ECS Lunch and Learn

Supporting internal knowledge transfer within TRCA

June 9, 2021

Toronto and Region Conservation Authority

Long-Term Monitoring of Lake Ontario Coastal Wetlands Reveals Distinct Water Quality Profiles Associated with Hydrogeomorphic Type

Kathryn Thomas[1], Krista Chomicki[2], Andrea Kirkwood[1]

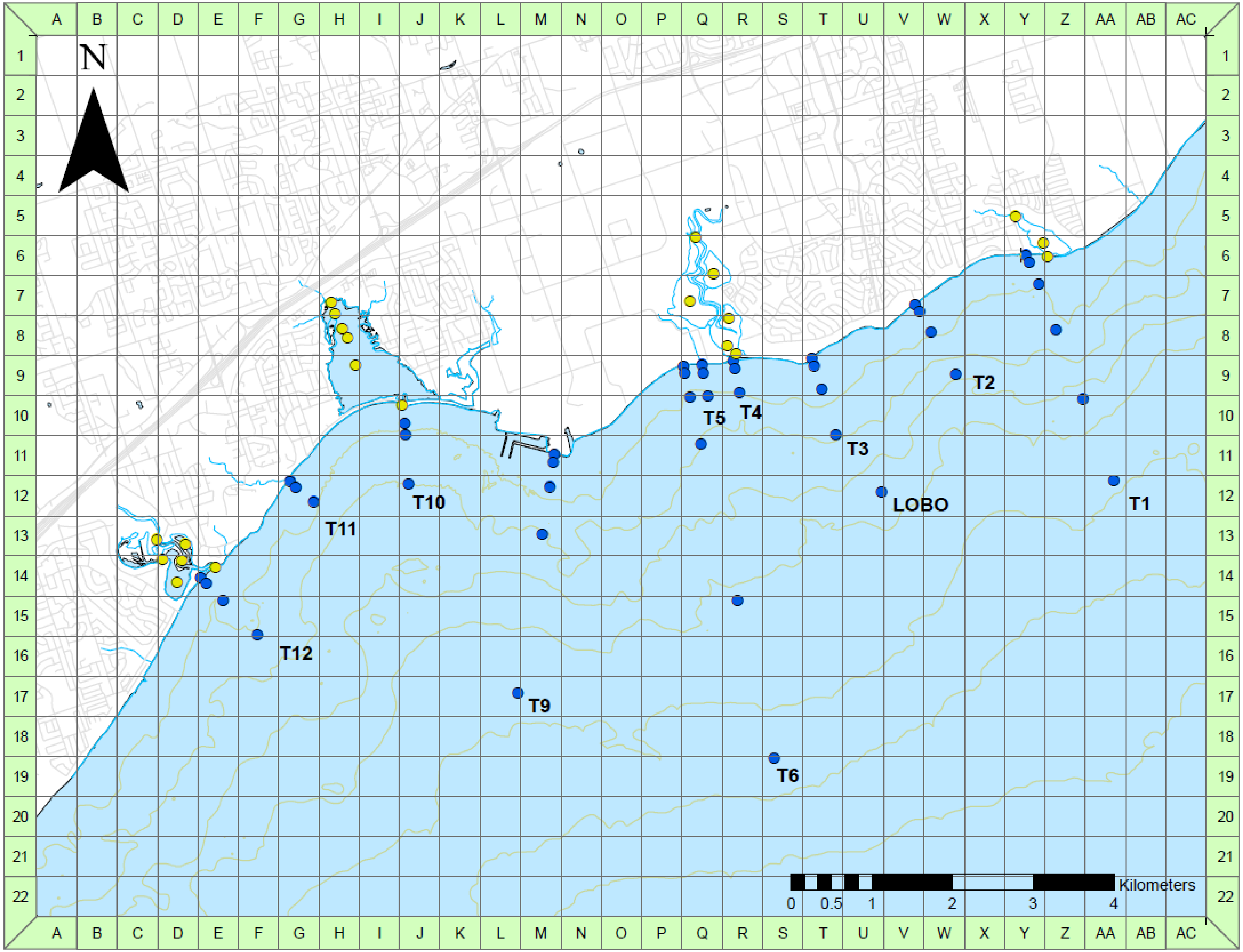
1 Ontario Tech University

2 Toronto and Region Conservation Authority

Project Funding and Support

- Mitacs post-doctoral fellowship
  - Partners: Toronto and Region Conservation Authority and Ontario Tech University
  - Funding support: Regional Municipality of Durham and also York Region

- Project builds off the Western Durham Nearshore Monitoring Program



N
T1
T2
T3
T4
T5
T6
T9
T10
T11
T12
LOBO
Kilometers
0
0.5
1
2
3
4

Project progress

- >10,000 data points
- Integrated Water Quality Monitoring Network (WQMN) data to expand dataset
- Presented at:
  - State of Lake Ontario – March 2021
  - Canadian Conference for Fisheries Research / Society of Canadian Limnology conferences – February 2021
- Duffin Creek Water Pollution Control Plant Advisory Committee Meeting in September
- Thomas et al, in preparation for the Journal of Great Lakes Research

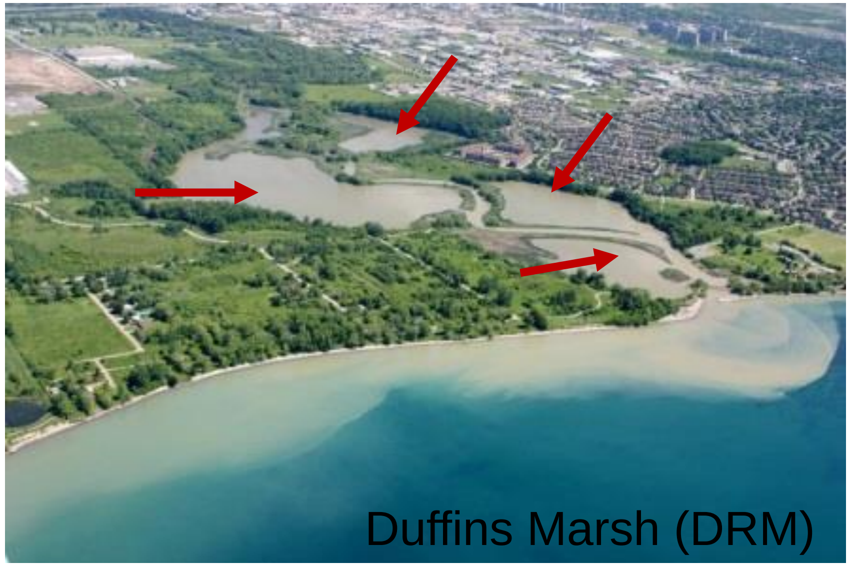
Durham Region Coastal Wetlands

- Great Lakes Coastal Wetlands
  - Ecological transition zones
  - Provide habitat for local flora and fauna
  - Erosion control
  - Flood regulation
  - Water quality purification

