ARCTIC WETLANDS QUESTIONS:
1. HOW ARE PEOPLE USING WETLANDS
2. HOW ARE HUMAN ACTIVITIES THAT IMPACT WETLANDS REGULATED?
3. DO WE KNOW ENOUGH TO TAKE ACTION, AND IF WE DO AND WE'RE NOT, WHY THE DELAY?

RESILIENCE AND MANAGEMENT OF ARCTIC WETLANDS

What are wetlands?

- Wetlands make up over 60% of the Arctic surface (Ramsar 2014)

- 64% of the world´s wetlands have disappeared since 1900 (WWF Living planet report 2014)
  - More than 40% of all wetlands have been lost past 50 years
- 76% loss in wetlands species over past 40 years (WWF Living planet report 2014)
  - Average loss in all ecosystems 50%

Why should we care?

- Carbon sequestration
- Hydrological functions
- Ecosystem services
  - Livelihood
  - Biodiversity
  - Recreation

- Global connectivity

- What do we actually know about effects of climate change effects on wetlands?

CAFF project: resilience and management of Arctic Wetlands

- Project Lead: Sweden
  - Ministry of Environment and Energy, Swedish EPA, Stockholm Environment Institute, Stockholm University, National Union of the Swedish Saami people
  - CAFF Secretariat
  - Steering Committe

- Three-stage project
  - Scoping study and literature review – Analysis of inventories of wetlands and their status
  - Identification of case studies and research questions
  - Produce policy options/recommendations for management of Arctic wetlands

- Phase 1 report (almost) finalized

- Phase 2 Work Plan to be adopted by CAFF Board

CAFF project: resilience and management of Arctic Wetlands

Project main goal:

"..to enhance the state of knowledge on the status of Arctic wetlands and the effect climate change have on them. The goal includes producing policy recommendations to support measures and further develop management strategies to conserve biodiversity and ecosystem services including reduction of anthropogenically induced greenhouse gas emissions as well as improving climate adaptation, and exploring possibilities for sustainable use, especially for indigenous peoples."

CAFF project: resilience and management of Arctic Wetlands

- To build long-term resilience of Arctic wetlands, adaption of management to a changing climate is key

Phase 1

<u>Goal</u>

- To investigate the knowledge on the status of Arctic wetlands and their resilience

- To identify knowledge needed for developing policy and strategy recommendations

<u>Three components</u>

- Analysis of wetland inventories

- Scoping study of scientific literature and grey literature

- Identification of key knowledge needs for developing policy and strategy recommendations

Analysis of wetland inventories

<u>Investigation of</u>
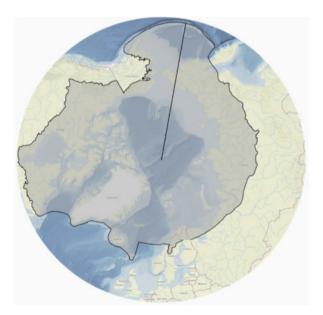
- Definitions of wetlands and wetland types

- Coverage of inventories

- Areal extent and distribution of wetlands.

- Framework

- Collected data (type, status, functions, biodiversity, human impact and disturbance)

- Assess comparability of inventories across the Arctic countries

- Compile key parameters including land use affecting wetlands, drainage of wetlands, management approaches

<u>Results</u>

- Most Arctic countries have conducted wetland inventories

- In USA and Canada the inventories are on-going projects

- In Iceland the national inventory was recently completed

- In other countries national wetland inventories are older

- Many inventories include data on disturbances such as drainage.

- The Arctic countries use their own definitions and frameworks

- Comparability across Arctic countries is limited

Scoping literature study

Search performed using **Web of Science Core Collection** (November, 2017)

(arctic OR sub?arctic OR tundra OR taiga) AND (wetland OR mire OR peatland OR bog OR fen OR marsh)

- **N=2,132 articles**

- 854 randomly selected articles (40%) were screened for relevance

- 45% (383 articles) were excluded based on relevance criteria

- Included articles (471) were coded based on information in the abstract

- Coding for studied environmental driver and outcome

Scoping literature study

	Climate change	Long-term past climate	Land use change	Migration	drainage/moisture	Animals	Chemical pollution	Observational	Restoration	Protected area	Management	Natural processes
Biodiversity	8	2	7	1	0	6	1	47	0	1	0	1
Plant performance	23	6	10	0	1	33	0	11	0	0	0	7
GHG emission/uptake	29	4	2	0	2	4	0	4	0	0	0	74
Carbon storage	10	3	0	0	0	1	0	4	0	0	0	8
Permafrost thawing	22	4	3	0	0	0	0	2	0	0	0	0
Energy balance	2	0	0	0	0	0	0	1	0	0	0	5
Hydrology	9	6	3	0	0	1	0	2	0	0	0	41
Water storage capacity	1	0	0	0	0	0	0	0	0	0	0	2
Water quality	1	0	5	0	0	0	2	1	0	0	0	2
Nutrient reduction	0	0	1	0	0	0	0	0	0	0	0	0
Biogeochemical cycling	11	2	3	0	0	4	5	5	0	0	0	40
Morphology	3	11	2	0	0	0	0	5	0	0	0	13
Wetland mapping	1	0	0	0	0	0	0	11	0	0	0	0
Modelling study	3	0	0	0	0	0	0	0	0	0	0	1

Scoping literature study

- Most studies on Arctic wetlands have investigated natural processes

- The most studied natural processes are greenhouse gas uptake/emission, biogeochemical cycling, and various hydrological aspects

- Pure observational studies, where no particular process, intervention, or exposure were studied, are also fairly common. In most of these cases biodiversity was studied

- The most studied environmental pressure is climate change, whereas land use change, drainage, and chemical pollution have been studied to a lesser extent

- In studies on effects of climate change, the most frequently studied outcomes are greenhouse gas balance, plant performance, and permafrost thawing

- The effect of animals (mostly herbivores) on plant performance is relatively well studied

- There is little research on effects of management interventions, e.g. restoration efforts and establishment of protected areas.

