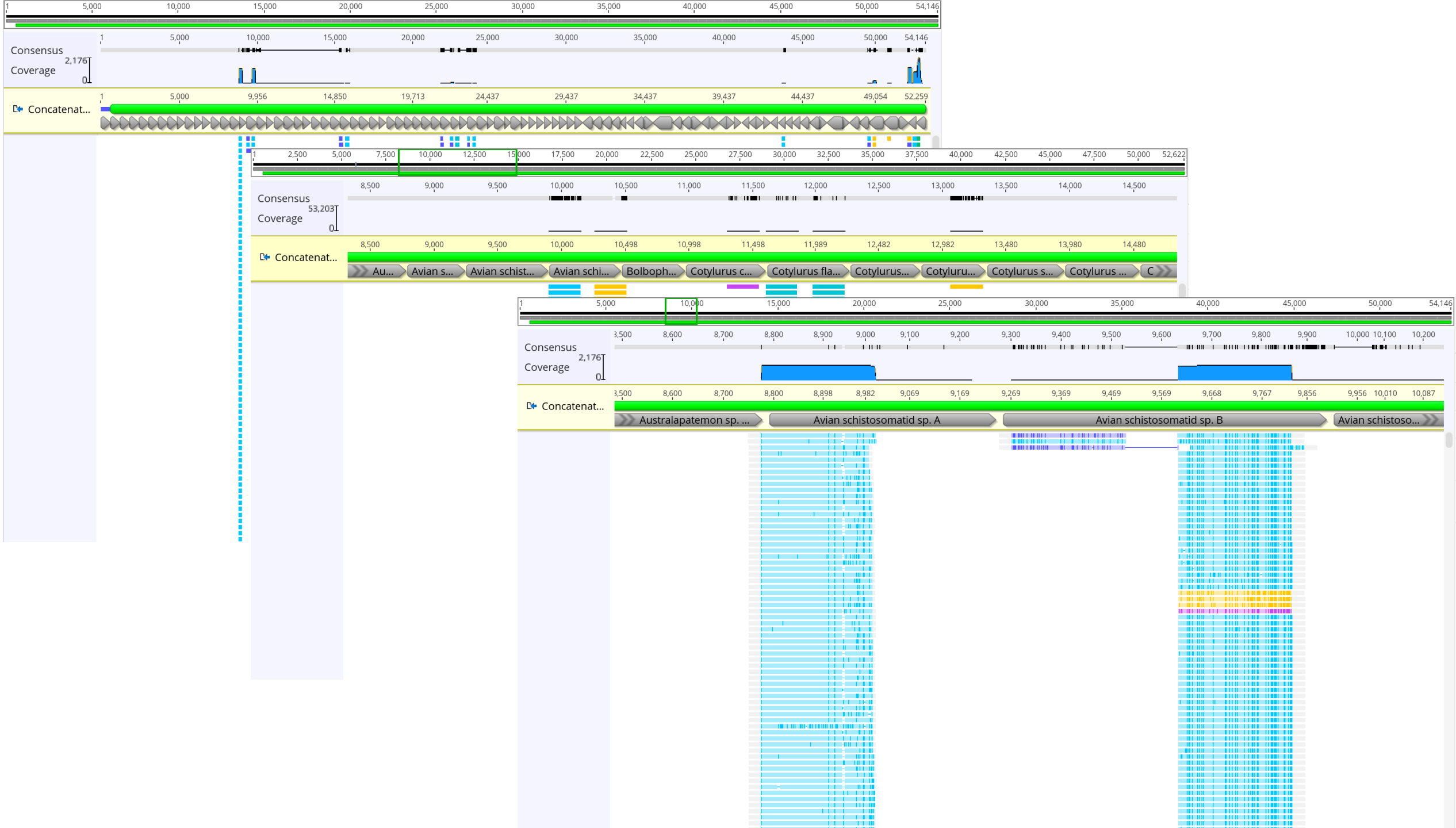
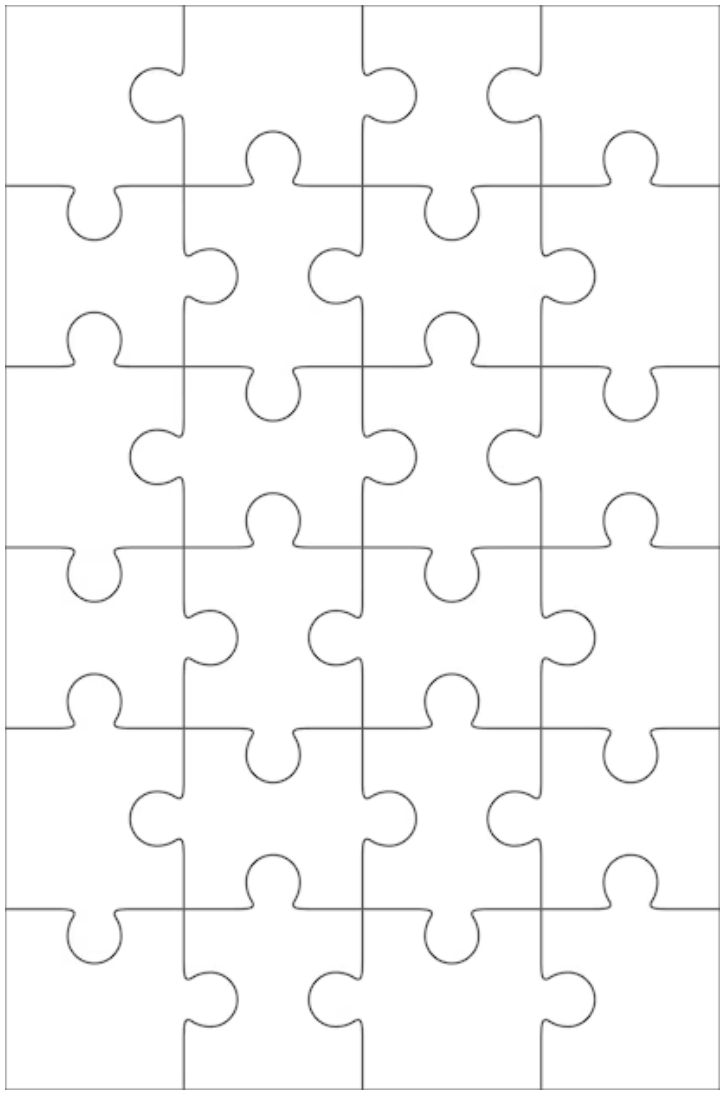
qPCR