  - Impacted and degraded by human activities
  - Internal cycling of nutrients, therefore a source or a sink of nutrient or ions

Marsh	Size (ha)	Watershed (ha)	Watershed :Size	Urban Land Cover	Water Quality	Trending
Drowned River Mouth						
Carruthers	116	3,690	335	41% urban	Poor	Mixed
Duffins	78	28,653	367	18% urban	Fair	Improving
Rouge	56	33,289	594	41% urban	Fair	Improving
Barrier Beach Lagoon						
Frenchmans Bay	39	1,652	42	>50% urban	Fair	Mixed

Each Wetland is Unique



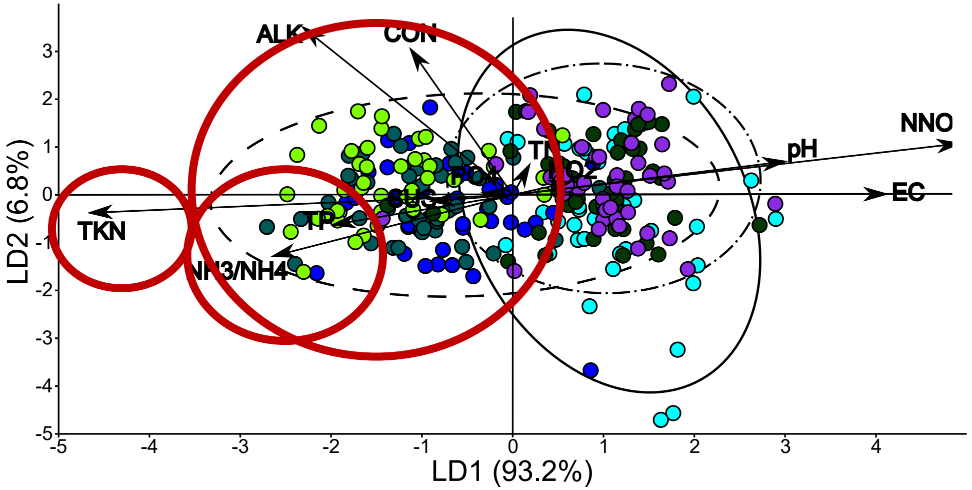
How do we assess wetland function in the land to lake nexus?

- TRCA long-term monitoring program
    - Sampling generally occurred between 2006 and present
        - FB not sampled in until 2008
        - No marsh sampling between 2011 and 2014
    - Monthly (May - November)
    - Water quality
        - Nutrients (TP, PO_4, TN, TKN, NO2, NNO, NH_3/NH_4)
        - Environmental measures (pH, alkalinity, conductivity, suspended solids)
        - Biological (E.coli)

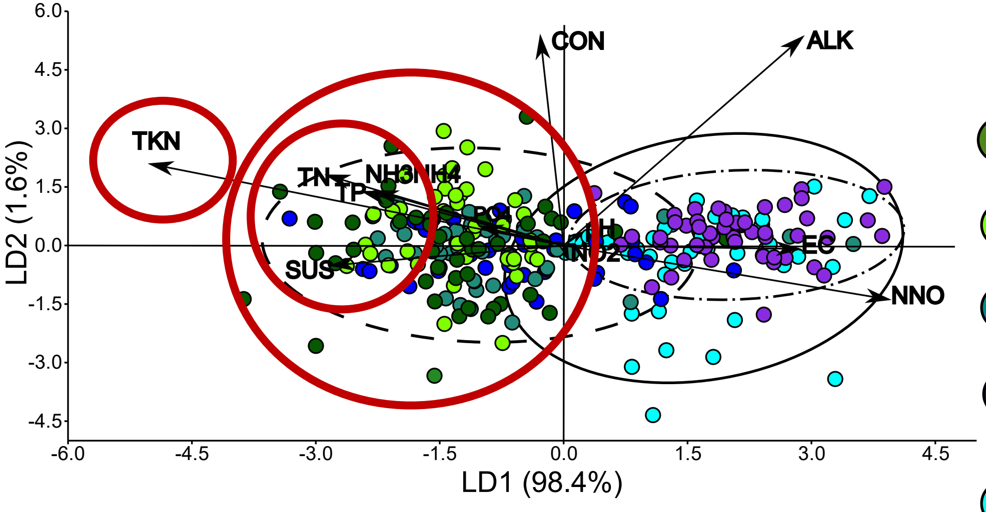
Confluence of River and Marsh · Internal Marsh Sites · Marsh Site Closest to Lake

Water quality trends at internal marsh sites show distinct differences in function between marsh types

