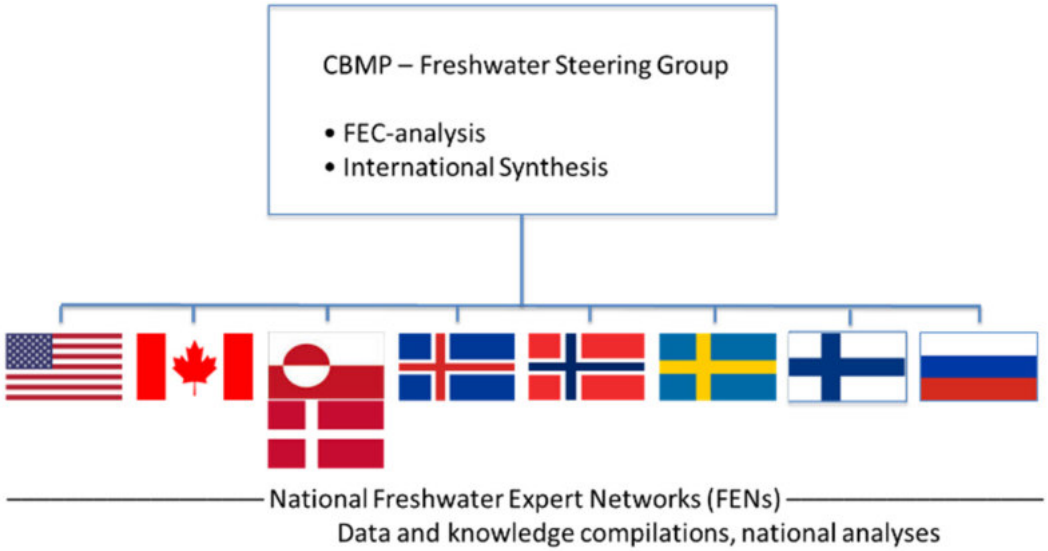
CBMP-Freshwater Indicator/ FEC Development and Data Creation: Potential Links to GEO - BON

Jennifer Lento
CBMP-Freshwater Science Coordinator
FWBON Regional Coordinator – North America

