Next Generation Solutions to Ensure Healthy Water Resources for Future Generations

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Environmental DNA (eDNA) as an emerging tool

Figure credit http://fishbio.com/field-notes/conservation/traces-left-behind

DNA sequences are unique
and can be identified
for each species

DNA released
to the environment

DNA can be collected

DNA sequences are unique
and can be identified for each species

DNA released to the environment

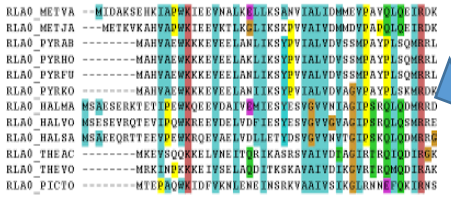
Collect the sample

Extract the eDNA

Amplify it

Sequence it

Check who's there



DNA can be analyzed to
identify specific species

What does the project address?

Applying emerging technologies to environmental assessment!

Method Validation
(Laboratory Development)

qPCR (key species) and **Next Gen Seq** (complex communities)

Defining factors affecting species detection
(controlled experiments)

Refine Species Detection

Validating complex aquatic communities
(eDNA vs traditional assessment)

Assessing Biodiversity in Natural and Impacted Environments
(Field Application)

Progress to date

Project management:

- Many conference calls to coordinate project activity (monthly)
- Prepared a Project Summary for each subcomponent/study
- Prepared a series of Standard Operating Procedures (SOPs)
- Site visit to coordinate activities and future lab visits
- Developed web site for project

HQP Recruitment:

Postdoctoral Fellow, Yuwei Xie (Sept. 2017)
Postdoctoral Fellow, Patricija Marjan (Sept. 2017)
PhD, Heather Ikert (transferred in summer 2017)
PhD, Abby DeBofsky (Jun. 2017)
MES, Renata Mont'Alverne (Jan. 2018)
UG, Alexander Douglas (Sept 2018)

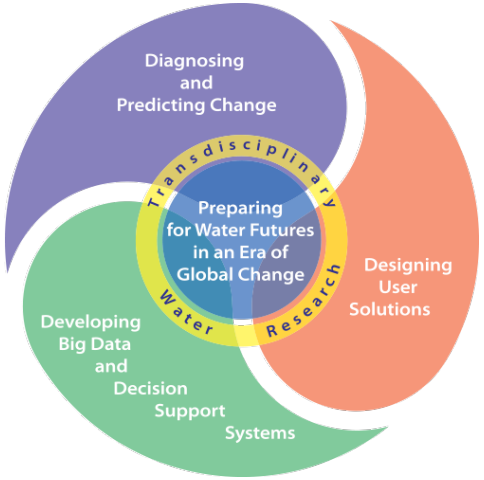
Research:

- Testing and validating methods for
  - qPCR detection of specific species
  - Next Gen Sequencing
- Screening for invasive zebra mussels
- Initiated controlled lab experiments with specific species to determine primer specificity and sensitivity
- Validate the eDNA metabarcoding against the community-level ecotoxicological mesocosm experiments
- Building eDNA library for several regions of Canada
- Site selection and initial field collections

Collaborations with other projects?

Established linkages to:

- Transformative Sensor Technologies and Smart Watersheds for Canadian Water Futures; Rudolph et al. project component on sensors in Alder Creek to assess interactions among hydrology and fish communities.
- Lake Futures – Enhancing Adaptive Capacity and Resilience of Lakes and their Watersheds; Basu et al. especially the bioassessment components.
- Linking multiple stressors to adverse ecological responses across watersheds; Servos et al. project on wastewater contaminants and effects.
- 'Omic' and chemical fingerprinting methodologies using ultrahigh-resolution mass spectrometry for geochemistry and healthy waters; Jones et al. conducting assessments in watersheds.



Potential linkages to contribute to projects related to biodiversity and effects on ecosystems, for example:

- Northern Water Futures
- Linking stream network process models to robust data management systems for the purpose of land-use decision support
- Lots of potential for collaboration?

Core needs and contributions to the core?

