Southern Hudson Bay and James Bay 2021-2023 Oceanography Expedition

BACKGROUND AND RATIONALE

February 26, 2026
Ottawa, ON

University of Manitoba

History

In 2020, University of Manitoba researchers and other partners, including Mushkegowuk Council, initiated the **planning** of an oceanographic study of southern Hudson Bay and James Bay.

Newly available vessel (UM-Arctic Research Foundation) equipped for scientific studies that could work in shallow waters – operated via UM-Arctic Research Foundation agreement.

Purpose

A ship-based mission to document baseline conditions in James Bay and Southern Hudson Bay

- Scientists know little about James Bay, the southernmost extension of the Arctic Ocean
- Most research about the bay was done prior to the development of hydroelectric projects in the 1970s
- What researchers do know is that these marine and estuary ecosystems are unique

Timeline

2018-2019	Regional leaders noted critical gaps in knowledge of James Bay
Aug. 2020	UM researchers received ‘seed funding’ from Oceans North and letters of support from Federal Government and regional organizations
Dec. 2020	UM granted additional funding by National science granting council (NSERC)
Feb. 2021	UM started planning the field campaigns in consultation with regional organizations and community leaders

Cree Marine Research Needs Working Group

What we learned about regional research needs:

Desire to update knowledge (using modern tools) on circulation, productivity, river influence in the bay and impact of damming, environmental change, invasive species

Need for baseline data for future planning and monitoring associated with Indigenous-led marine conservation initiatives

Need to build understanding of impacts of possible future climate-related changes and development in the watershed

Consultations with Leadership

Presentations to Chiefs and Councils

April 8, 2021: Moose Cree First Nation

April 16, 2021: Cree Nation of Chisasibi

May 31, 2021: Cree Nation of Eastmain

June 2, 2021: Cree Nation of Wemindji

June 14, 2021: Cree Nation of Waskaganish

July 14, 2021: Cree Nation of Whapmagoostui

Additional Emails and Posters

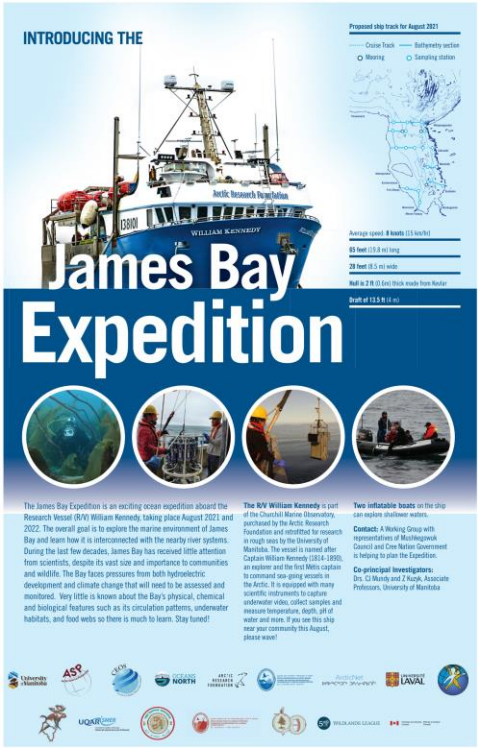
Fort Albany First Nation

Attawapiskat First Nation

Kashechewan First Nation

Weenusk First Nation

Sanikiluaq NU



Initiation of Qikiqtait Project (2022)

Partnership with
Sanikiluaq Hunters and Trappers Association and Arctic Eider Society

Additional funding from
Fisheries & Oceans Canada

Research Team

Varied year to year; 12-14 research team + 6-7 ship's crew

University of Manitoba

University of Sherbrooke

University of Alberta

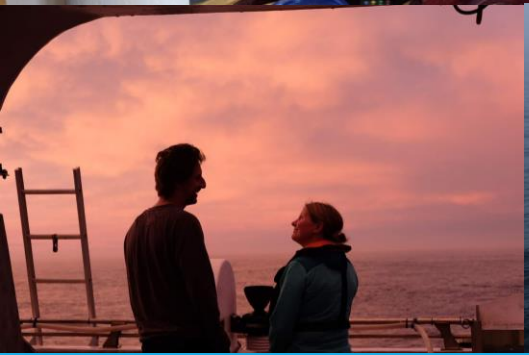
Université du Québec à Rimouski

Université Laval

Fisheries and Oceans Canada

Photo Credit: Maude Durand

Photo Credit: Carrie Gray



University of Manitoba

Life Onboard

University of Manitoba

Life Onboard

COVID Impacts 2021

Expedition nearly cancelled & strict protocols enforced

- Negative COVID tests (3)
- No community visits
- No community members allowed to come onboard

Lawrence Martin, CJ Mundy, Zou Zou Kuzyk in Moose Factory

MOU signing ceremony for NMCA Feasibility Study (August 2021)

Community Participation Onboard 2022

In 2022, Elder, educator, and Knowledge Keeper Stella Koostachin along with her son David came onboard for the expedition.

Youth Engagement 2022

With support from the Wildlife Conservation Society (WCS) Canada, Moose Cree First Nation youth came onboard for an afternoon and overnight stay to get hands-on experience when the ship anchored off Moose Factory.

Sanikiluaq Community Visit 2022

Weenusk First Nation Meet-up 2023

In 2023, researchers met with Weenusk First Nation community members and land-based researchers when the ship anchored offshore from the Winisk River.

Photo Credit: Jane McDonald


Photo Credit: Zou Zou Kuzyk


Photo Credit: Jane McDonald

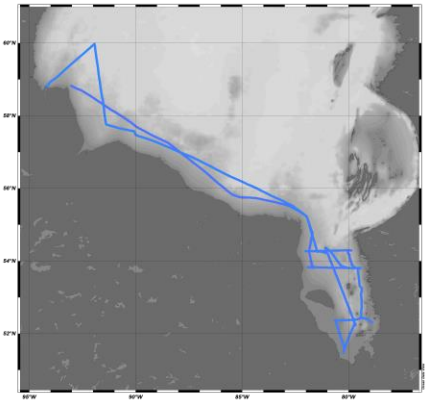
Scientific Objectives of the Research

Collect new data on the southern Hudson Bay and James Bay marine ecosystems and learn how it is interconnected with the nearby river systems

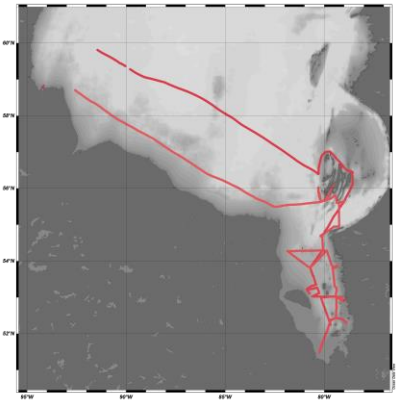
- Physical Oceanography
- Water Properties
- Primary Production
- Fish
- Biodiversity
- Microbiology
- Moorings
- Carbon
- Invertebrates
- Marine Mammals
- Sediments
- Food Web

Where did the ship go?

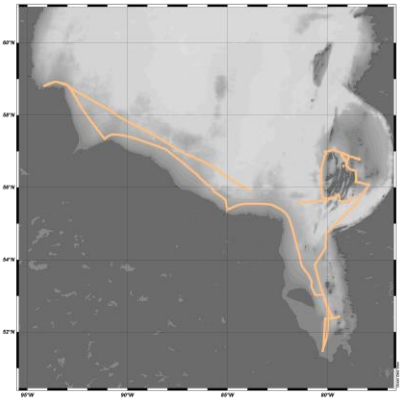
2021



2022



2023



What was measured and sampled?

Rosette water sampler

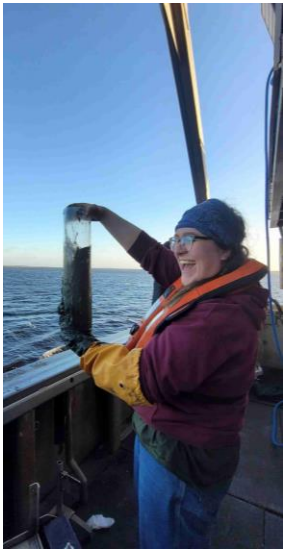
Student Pascale Bouchard in the ship's lab

Water samples were collected from the top to the bottom of the water column using a device called a 'rosette', which has bottles mounted on a frame. They are operated electronically so they close at a specified depth.

The water collected from the rosette was filtered in the lab on board the ship.

Some properties like salinity, temperature, turbidity, and dissolved oxygen content were measured right away using sensors.

What was measured and sampled?



Samples of the sediment from the bottom (seabed) were collected using various coring devices.

Some of the sediment was sorted to identify the kinds of animals that were living there (clams, worms, etc.)

Some of the sediment was placed in containers to be analyzed in labs for properties like carbon content.

Sediment core samples are also being examined to determine whether they contain a record of environmental change.

What was measured and sampled?

The research team used nets to catch small plants and animals at the base of the food web (shrimp, krill, small fish).

These were sorted and packaged to be identified and measured.

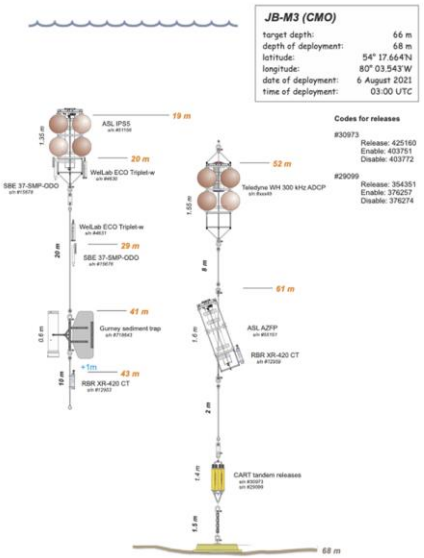
These samples will help update knowledge about carbon cycling, benthic biodiversity, and productivity of the marine food web.

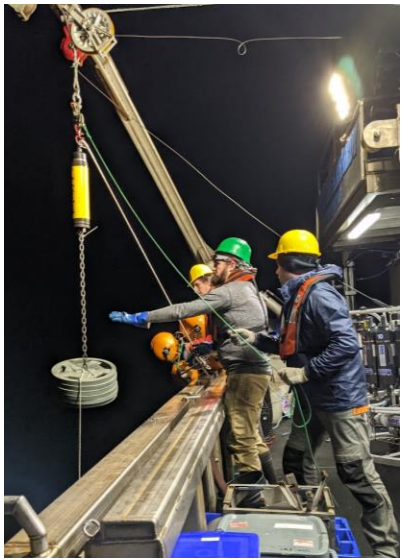
Instruments and Methods

Ocean moorings were also put out to measure water properties like currents throughout a full-year period.

They consisted of floats, long lines containing various sensors, and then heavy weights on the bottom.

Smaller versions were also deployed near river mouths.





Results to be Presented Today

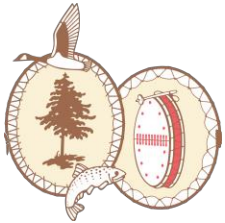
- Circulation and productivity
- Carbon system
- Microbial community
- Food web
- Belugas

Thank you to all Partners and Funders

EEYOU MARINE REGION PLANNING COMMISSION
COMMISSION D'AMÉNAGEMENT DE LA RÉGION MARINE D'EEYOU

MUSHKEGOWUK COUNCIL

EEYOU MARINE REGION WILDLIFE BOARD
CONSEIL DE GESTION DES RESSOURCES FAUNIQUES DE LA RÉGION MARINE D'EEYOU



University of Manitoba

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Fisheries and Oceans Canada
Pêches et Océans Canada

UQAR SMER
Université du Québec à Rimouski
Institut des sciences de la mer de Rimouski

NSERC CRSNG

Parks Canada Parcs Canada

ARCTIC RESEARCH FOUNDATION

WILDLANDS LEAGUE
A chapter of the Canadian Parks and Wilderness Society

Thanks also to the larger team that made the project and this event possible

University of Manitoba – Riddell Faculty

Arctic Research Foundation

Fisheries and Oceans Canada

Parks Canada

Natural Sciences and Engineering Research Council (NSERC)

Canadian Foundation for Innovation (CFI)

ArcticNet

Oceans North

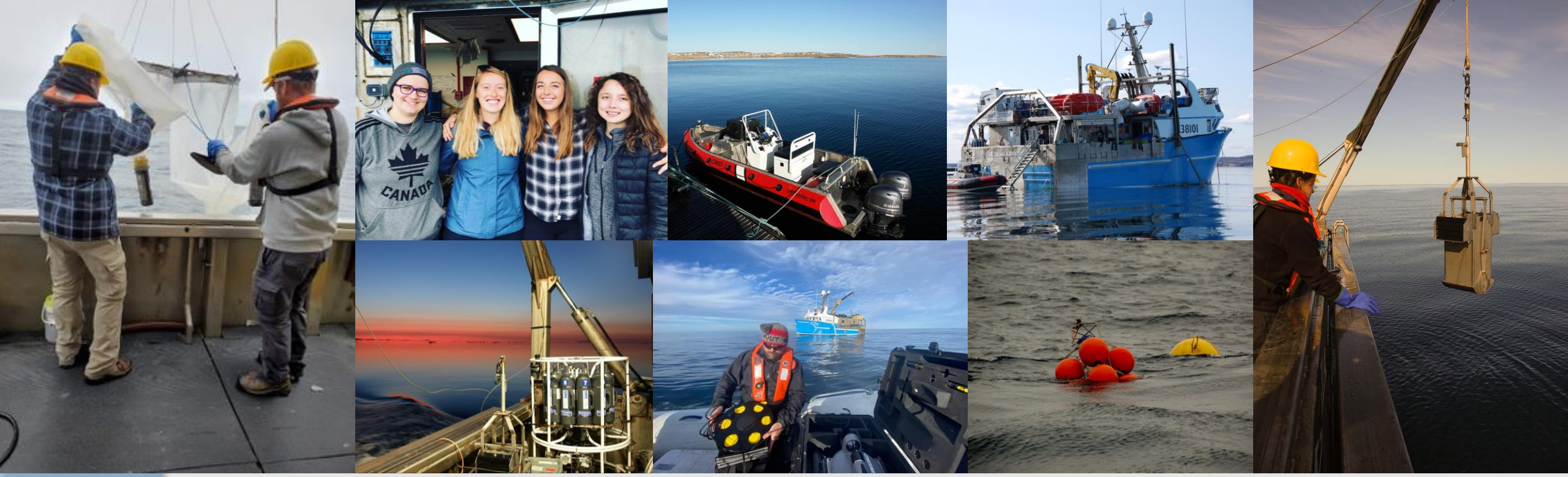
Wildlands League

Wildlife Conservation Society (WCS) Canada

Mushkegowuk Council

Eeyou Marine Region

And all our community partners across southern Hudson Bay and James Bay!!