CIRCUMPOLAR BIODIVERSITY MONITORING PROGRAM

FWBON



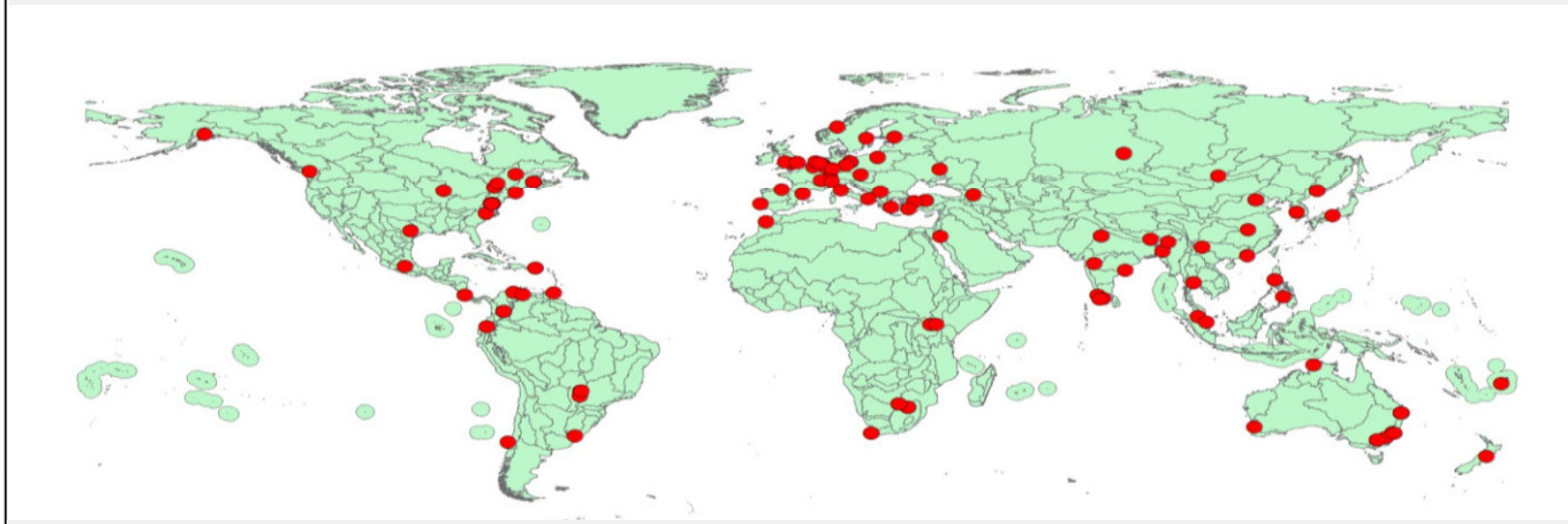
CBMP-Freshwater Steering Group

- Circumpolar monitoring plan for freshwaters
- Regional and circumpolar assessments of biodiversity
- National Freshwater Expert Networks to facilitate data collection and assessment
- Upcoming 2019 State of Arctic Freshwater Biodiversity Report and special issue of Freshwater Biology
- Database of Arctic freshwater biodiversity and abiotic drivers

Developing FW-BON globally: Current membership and governance

Current membership: >150 members from < 50 countries

Co-chairs: Eren Turak, Aaike DeWever, Jeanne Nel



Regional Coordinators

Asia	Central & S America	Oceania	North America	Africa	Europe
Lu Cai	Andrea Encalada	Bindiya Rashni	Jennifer Lento	John Simaika	Astrid- Schmidt-Kloiber
Shin-Ichi Nakano	Mathias Kuemmerlen	Simon Linke	Erin Hestir	Mike Hudson	Aaike DeWever
Anila Ajayan	Claudio Valdovinos	-	Alex Bush	-	Adrian Strauch

Advisory Board : Carmen Revenga, Ian Harrison, Robin Abell, David Dudgeon, Jorg Freyhof

NatureFiji MareqetiViti

Lab. Ecología ACUÁTICA

FWBON

Universidad San Francisco de Quito

Similar Goals and Objectives

CBMP-Freshwater

- Develop a circumpolar monitoring plan with standardized sampling methods
- Identify key ecosystem components and indicators to monitor and assess biodiversity in the Arctic
- Identify and build a database of existing monitoring data for Arctic freshwaters
- Conduct regional and circumpolar assessments of freshwater biodiversity to identify species distributions and detect change
- Promote harmonized and coordinated monitoring across the circumpolar region

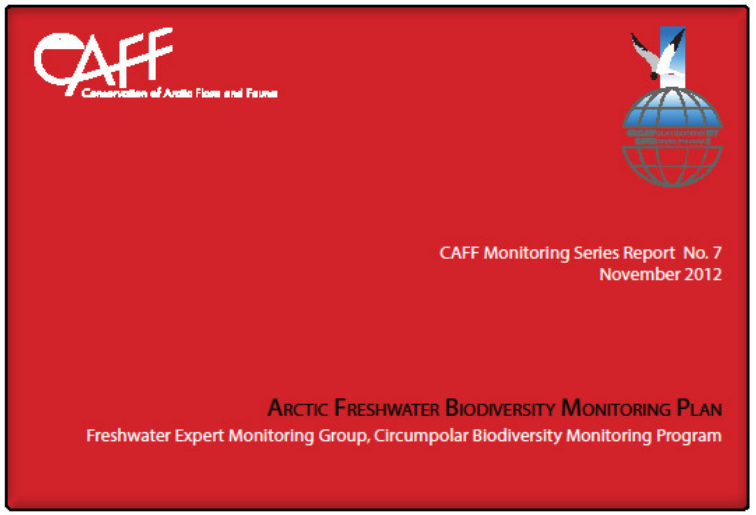
Freshwater BON

- Develop globally-standardized sampling methods for freshwater organisms
- Support the development of Essential Biodiversity Variables (EBVs) for freshwater
- Identify existing freshwater biodiversity data from across the globe and create a central hub to make data available
- Synthesize existing biodiversity data to conduct global assessments of freshwater biodiversity, identify species distributions, and detect change
- Promote harmonized and standardized monitoring across the globe

CBMP-Freshwater Plan

Freshwater Monitoring Plan identifies:

- Scientific questions and user needs
- Specific monitoring and management objectives
- Focal ecosystem components & indicators
- Key abiotic parameters to be monitored
- Existing monitoring capacity and information
  (e.g., Scientific and Traditional Knowledge)
- Monitoring gaps (elemental, spatial, temporal)
- Core set of standardized protocol
- Strategy for implementing long-term monitoring plan



(2012) *"Developing a Circumpolar Framework for Arctic Freshwater Biodiversity"* **Biodiversity 13:215-227**

(2012) *"Arctic Freshwater Biodiversity Monitoring Plan"* **CAFF Monitoring Series Rpt. 7. 165 p.**

Uppsala Workshop (November, 2010)
Approach for Developing Freshwater Plan

Adaptive Environmental Assessment & Management (AEAM) approach:

Identify a limited number of issues to be addressed through considerations of key questions, measurable objectives, impact factors, or drivers.

