Arctic Freshwater Plankton Response to Environmental Stressors on a Circumpolar Scale

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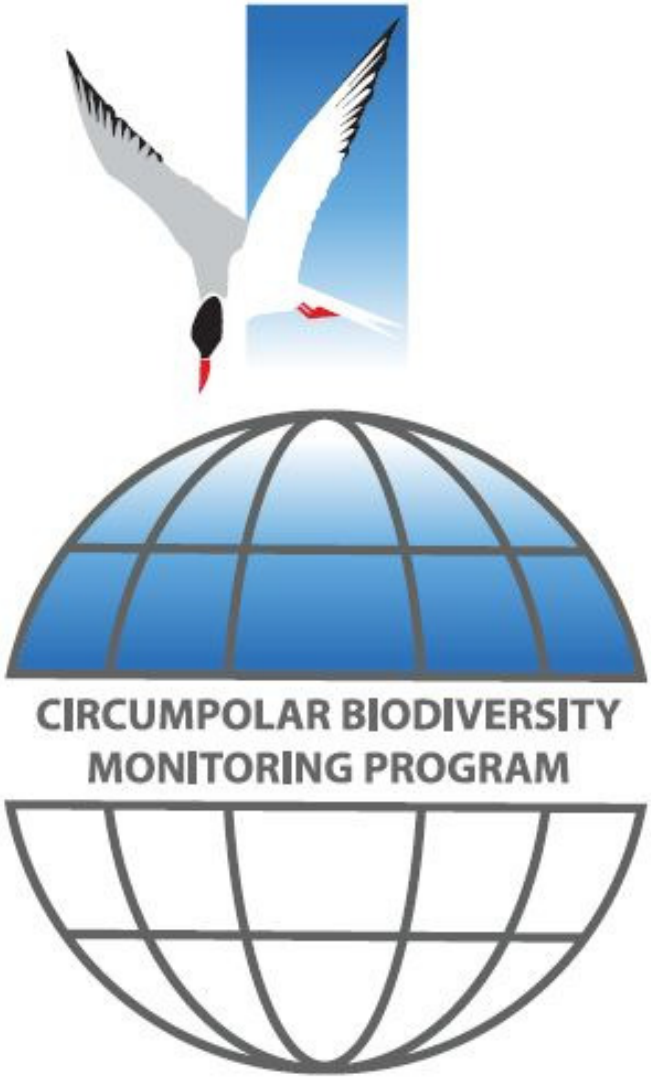
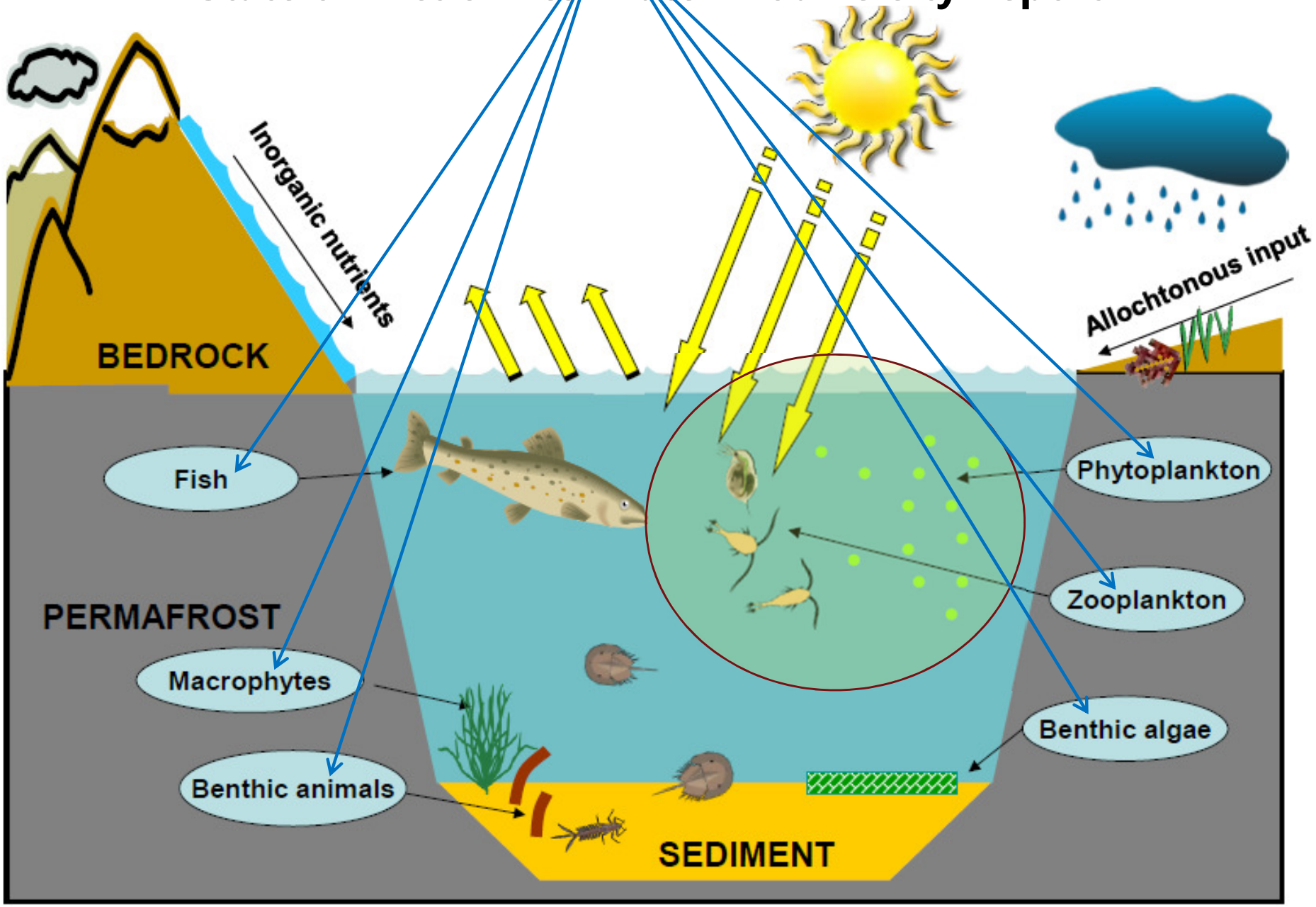