Instrumentation:

- Next Gen Seq
- High Resolution Mass Spectrometry

Nextgen DNA Sequencer

Core:

- Forecasting and Modelling– supporting biodiversity
- Knowledge Mobilization Team – assistance in structuring and delivery of KM
- Computer Science Team – supporting the big data requirements of Next Gen Seq
- Data Team – Management of very large data sets

Ultrahigh resolution, Orbitrap) mass spectrometer

Technical:

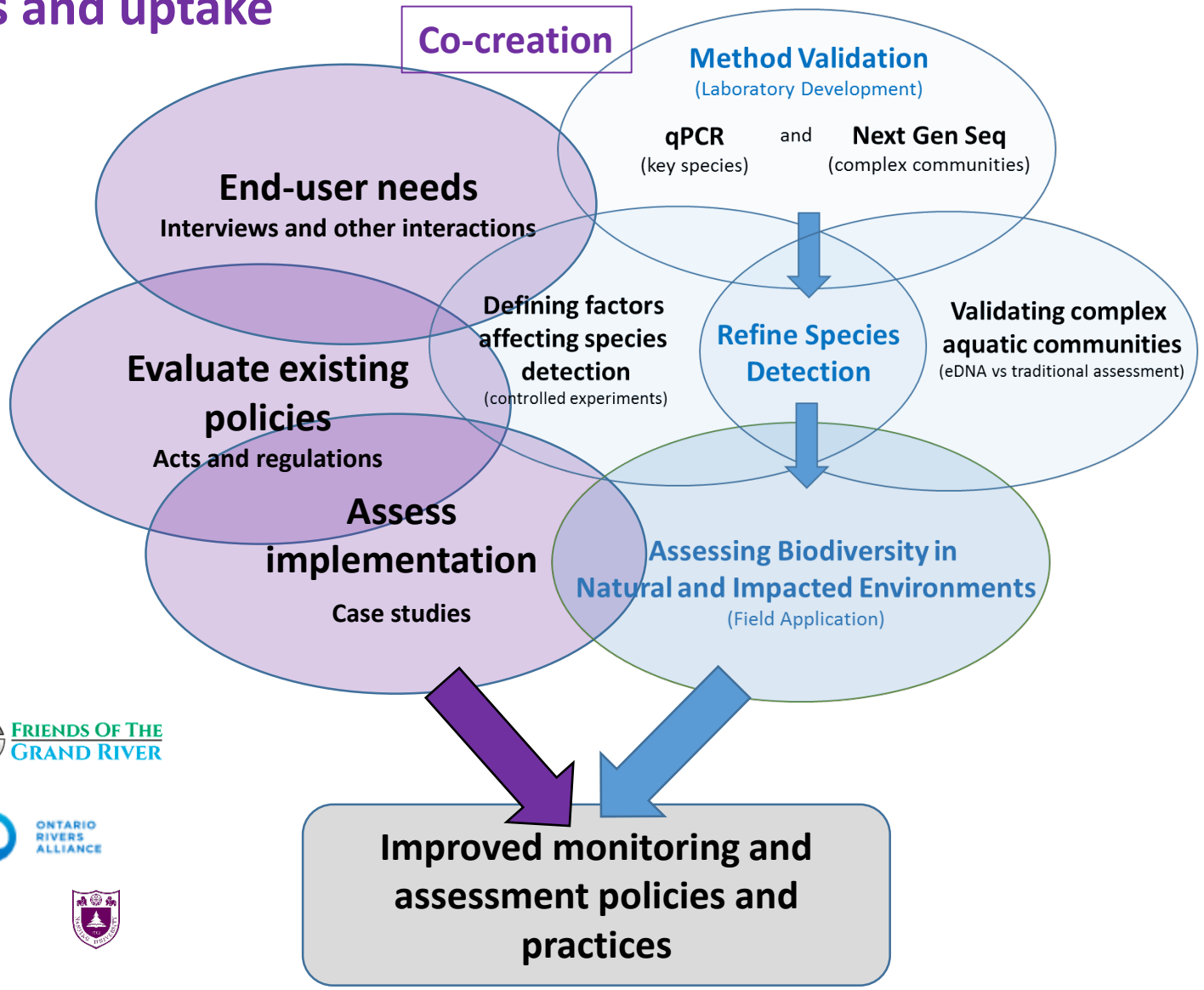
- Water Quality and Ecotoxicology Technician

We can support collaborators to apply eDNA technology in their projects.

Knowledge Mobilization

Applications and uptake

Our partners are actively engaged in the project



Path Forward

Continue method development and validation
Examine factors influencing eDNA detection (lab and field)
Contrast eDNA to traditional assessment approaches:

- ELA (pristine and manipulated systems)
- Sites with active bioassessments (mines, etc.)
- Grand River (agriculture/urbanized streams)
- North Saskatchewan River (Husky Oil Spill)
- Beaver River (agriculture)

Global Water Futures
Solutions to Water Threats in an Era of Global Change

Delta N90
Trappers