1. Identify Focal Ecosystem Components of key importance to ecosystem (or humans).
2. Identify key drivers affecting FECs & develop impact hypotheses.
3. Determine key variables (indicators) that should be monitored for production of indices and/or metrics.
4. Determine focal areas for monitoring based on factors such as data availability, environmental sensitivity, importance to humans, etc.
5. Produce conceptual framework for freshwater assessment.

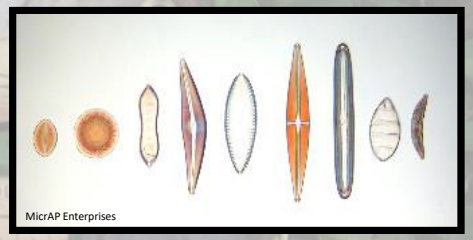
Focal Ecosystem Components

FEC: *Biotic or Abiotic Element judged to be ecologically pivotal, charismatic or particularly sensitive to environmental change*

State of Arctic Freshwater Biodiversity Report: focus on biotic FECs with most data and supporting abiotic variables (where possible):

BIOTIC

- Phytoplankton (Lakes)
- Benthic algae (Lakes, Rivers)
- Zooplankton (Lakes)
- Benthic invertebrates (Lakes, Rivers)
- Fish (Lakes, Rivers)
- Macrophytes (Lakes)



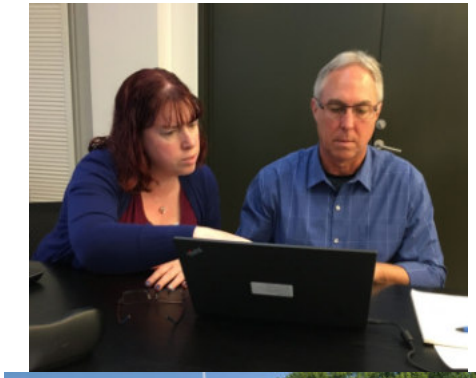
Parameters and Indicators/Indices

FECs	Monitored Parameter	Indicators/Indices
Benthic algae and phytoplankton	Number of individuals of each taxon	Community indices (e.g., abundance and density, taxonomic richness, diversity and dominance, tolerance indices)
		Numbers of keystone, red-listed (threatened) and rare taxa
		Distribution and range (e.g., latitudinal and altitudinal)
	Chlorophyll *a*	Bulk algal biomass
Fish, benthic macroinvertebrates and zooplankton	Number of individuals or biomass of each taxon	Community indices (e.g., abundance and density, taxonomic richness, diversity and dominance, biomass, ecological traits, tolerance indices)
		Numbers of keystone, red-listed (threatened) and rare taxa
		Distribution and range (e.g., latitudinal and altitudinal, residency/anadromy for fish)
	Length and body weight (fish only)	Size structure of entire population or of keystone taxon
	Age of individuals (fish only)	Age structure of entire population or of a keystone taxon; growth rates (size at age or age at length (fish)
Macrophytes	Areal cover or number of individuals of each taxon (as feasible)	Community indices (e.g., abundance and density, taxonomic richness, diversity, and dominance)
		Numbers of keystone, red-listed (threatened) and rare taxa
		Distribution and range (e.g., latitudinal and altitudinal)

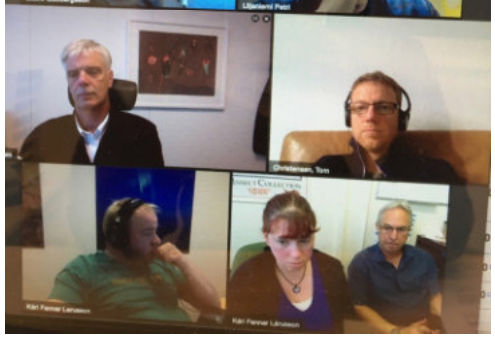
Indicators can feed into GEO BON EBVs and help FWBON meet targets