CAFF report:

State of Arctic Freshwater Biodiversity Report
Submitted August 2018

Arctic lake ecosystem

- and the biotic focal ecosystem components (FEC´s) included in the State of Arctic Freshwater Biodiversity Report



What can tiny aquatic organisms tell us about biodiversity, general conditions in Arctic lakes and needs for monitoring?

Vocabulary:
Plankton (Greek) means drifting around;
phyto = plant; ***zoo*** = animal

Phytoplankton: **Phototrophs**
2-20 µm but also larger as colonies and filaments

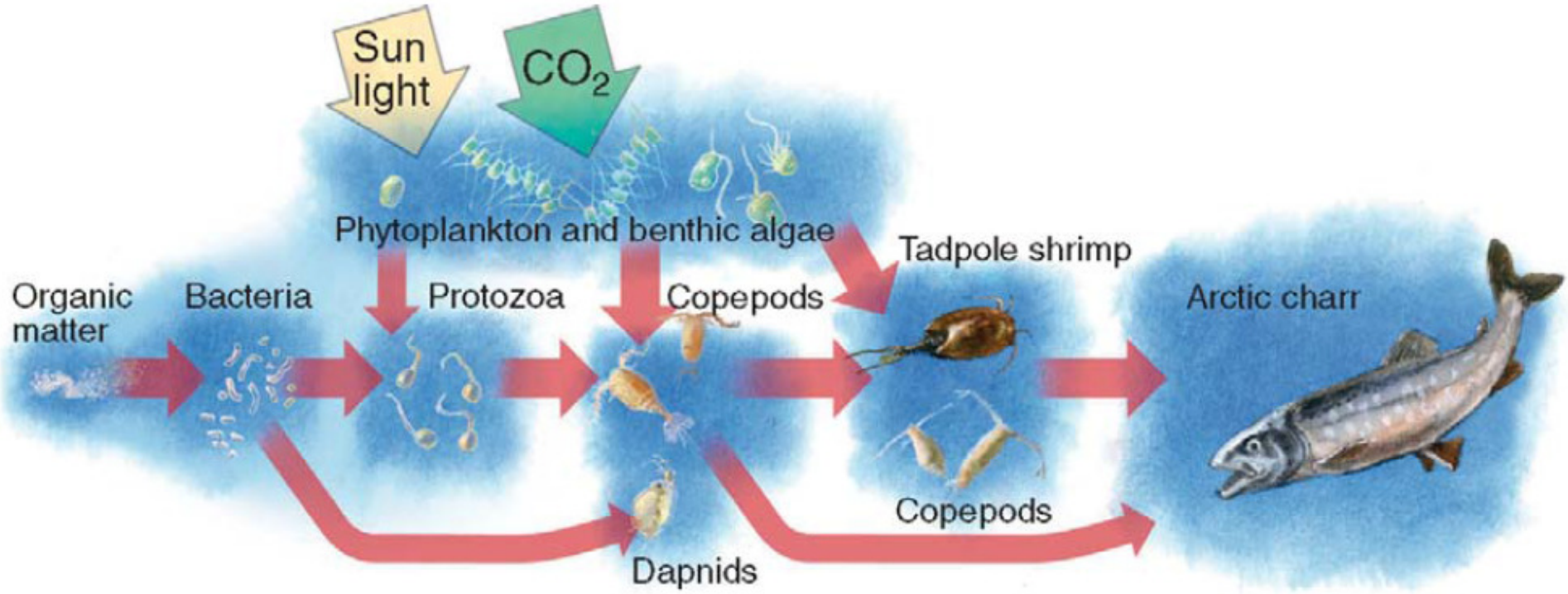
Major groups: Diatoms, green algae, dinoflagellates, crysophytes, cyanobacteria

Zooplankton: **Consumers**
50-2000 µm but some species larger

Major groups: Rotifers, copepods cladocerans

Plankton (phyto and zoo) form the most important components of the pelagic food web

i.e., the primary producers (phytoplankton) and the primary consumers (zooplankton) – which support all other trophic levels (from bacteria to fish)



Source: Christoffersen 2006)

Increased understanding of spatial and temporal patterns of plankton biodiversity over a circumpolar scale

The goals:

- **Assess the biodiversity from sub to high Arctic**
- **Baseline for future monitoring programs**
- **Detect changes over time**
- **Identify gaps in spatial coverage**