CJ Mundy

Professor

Biological Oceanography

Qikiqtait and James Bay Expeditions

James Bay and Southern Hudson Bay Expeditions *RV William Kennedy* 2021-2023

Biological Oceanography (Students: P. Bouchard, M. Guillaume, E. Jones, F. Ahmed)

UM Centre for Earth Observation Science

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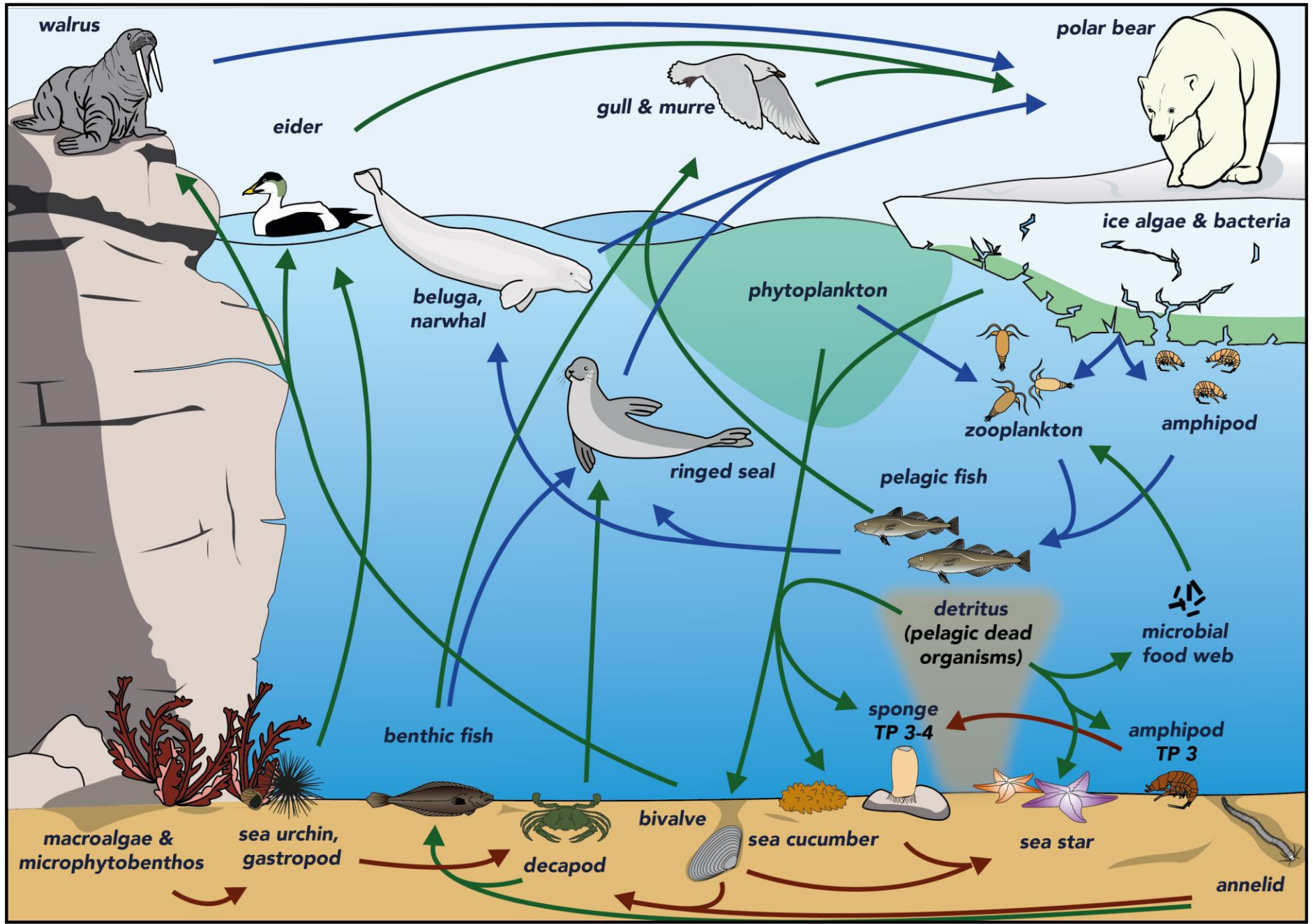
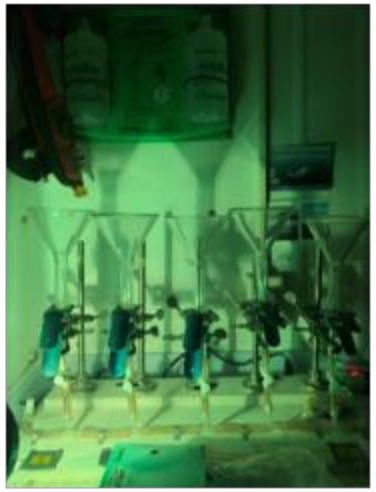
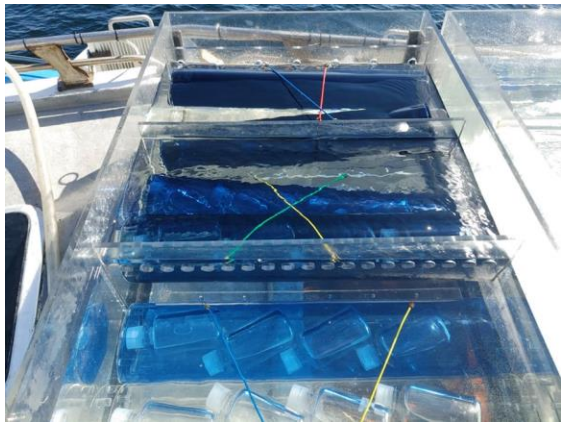
Arctic coastal zone food web

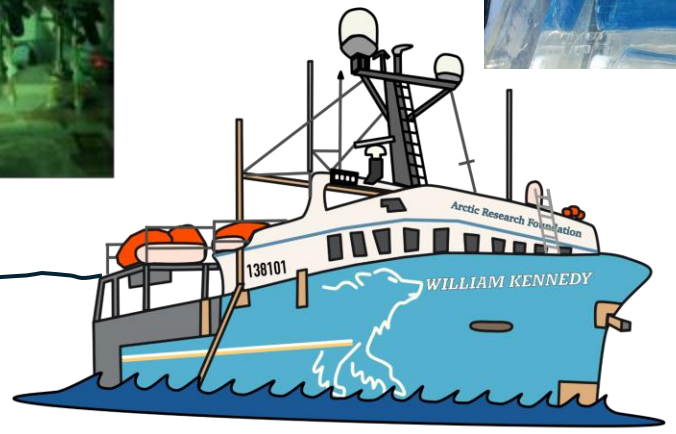


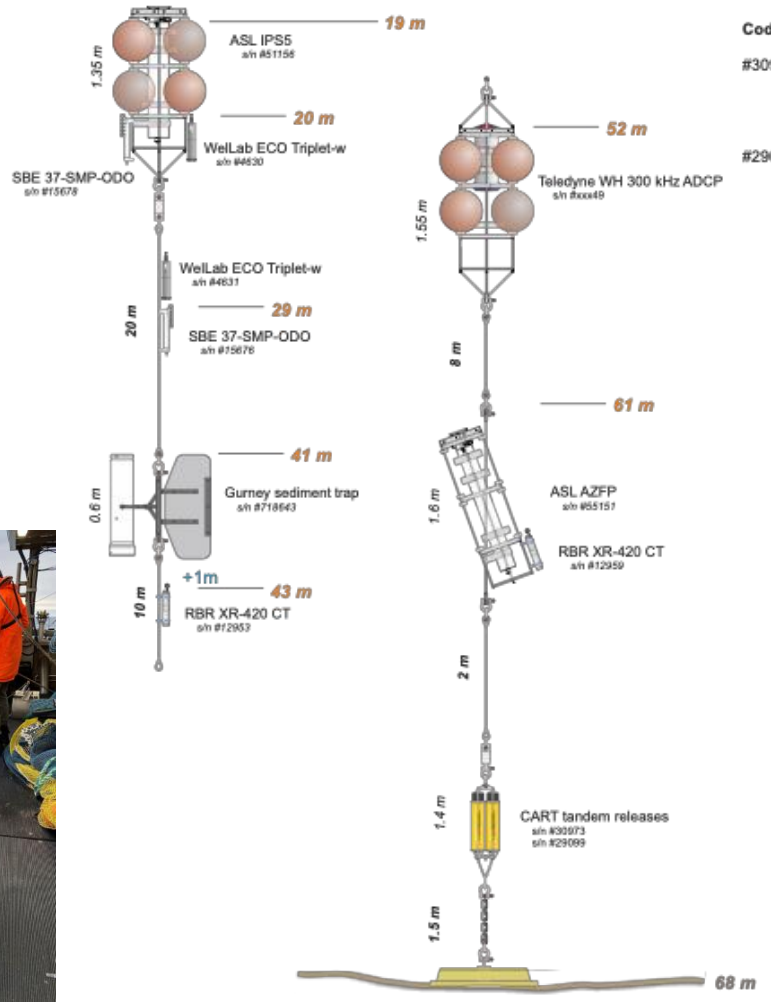
Amiraux et al., 2023, *PNAS*

How we measured it









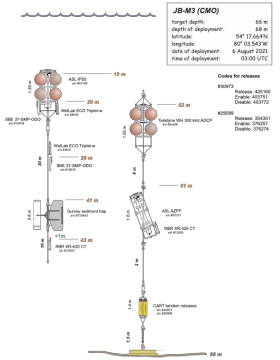
Currents

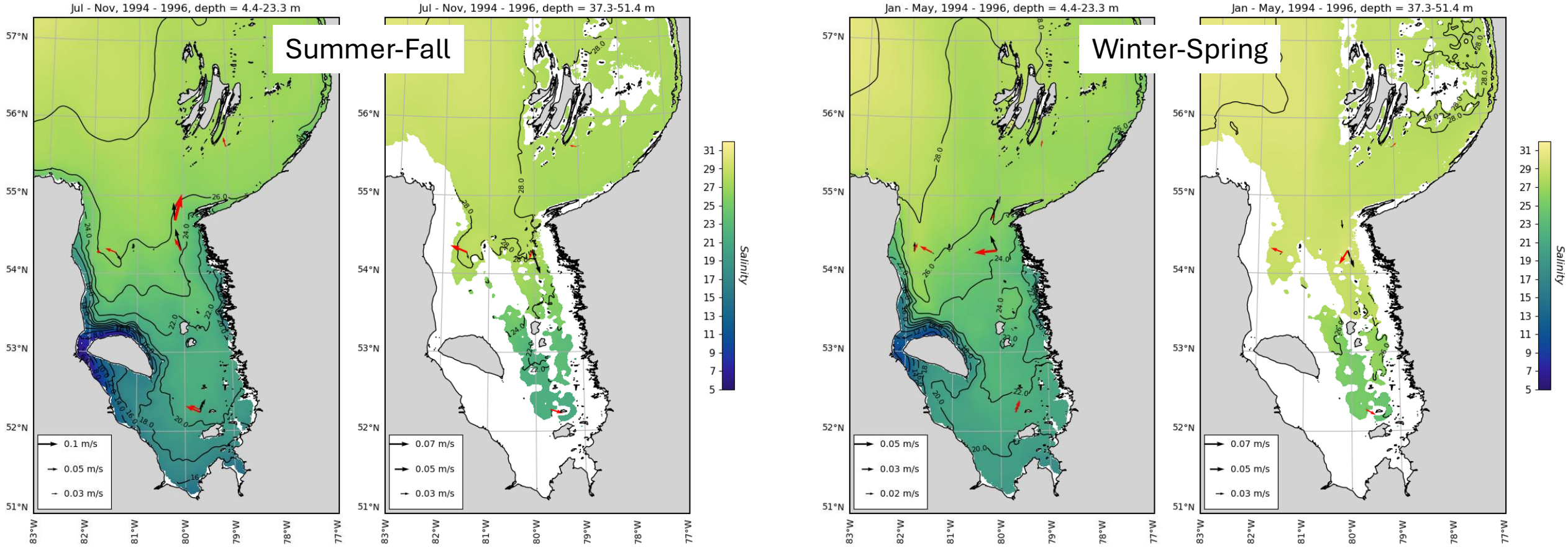
Expected:

- Strong northward surface flow along north-east James Bay in summer-fall and lower southward flow at depth (estuarine circulation)

Unexpected:

- Strong westward flow in winter-spring (likely forced by La Grande diversion)
- Currents were much more variable than expected



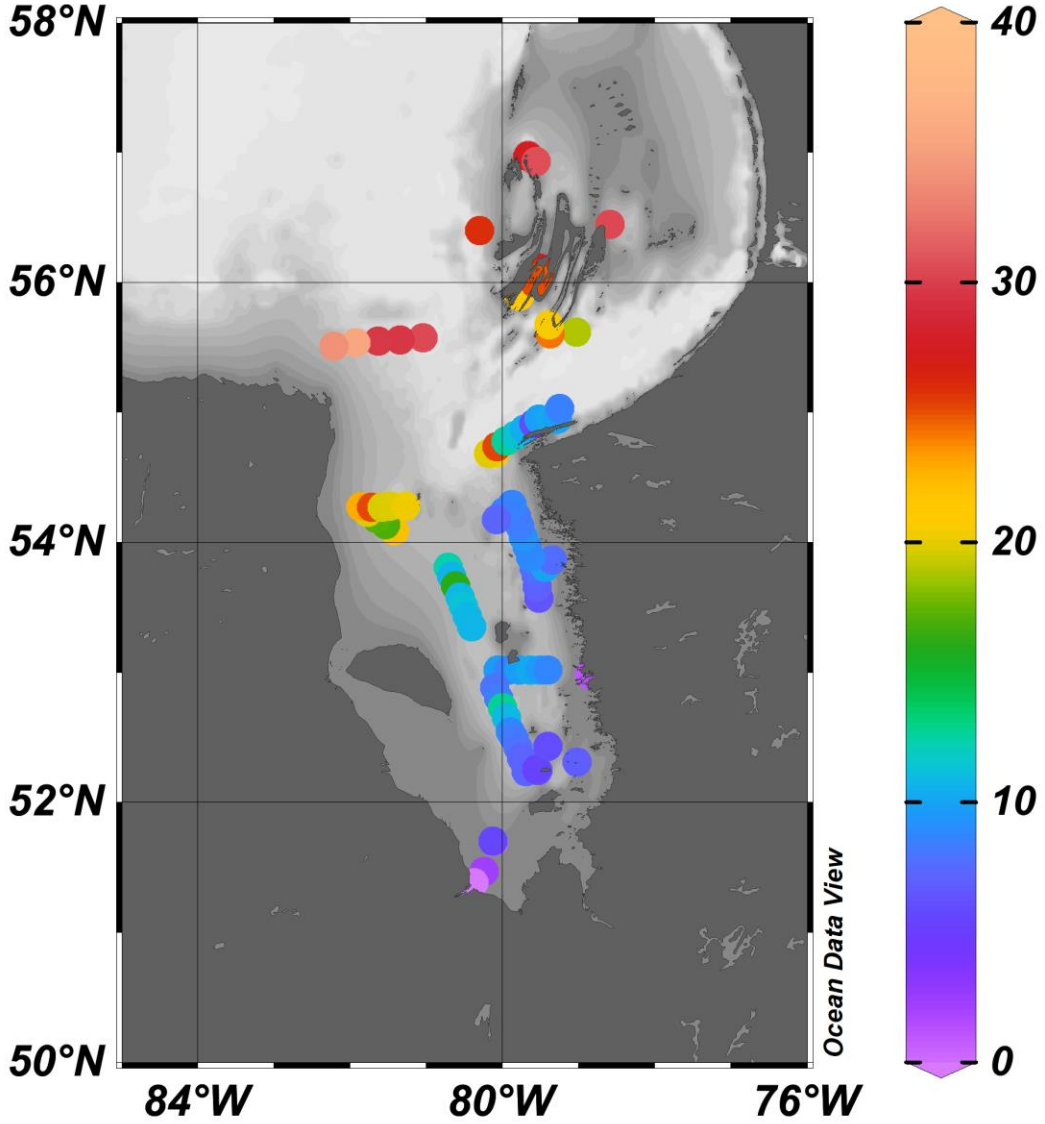


2022

Expected

- Light limitation in James Bay – Euphotic depth is <15 m in south and eastern James Bay increasing to >25 m in northwestern James Bay and around Qikiqtait (Belcher Islands)