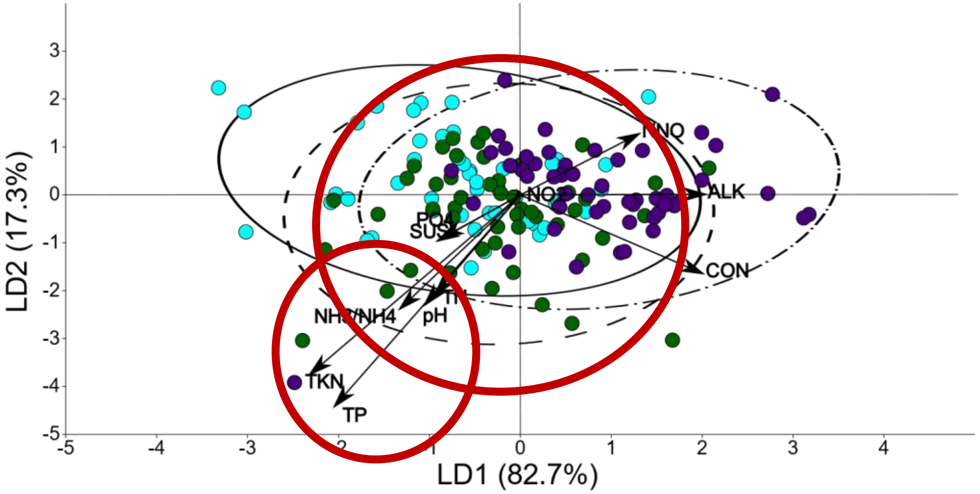
Rouge Marsh - DRM



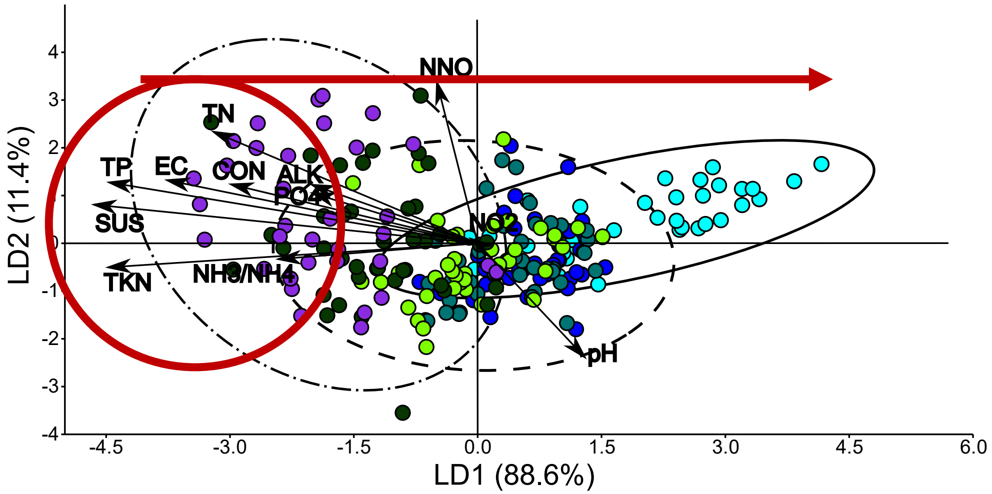
Duffins Creek Marsh - DRM



Carruthers Marsh - DRM



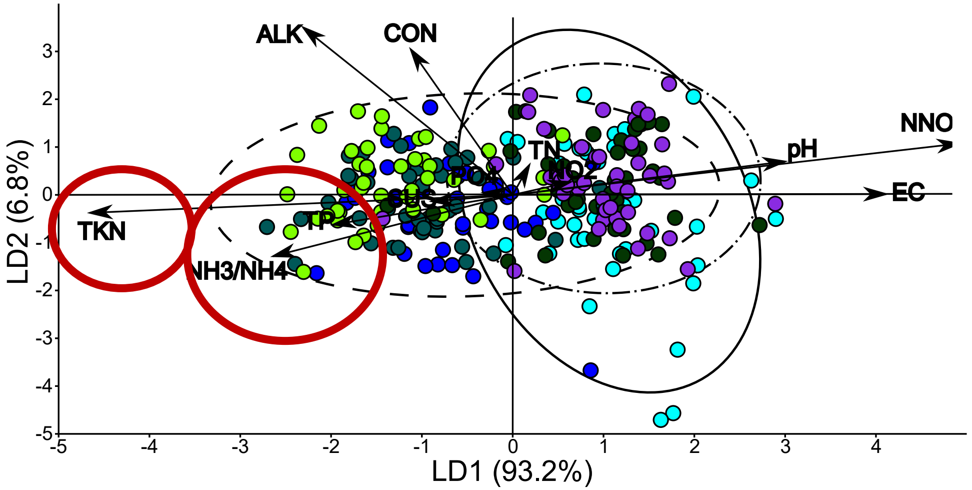
Frenchmans Bay Marsh - BB



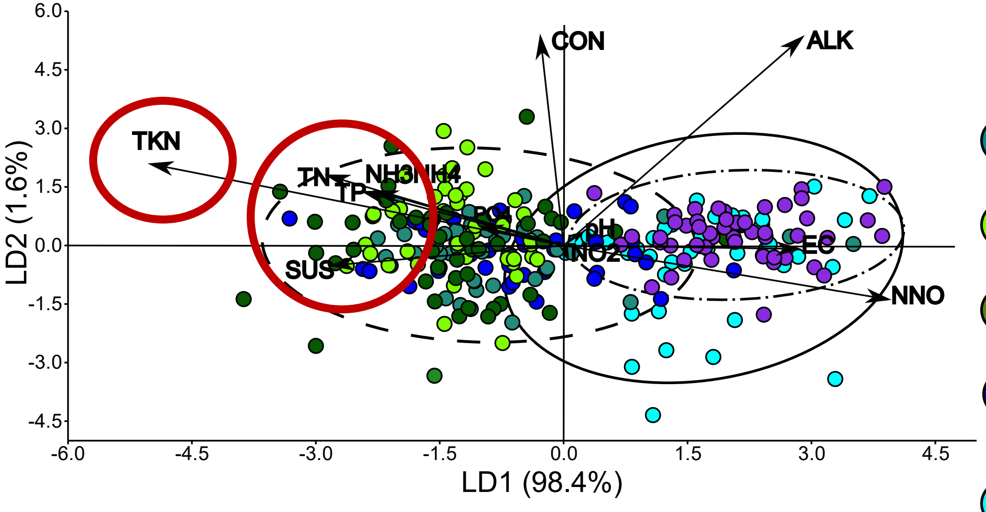
- Confluence of marsh and river
- Internal marsh sites
- Marsh site closest to lake

Water quality trends at internal marsh sites show distinct differences in function between marsh types

Rouge Marsh - DRM



Duffins Creek Marsh - DRM



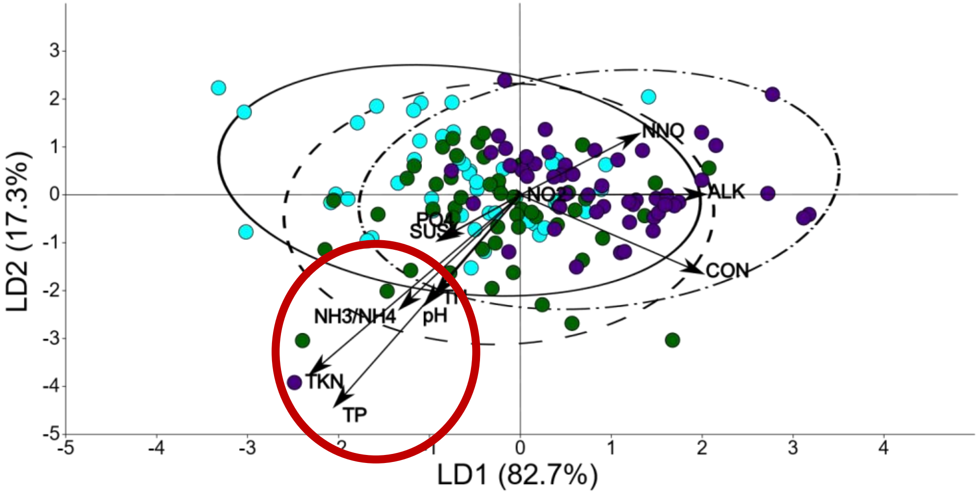
- Confluence of marsh and river
- Internal marsh sites
- Marsh site closest to lake

Group means for key water quality parameters	TKN	NH3/NH4	TP	PO_4	NNO	E.coli
Rouge Marsh						
Confluence of river and marsh	0.61	0.06	0.05	0.010	0.49	204
Internal marsh	0.88	0.09	0.08	0.015	0.16	60
Closest to lake	0.61	0.06	0.06	0.010	0.46	213
Duffins Creek Marsh						
Confluence of river and marsh	0.61	0.04	0.04	0.006	0.42	166
Internal marsh	1.05	0.09	0.13	0.016	0.12	42
Closest to lake	0.46	0.04	0.04	0.006	0.40	140