Culp et al. 2012

……..and the way we sourced data

- National monitoring programs (few)
- Reports and surveys (quite a lot)
- Research publications (many)
- Archives (governmental, academia, industrial)

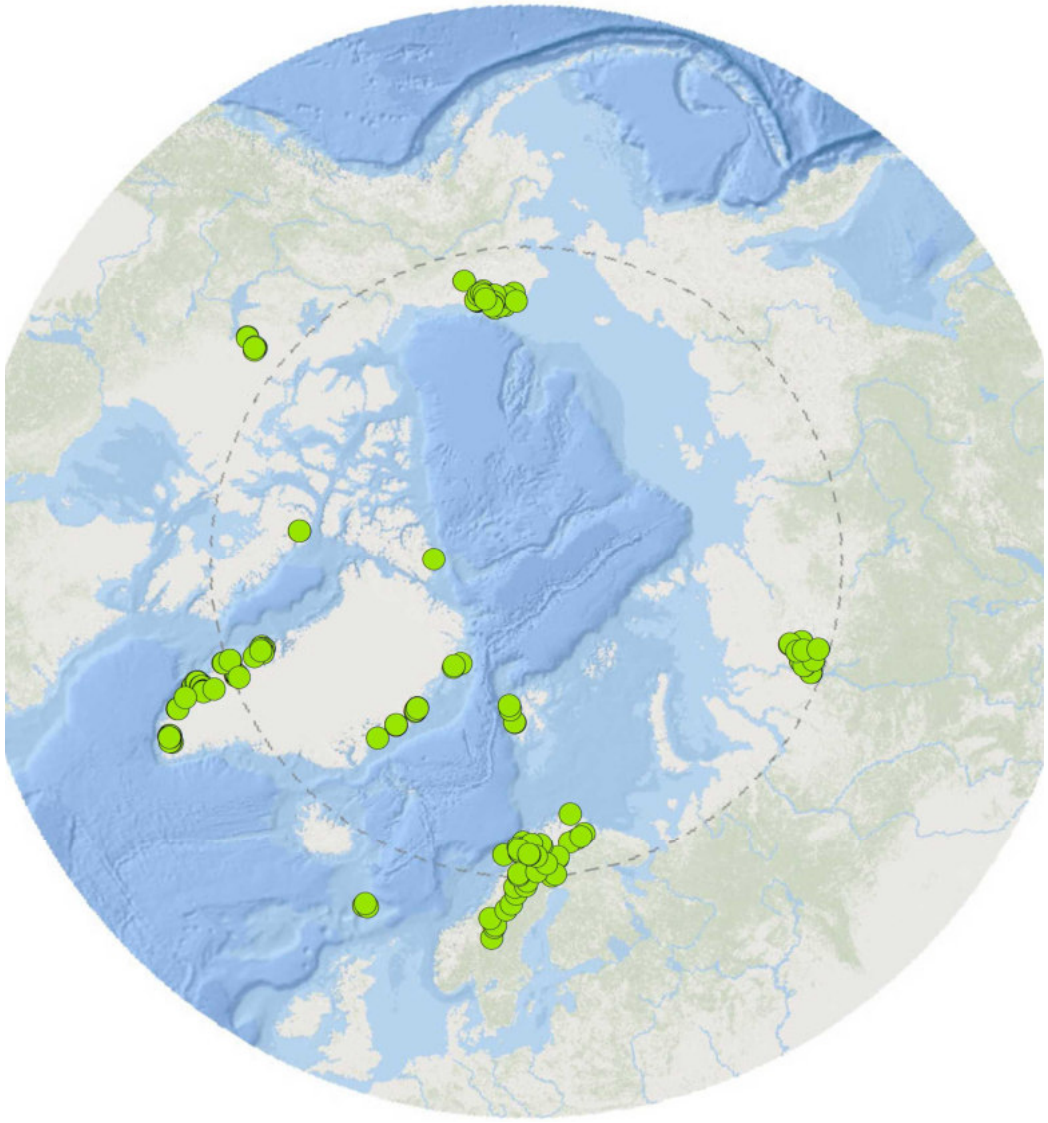
Data acquisition and analyses

Meta database
- **Numerical database**
  - **Harmonization of data**
    - **Statistical analyses**

Phytoplankton: biovolume and presence-absence
Sites= 272 , taxa= 1534

Zooplankton: relative abundance and presence-absence
Sites = 331 crustaceans; taxa = 133
= 154 rotifers; taxa = 109