Euphotic depth at 1% PAR



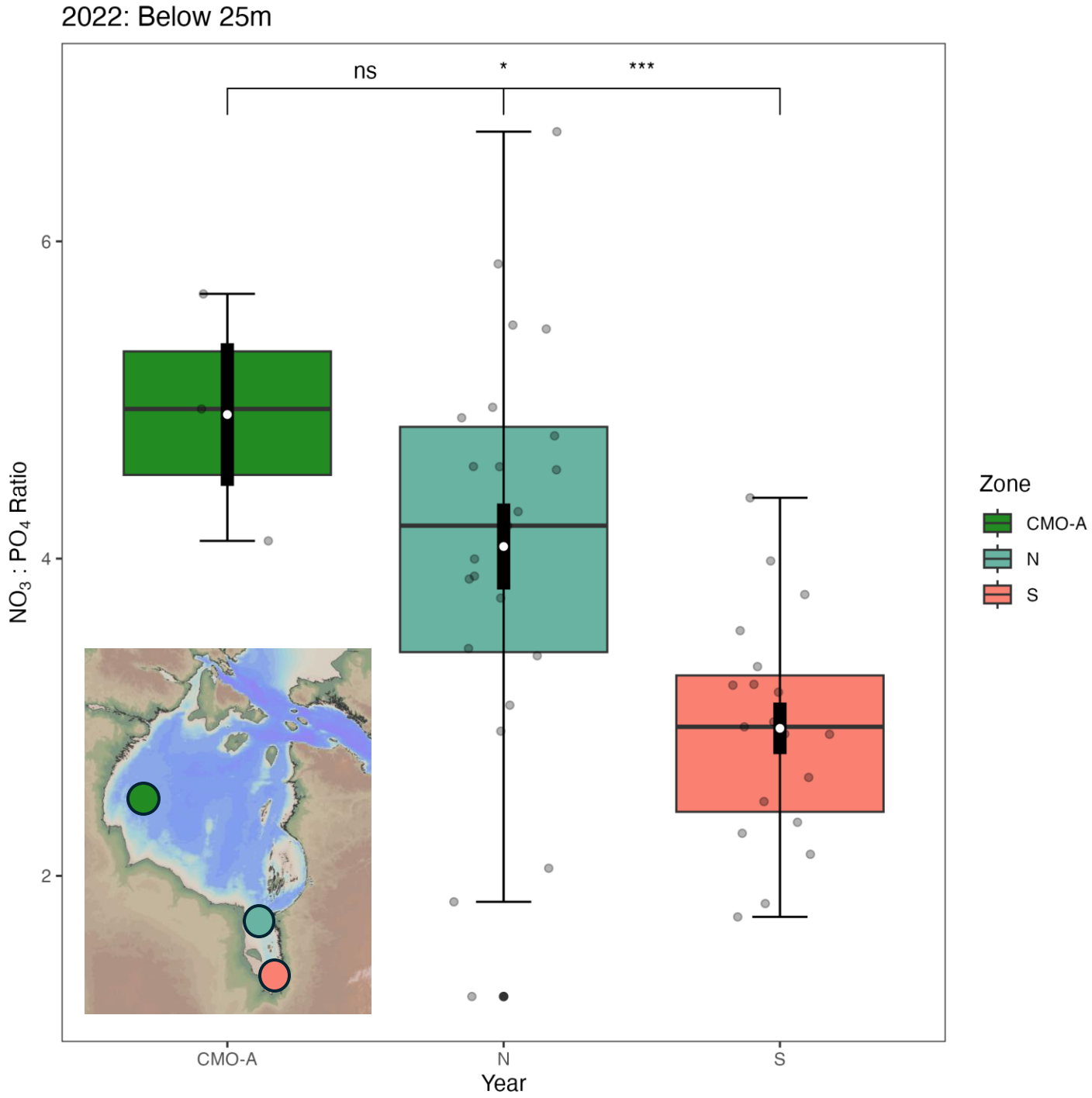
Nutrients

Expected

- nitrate limited system

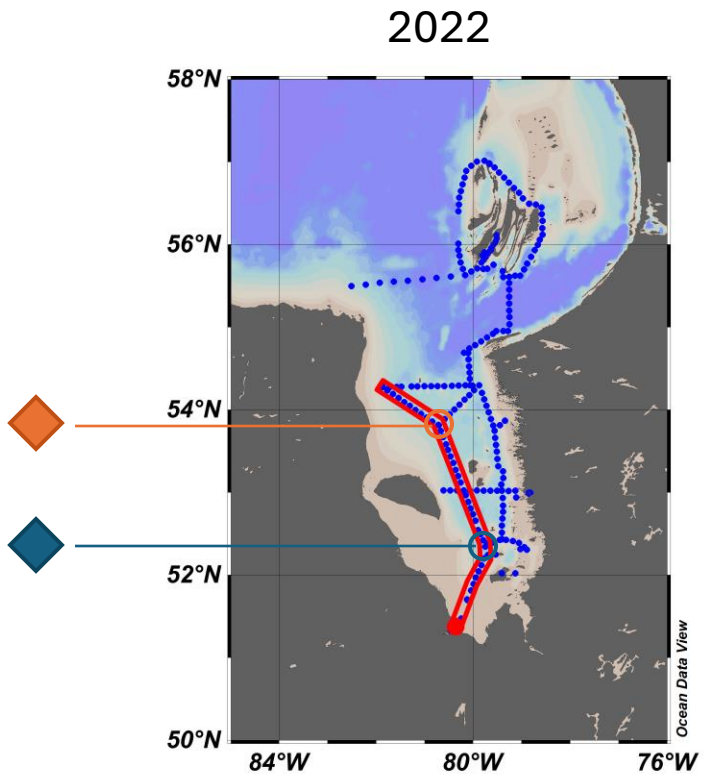
Unexpected

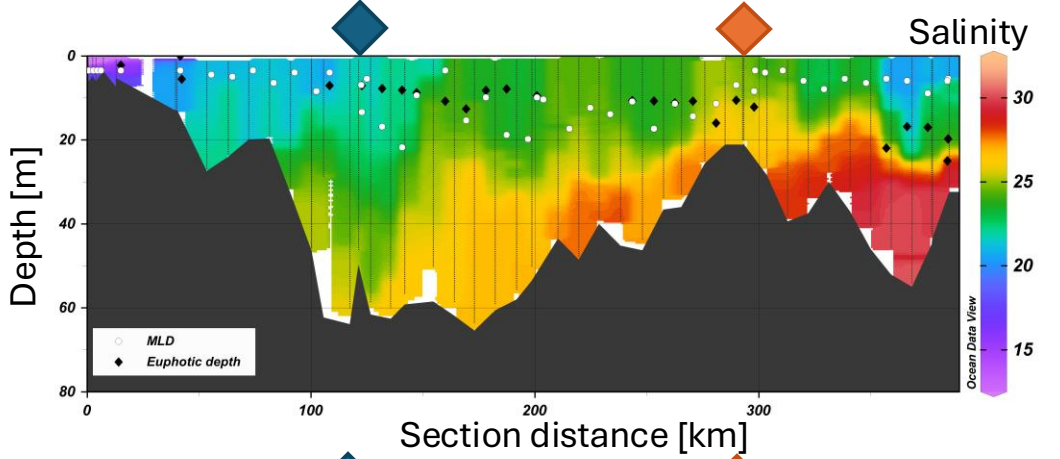
- Nitrate:phosphate ratio decreases from Hudson Bay (CMO-A near Churchill) to north James Bay (N) to south James Bay (S) – appears to influence downstream in Qikiqtait

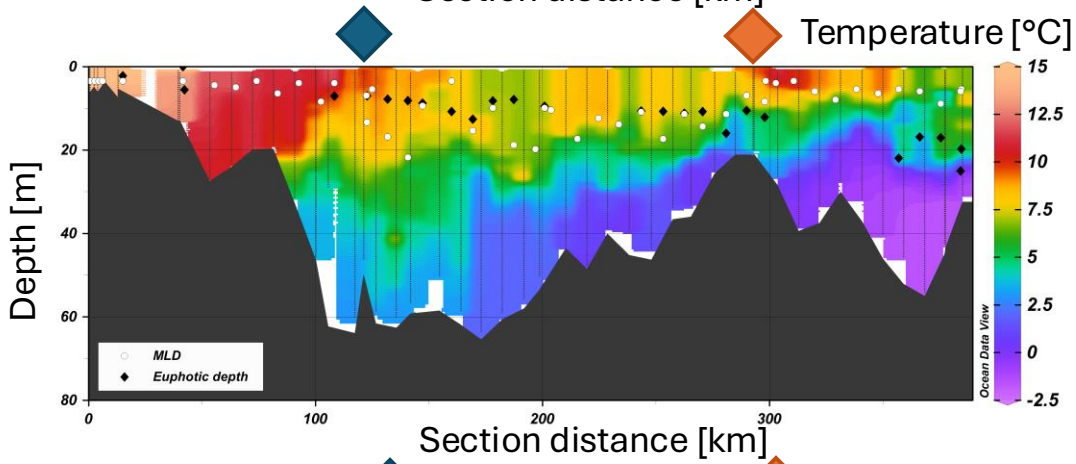


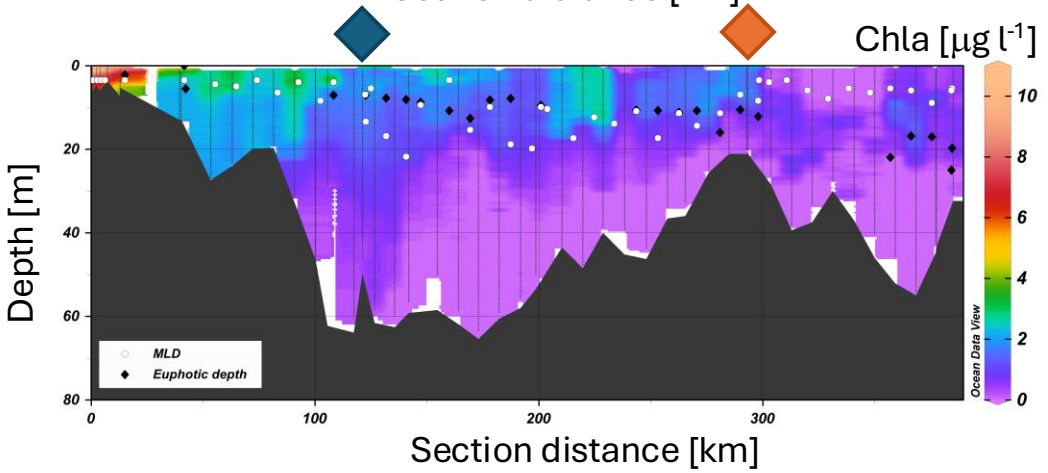
Mixing and phytoplankton

- High Chl *a* near riverine input, but decreases to < 3 μg l^{-1} throughout offshore James Bay
- Limited advection of Hudson Bay waters into James Bay



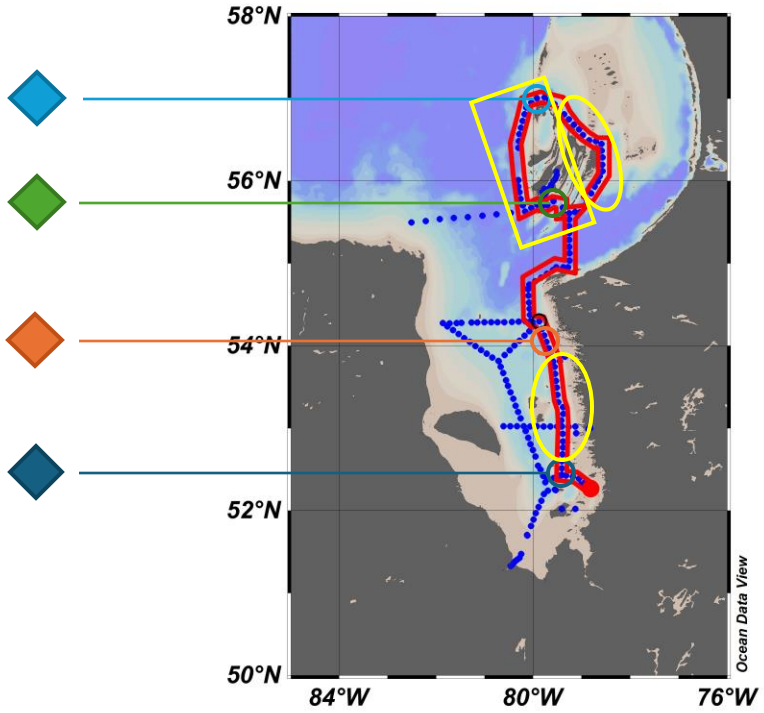


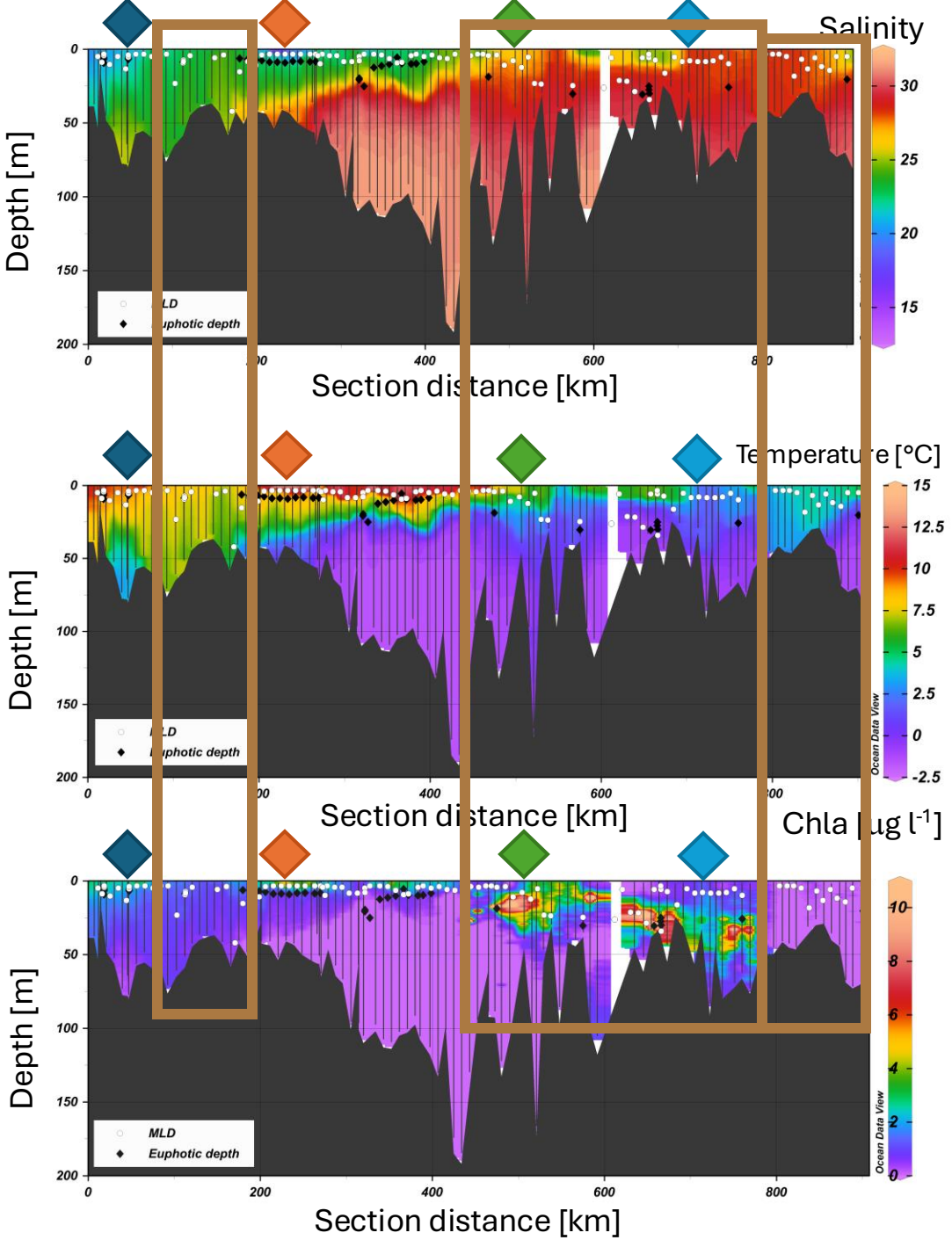




Mixing and phytoplankton

- Deep tidal mixing along eastern James Bay and along eastern shores of Qikiqtait dilutes Chl *a*
- Large boom evident around south, west, and north shores of Qikiqtait