Meetings, workshops, writing meetings

Data Availability – Compiled by CBMP Freshwater Expert Networks



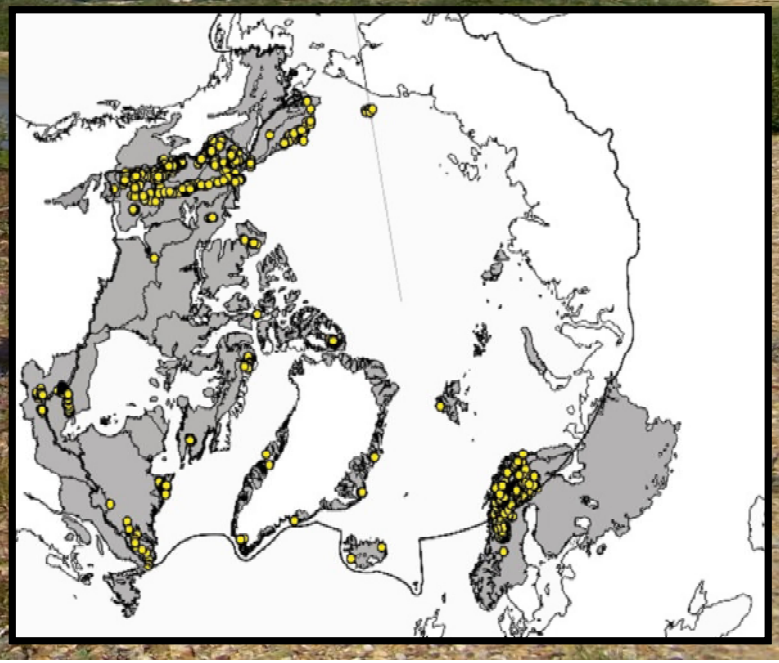






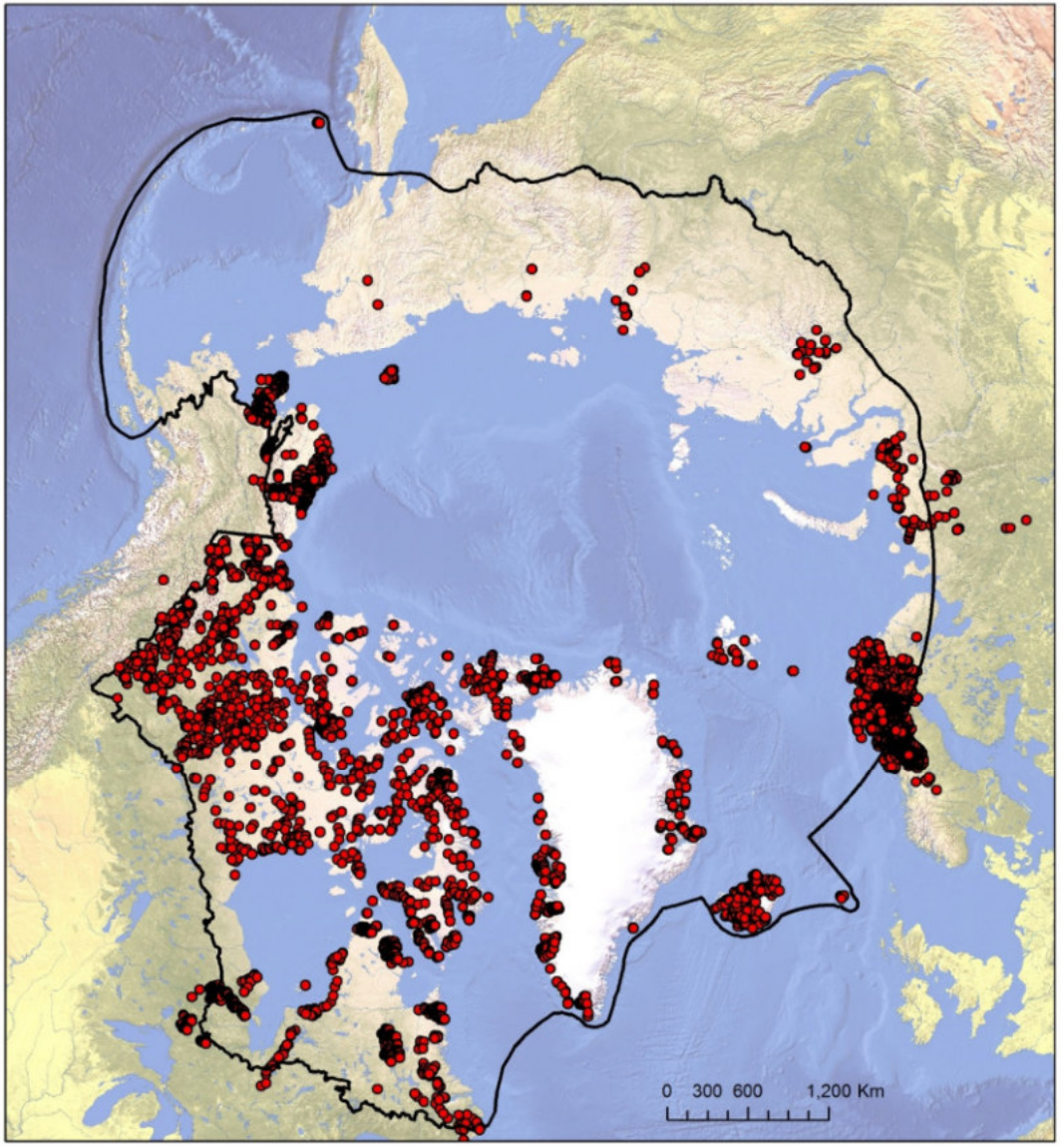
Data Collection

- Data collected by each country for each FEC for the time periods:
  - Contemporary: 1950 – present
  - Historical (where available)
    - Post-industrial: 1850 – 1949
    - Pre-industrial: paleo data
- Represent government, academic, industrial, and where possible, TK sources
- Coverage was used to select focal regions for assessment of trends