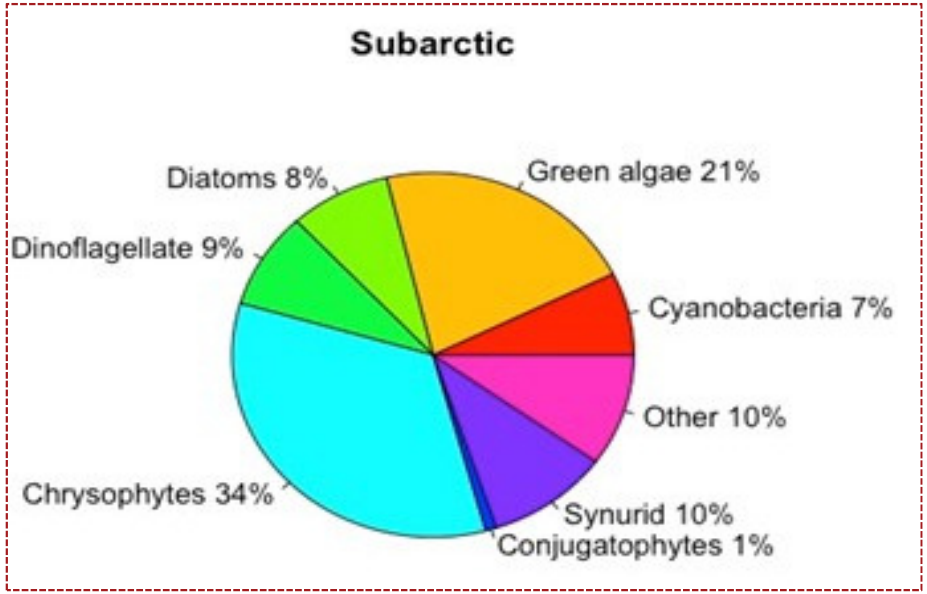
Results of circumpolar assessment of lake phytoplankton diversity

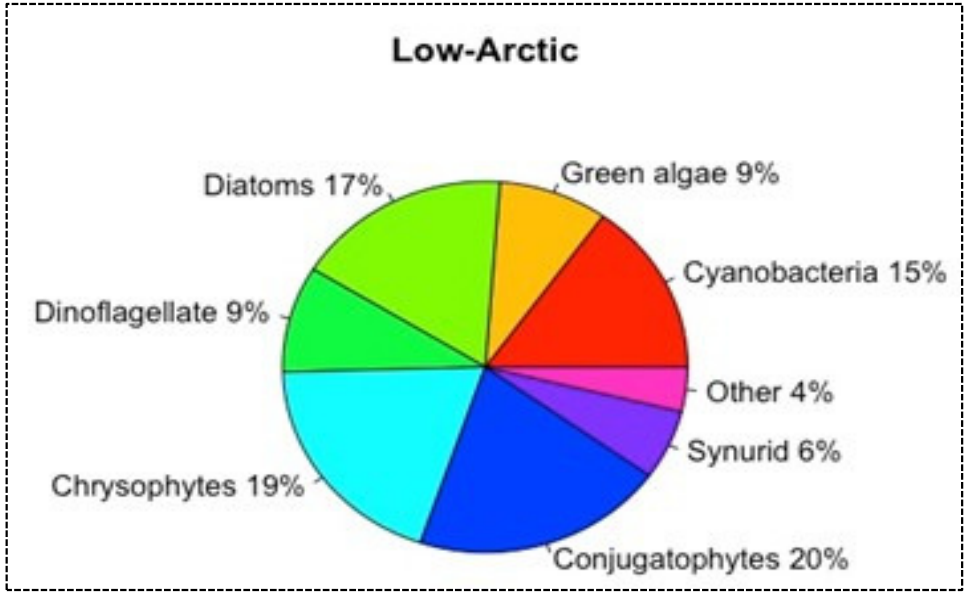


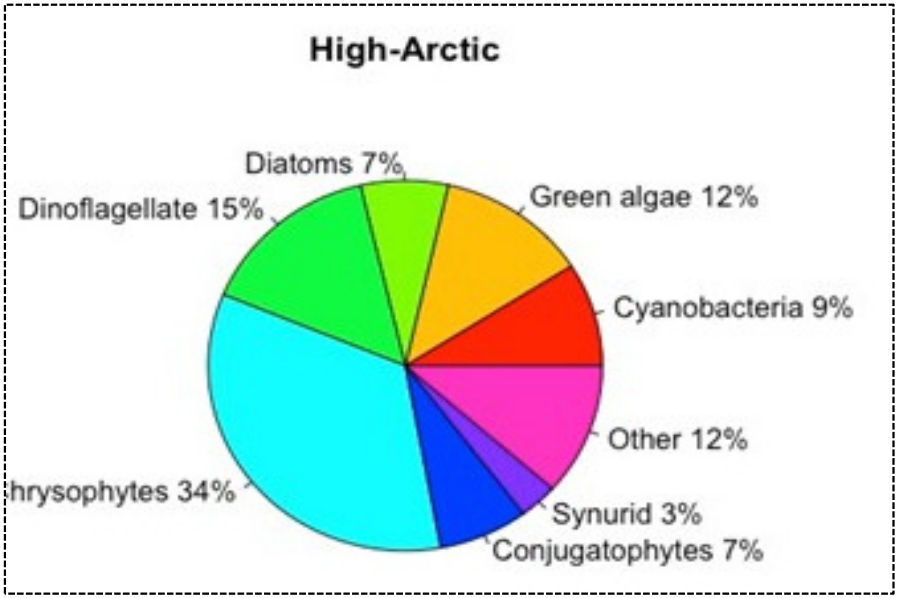
Location of all phytoplankton stations (note a dot often represent several sites in the area)

- There were 8-10 phytoplankton classes present within each Arctic region.
- Higher number of taxa per lake in sub-Arctic regions, averaging 30-40 taxa per lake, compared to <20 taxa in the higher Arctic regions
- Low and high Arctic lakes had more similar communities than the subarctic sites (but which had more variation in beta diversity)