Metabarcoding




Consensus
Coverage
2,176
0
Concatenat...
Consensus
Coverage
53,203
0
Concatenat...
Au...
Avian s...
Avian schist...
Avian schi...
Bolboph...
Cotylurus c...
Cotylurus fla...
Cotylurus...
Cotyluru...
Cotylurus s...
Cotylurus ...
C
Consensus
Coverage
2,176
0
Concatenat...
Australapatemon sp. ...
Avian schistosomatid sp. A
Avian schistosomatid sp. B
Avian schistoso...



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Ancient Mammalian and Plant DNA from Late Quaternary Stalagmite Layers at Solkota Cave, Georgia

M. C. Stahlschmidt, T. C. Collin, D. M. Fernandes, G. Bar-Oz, A. Belfer-Cohen, Z. Gao, N. Jakeli, Z. Matskevich, T. Meshveliani, J. K. Pritchard, F. McDermott & R. Pinhasi

Scientific Reports **9**, Article number: 6628 (2019) | Cite this article

Article | Open Access | Published: 03 May 2021

Environmental DNA provides higher resolution assessment of riverine biodiversity and ecosystem function via spatio-temporal nestedness and turnover partitioning

Mathew Seymour, François K. Edwards, Bernard J. Cosby, Iliana Bista, Peter M. Scarlett, Francesca L. Brailsford, Helen C. Glanville, Mark de Bruyn, Gary R. Carvalho & Simon Creer

Environmental DNA
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Dedicated to the study and use of environmental DNA for basic and applied sciences
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ORIGINAL ARTICLE

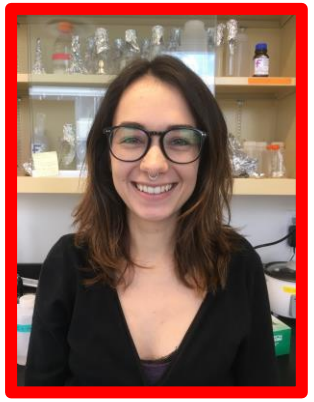
Development and validation of targeted environmental DNA (eDNA) metabarcoding for early detection of 69 invasive fishes and aquatic invertebrates

Yueyang Wu[1] | Scott F. Colborne[1,2] | Matthew R. Charron[1] | Daniel D. Heath[1,3]