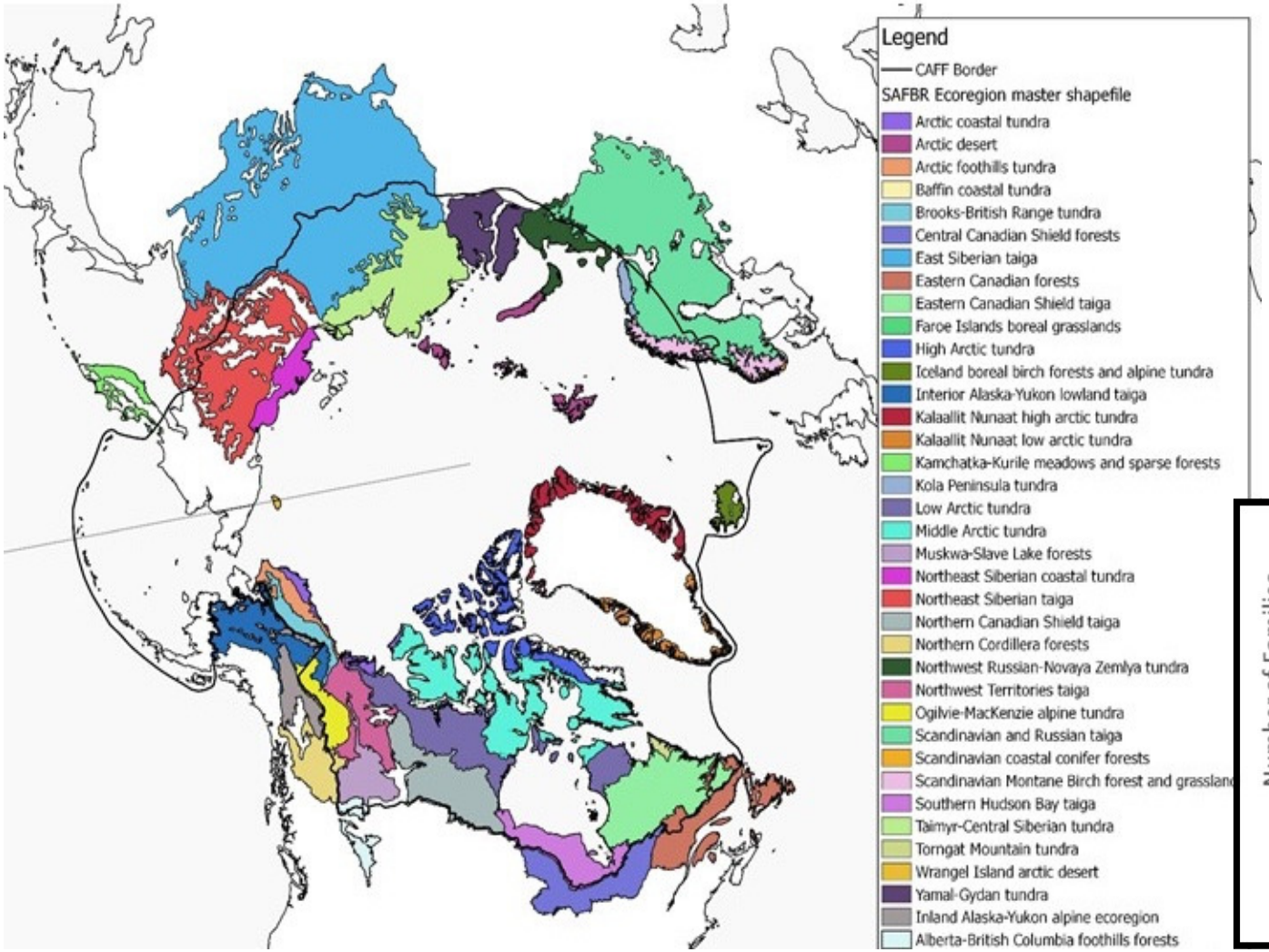


CBMP-Freshwater Database

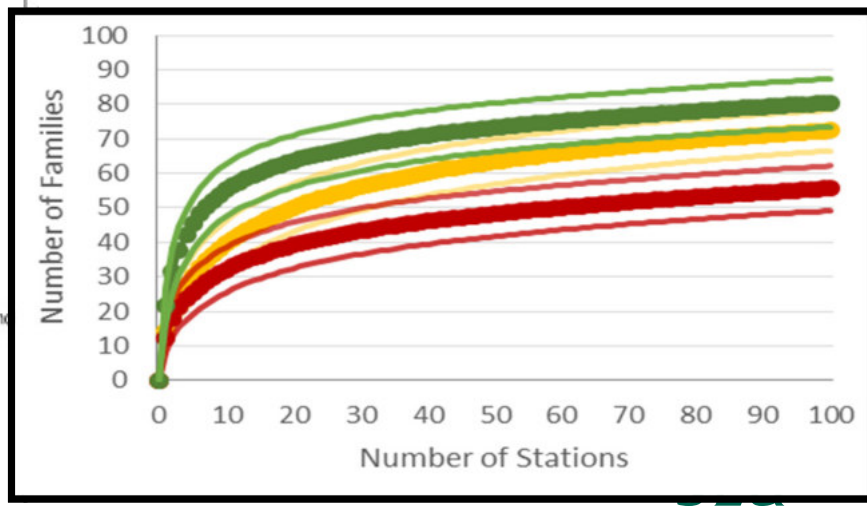
- Database includes over 9000 stations
- Stations include multiple samples over multiple years
- Data include fish, macroinvertebrates, diatoms, plankton, macrophytes, and abiotic
- Nomenclature harmonized across circumpolar region