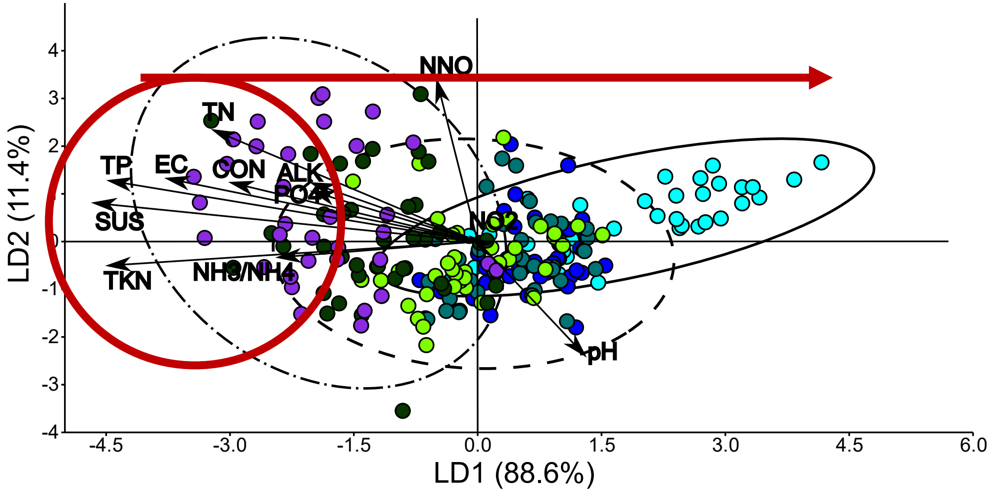
Water quality trends at internal marsh sites show distinct differences in function between marsh types

Group means for key water quality parameters	TKN	NH3/NH4	TP	PO_4	NNO	E.coli
Carruthers Marsh						
Confluence of river and marsh	0.75	0.07	0.07	0.014	0.31	228
Internal marsh	1.00	0.10	0.11	0.018	0.21	117
Closest to lake	0.90	0.09	0.09	0.017	0.23	102
Frenchmans Bay Marsh						
Confluence of river and marsh	1.10	0.12	0.12	0.011	0.36	304
Internal marsh	0.75	0.08	0.07	0.006	0.18	35
Closest to lake	0.42	0.04	0.03	0.003	0.24	7