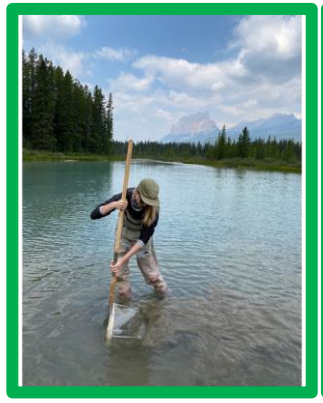


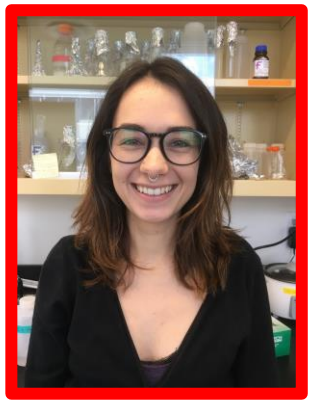













Fisheries and Oceans Canada

Pêches et Océans Canada

NSERC
CRSNG

ALBERTA INNOVATES

NSWA
NORTH SASKATCHEWAN WATERSHED ALLIANCE

ALMS
Alberta Lake Management Society

Alberta

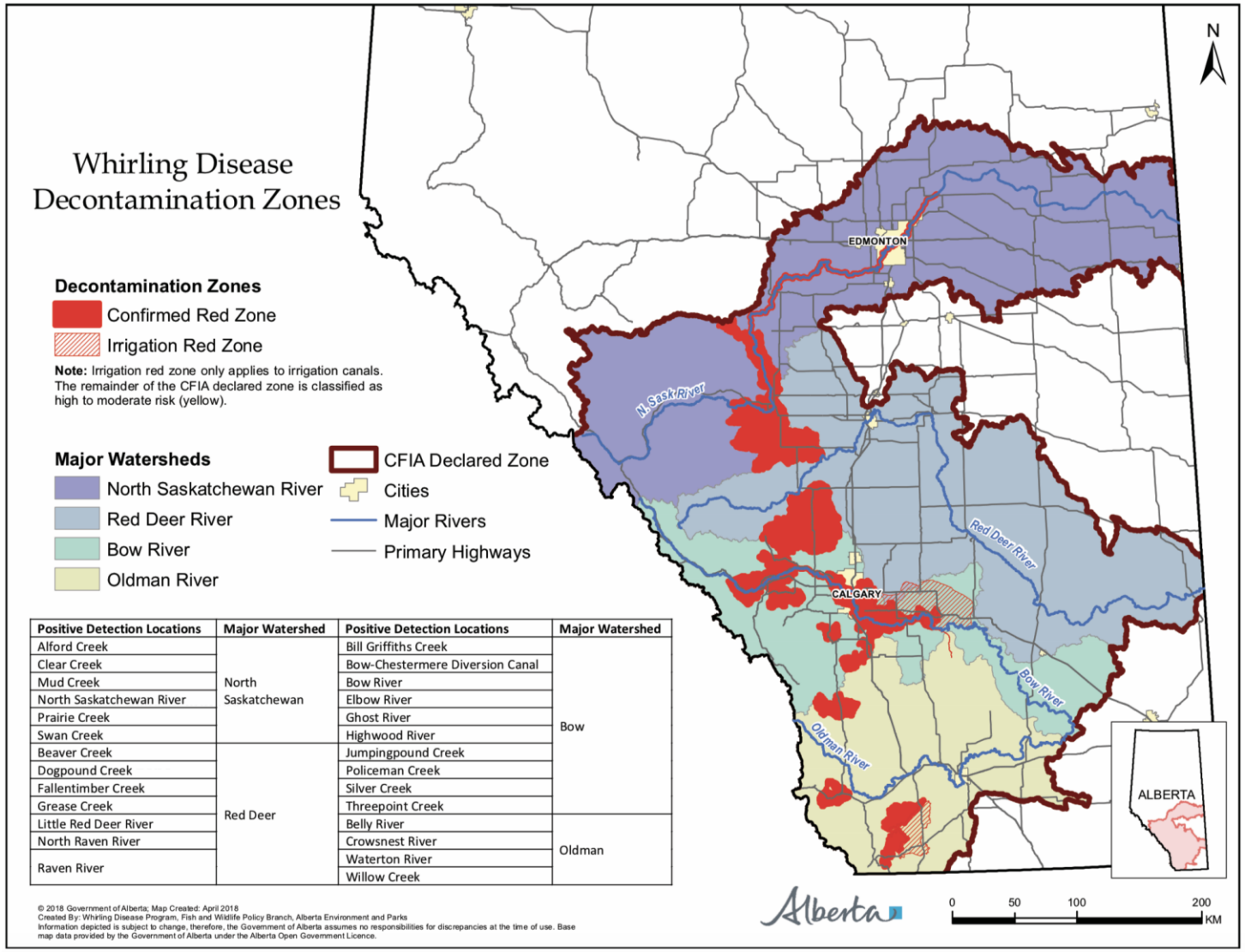
Parks Canada

Parcs Canada

Papaschase First Nation

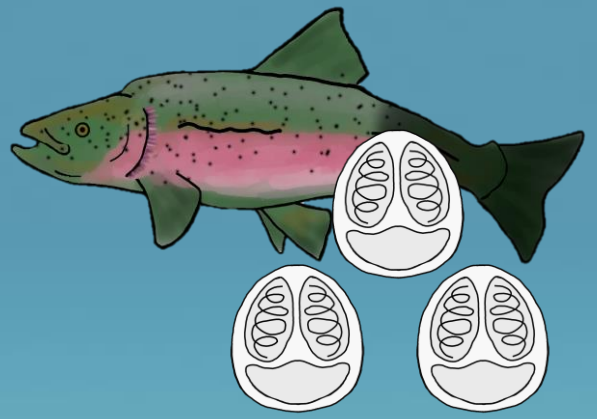
Alberta Detection

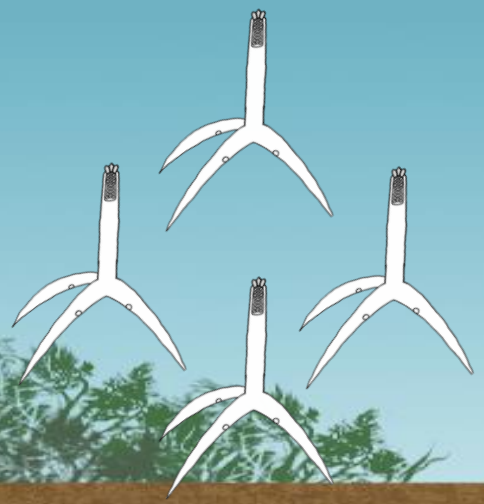
- In August of 2016 positive detections for whirling disease were found in Johnson Lake, Banff.
- Four watersheds have been confirmed infected by the Canadian Food Inspection Agency (CFIA)

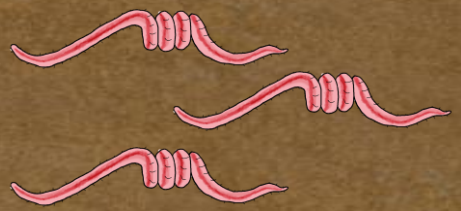


Positive Detection Locations	Major Watershed	Positive Detection Locations	Major Watershed
Alford Creek	North Saskatchewan	Bill Griffiths Creek	Bow
Clear Creek		Bow-Chestermere Diversion Canal	
Mud Creek		Bow River	
North Saskatchewan River		Elbow River	
Prairie Creek		Ghost River	
Swan Creek		Highwood River	
Beaver Creek	Red Deer	Jumpingpound Creek	
Dogpound Creek		Policeman Creek	
Fallentimber Creek		Silver Creek	
Grease Creek		Threepoint Creek	
Little Red Deer River		Belly River	Oldman
North Raven River		Crowsnest River	
Raven River		Waterton River	
		Willow Creek	