- Data selected by methods, or used presence/absence where necessary
- Geospatial variables extracted for hydrobasins



Ecoregion-Based Analysis



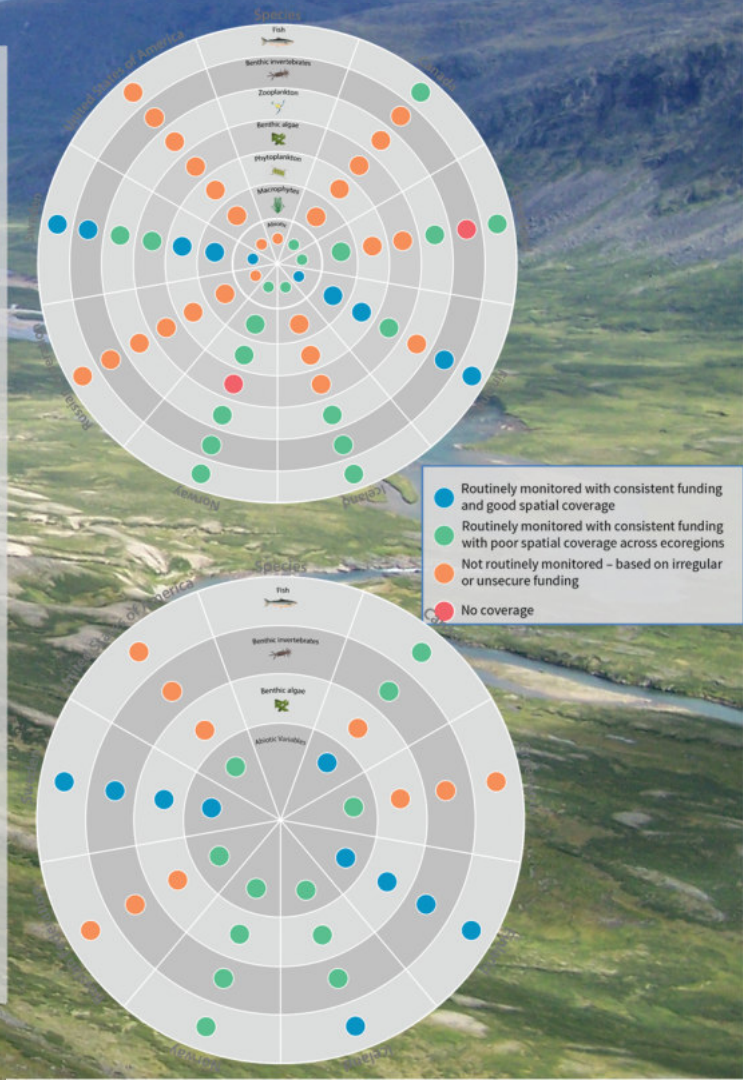
- Diversity estimated within ecoregions using rarefaction curves
- Diversity compared among ecoregions by estimating at a set number of stations along the curve