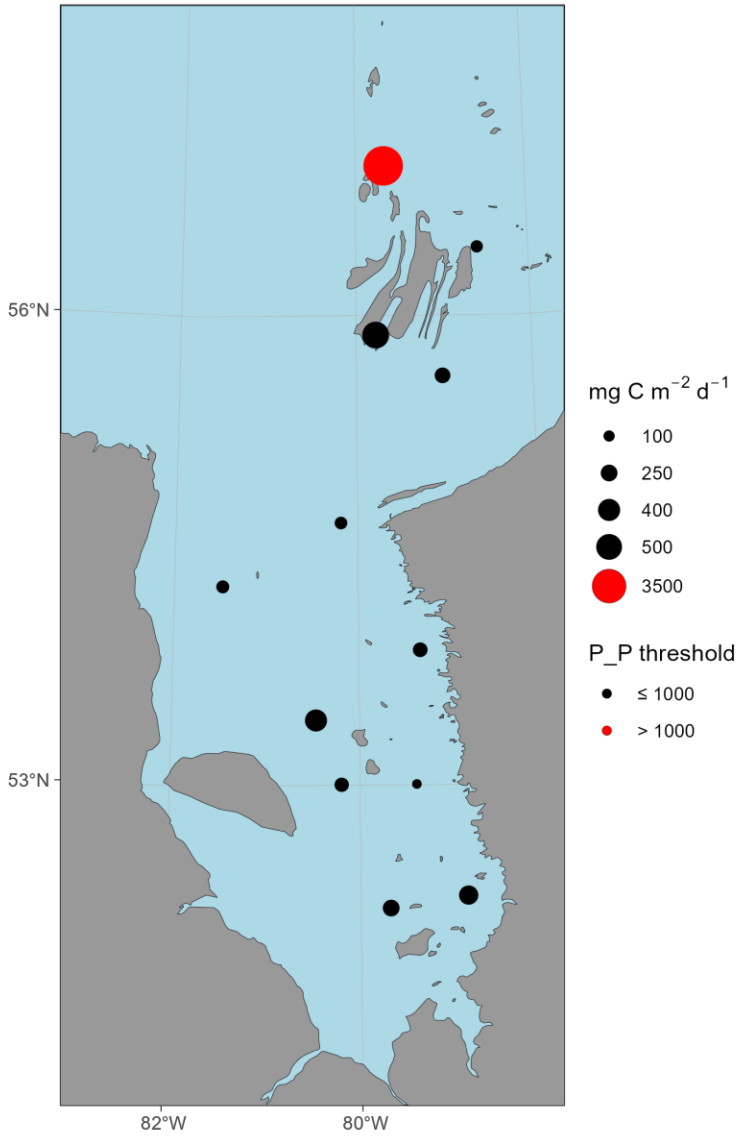


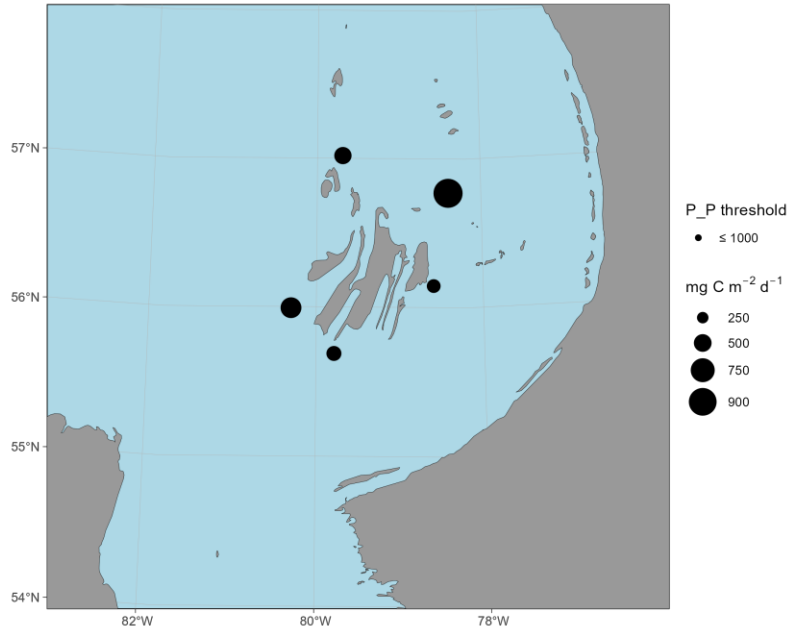


Primary production

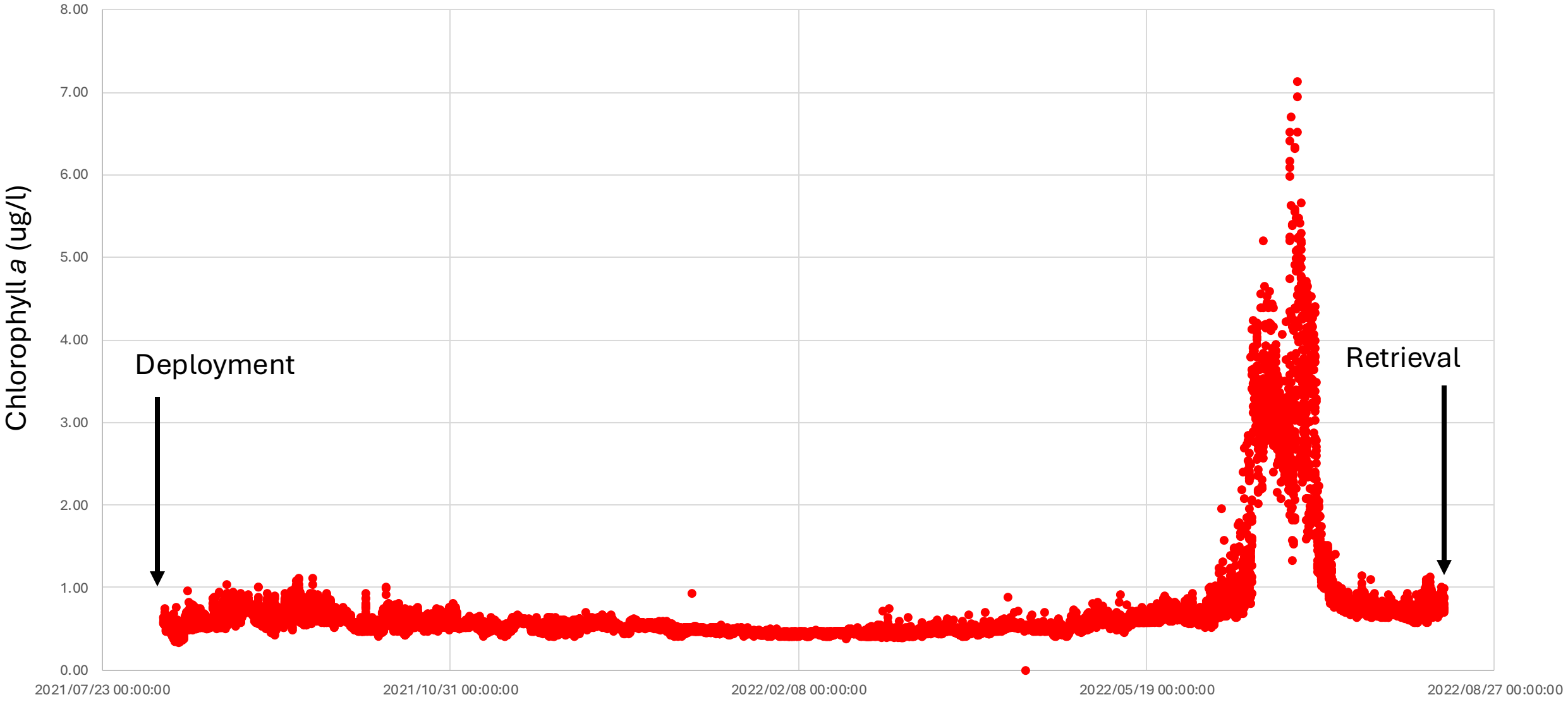
New Information

- **Low overall phytoplankton production in James Bay**
  - Averaged 288 ± 96 mg C m^{-2} d^{-1}
- **Significantly greater phytoplankton production in Qikiqtait**
  - Averaged 407 ± 228 mg C m^{-2} d^{-1}
  - Maximum 846 mg C m^{-2} d^{-1}
  - Outlier >3600 mg C m^{-2} d^{-1}





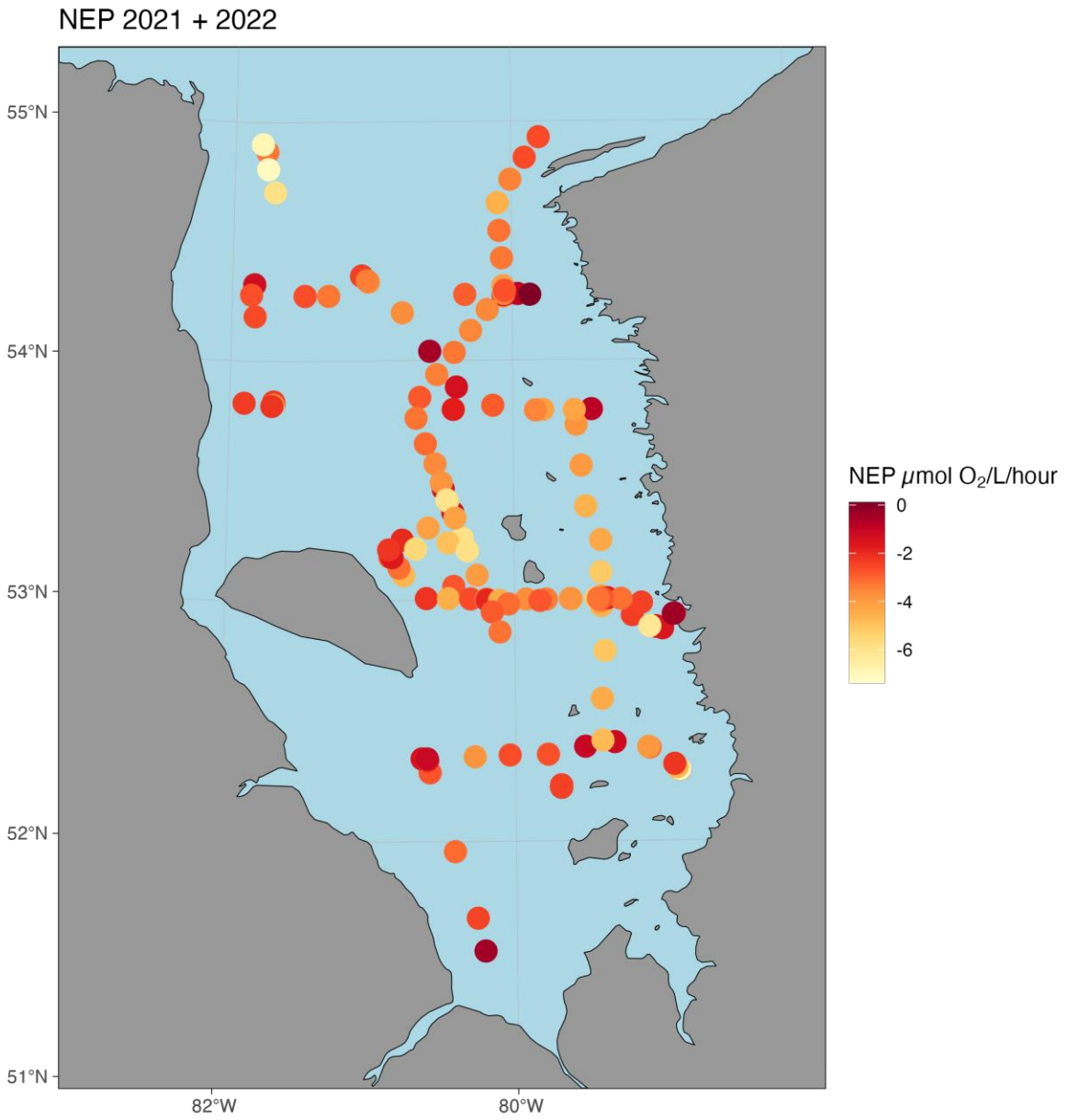
Primary production



Primary production

New Information

- **James Bay is net heterotrophic** - Surface net ecosystem production is <0 μmol O l^{-1} hr^{-1}



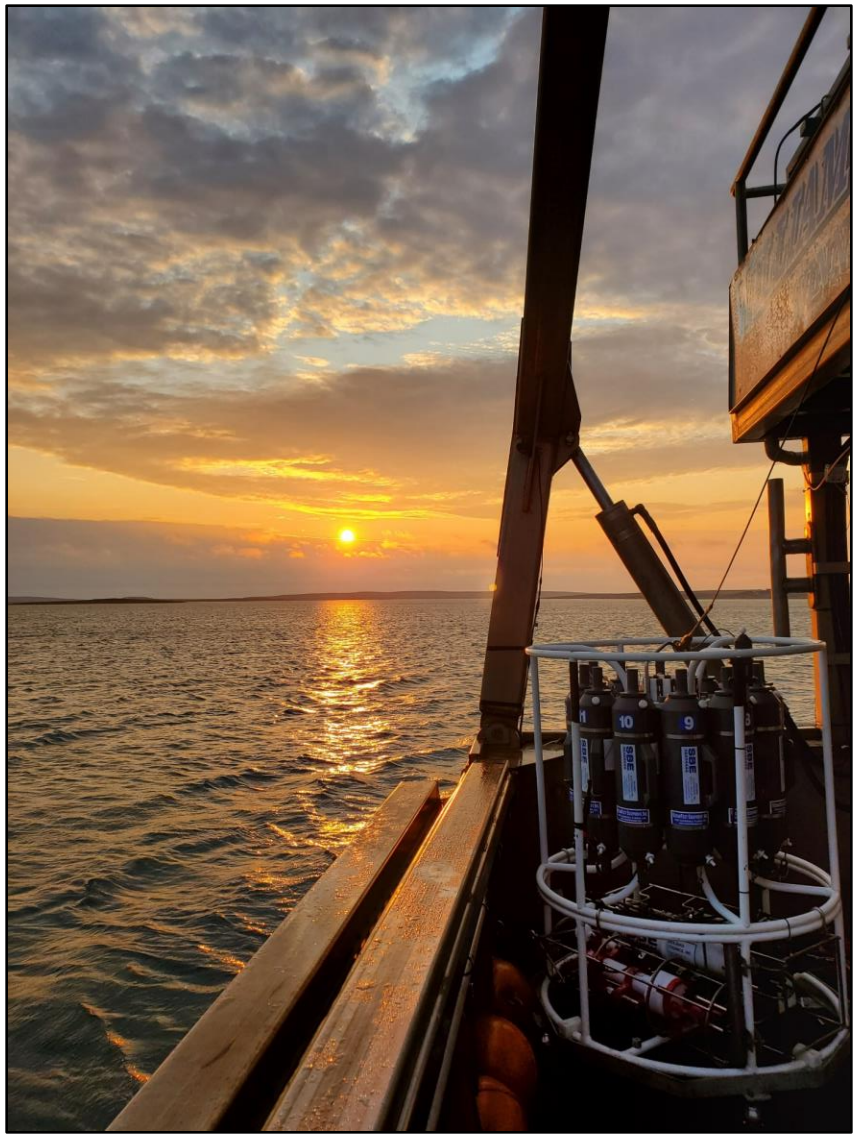
Conclusions

- Circulation does not follow exactly as expected with tidal mixing playing an important role in certain regions as well as winter flow of the La Grande River system
- James Bay phytoplankton is light and nutrient limited, net heterotrophic with relatively low production – food web is likely more dependent on terrestrial organic matter
- Mixing around Qikiqtait (Belcher Islands) enhances local phytoplankton blooms – food web is dependent on marine production

Future Research Suggestions

- More moorings required to better understand oceanographic circulation and improve modelling tools that can help project future state of the system
- James Bay sea ice studies in winter-spring could add new information on the system
- Better quantification of terrestrial organic matter and its contribution to the food web

CO_2 and Ocean Acidification in Southern Hudson Bay and James Bay



Nicholas Decker, *D. Capelle, Z. Kuzyk, T. Papakyriakou, K. Yezhova, and K. Brown*

University of Manitoba

Centre for Earth Observation Science (CEOS)