Infecting Salmonid fish



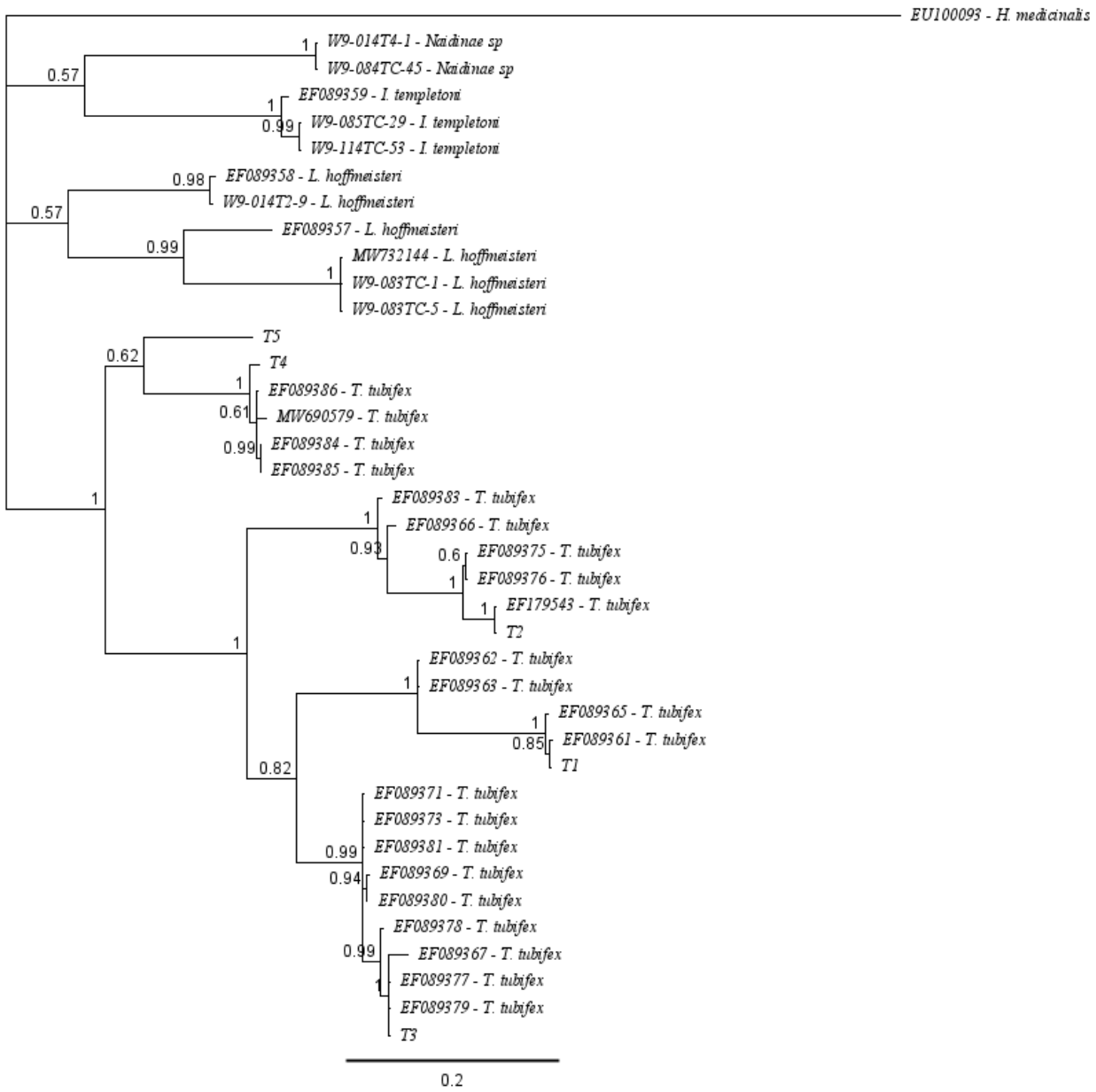




Consumed by *T. tubifex*

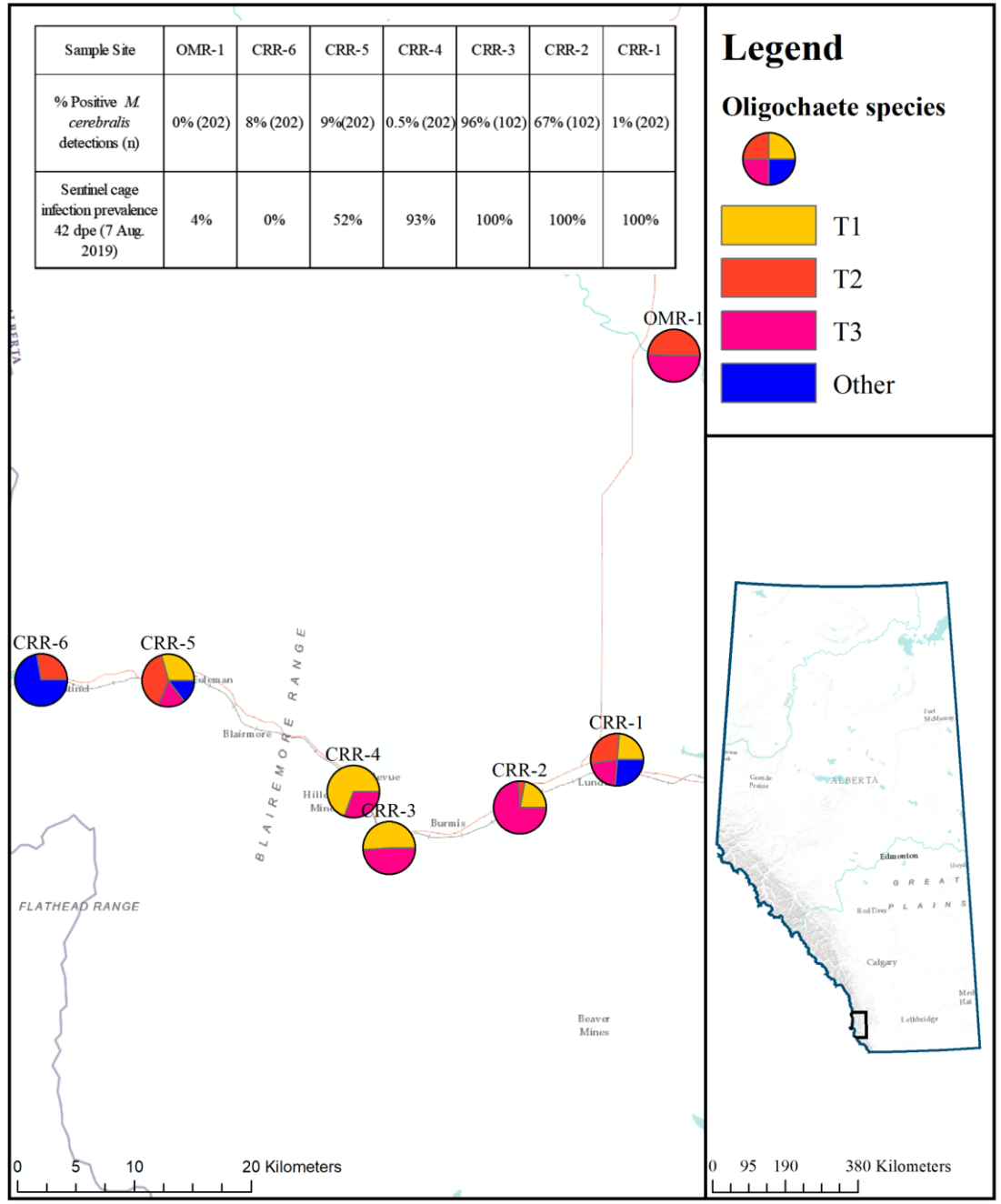
Phylogenetic results

- Previously described *T. tubifex* groupings, consistently separate into distinct groups when analysed phylogenetically.
- This separation is consistent for 16s, 12s and CoxI genes/regions.
  - Placement along trees vary



CoxI phylogenetic tree of reference NCBI sequences and representative Alberta aquatic oligochaete species, emphasizing T. tubifex sequence distinctions.