Scoping grey literature review

Socio-ecological aspects of Arctic wetlands

Katarina Inga[1], Jannie Staffansson[2] and Jenny Wik-Karlsson[1]

[1]National Union of the Swedish Saami People (SSR)

[2]Sámi council

Wetlands in relation to the Sámi people in Sweden

- Value and use of wetlands

- Conflicting interests

- Bridging knowledge systems

- Knowledge gaps

Legal frameworks

- Ramsar

- Convention on Biodiversity (CBD)

- EU Water Framework Directive (WFD)

- Environmental Assessments

Sámi uses of wetlands areas

Identified knowledge needs

- Effects on wetlands in areas with more frequent use (forest reindeer herding areas)

- Evaluation of actions taken to protect wetlands from terrain vehicle destruction

- Documentation of haymaking and other use of wetlands

- Compilation of *Lavdnjegoahti* projects.

- methods to include traditional indigenous knowledge with academic science

- Effects on wetland vegetation due to changed land-use

- Further investigation of how to use the reindeer as indicator to fulfil environmental goals.

- Effects of restoration efforts on Arctic wetlands

- Effects of management strategies, differences between vast remote areas and more densly populated areas

- Are protected area networks working as intended?

- Interactions between legal frameworks

Wetlands resilience and management WITH people in the picture

Marcus Carson, PhD
Rovaniemi, Finland

Arctic Biodiversity Congress
9-12 October 2018
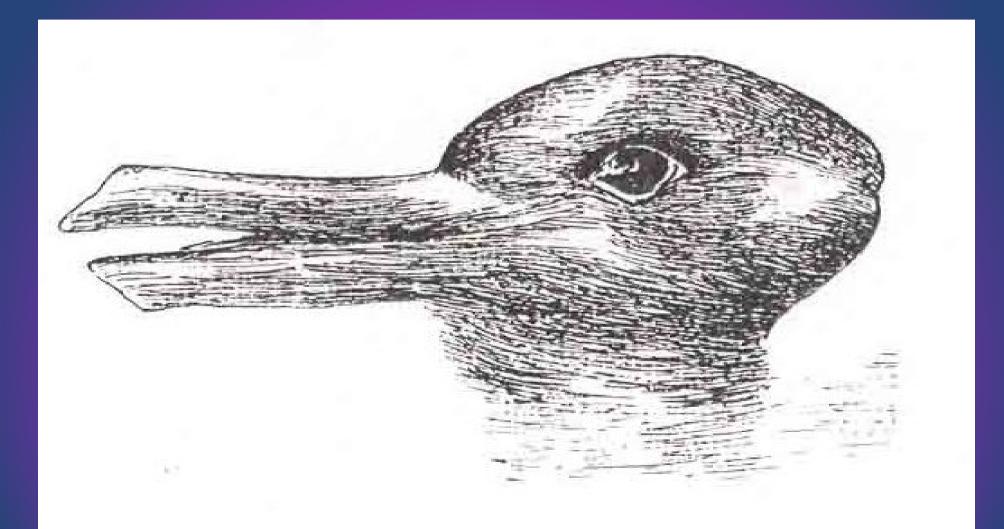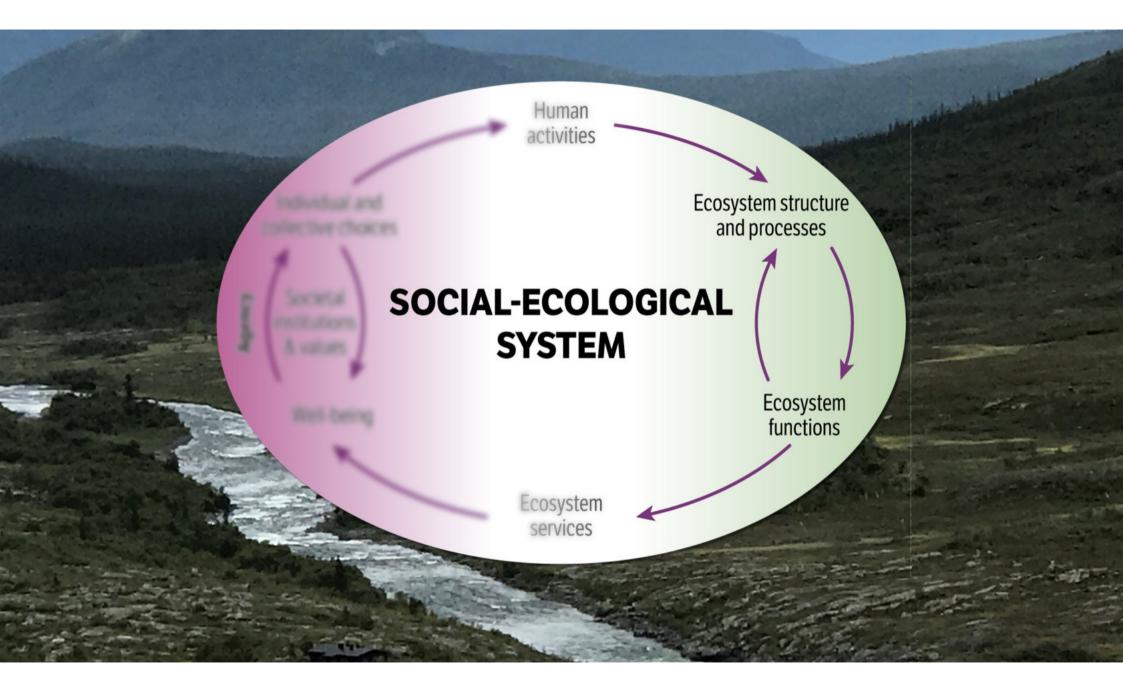
Resilience and Management of Arctic Wetlands: Goals
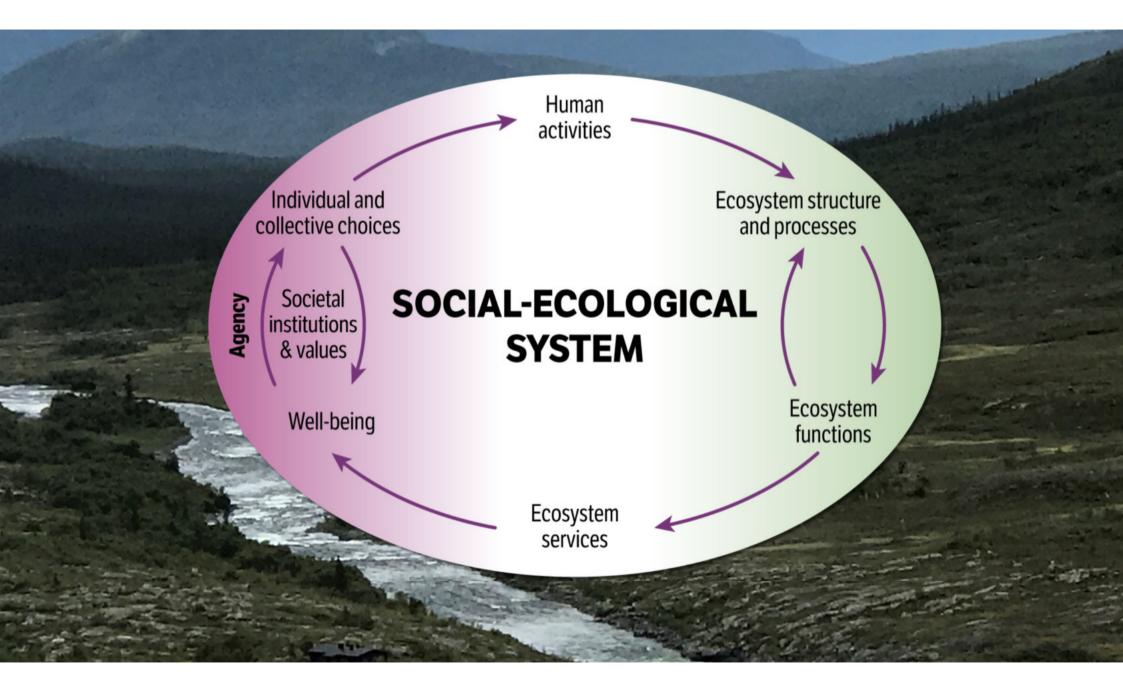
Phase 1:

Scoping: gather information, identify knowledge needs

Phase 2:

Address critical knowledge needs, synthesize

Phase 3:

Develop actionable recommendations for policy initiatives, management strategies

SOCIAL-ECOLOGICAL SYSTEM

Human activities

Ecosystem structure and processes

Ecosystem functions

Ecosystem services

Well-being

Individual and collective choices

Societal institutions & values

Agency

SOCIAL-ECOLOGICAL SYSTEM

Human activities

Ecosystem structure and processes

Individual and collective choices

Agency

Societal institutions & values

Ecosystem functions

Well-being

Ecosystem services

Resilience and Management of Arctic Wetlands: Phase 2:

- **Fill out wetlands inventories, identify ways they might be made comparable**

- **Case studies as examples of human interactions with wetlands, including efforts to regulate human impacts, manage social-ecological systems**

- **Systematic map/review of regulatory & management efforts**

Regulation & management
of human activities impacting wetlands

International conventions	• RAMSAR • CBD
Regional (i.e. EU Directives)	• Water Framework Directive • Habitats Directive
National	• Implementing legislation • Reporting upward • National legislation – i.e. Clean Water Act
Local	• implementation • management

Systematic evidence synthesis: supporting decisions in policy and practice

Biljana Macura, PhD

Photo credit:
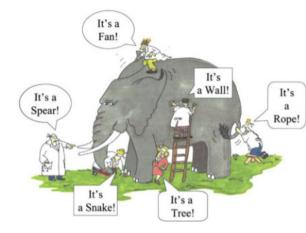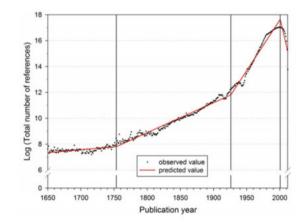
Need for reliable evidence synthesis

✓ Decision makers have no time!

✓ Ever-expanding evidence base

✓ One study is not enough

✓ Uncertainty

✓ Controversy/disagreement

✓ Large/disparate evidence base

- > literature reviews, meta-analysis, meta-syntheses

But...traditional ways of summarizing literature subject to fatal bias/limitations

Why systematic reviews?