Carruthers Marsh - DRM



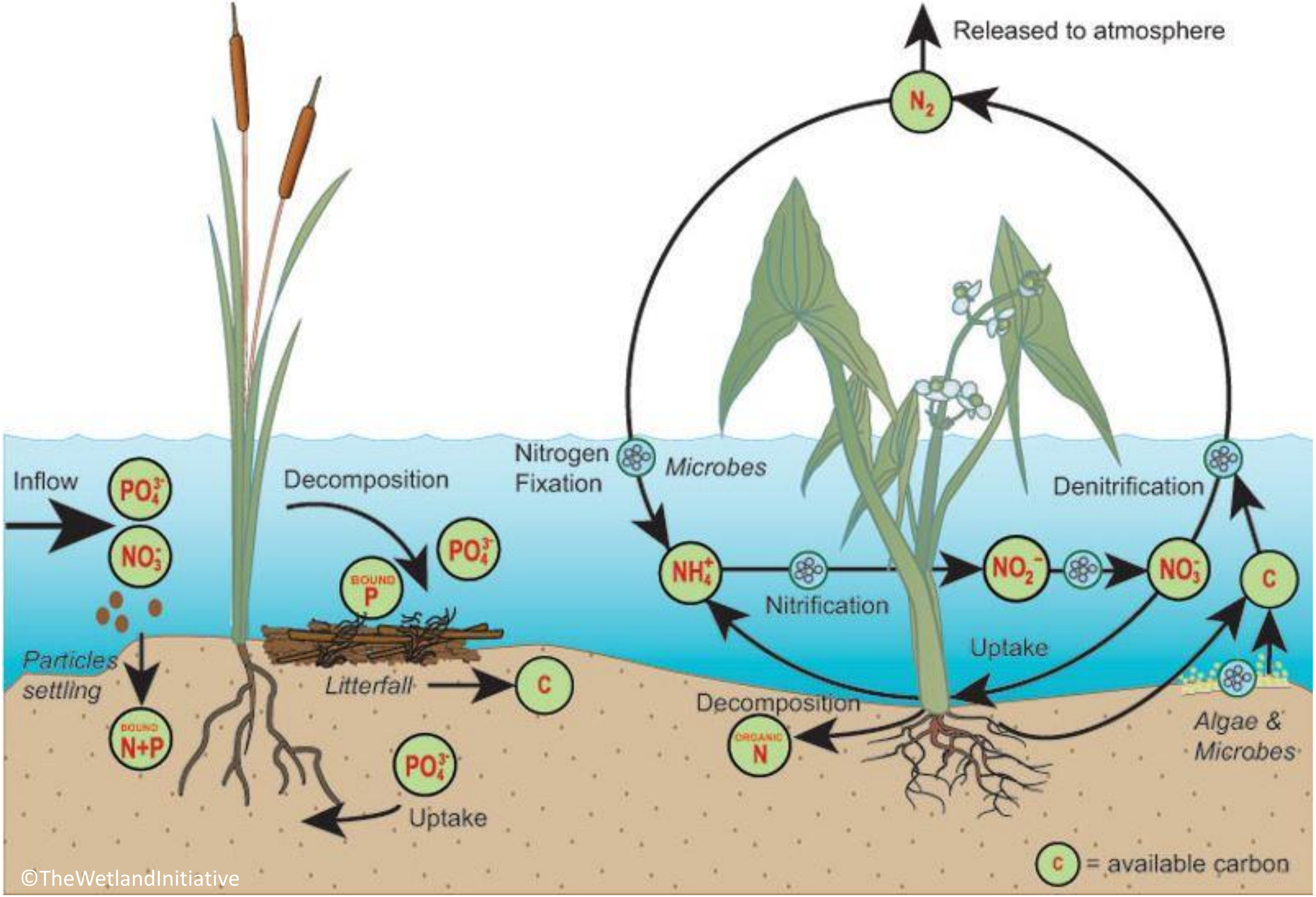
Frenchmans Bay Marsh - BB



Confluence of marsh and river

Internal marsh sites

Marsh site closest to lake



Released to atmosphere
N2
Nitrogen Fixation
Microbes
Denitrification
Inflow
PO4 3-
NO3 -
Decomposition
PO4 3-
BOUND P
NH4 +
Nitrification
NO2 -
NO3 -
C
Particles settling
BOUND N+P
Litterfall
C
Uptake
Decomposition
ORGANIC N
Algae & Microbes
PO4 3-
Uptake
C = available carbon
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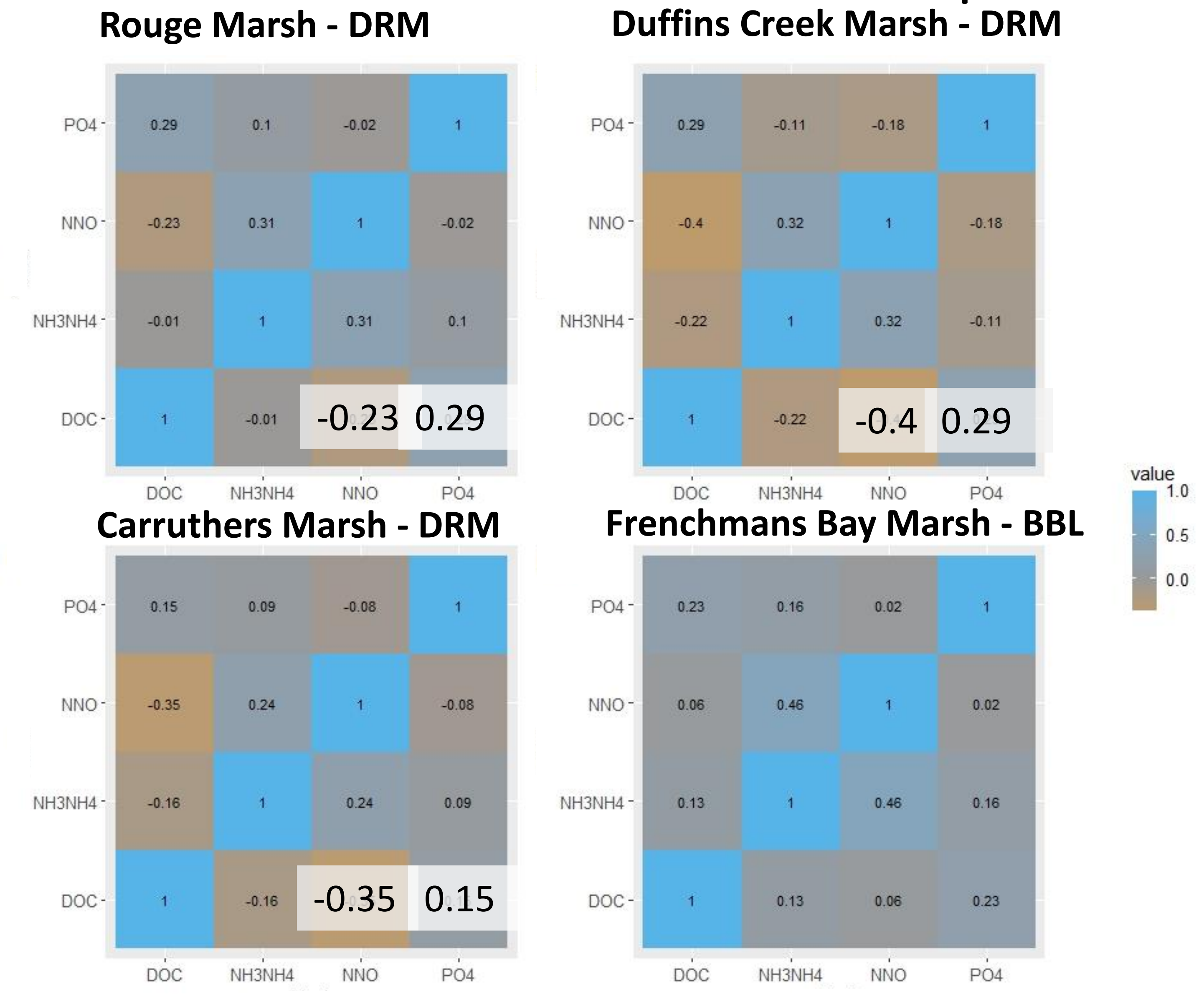
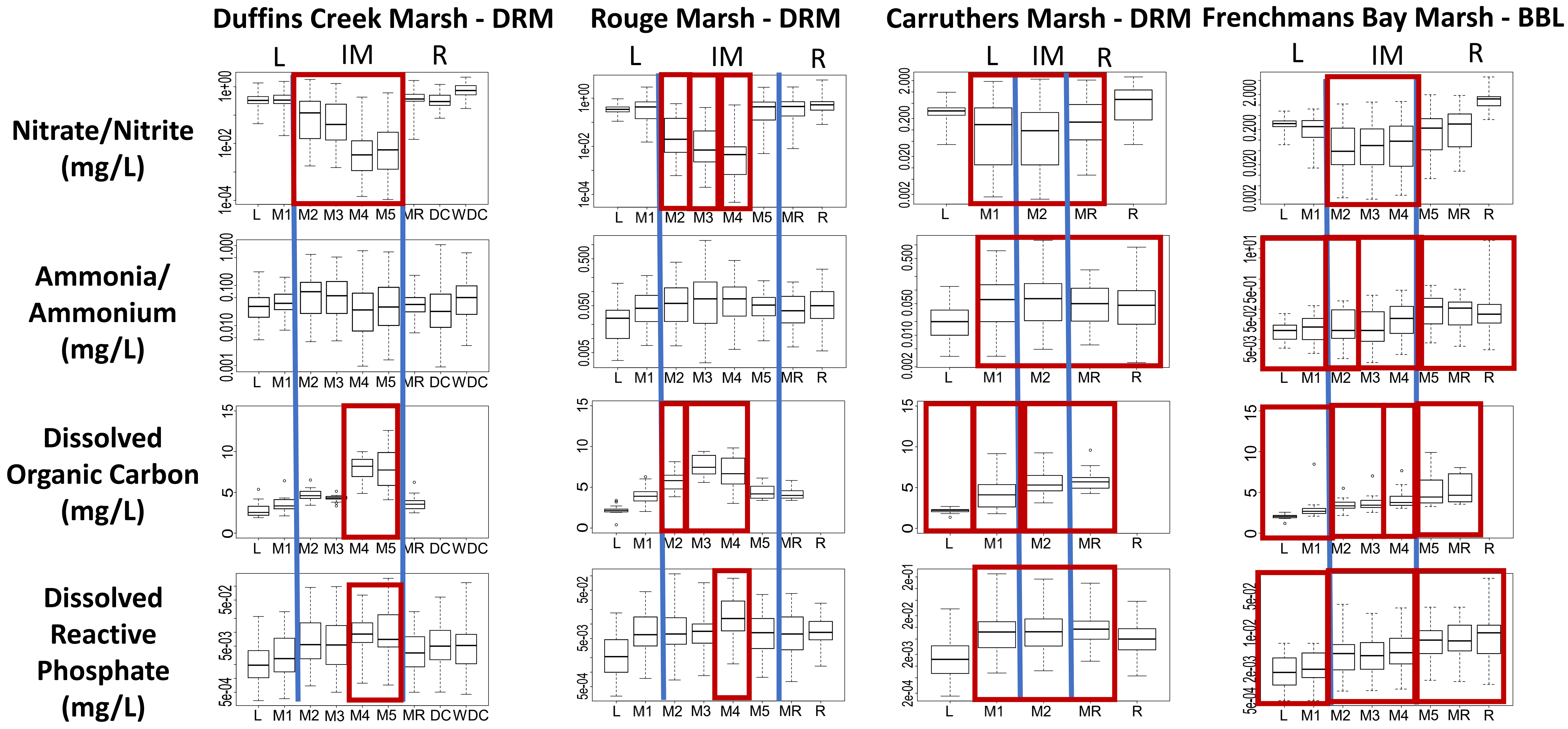
What are the relationships between nutrients?