Hudson Bay and James Bay Expedition Results Presentation – Ottawa, Feb 26, 2026

ARCTIC RESEARCH FOUNDATION

Fisheries and Oceans Canada

Pêches et Océans Canada

Parks Canada

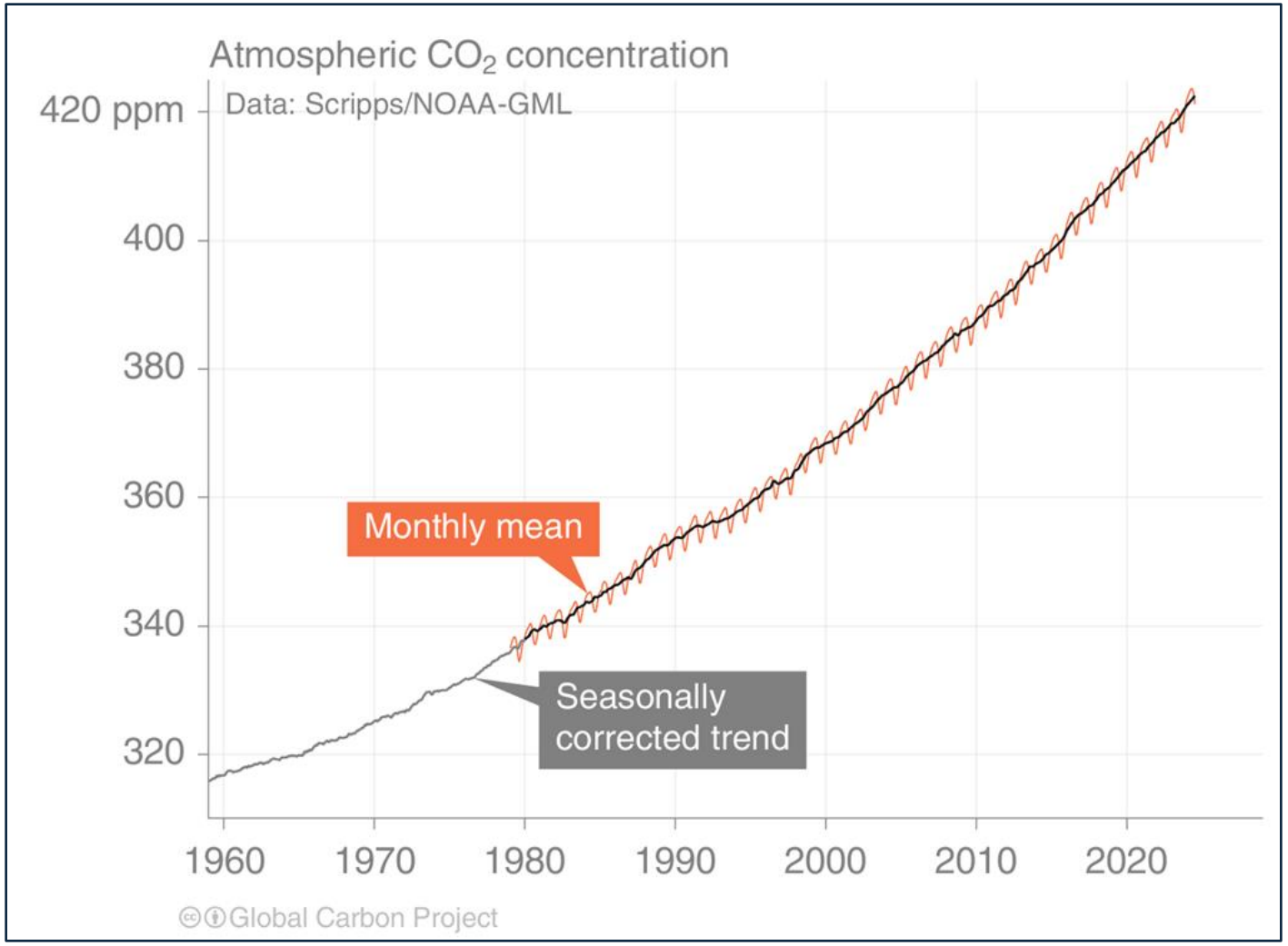
Parcs Canada

NSERC CRSNG

ASP Arctic Science Partnership

Climate Change and Carbon-Dioxide (CO_2)

- Since ~1750, atmospheric CO_2 has increased steadily



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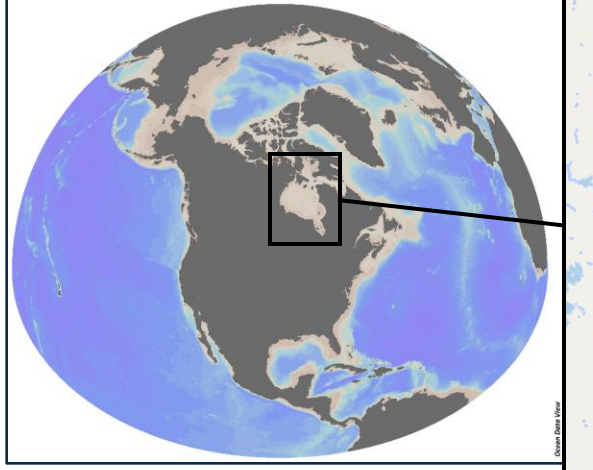
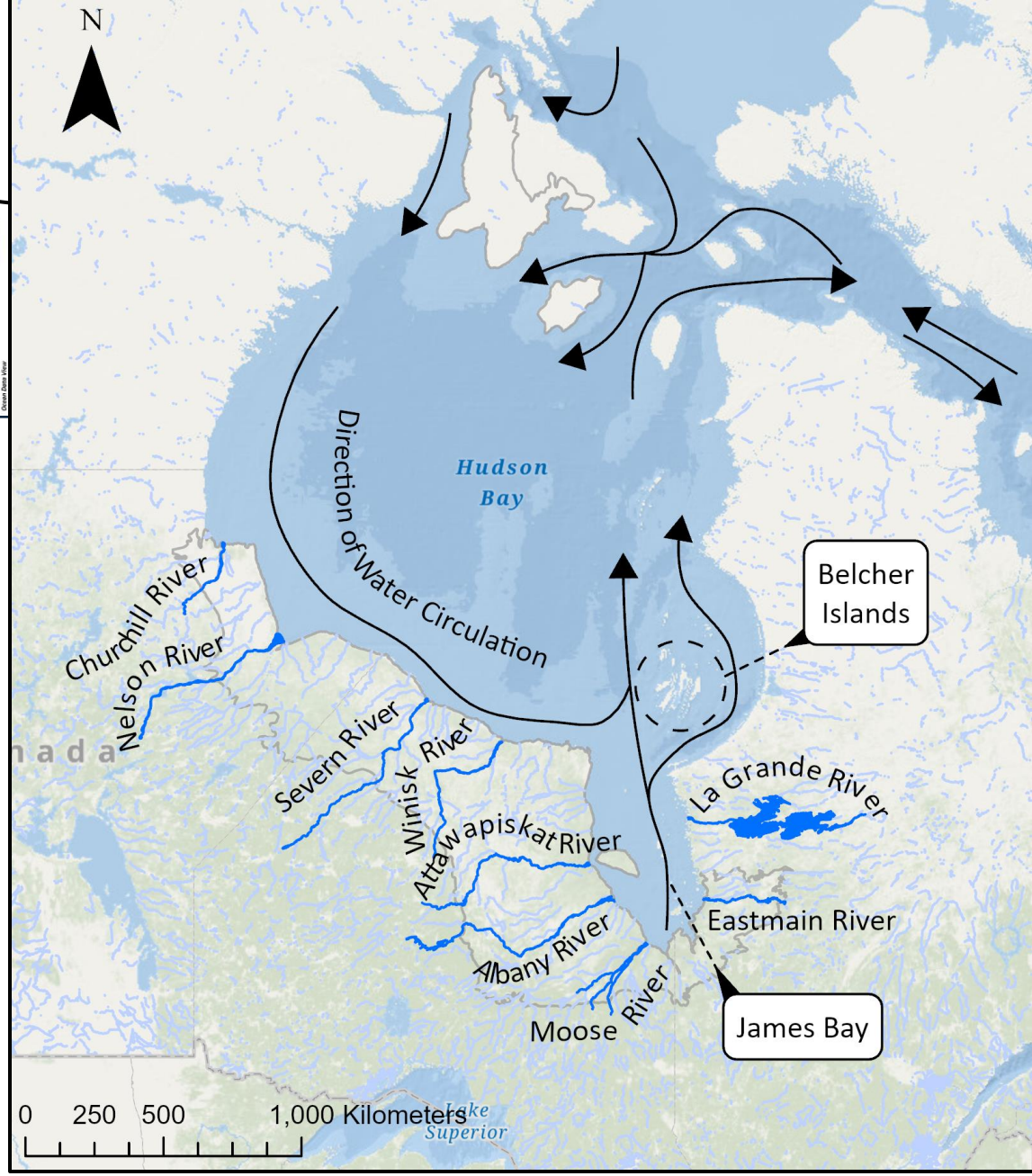
Hudson Bay & James Bay



- Cold, fresh water and river runoff make the Arctic Ocean naturally sensitive to **Ocean Acidification**
- No previous studies of dissolved CO_2 and Acidification in James Bay
- We do know Hudson Bay = high CO_2 and Ocean Acidification stress



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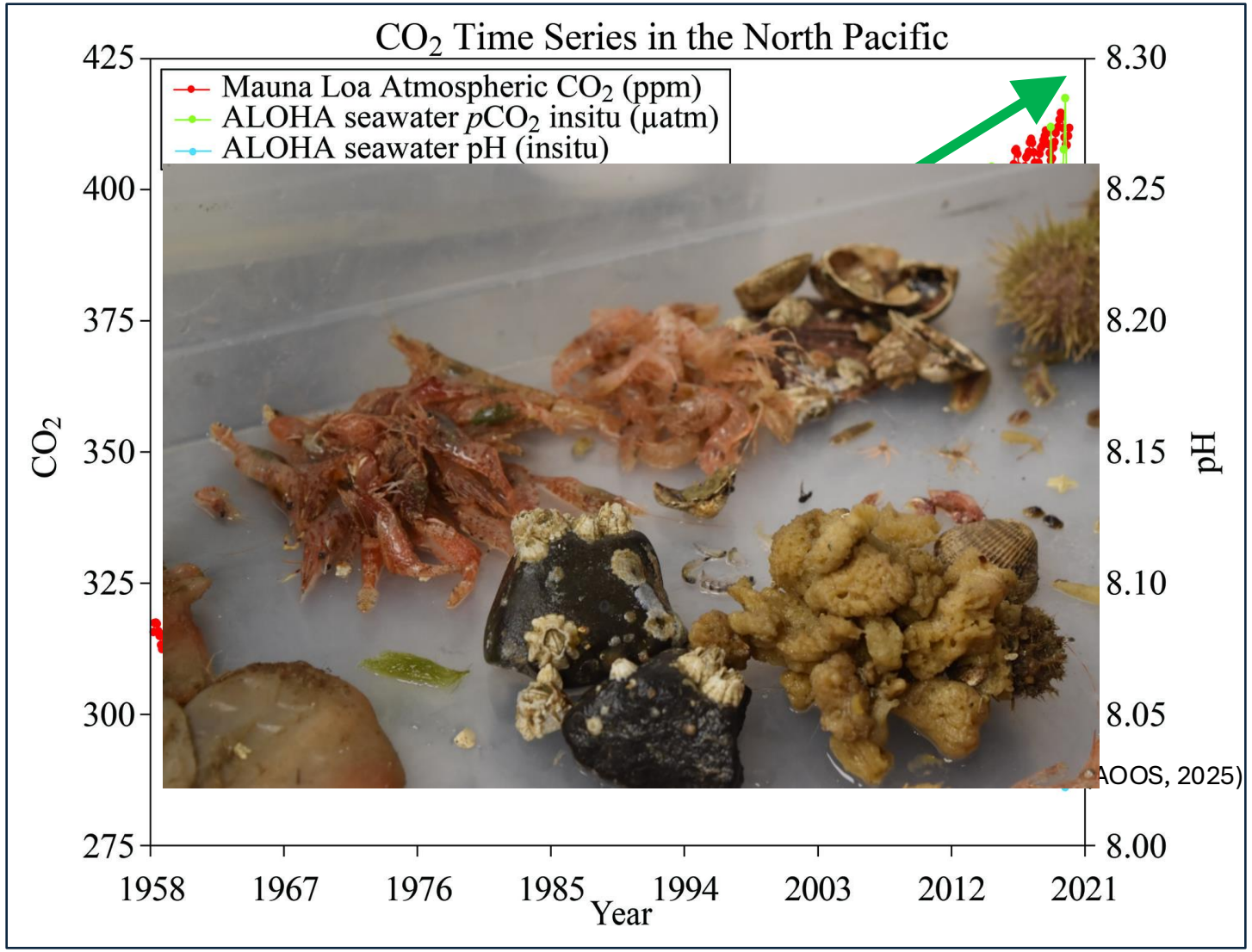
Ocean Acidification: 'The Other CO_2 Problem'

- Oceans absorb CO_2 from atmosphere
- Surface ocean pH ↓ by 30%
- Marine organism growth and reproduction may be impacted
- Rivers can also raise ocean CO_2



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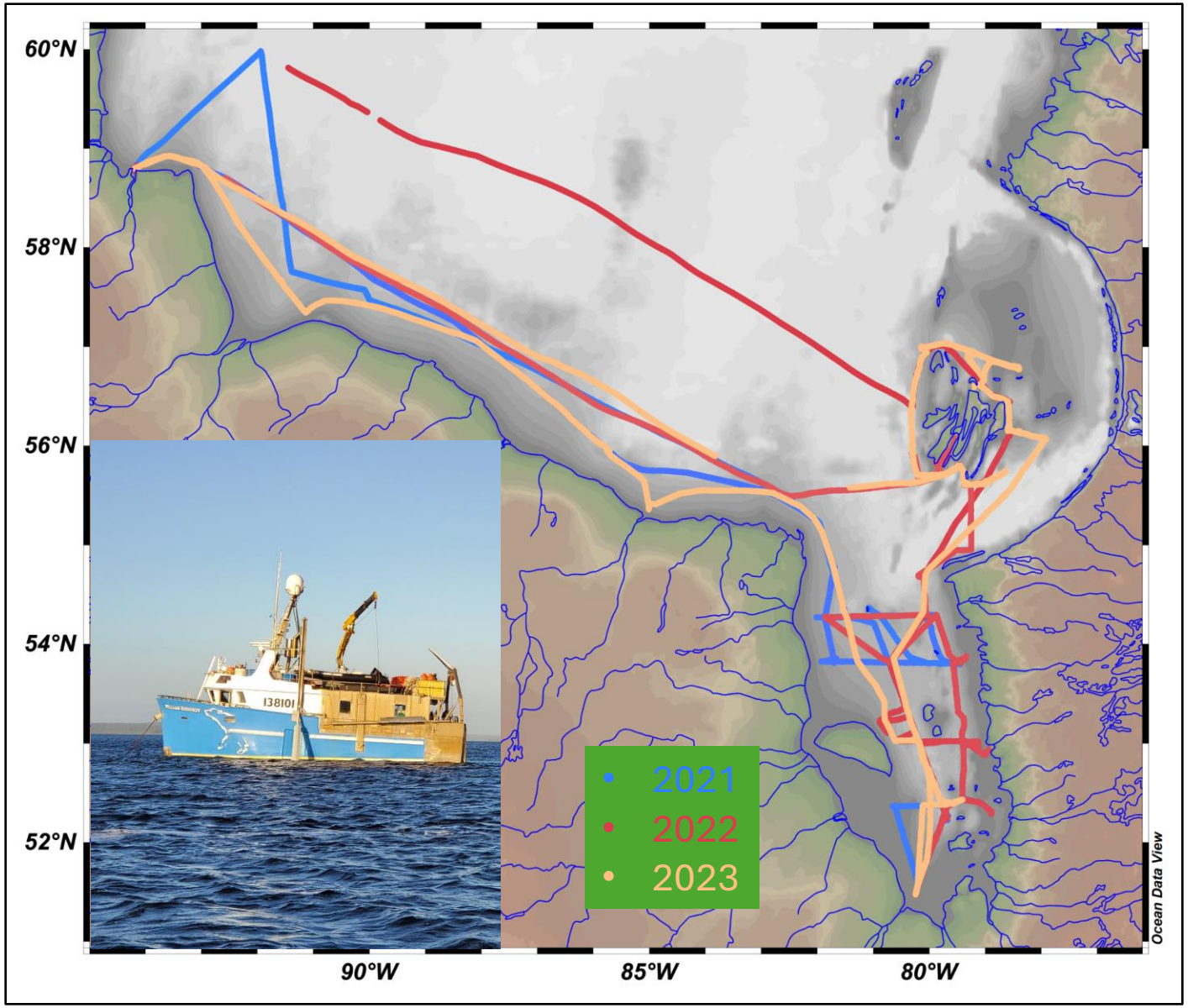
R/V William Kennedy Cruises