Traditional reviews	Systematic reviews
Selection bias	Exhaustive searching/ protocol
Lack of comprehensiveness	Comprehensiveness/multiple sources of literature
Publication bias	Grey literature
No transparency	Transparent methods/Detailed reporting
Vote-counting/quality bias	Weight studies/Study validity assessment
Discussion bias	Synthesis of all relevant studies

Haddaway, N. R., Woodcock, P., **Macura, B.,** and Collins, A. (2015) Making literature reviews more reliable through application of lessons from systematic reviews. Conservation Biology, DOI: 10.1111/cobi.12541.

What can we do with systematic reviews?

-> intervention effectiveness

-> impact

⇒**Support decisions**: funding agencies, primary research, individual and institutional decision-makers
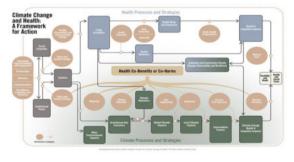
-> policy effectiveness
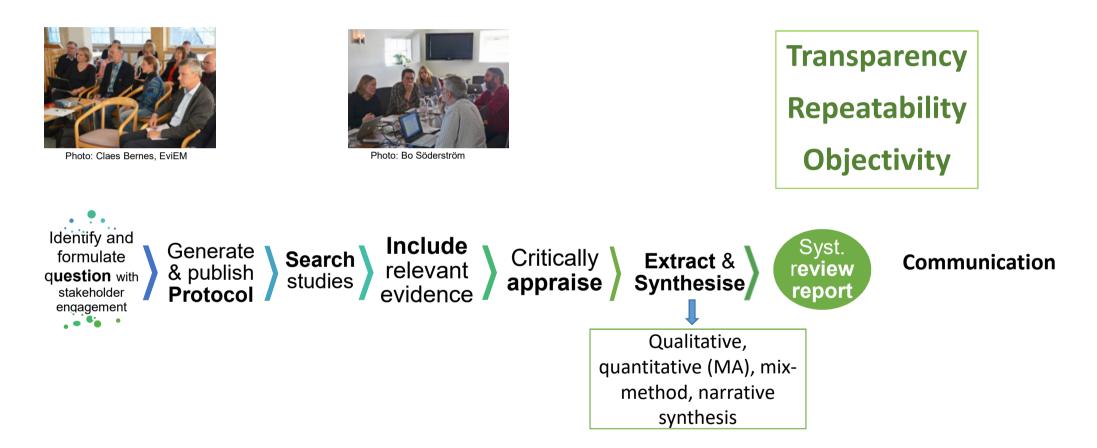
-> theories and frameworks

Methodology

Photo: Claes Bernes, EviEM

Photo: Bo Söderström

Transparency

Repeatability

Objectivity

Identify and formulate **question** with stakeholder engagement > Generate & publish **Protocol** > **Search** studies > **Include** relevant evidence > Critically **appraise** > **Extract** & **Synthesise** > Syst. review report   **Communication**

Qualitative, quantitative (MA), mix-method, narrative synthesis

- Multiple evidence base & weaving knolwedge systems (Tengö et al 2016, Ambio)

Systematic Maps

- What evidence exists on…?
- Broad subject
- No full synthesis
- Searchable database
- Knowledge **gaps** and **clusters**
- Primary research deficiencies/best practices

CONSERVATION INTERVENTION

Area Protection	Land/Water Management	Resource management	Species management	Education & awareness	Law & Policy	Livelihood incentives	Ext. Capacity Building	Sustainable Use	Other	HUMAN WELL-BEING
18	24	39	10	3	21	28	6	0	1	Economic living standards
11	19	23	6	1	13	16	1	0	1	Material living standards
4	5	6	0	2	5	5	1	0	0	Health
0	2	12	1	2	3	5	0	0	0	Education
2	6	12	2	1	4	7	2	0	0	Social relations
1	3	3	3	0	1	1	0	0	0	Security & safety
1	3	12	2	0	5	6	1	0	0	Governance & empowerment
2	1	0	0	0	0	1	0	0	0	Subjective well-being
0	0	0	0	0	0	0	0	0	0	Culture/Spirituality
0	0	0	0	0	0	0	0	0	0	Freedom of choice/action
0	0	2	0	0	1	1	0	0	0	Other

NO. OF STUDIES

0 10 20 30 40

McKinnon et al 2016

Identify **Question** with stakeholder engagement 〉 Generate & publish **Protocol** 〉 **Search** studies 〉 **Include** relevant evidence 〉 Critically **appraise** 〉 **Meta-data Extraction** 〉 Syst. map **report**

Thank you!

Contact:

biljana.macura@sei.org

SEI Stockholm Environment Institute

Wetland Classification and Monitoring in the CHARS ERA

Donald McLennan and Serguei Ponomarenko

Arctic Biodiversity Congress Oct 8-12, 2018, Rovaniemi, Finland
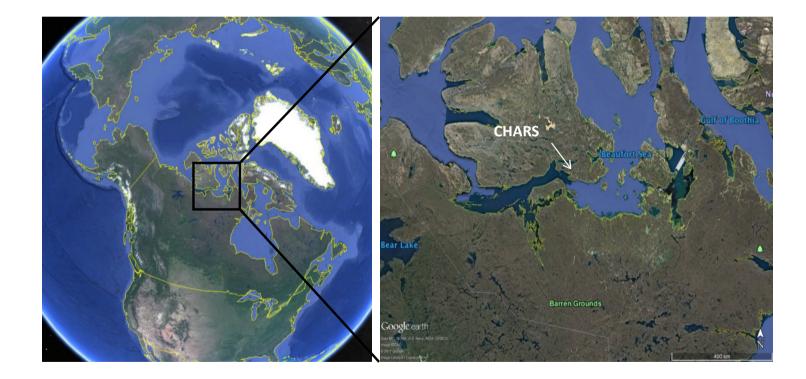
Polar Knowledge
Canada

Savoir polaire
Canada

Canada

Presentation Overview

- About CHARS
- CASBEC – proposed national standardized terrestrial ecosystem classification
- Long term wetland monitoring experiments
- Social ecological systems and regional issues
- A special case - Arctic coastal wetlands

Where is CHARS?