- Similar relationships between nutrient species at DRM marshes
- At DRM marshes 2 important relationships:
  1. Negative correlations between Nitrate+Nitrite (NNO) and Dissolved Organic Carbon (DOC)
  2. Positive correlations between Dissolved Reactive Phosphate (PO4) and Dissolved Organic Carbon (DOC)

Celled drowned river mouth marshes show evidence of internal nutrient cycling



Are coastal wetlands sources or sinks of nutrients?

- Celled marshes
  - Cycling at internal marsh sites (decreased NNO, increased NH_3)
  - Potential evidence of anoxia or additional source of PO_4 at internal sites
  - Marshes could be source of nutrients (e.g., NH_3/NH_4, PO_4) to Lake Ontario,
    - Timing of sampling
    - Seasonality
    - Uptake
    - Dilution

Are coastal wetlands sources or sinks of nutrients?

- Non-celled marsh
  - Evidence of nutrient cycling within internal wetland sites
  - No evidence of anoxia or additional sources of PO_4 at internal sites

Carruthers Marsh (DRM)

Frenchmans Bay Marsh (BBL)

- Barrier beach lagoon
  - Gradient of nutrients from high (river) to low (lake) concentrations (vise-versa for WQI)
  - Evidence of nutrient cycling within upper sites in wetland
  - No evidence of anoxia or additional sources of PO_4 at internal sites

Take Home Messages

- Wetlands have the ability to improve water quality, but can also act as sources of nutrients.
  - When are these nutrients being delivered to the lake?
  - What happens once they are delivered?
- Drowned River Mouth wetlands with cells could be a source of dissolved P
  - Potential anoxic events within cells
  - Additional sources of P

Do carp gates and stormwater outflows play a role in water quality within the cells?

Do carp gates and stormwater outflows play a role in water quality within the cells?

Duffins Marsh Case Study

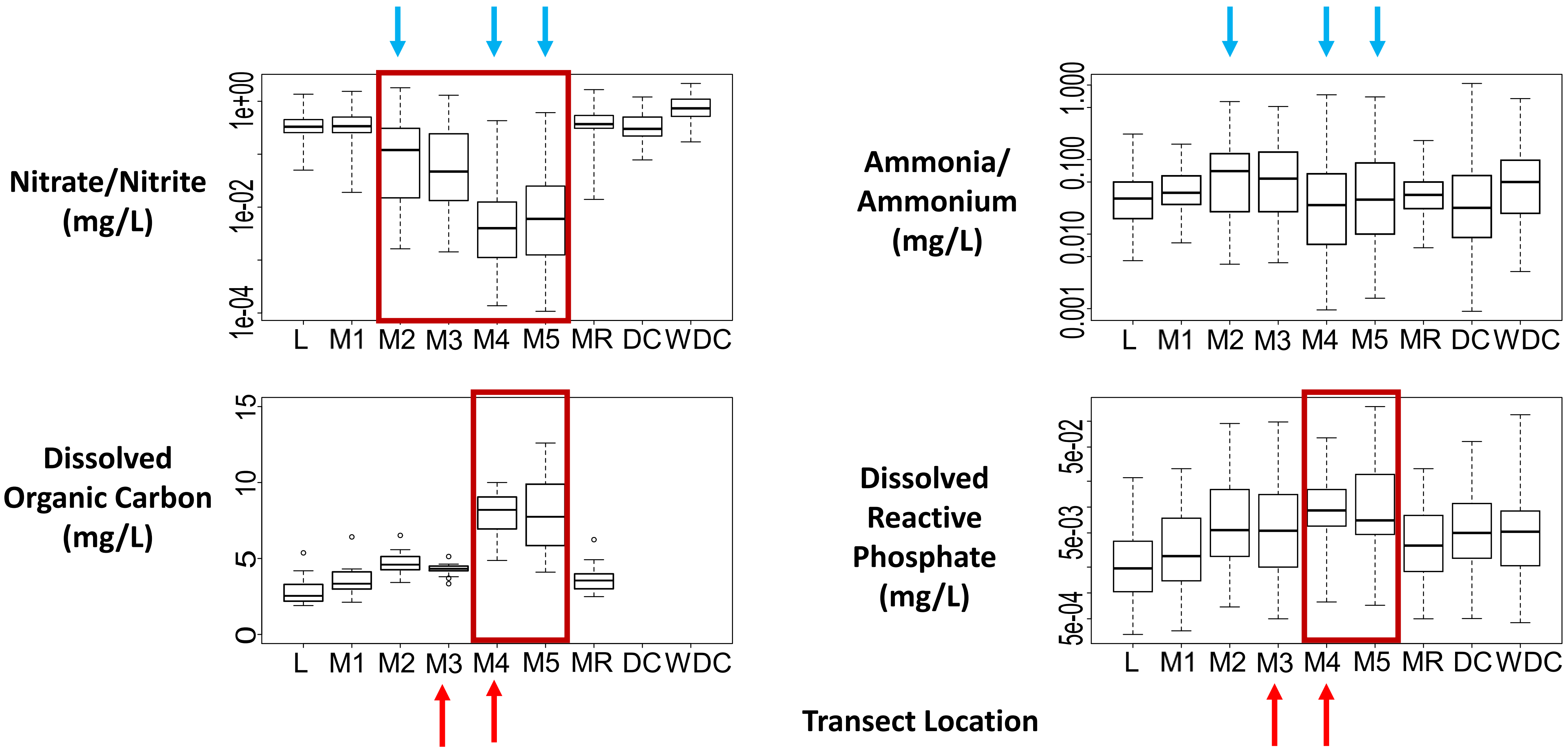
Corner Marsh

2004
High turbidity

2008
Improved water clarity
Emergent vegetation present

2010
Sustained water clarity
Emergent and floating vegetation present

Do carp gates and stormwater outflows play a role in water quality within the cells?