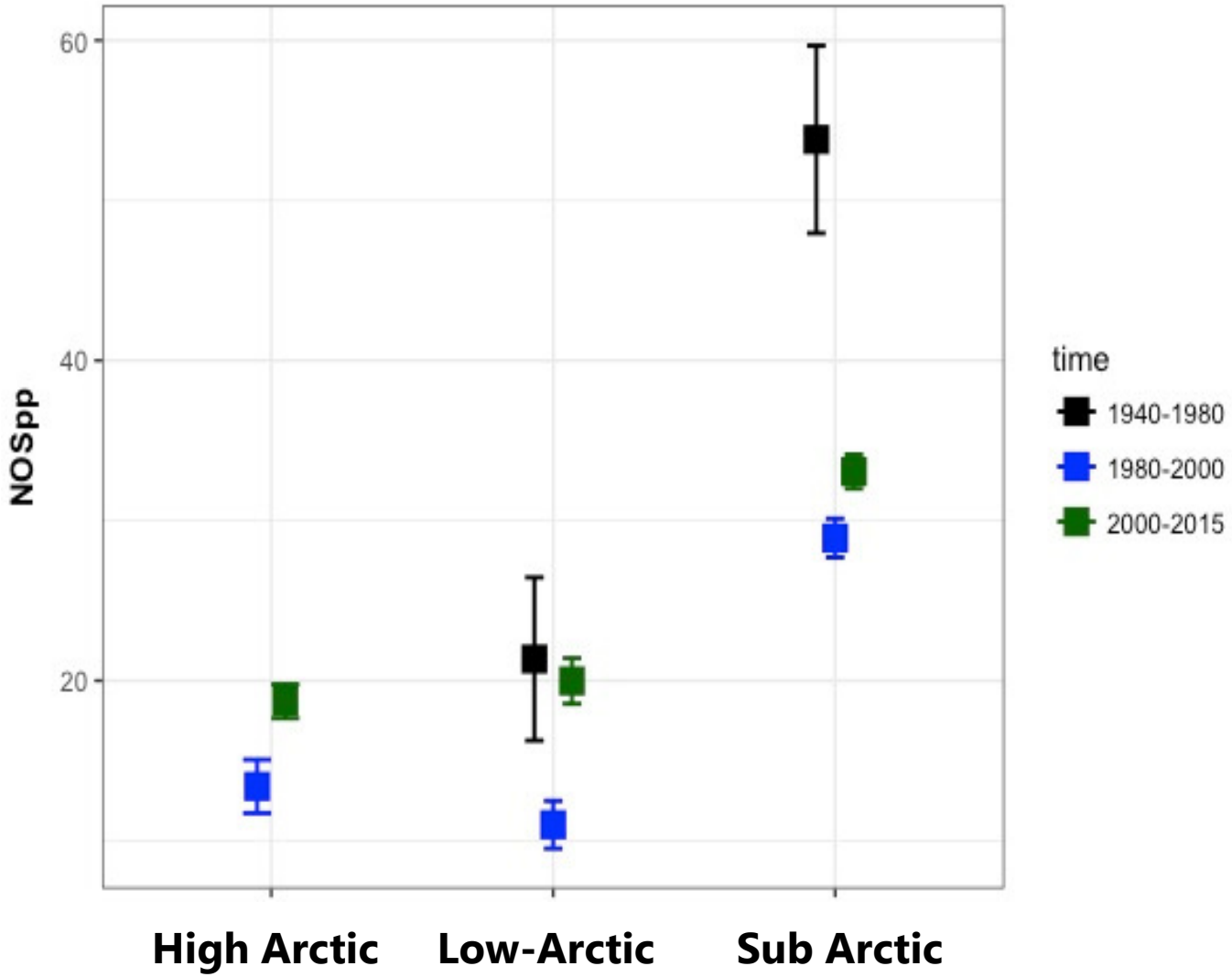
Phytoplankton composition by dominant classes across the Arctic regions (relative presence based on presence –absence data