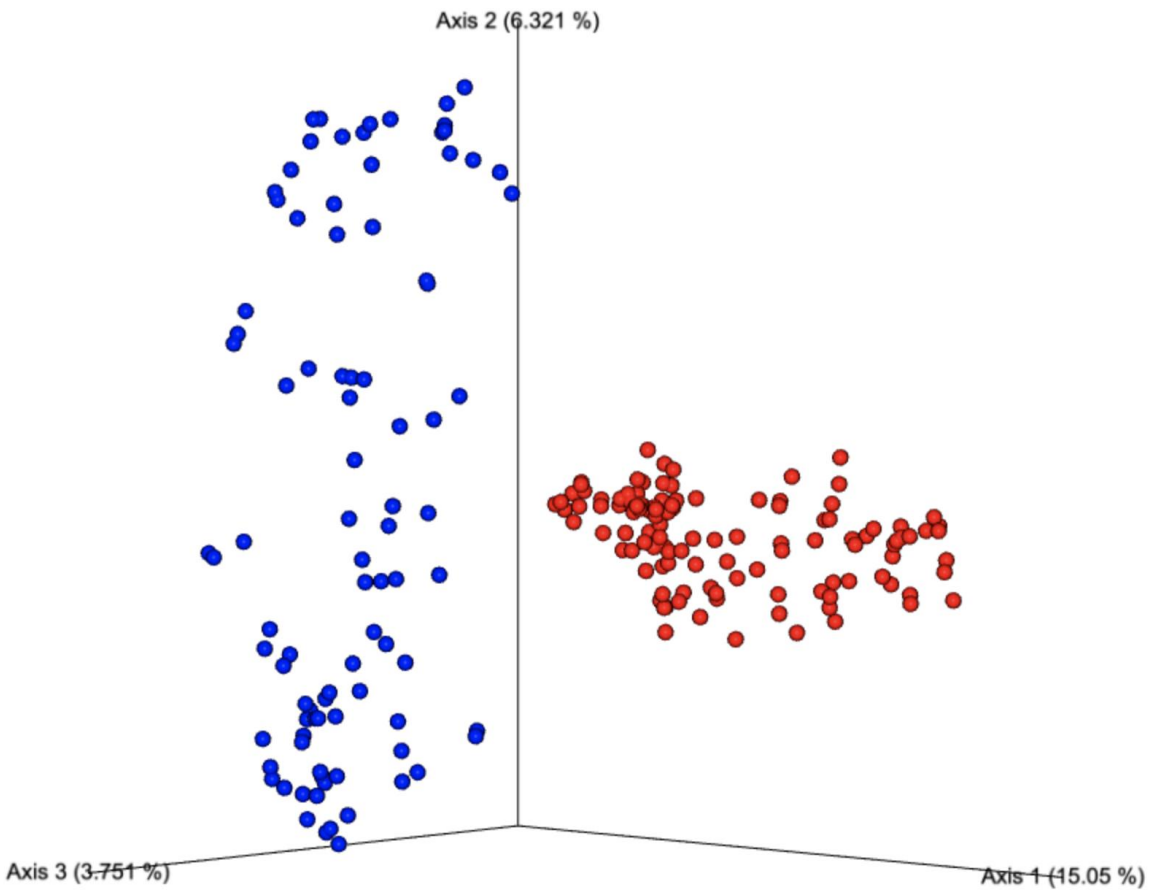
Sample Site	OMR-1	CRR-6	CRR-5	CRR-4	CRR-3	CRR-2	CRR-1
% Positive *M. cerebralis* detections (n)	0% (202)	8% (202)	9%(202)	0.5% (202)	96% (102)	67% (102)	1% (202)
Sentinel cage infection prevalence 42 dpe (7 Aug. 2019)	4%	0%	52%	93%	100%	100%	100%