- August of 2021, 2022, and 2023
- Data collection:
  - Dissolved CO_2
  - ocean acidification index - Ω_{AR}
- When $\Omega_{AR} < 1$ = shells can dissolve



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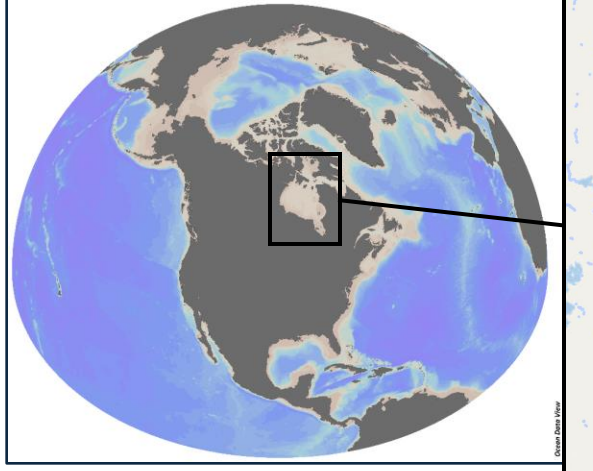
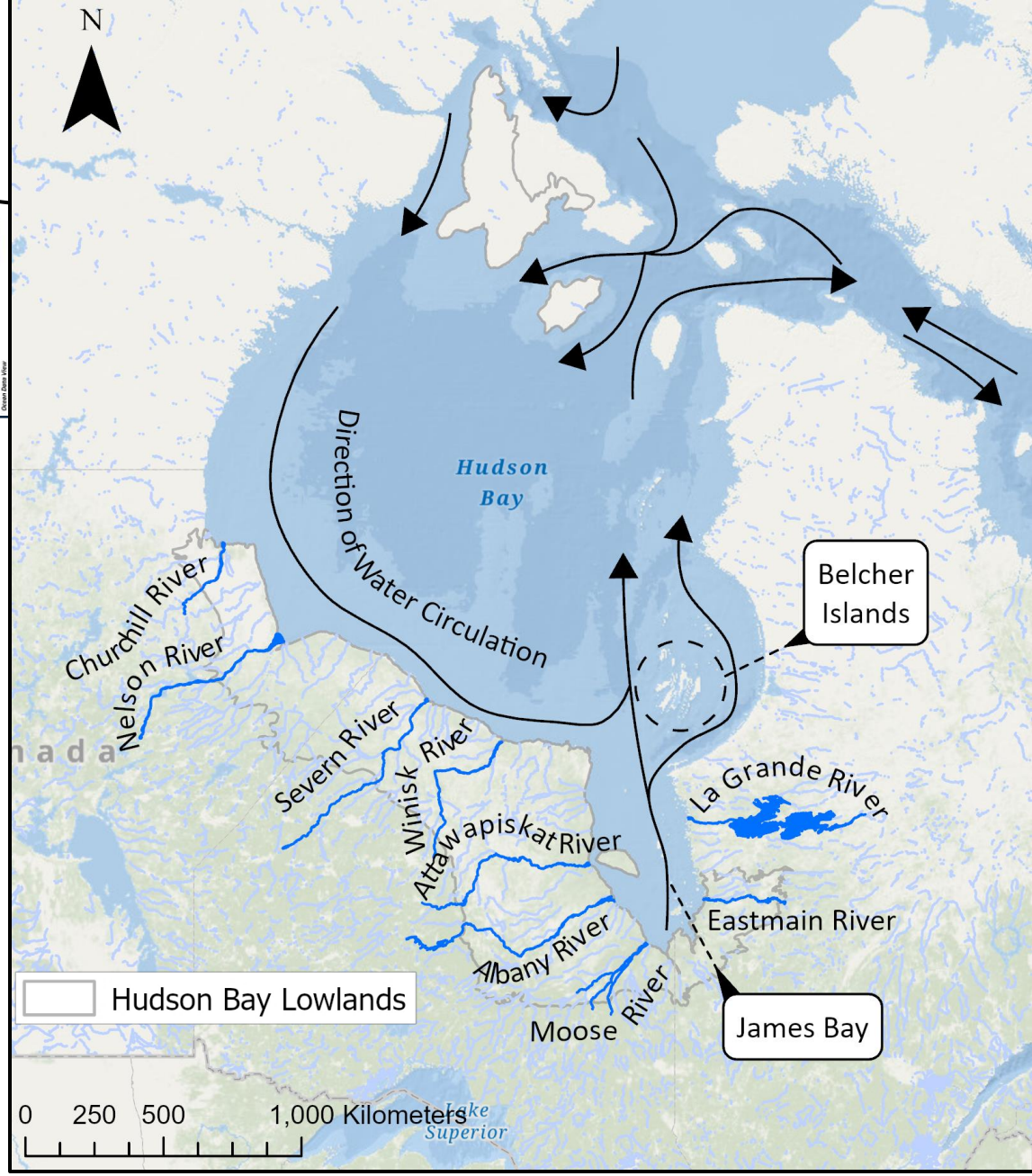
What did we Learn?



- James Bay and South Hudson Bay :
- high CO_2 concentrations
- acidification levels could stress organisms

- Link to river runoff and land-carbon
- Not all rivers the same



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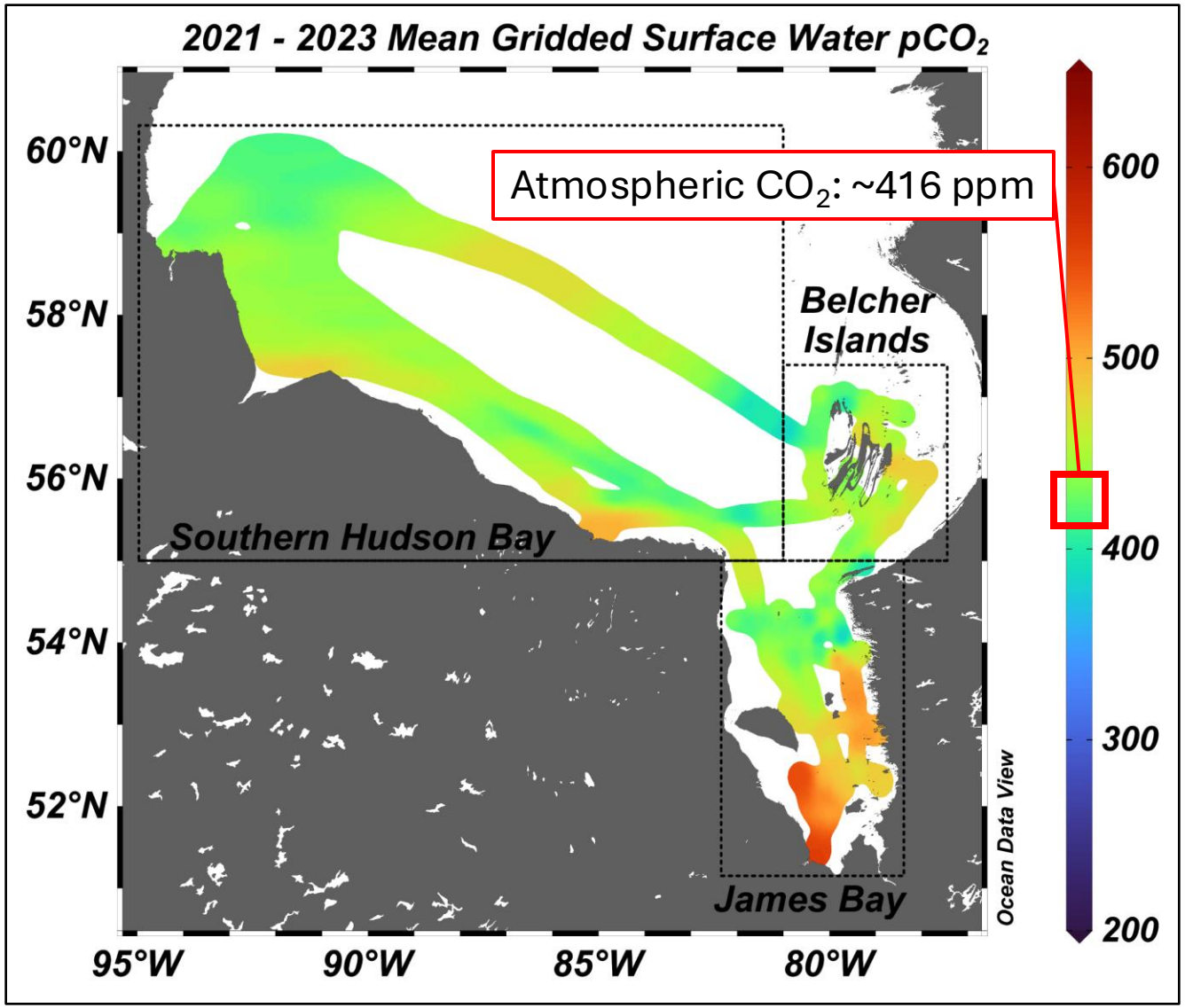
Surface Water CO_2

- High CO_2 in James Bay, near rivers
- water releasing CO_2 to atmosphere



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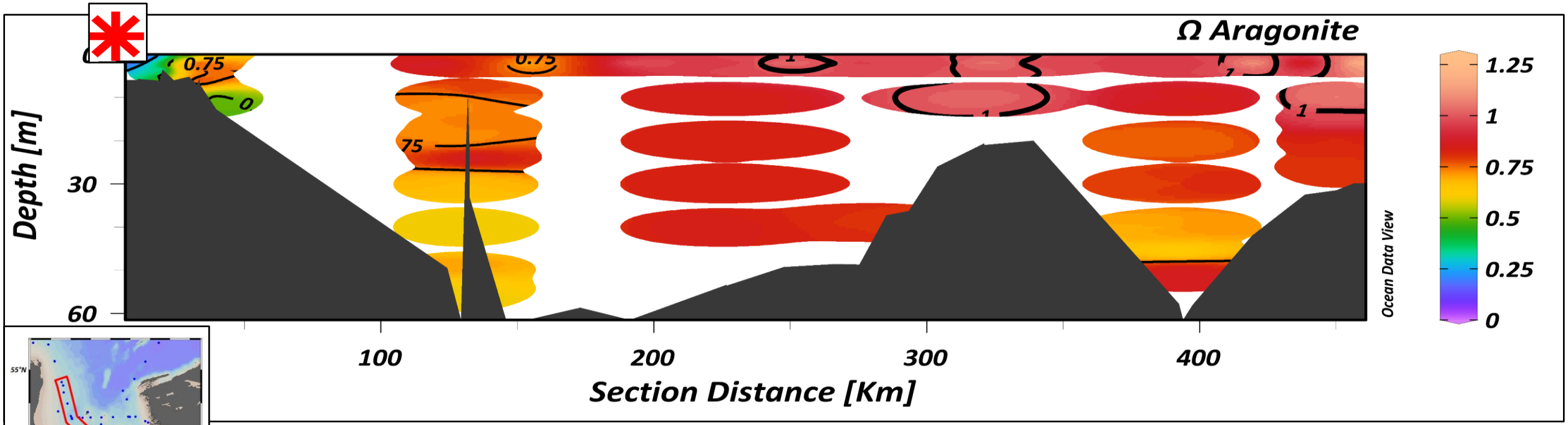
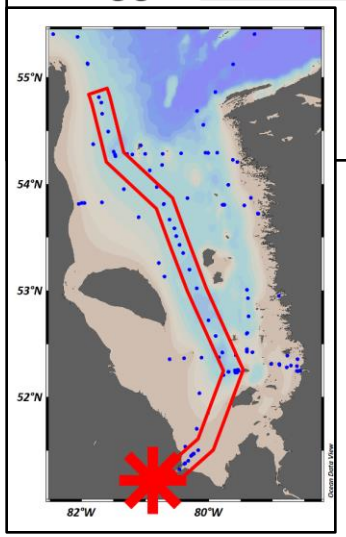
Pêches et Océans Canada

State of Acidification, **James Bay**



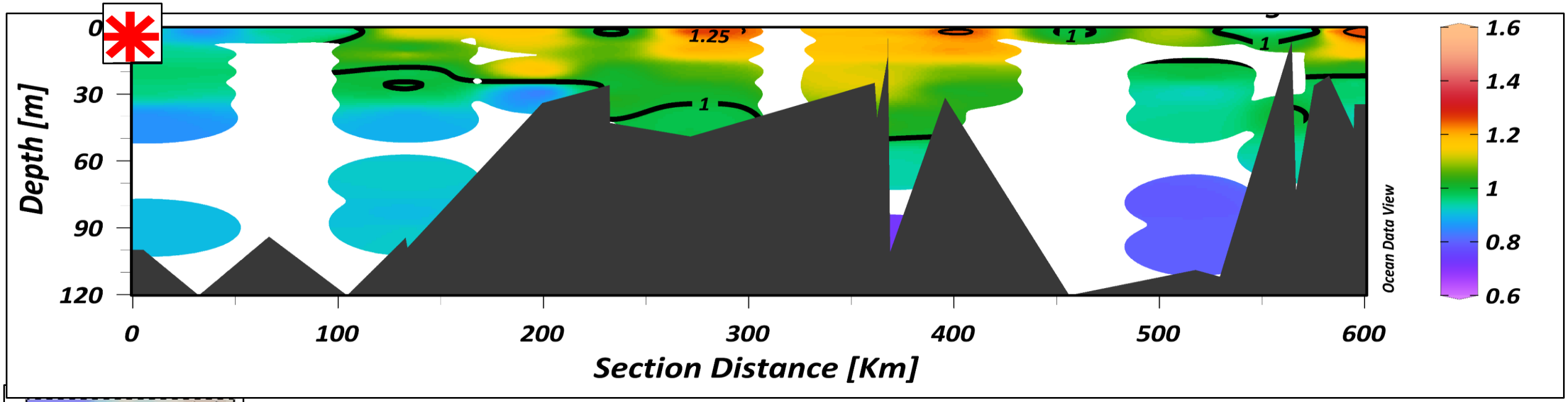


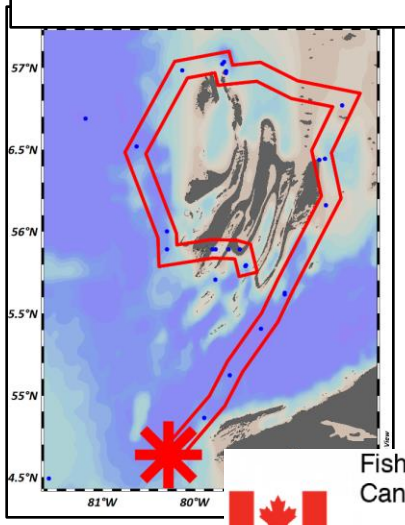
- Ω_{AR} <1 almost everywhere
- Lowest near Moose River