Based on: Terrestrial Ecoregions of the World, TEOW; Olson et al. 2001

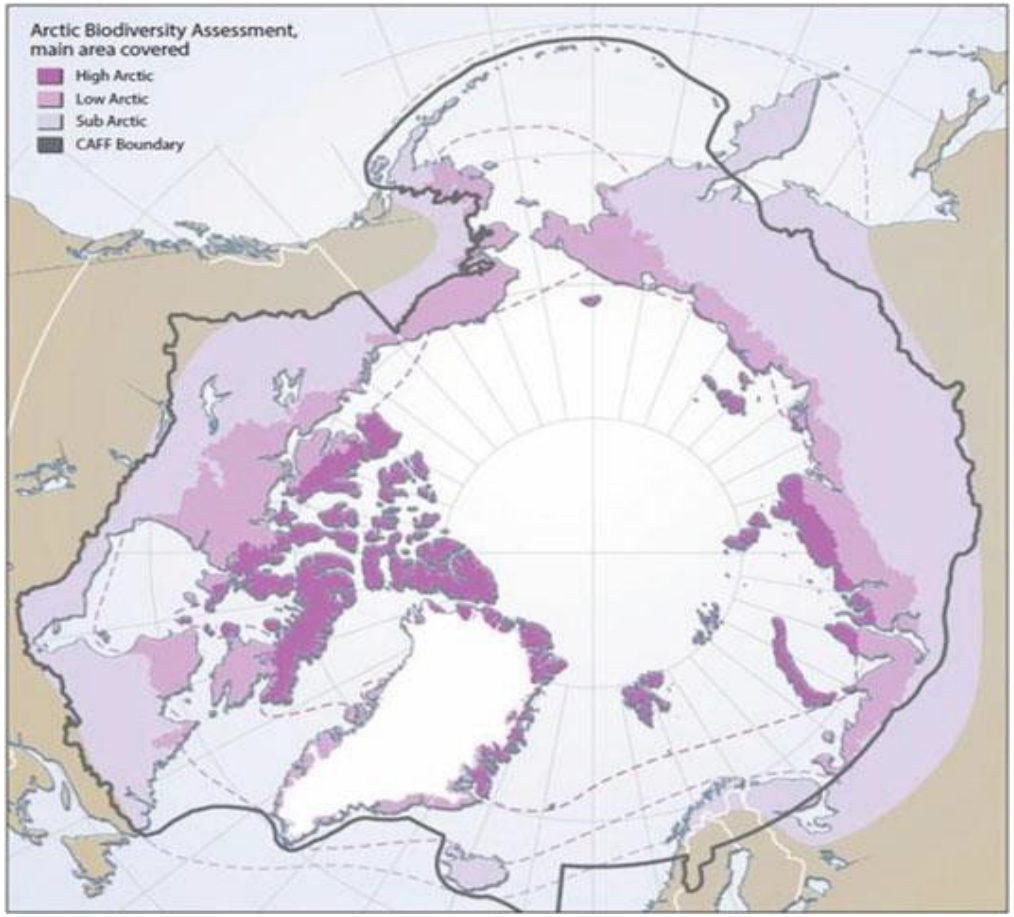
CBMP-Freshwater Outputs to Support FWBON

- Information about sampling methods across Arctic region
- Recommendations for standardized sampling methods
- Compiled database for freshwater biodiversity for Arctic region
- Example approach to assessing biodiversity on a large spatial scale using data from multiple sources
- Descriptions of diversity and species distributions for the Arctic
- Descriptions of monitoring gaps across Arctic



Outcome 1-FWBON ready to work on macroinvertebrate protocols: Proposed EBV Operationalization pilot in conjunction with the Arctic Freshwater Biodiversity Monitoring Program

- Extensive macroinvertebrate sampling was undertaken towards the First State of Arctic Freshwater Biodiversity Report
- These data were used estimate, Alpha, Beta and Gamma diversity at the ecoregion scale across 12 countries.
- FWBON will link this work to the EBV Operationalization Trials for GEOBON's BON development WG



Culp, J., Goedkoop, W., Lento, J., Christoffersen, K., et al., 2012. *Arctic freshwater biodiversity monitoring plan*. Conservation of Arctic Flora and Fauna (CAFF).