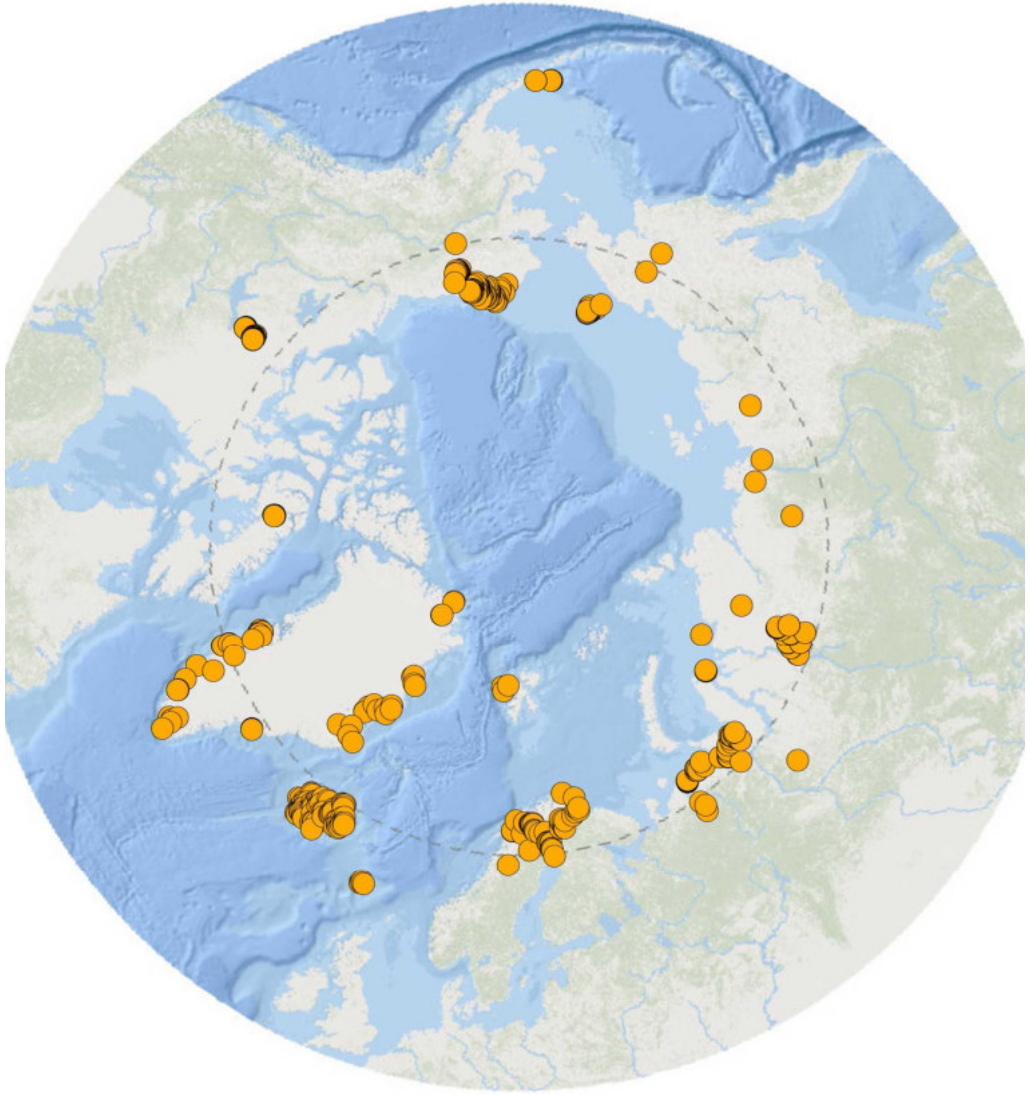




Phytoplankton species richness averaged by time periods (±SE) in each Arctic region



Results of circumpolar assessment of lake zooplankton (crustacean and rotifers) diversity