Fisheries and Oceans Canada

Pêches et Océans Canada

State of Acidification, **Belcher Islands**





- Mostly deep water Ω_{AR} <1
- Less river water

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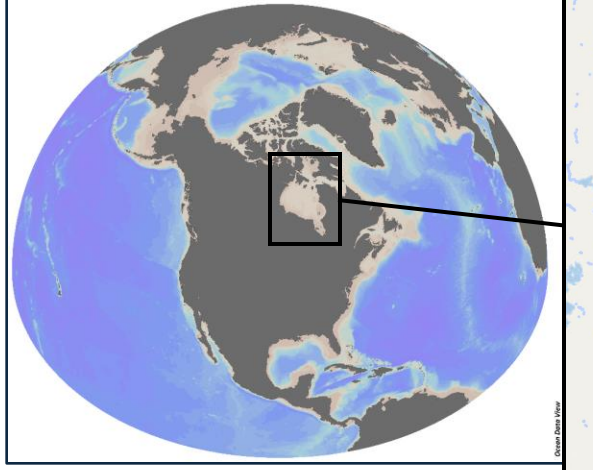
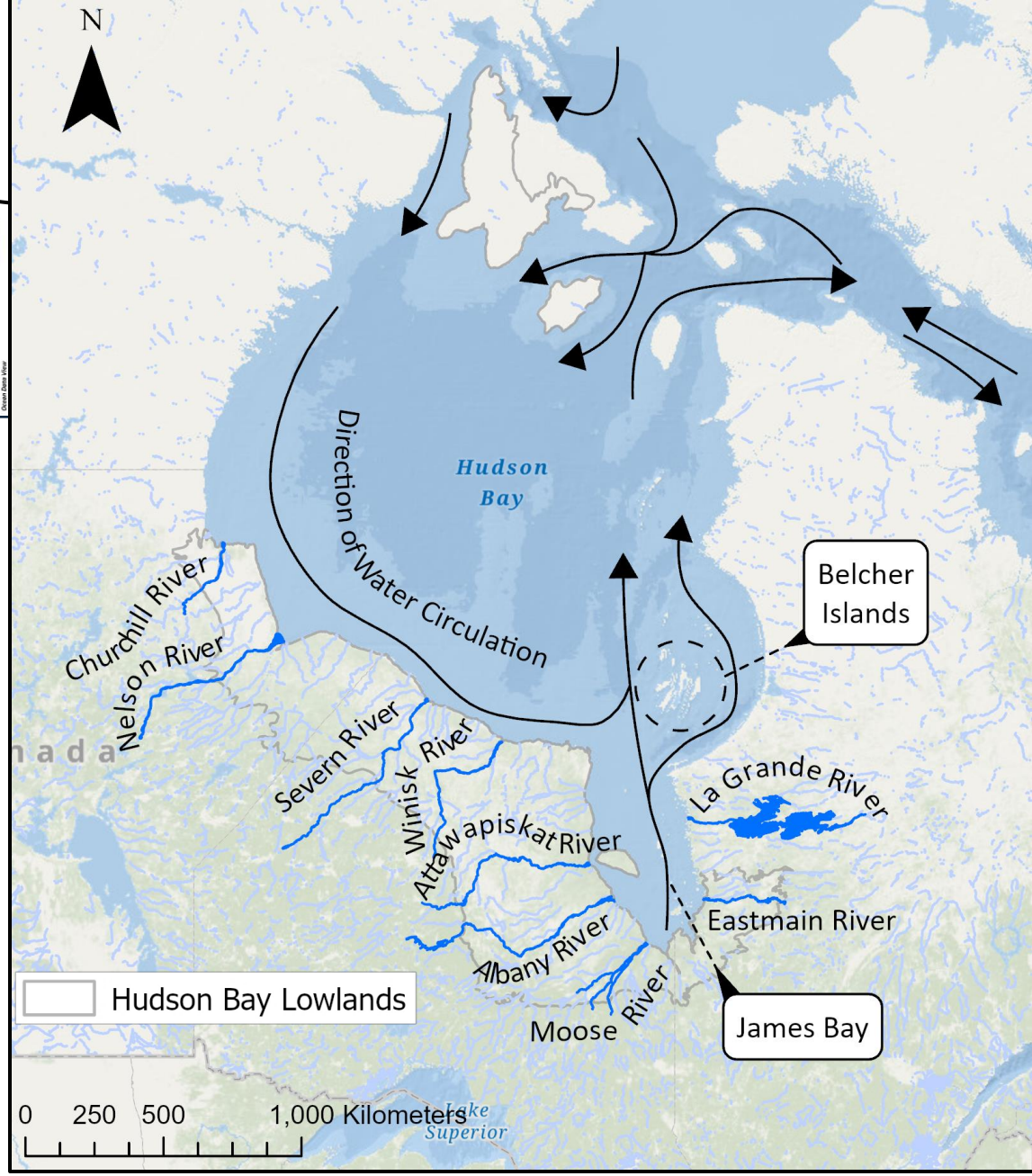
What's Next?



- Does James Bay use land-carbon from rivers?
- Seasonal differences?
- Animal/organism sensitivity to current and future acidification (connection to land/atmosphere)?



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Summary and Acknowledgements

- Baseline state of ocean acidification
- Hudson Bay and James Bay are a harbinger of Arctic change
- Future work
  - Land – sea continuum
- Thank you!
  - Carbon Group
  - WK crew

ARCTIC RESEARCH FOUNDATION

Fisheries and Oceans Canada

Pêches et Océans Canada

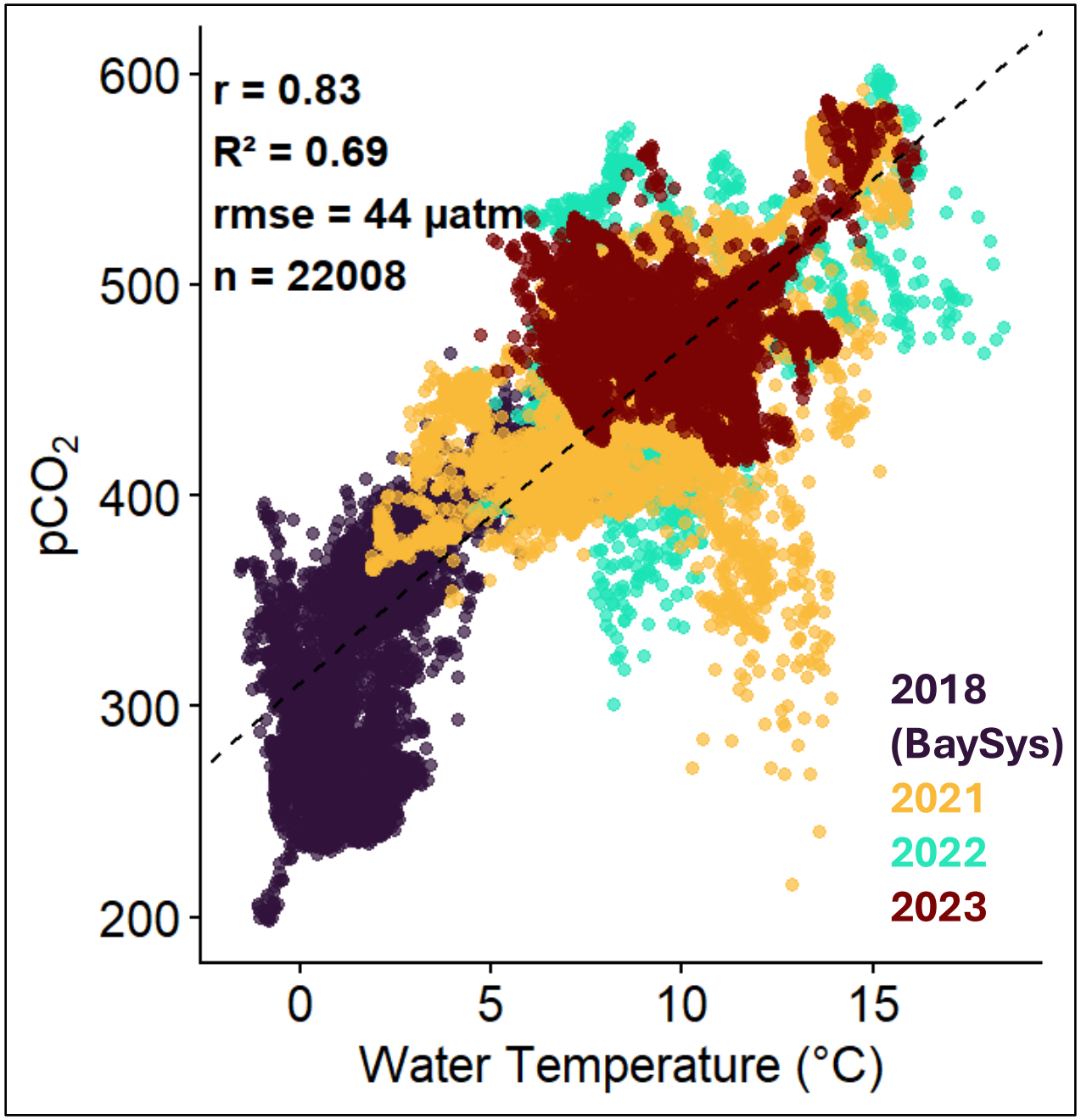
ASP Arctic Science Partnership

Parks Canada Parcs Canada

NSERC CRSNG

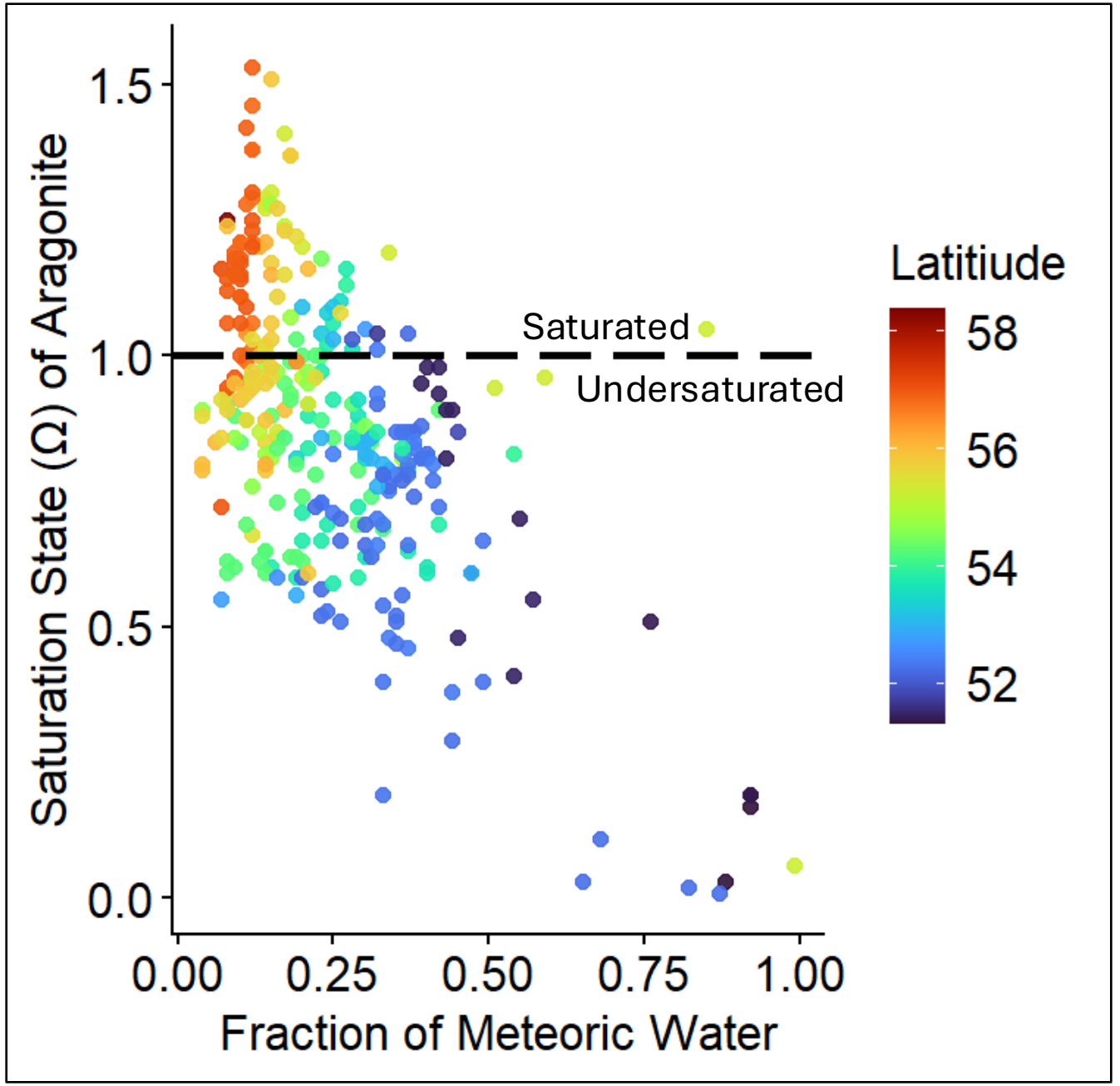
Observed controls on Carbonate System

- Objective 1:
  - Surface Water CO_2 dominantly controlled by water temperature
  - Other factors play important roles



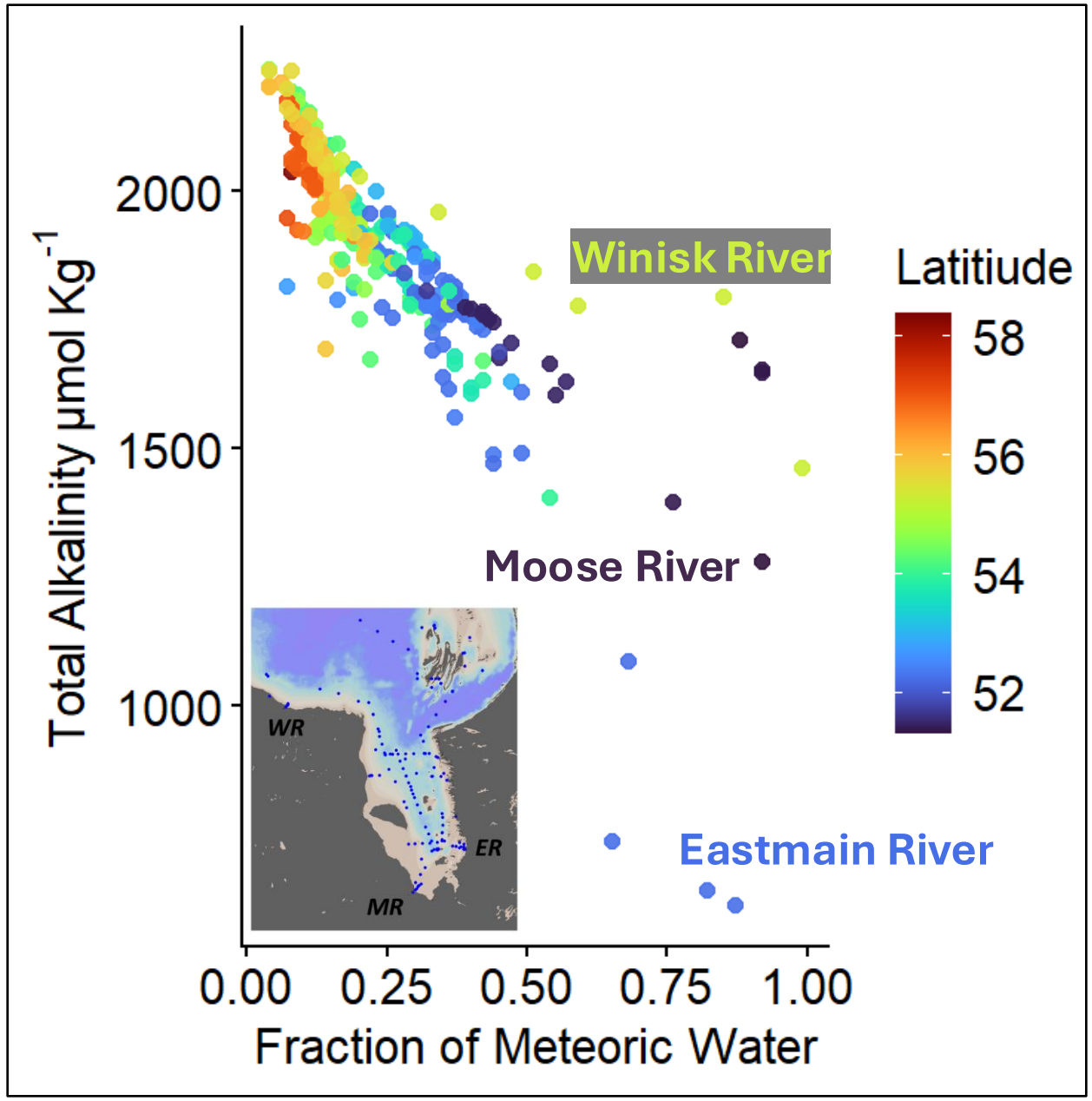
Observed controls on Carbonate System

- Objective 1:
  - Surface Water CO_2 dominantly controlled by water temperature
  - Other factors play important roles
- Objective 2:
  - State of acidification
  - Carbonate mineral saturation controlled by meteoric water addition