CHARS Campus

CHARS Regional ERA

Dry   Mesic   Wet   Snowbed   Riparian

Subzone 1
Cushion-forb

a. Ridge top, lemming barrow, Amund Ringnes Island, <5% vegetation cover, dry graminoid barrens.

b. Arctic hares on level plain, Ellesmere Island, moist cushion-forb tundra. Extra-zonal elevational Subzone 1.

c. Amund Ringnes Island, 80-100% vegetation cover, wet graminoid-moss tundra.

d. Amund Ringnes Island, graminoid-cryptogam snowbed barrens.

e. Amund Ringnes Island, 25% vegetation cover, riparian cushion forb-graminoid barrens.

Subzone 2
Prostrate dwarf-shrub

f. Resolute, Cornwallis Island, dry graminoid-cushion forb barren.

g. Eureka, Ellesmere Island, moist prostrate dwarf-shrub rush community.

h. Resolute, Cornwallis Island, wet *Carex aquatilis* prostrate dwarf-shrub.

i. Resolute, Cornwallis Island, *Dryas-Cassiope* snowbed community.

j. Resolute, Cornwallis Island, <10% cover, riparian graminoid rush, forb community.

Subzone 3
Hemiprostrate dwarf-shrub

k. Ellesmere Island, dry dwarf-shrub sedge barren.

l. Central Victoria Island, moist dwarf-shrub sedge.

m. East Wind Lake, Ellesmere Island, wet sedge dwarf-shrub. Fred Daniëls at work.

n. Ellesmere Island, *Cassiope* dwarf-shrub heath snowbed.

o. Ellesmere Island, moss graminoid riparian meadow.

Subzone 4
Erect dwarf-shrub

p. Cambridge Bay, Victoria Island, dry *Dryas*, cushion forb, sedge barren.

q. Cambridge Bay, Victoria Island, moist dwarf-shrub sedge with *Salix lanata*.

r. Cambridge Bay, Victoria Island, wet sedge-bryophyte community.

s. Cambridge Bay, Victoria Island, *Cassiope-Dryas* prostrate shrub cushion-mat snowbed.

t. Cambridge Bay, Victoria Island, *Salix lanata-Carex misandra* riparian low-shrub sedge.

Subzone 5
Low-shrub

u. Daring Lake, mainland Canada, dry lichen-shrub community.

v. Daring Lake, mainland Canada, moist erect low-shrub sedge community.

w. Daring Lake, mainland Canada, *Eriophorum-Sphagnum* tundra.

x. Daring Lake, mainland Canada, lichen-heath snowbed.

y. Daring Lake, mainland Canada, riparian shrubs up to 2m tall.

Changes in Terrestrial Ecosystems Across the Canadian Arctic

CHARS ERA

Gould et al 2003

37

Greiner Lake Watershed

Ecosystem Classification and Mapping

Canadian Arctic – Subarctic Biogeoclimatic Ecosystem Classification (CASBEC)

McLennan *et al* Arctic (2018)

Snow Cover Regime

Relative	v. exp. A	exposed B	neutral C	protected D	v. protected E
very xeric 0					
xeric 1	02	xx1			
bxeric 2	(ithic)				
submesic 3			xx2		
mesic 4					
subhygric 5			05	03	
hygric 6		07			06
subhydric 7		09	10	08	
hydric 8			11		

Site Series

01 (Arc041) Mountain-avens - Curly sedge

02 (Arc) Three-toothed Saxifrage - Blackish locow

xx1 (Arc) Arctic willow || xx2 Mountain-avens - O:

03 (Arc) Mountain-avens - Net-veined willow

04 (Arc027) Mountain-heather - Mountain-avens

05 (Arc) Mountain-avens - Water sedge - Arctic wil

06(Arc) xxMountain-avens - Horsetail - Bearberry||

07 (Arc) Arctic willow - Water sedge - Scorpidium

08 (Arc) Richardson's willow - Water sedge

09 (Arc) Water sedge

10 (Arc) Dupontia - Water sedge

11 (Arc) Arctophila fulva

Wetland Ecosite Types (1)

Ecosite 05: *Dryas integrifolia – Carex aquatilis*

Ecosite 06 - *Dryas integrifolia – Equisetum arvense*

Ecosite 07: *Salix arctica – Carex aquatilis*

Ecosite 08 – *Salix Richardsonii – Carex aquatilis*

Wetland Ecosite Types (2)