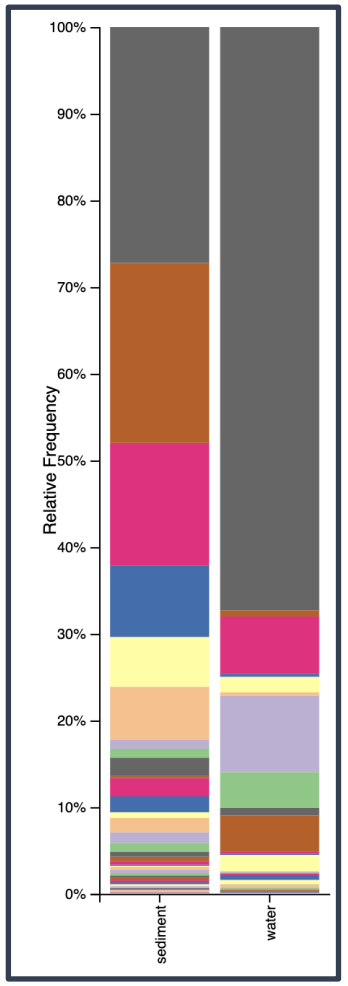


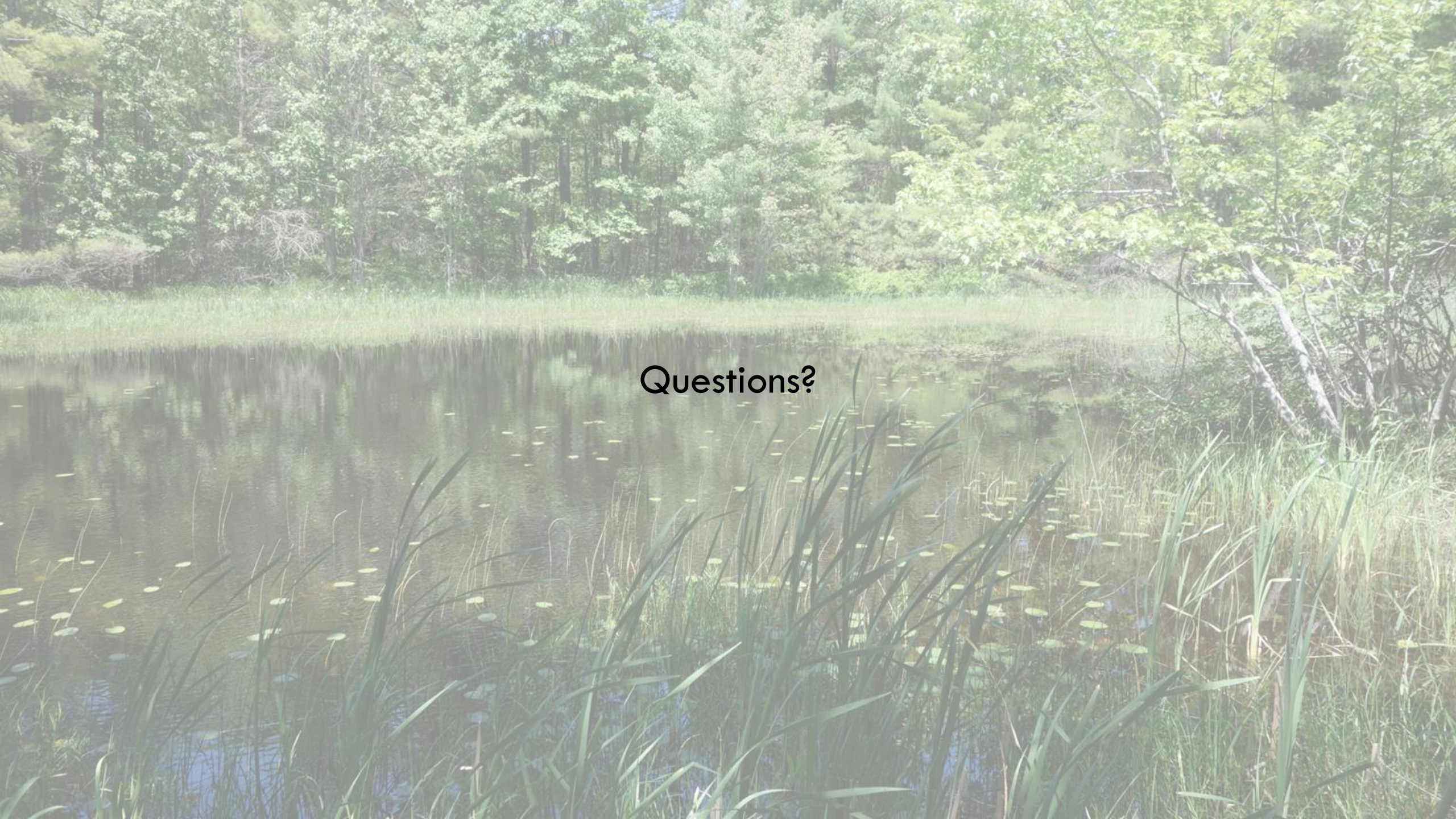
Service Layer Credits: Sources: Esri, USGS, NOAA