Take Home Messages

- 2 of 3 cells with carp gates show evidence of anoxia and release of PO4
  - Is this a result of less perturbation of sediments, increased biomass, a combination of factors?
- Are we trading one water quality measure for another?
- More work needed to help flesh this out
  - Temporal examination of data
  - Measures of oxygen levels within the cells
  - Comparison to other cells (e.g., Rouge)

Next Steps

- Explore whether these marshes could be sources of dissolved reactive phosphate to the nearshore
  - What is the role of nearshore currents, temperature and water level on water quality within the marshes and delivery to the lake
- Expand work on interaction of marshes and the watershed and lake
  - Examining the relationship between land-use within delineated watersheds and biogeochemistry to coastal wetlands




Acknowledgements

- Toronto and Region Conservation Authority
- Regional Municipality of Durham
- MITACS Accelerate Fellowship program

Upcoming ECS Lunch and Learns!

Wednesday, June 23
11:00am-12:00pm

Demo of the Recently Launched Watershed and Ecosystems Reporting Hub

By Shari Dahmer

Wednesday, July 14
11:00am-12:00pm

TRCA's Water Resource System

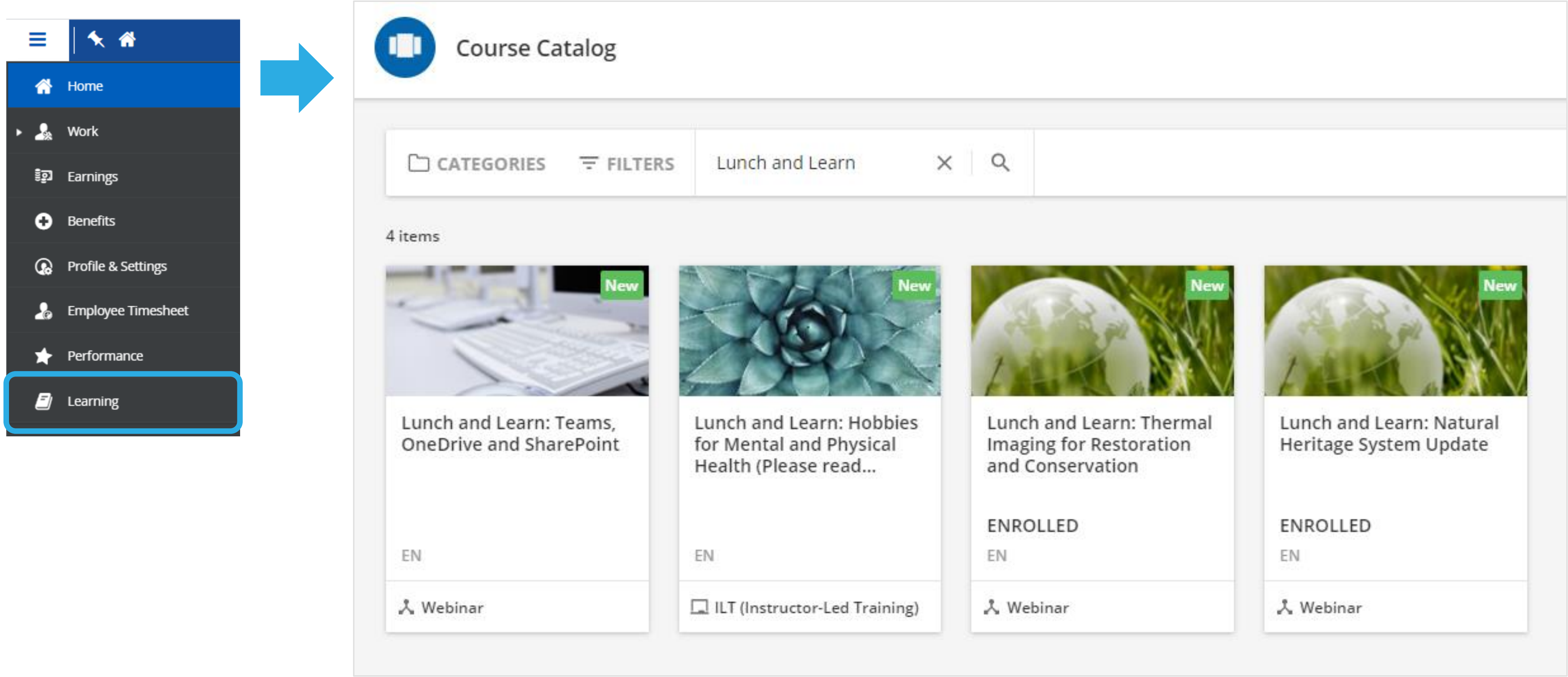
By Jonathan Ruppert

Wednesday, August 4
11:00am-12:00pm

Broadview and Eastern EA and Port Lands Flood Protection Implementation

By Meg St John and Maryam Iler

Learning Management System



New! Scientific Knowledge Sharing Hub

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Search the Staff Hub

Home > Scientific Knowledge Sharing

Scientific Knowledge Sharing

Evidence-based decision making is at the core of what TRCA does. Several of our Business Units engage in generating new scientific knowledge to support watershed management actions and decisions.

It is critical that the knowledge generated is effectively shared.

The Scientific Knowledge Sharing platform is dedicated to sharing the latest scientific knowledge generated by TRCA and our partners. It is a place where staff can learn about and engage in the scientific work TRCA is undertaking.

PLEASE NOTE: *There are several TRCA teams engaged in generating new scientific knowledge. Currently the content on the platform is specific to the Watershed Planning and Ecosystem Science business unit. Additional content from other TRCA teams will be added as the platform develops.*



Knowledge Sharing: Learn More

- Watershed and Ecosystems Reporting Hub
- Environmental Monitoring
- Research and Science Working Group
- TRCA Research Agenda
- Development and Engineering Services Hub Space

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Knowledge Sharing: Latest Updates