Ecosite 09: *Carex aquatilis*

Ecosite 10: *Dupontia fisherii - Carex aquatilis*

Ecosite 11: *Arctophila fulva*

Ecosite 12: *Carex subspathacea*

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Tundra Ecosystems - IMA

Legend:
- Unvegetated and Sparsely Vegetated (<10%)
- Dryas integrifolia - Carex rupestris Lithic or Dryas integrifolia - Oxytropis arctobia (rocks 75-90%)
- Dryas integrifolia - Carex rupestris Lithic (stones 50-75%)
- Dryas integrifolia - Carex rupestris Lithic (rocks 25-50%)
- Turfy Dryas integrifolia - Carex rupestris (rocks 5-25%)
- Dryas integrifolia - Carex scirpoidea
- Micro-hummocky Dwarf Salix - Dryas - Moss
- Shrub - Sedge - Dryas (drier end)
- Shrub - Sedge - Dryas (wetter end)
- Shrub - Sedge Fen
- Sedge Fen
- Hygric Sedge Fen
- Intermitent Water - Dry Pond
- Shallow Water
- Medium-Deep Water 1.2-2m
- Deep Water >2

0   1   2   3   4 km

Focal Ecosystems

Mesic Ecotype - 01

Snow Ecotype - 04

Sedge Fen Ecotype - 08

Shrub-Sedge Fen Ecotype- 09

CHARS ERA Intensive Monitoring Area

Abiotic Drivers

air temperature, soil temperature and moisture/drainage, water quality, rainfall, snow depth, distribution, condition and duration, flooding and sedimentation, contaminants, wind direction and severity, topography, elevation, aspect and exposure

Ecological Processes

organic decomposition and nutrient cycling, pollination, pathogens and parasitism, competition and mutualism, growth and reproduction, herbivory, predation, evolution, invasion

Distribution and Character of Tundra Ecological Communities

CBMP Focal Ecosystem Components

vegetation composition, productivity and structure, arthropod, bird, and mammal diversity and productivity

Detailed Monitoring Transects

Savoir polaire Canada · Polar Knowledge Canada

44

Canada

IMA - Detailed Monitoring Plots/Transects

Monitoring Plot

20 m
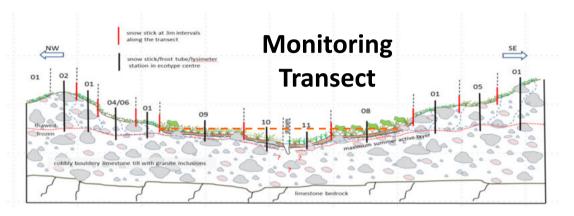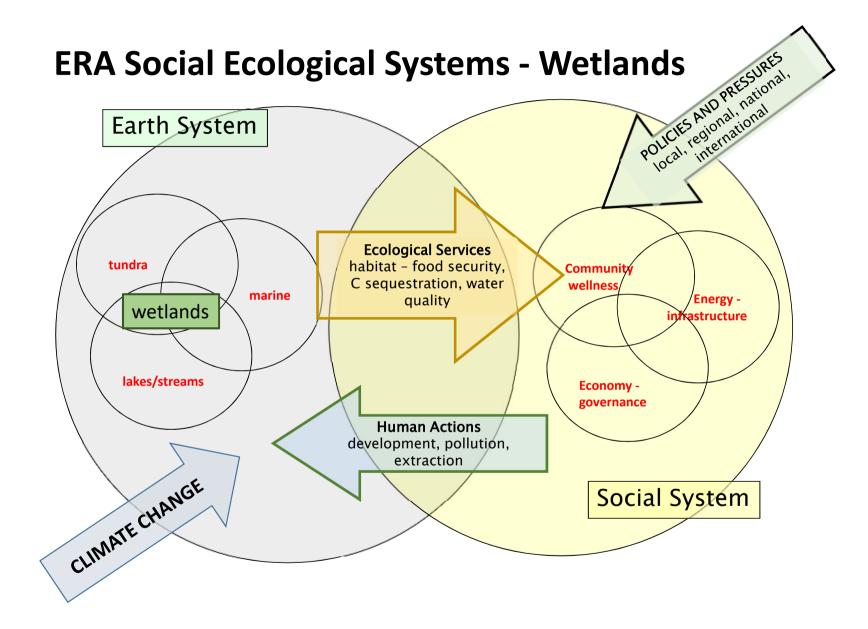
☐ ITEX vegetation plot

✚ digital camera, soil moisture meter, soil thermistors, soil solution lysimeters
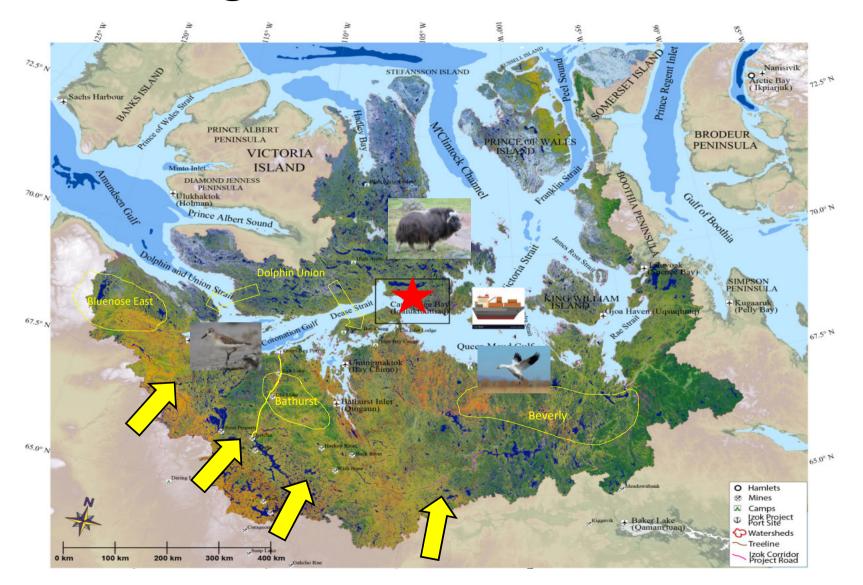
• snow stick