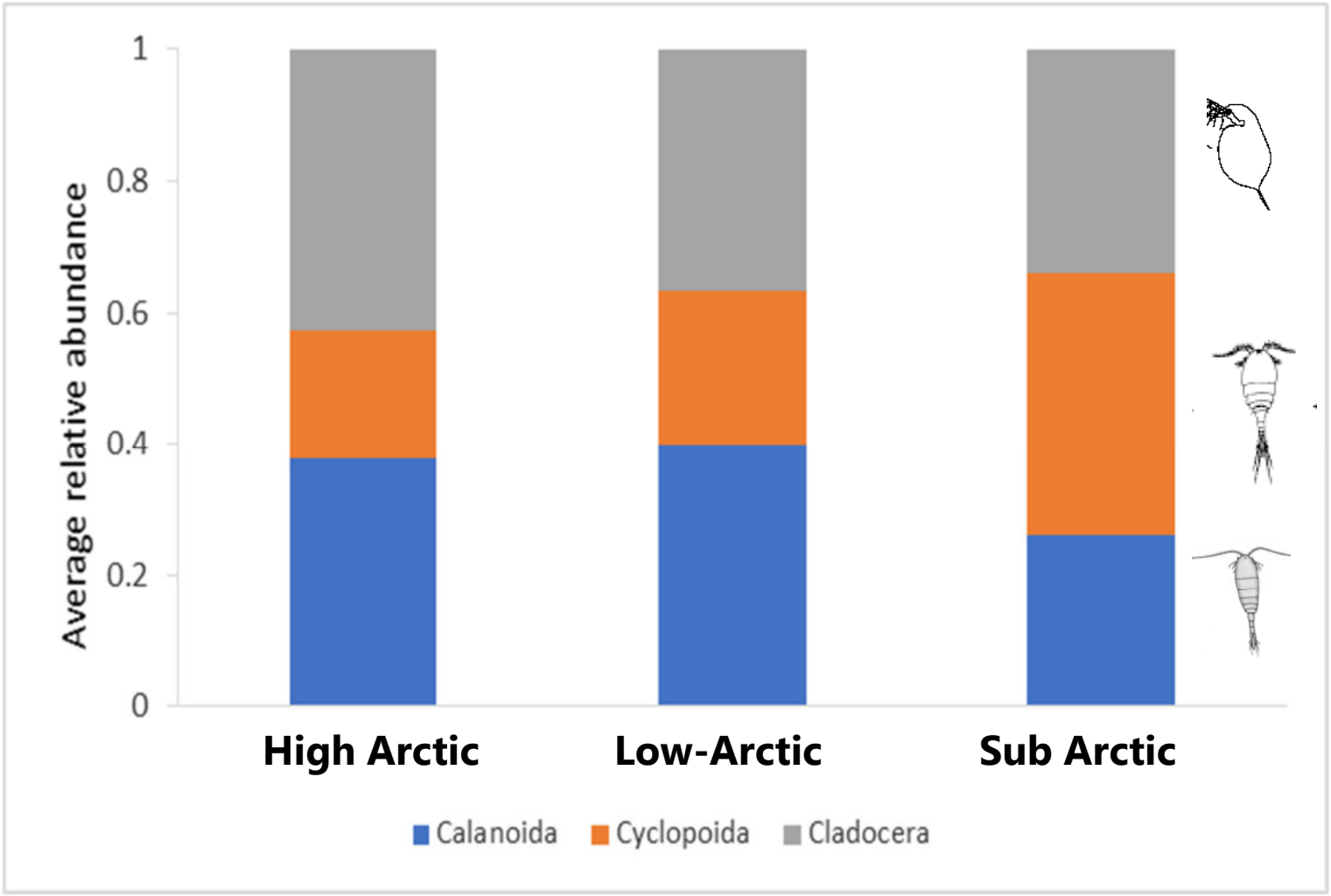


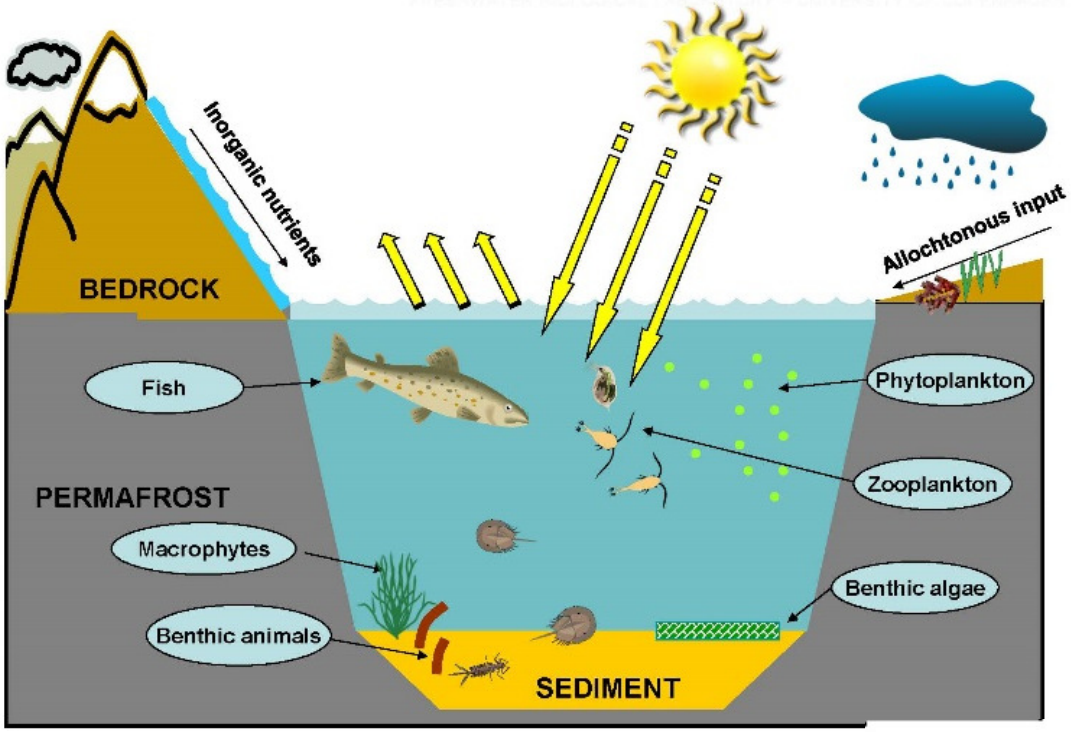
The location with zooplankton station data (note a dot often represent several sites in the area)

- Including rotifers added on average 3- 23 taxa to zooplankton diversity
- High diversity is in coastal regions, particularly in Alaska (Arctic coastal tundra), Kola Peninsula, and Fennoscandia)
- The lowest diversity is in the in the High Arctic (North Greenland, Svalbard and Northern Canada)

Average relative abundance of the main zooplankton groups

Sites: sub-arctic (n=150), low-Arctic (n=154), and high-Arctic (n=55) regions. Samples with a single taxon have been excluded.