Knowledge Sharing – Climate Change Analysis at the Local Scale

April 19, 2021 by Hub Admin Featured

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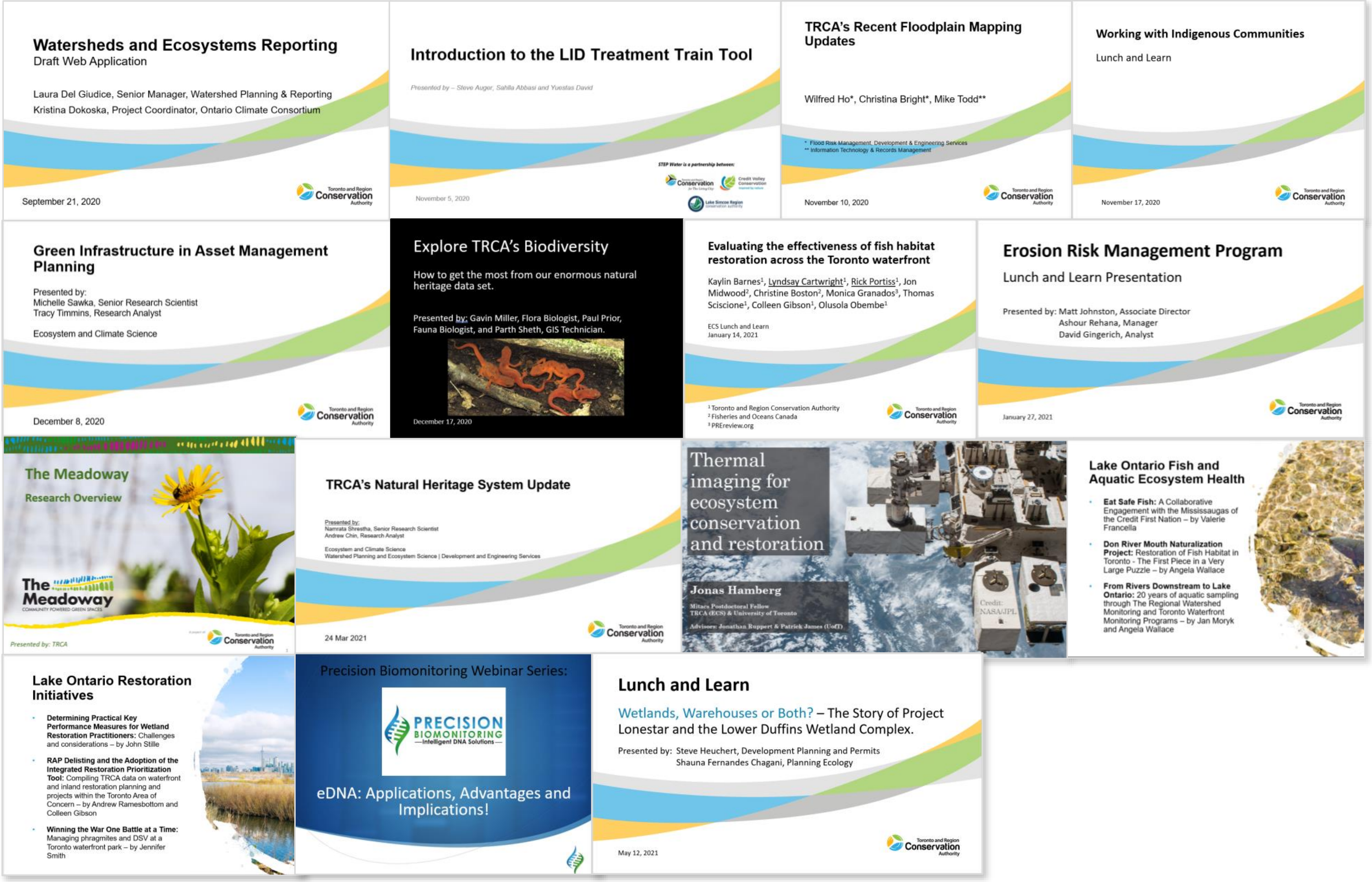
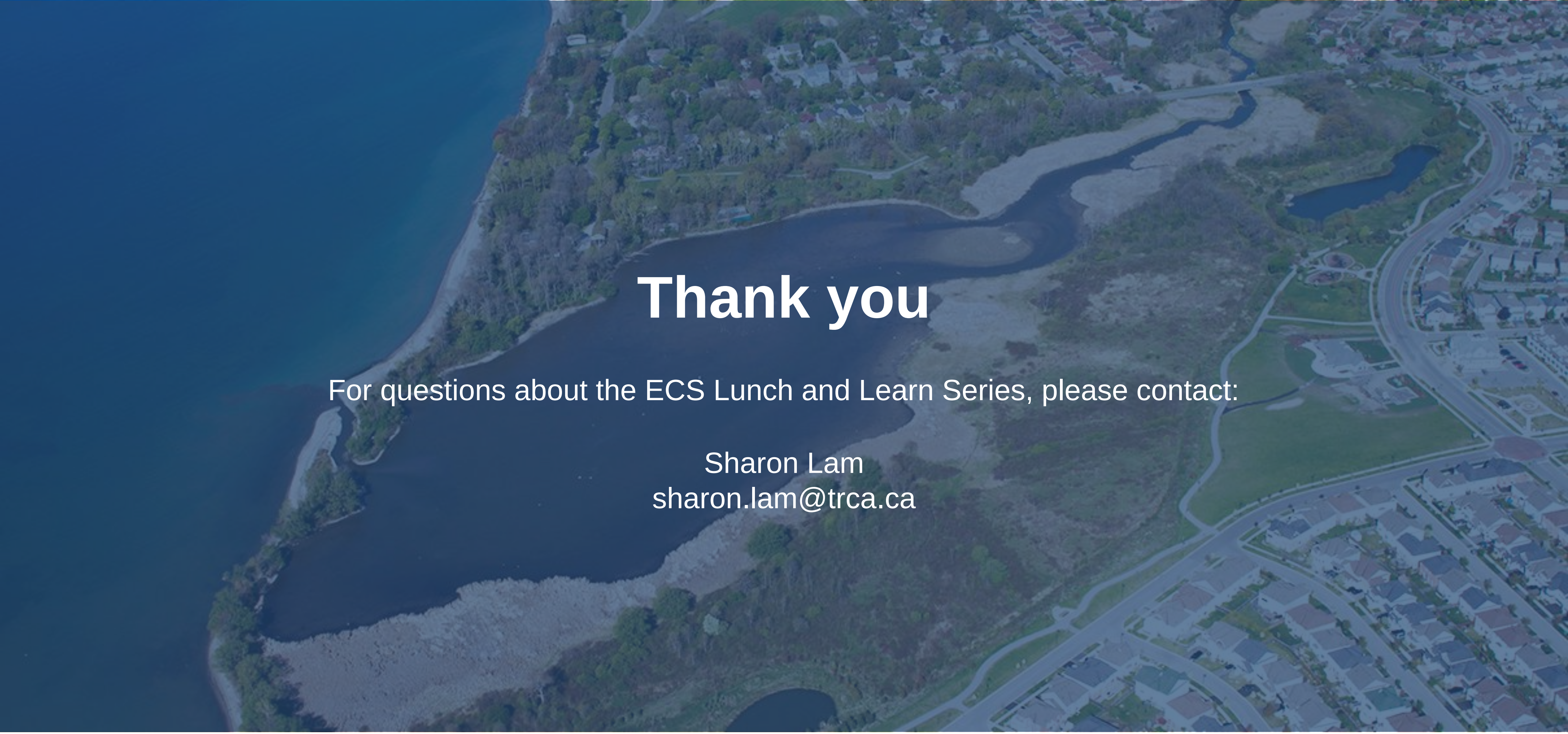
Past Recordings





Thank you

For questions about the ECS Lunch and Learn Series, please contact:

Sharon Lam
sharon.lam@trca.ca

Toronto and Region Conservation Authority