Monitoring Transect

- species Interactions (e.g., pollination, predation, herbivory, parasites)
- vegetation change (structure, composition)
- gradient studies across ecotones
- terrestrial – freshwater connections
- processes/abiotic drivers (snow, inundation, soil texture, OM, active layer)
- quantitative rationale for regional ecosystem extrapolations (e.g., C storage, vegetation/shrub change, habitat quality)

ERA Social Ecological Systems - Wetlands

Earth System

tundra

wetlands

marine

lakes/streams

Ecological Services
habitat – food security,
C sequestration, water
quality

Community
wellness

Energy -
infrastructure

Economy -
governance

Human Actions
development, pollution,
extraction

POLICIES AND PRESSURES
local, regional, national,
international

CLIMATE CHANGE

Social System

Regional Wetland Issues

Coastal Wetlands

Wetlands adjacent to the coast where the key drivers are:

- **tidal, daily, sea water inundation**
- **coastal sedimentation and erosion processes**
- **storms and sea ice**
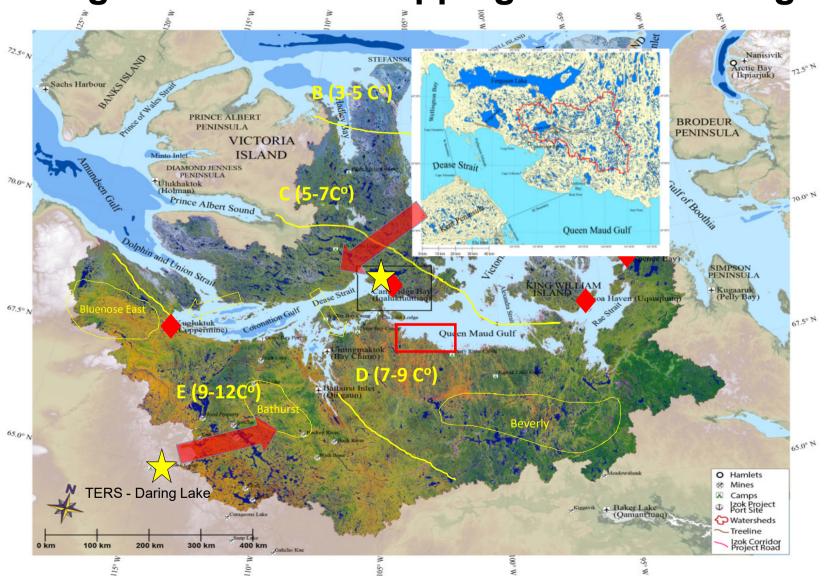
Coastal wetlands are abundant and provide important staging, nesting and rearing habitat for waterfowl, shorebirds and many other Arctic species
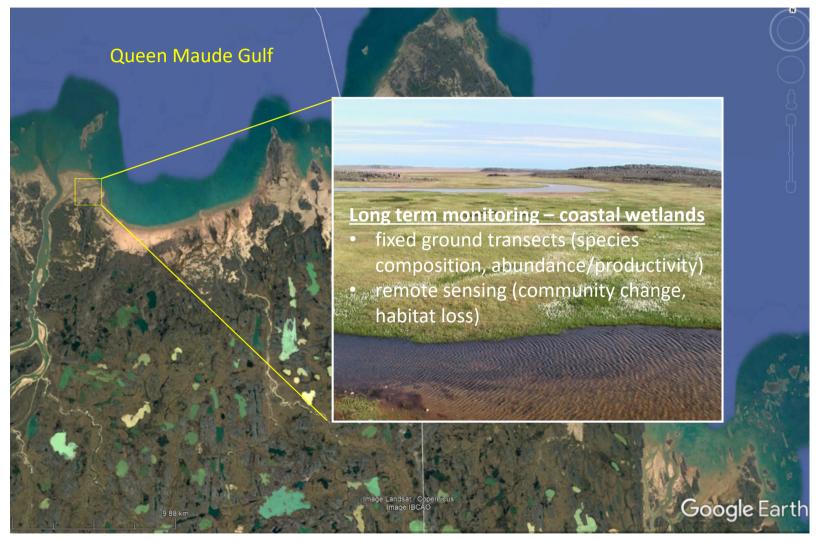
Also important for seasonal ungulate grazing and are linked to coastal freshwater systems such as lagoons and estuarine lakes that provide unique coastal habit for fish and marine mammals

Coastal Wetlands
Processes, Drivers and Threats

shorebirds

waterfowl

caribou/muskoxen

outside Arctic threats

vegetation arthropods

soils and soil processes

coastal landform processes

Direct Human Threats
- direct pollution (e.g., fuel spills)
- global contaminants (Hg, POPs)
- invasive alien species
- overharvesting

Abiotic Drivers
- inundation by saline water
- sedimentation/deposition
- erosion
- sea ice phenology
- water chemistry

Potential Climate Change Threats
- increased air/seawater temperatures
- shorter sea ice season/more exposure
- relative sea level rise
- increased storm frequency/intensity
- changes to sedimentation and inundation regimes
- changes to riverine inputs

Regional Wetland Mapping and Monitoring

Vulnerable Areas - Coastal Wetlands

Queen Maude Gulf

Long term monitoring – coastal wetlands
- fixed ground transects (species composition, abundance/productivity)
- remote sensing (community change, habitat loss)

Thank You!