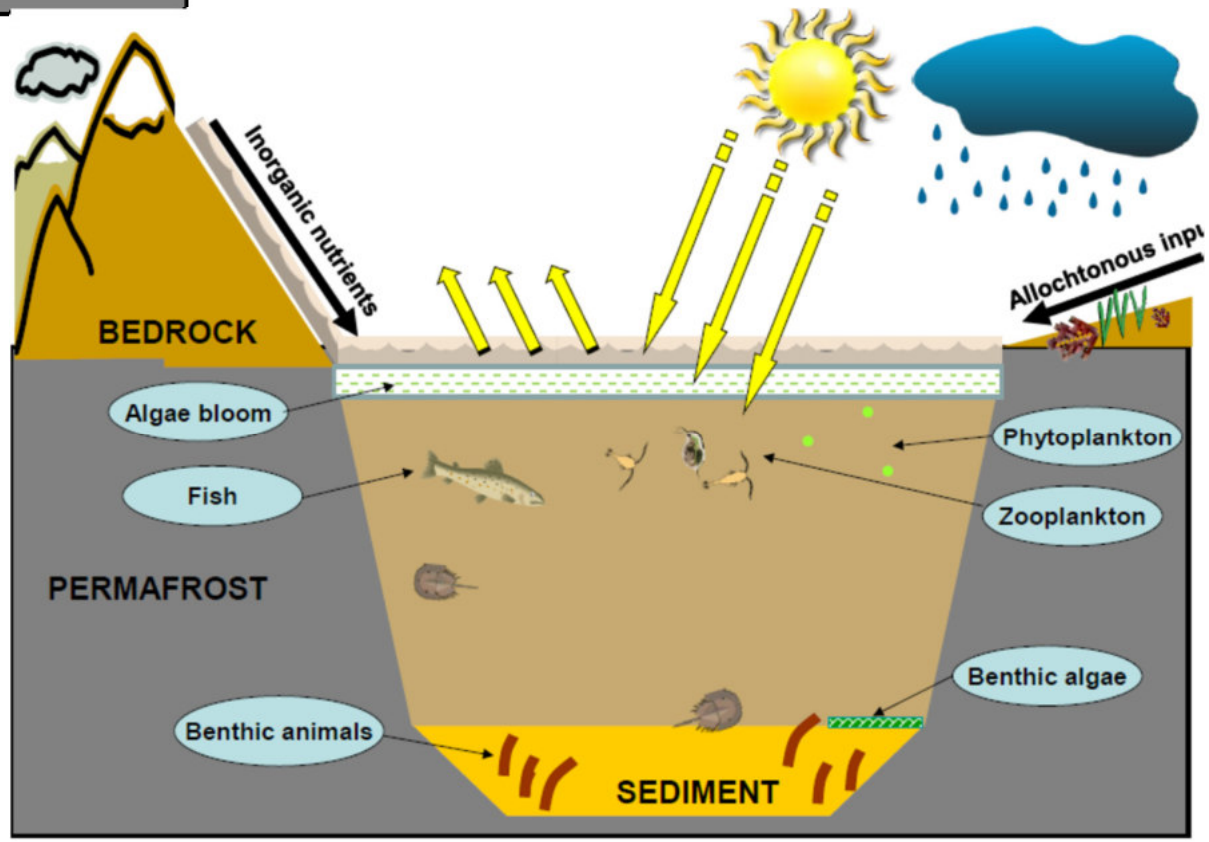
Present conditions

- Low algae biomass
- Crysophytes dominance
- High transparency
- Benthic production large
- Seldom lack of oxygen

The future…?

- Algae growth (blooms)
- Cyanobacterial dominance
- Turbid waters
- Reduced benthic production
- Oxygen limitation (winter)

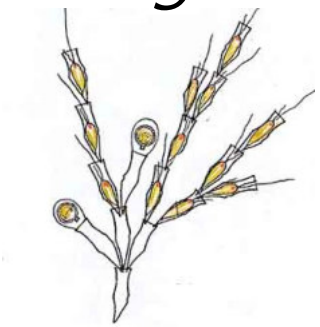
Invasive species?



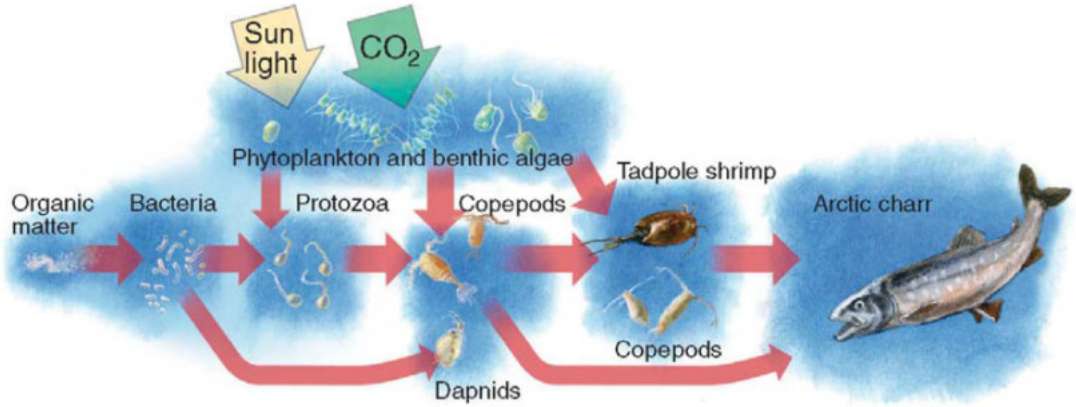
Gaps in knowledge and monitoring

- Monitoring of plankton is scarce and non-existing in several countries/regions
- Sampling design and methods vary greatly among countries and with different focus on taxonomical, spatial or temporal resolution
- Few sites with long-time series (> 10 years)
- Very few sites with coordinated sampling of plankton AND environmental parameters
- More monitoring at High Arctic sites is needed
- Harmonization of sampling strategy and methods

Thus, future efforts should focus on species-level data, using standardized sampling methods and including a standardized list of (min) environmental parameters



The highlights



- Plankton are essential for freshwater food webs
- Plankton diversity decreases with latitude
- Highest diversity in coastal areas (Fennoscandia, Kola peninsula, and Arctic foothills Alaska)

- Phytoplankton: 10-40 taxa per site
- Zooplankton: 5-25 taxa per site
- Temporal changes have been detected
- Climate change may enhance further shifts in diversity and provide opportunities for dispersal of species

(State of Arctic Freshwater Biodiversity Report, 2018)

FRESHWATER MATTERS

JUST ASK THE STEERING GROUP