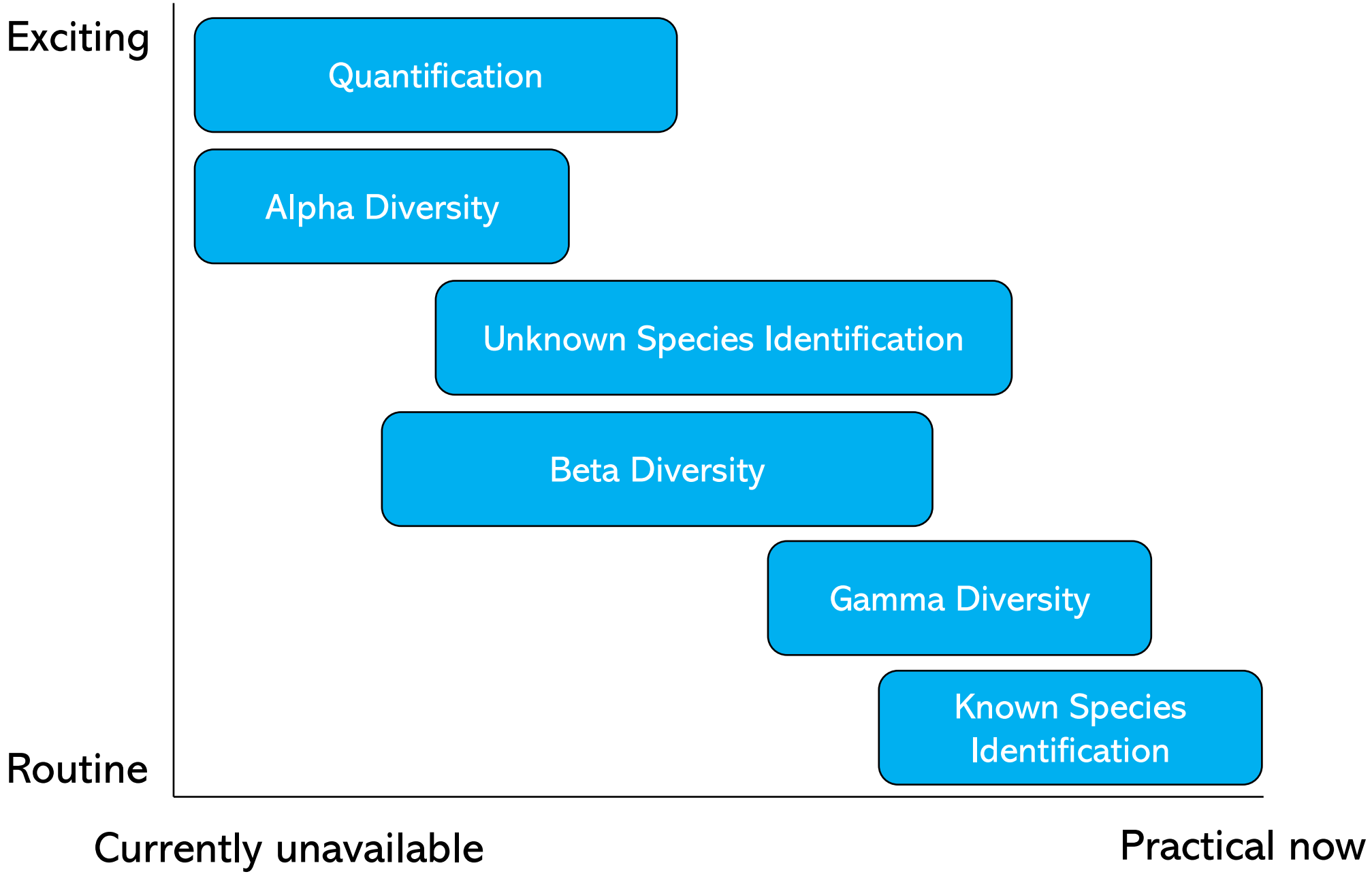
Sources: Esri, Garmin, USGS, NPS

Community assessment



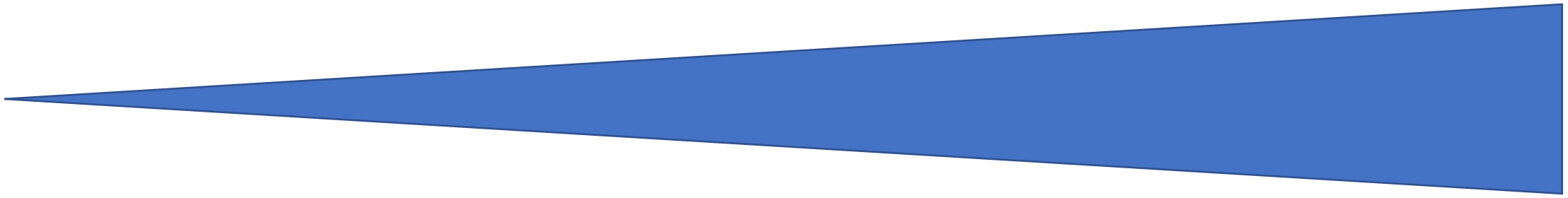



Questions?



Simon Jarman

Concentration of DNA from organism of interest



qPCR

Metabarcoding

Is it important to quantify the organisms of interest?

Do you want to know about more than one organism?

Is it helpful to establish baseline data to evaluate future change?