Thank you!

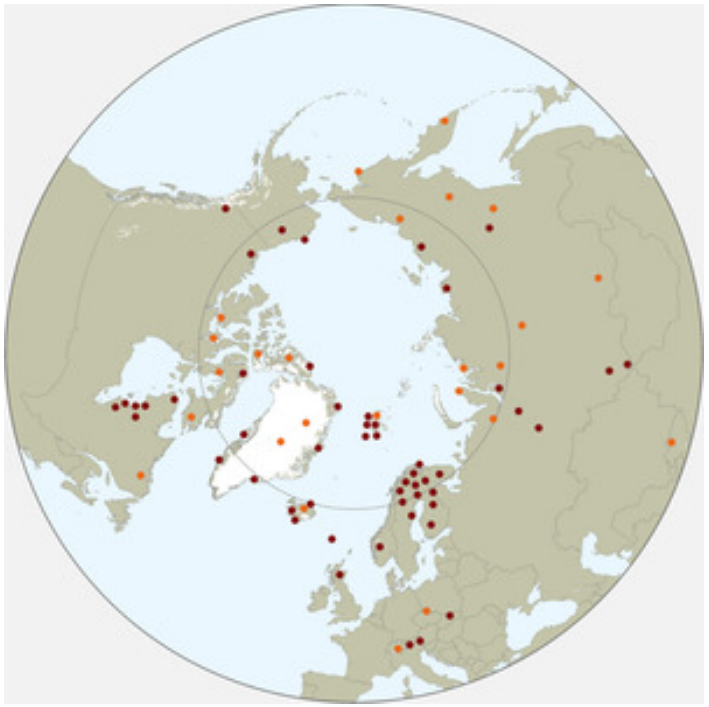
caff.is/freshwater
members.geobon.org/pages/freshwater.php

FSG Members:
Joseph Culp
Willem Goedkoop
Kirsten Christoffersen
Elena Fefilova
Petri Liljaniemi
Jón Ólafsson
Steinar Sandøy
Chris Zimmerman
Jen Lento

FWBON Co-leads:
Eren Turak
Aaike DeWever
Jeanne Nel

Coordinating Monitoring

- EU-INTERACT: International Network for Terrestrial Research and Monitoring in the Arctic
- Obtained funding for CBMP to implement Freshwater Plan at existing stations



CBMP International Approach to Circumpolar Monitoring

Circumpolar Biodiversity Monitoring Program

- International network of scientists, governments, Indigenous organizations and conservation groups working to harmonize and integrate efforts to monitor the Arctic's living resources
- Goal to facilitate more rapid detection, communication, and response to the significant biodiversity-related trends and pressures affecting the circumpolar world
- The CBMP organizes its efforts around the major ecosystems of the Arctic:
  - Marine
  - Freshwater
  - Terrestrial
  - Coastal

CAFF
Conservation of Arctic Flora and Fauna

CIRCUMPOLAR BIODIVERSITY MONITORING PROGRAM

Impact Hypotheses / Predictions Developed

- Response relationships of FECs to key drivers
- Statements for “environmental” & “human” stressors
- ~15 impact hypotheses identified lakes & rivers

Lake Example (environmental stressor)

Driver	Impact Prediction
Shift in Nutrient Regime Caused by permafrost degradation	Nutrient enrichment → Increased nutrient availability and decreased light → Changes in food availability and quality → Shift in relative importance of benthic/pelagic processes, microbial food web changes, shift in community composition and functional diversity, change in productivity

Drivers and Stressors Identified

Environmental

- Atmospheric deposition of short/long range contaminants
- Shift in hydrological regime
- Shift in thermal regime
- Shift in sediment regime (e.g., permafrost degradation)
- Shift in nutrient regime
- Atmospheric deposition of SOx and NOx (acidification)
- Shift in nutrient & contaminant levels due to biotic vectors (low-order streams)

Human Population Growth

- Over-harvesting (e.g., fisheries)
- Resource exploration/ exploitation (e.g., mining, oil/gas)
- Linear structures (e.g., roads)
- Flow alteration (hydropower)
- Increased agricultural activity (e.g., grazing domestic animals)
- Species introduction