For more information please contact:

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or
Serguei Ponomarenko
serguei.ponomarenko@polar.gc.ca

resilience and management of Arctic wetlands

an outlook from a global perspective
based on a social-ecological systems approach

Tobias Salathe
Ramsar Convention Secretariat

Global Wetland Outlook

the state of the world's wetlands and their services to people

Status and Trends:

Wetlands disappear three times faster than forests: **35% loss 1970 - 2015**
the accuracy of wetland area data is improving: natural wetlands decline, artificial wetlands increase

Wetland **ecosystem services** exceed terrestrial services in value

Wetlands maintain **hydrological processes** of the global water cycle, are among the most productive systems and the world's largest carbon store
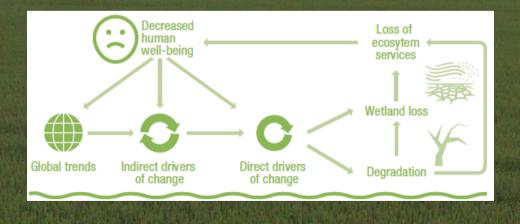
Water quality trends are mainly negative, a wide range of pollutants are impacting wetland water quality

Populations of many wetland-dependent **species are declining**, highest risks in the tropics

download the full text at ramsar.org
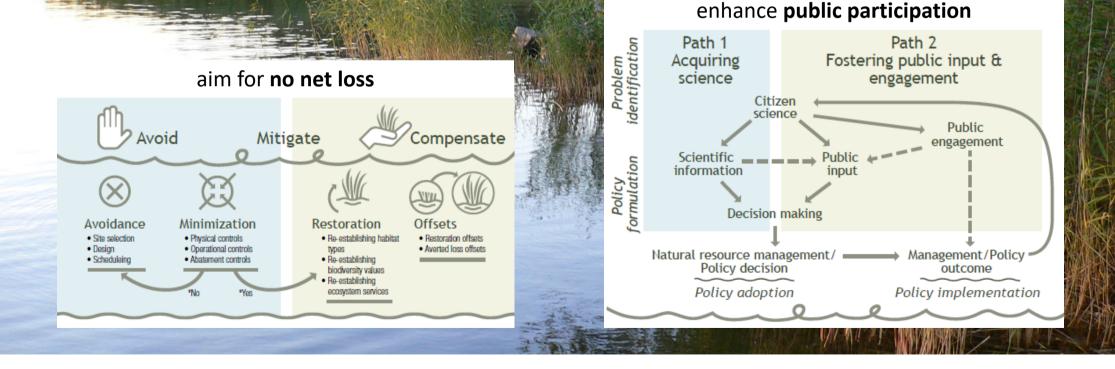
Drivers of Change:

1. **direct drivers**: biophysical changes such as **drainage, land-use change, pollution and urbanisation**

2. **indirect societal processes** (economic development) that create the direct drivers

3. **global megatrends** behind indirect drivers (population growth, consumption and trade patterns)

Responses:

enhance the Ramsar Sites network and wetland coverage in conservation areas
has shown to support threatened species

using business models and financial incentives for wetland restoration

aim for **no net loss**

enhance **public participation**

the role of Arctic wetlands in global processes

together, they cover the largest part of the Arctic

glacier forelands
rivulets-rivers-streams
ponds & lakes
peatlands of all sorts
shorelines & shallow marine bays
including islets and seabird cliffs

tracking wetland status and *trends*

to anticipate consequences …

… also for globally **connected** *and* **threatened** *species*

cultural services

Sacred natural sites and other faith sites
Recreation
Tourism and ecotourism
Cultural monuments

provisioning services

Fish and other food
Raw materials – timber, fodder, skins
Genetic resources
Water supply
Medical resources
Hydropower

regulating services

Carbon sequestration (e.g. blue carbon)
Water purification
Flow rate regulation
Flood mitigation
Coastal protection
Waste decomposition

supporting services

Primary production   Nutrient recycling   Global water cycle

extent **of different** wetland types

change of the extent (flooding, sea level rise, drought, permafrost thawing) and water quality

evolution in **wetland character** (natural > artificial) and their ecosystem **services**

global trends *driving societal processes* > changing Arctic wetlands

changes at **landscape scales** (water quantity and qualities, ice/no ice, urbanisation)

wetland resource uses (consumption, pollution, invasive species, land-use changes)

pressures from outside the Arctic: underlying policies and global interactions

Responses:

monitoring programme – *we can only manage what we measure*

priority areas to safeguard – *for wise use, for species protection*

processes to maintain and to restore – *including links outside the Arctic*

ecosystem **resources** to maintain and to manage
invasives to control and to manage

demonstration projects:
a selection of iconic Ramsar Sites
in all 8 Arctic countries

New opportunities:

demonstrate:
sustainable business for Arctic people
sustainable trade with Arctic wetland products

communication
outreach (language)
cooperation (partnerships)
communication

ARCTIC WETLANDS QUESTIONS:
1. HOW ARE PEOPLE USING WETLANDS
2. HOW ARE HUMAN ACTIVITIES THAT IMPACT WETLANDS REGULATED?
3. DO WE KNOW ENOUGH TO TAKE ACTION, AND IF WE DO AND WE'RE NOT, WHY THE DELAY?