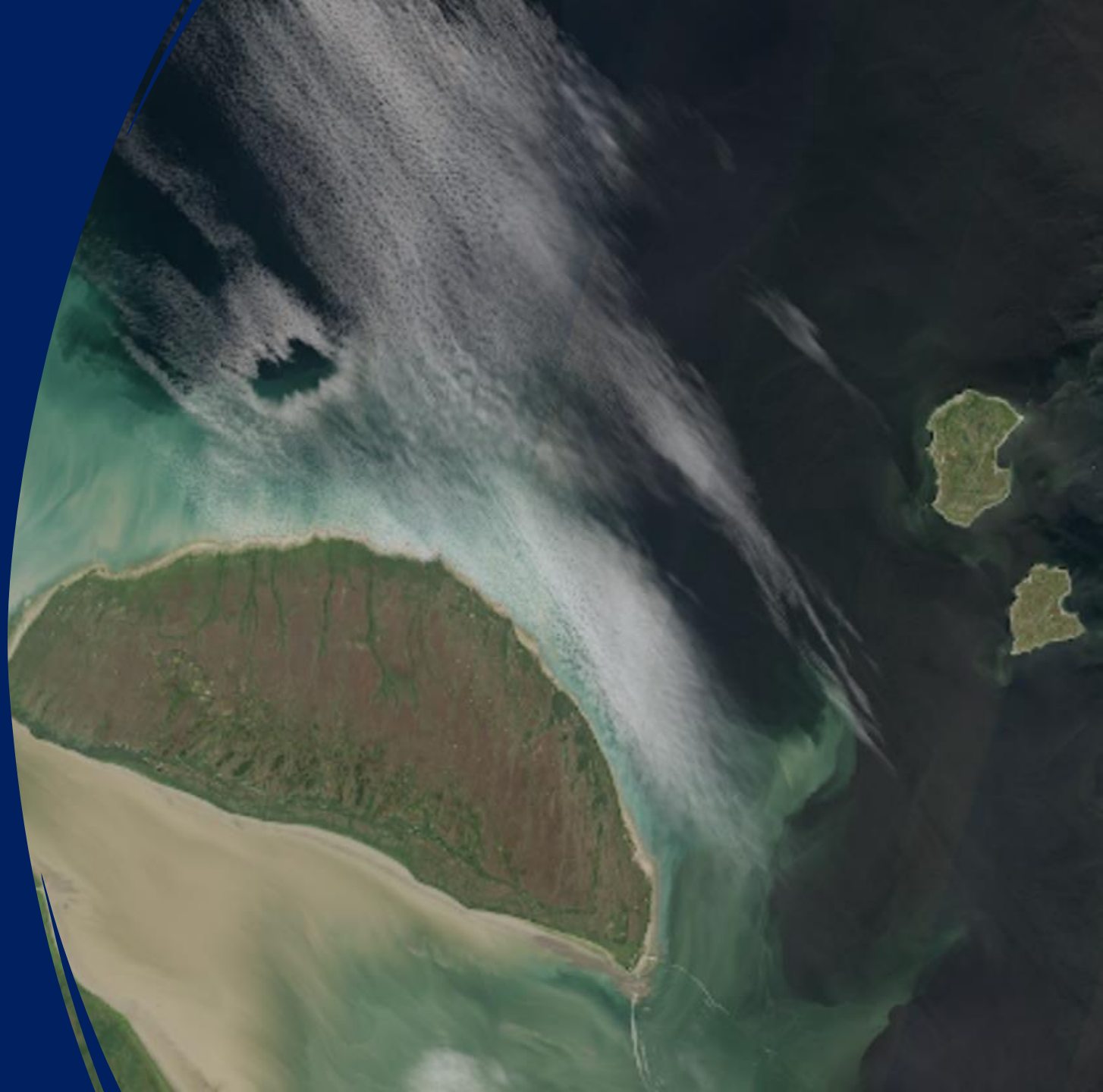
Observed controls on Carbonate System

- Objective 1:
  - Surface Water CO_2 dominantly controlled by water temperature
  - Other factors play important roles
- Objective 2:
  - State of acidification
  - Carbonate mineral saturation controlled by meteoric water addition
    - Water source plays an important role



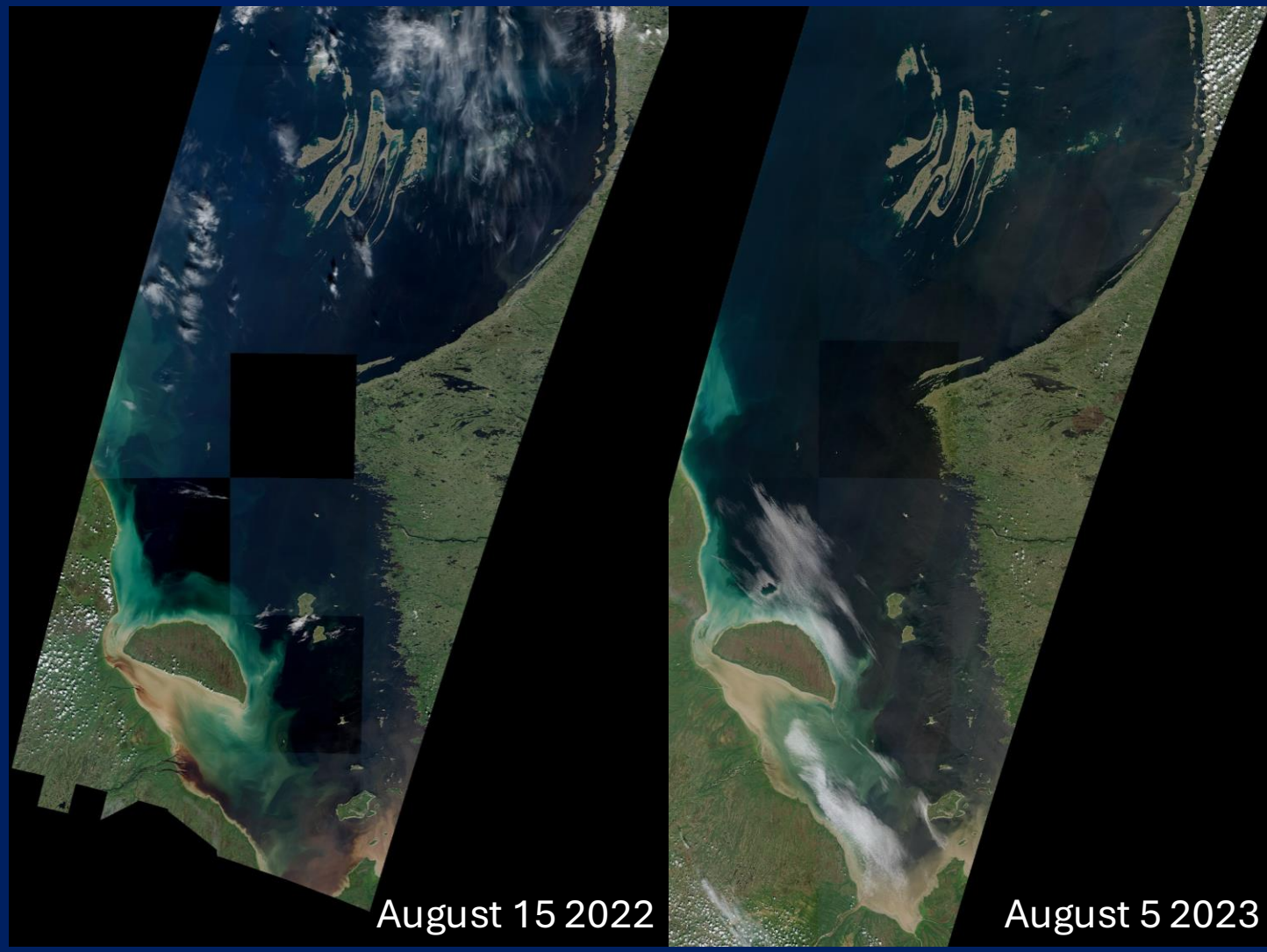
Microbial Plankton in Southern Hudson Bay and James Bay

- Eric Collins
- Zakhar Kazmiruk



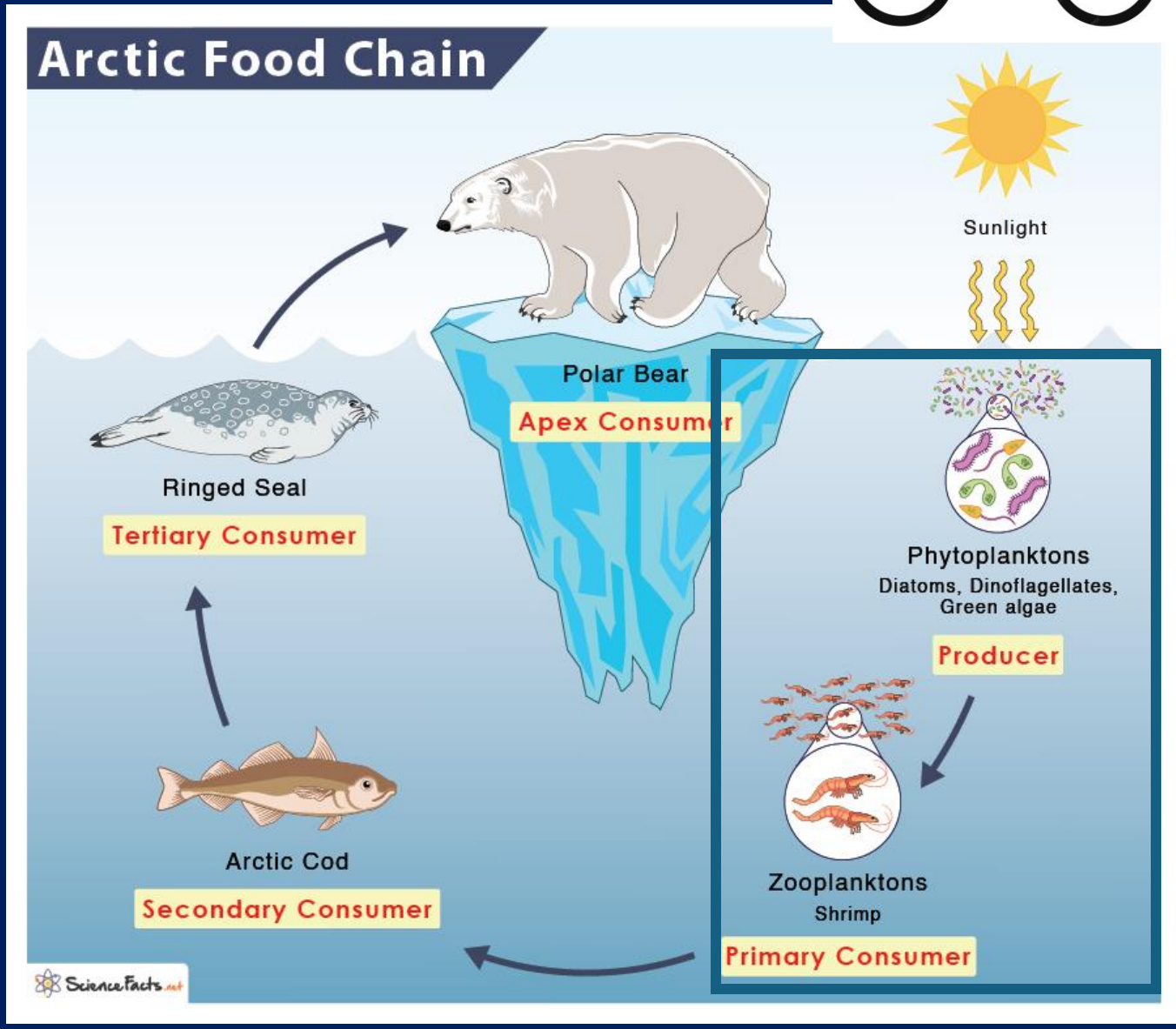
Background

- Southern Hudson Bay and James Bay support diverse plankton
- Climate change is altering freshwater discharge, sea ice dynamics, and thermal regimes — with unknown consequences for plankton and the food webs they support
- Most microbes are harmless degraders but the can have big impacts
- Microbes are important for both the release and degradation of greenhouse gasses
- Certain microbes can cause Harmful Algae Blooms that release toxins

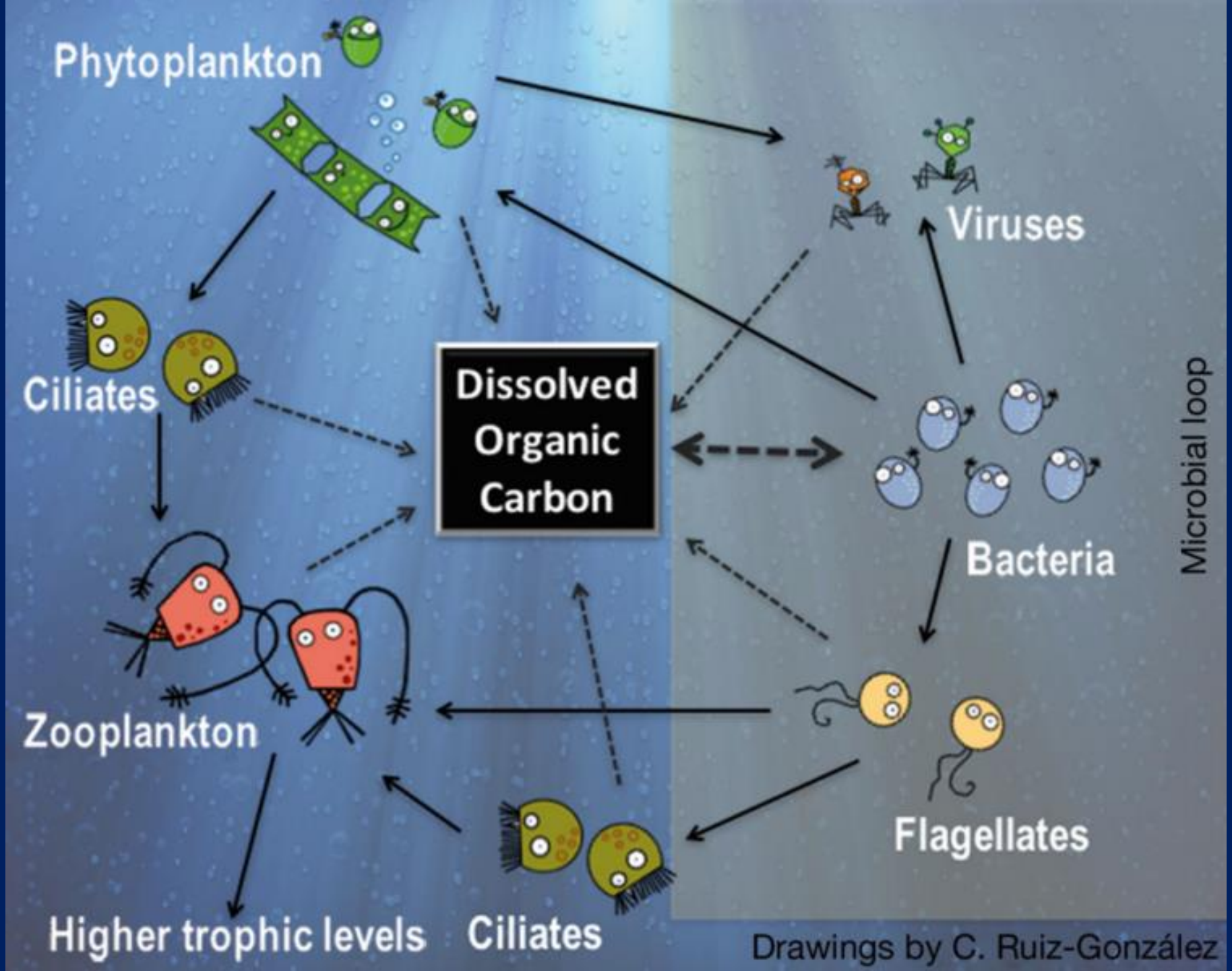


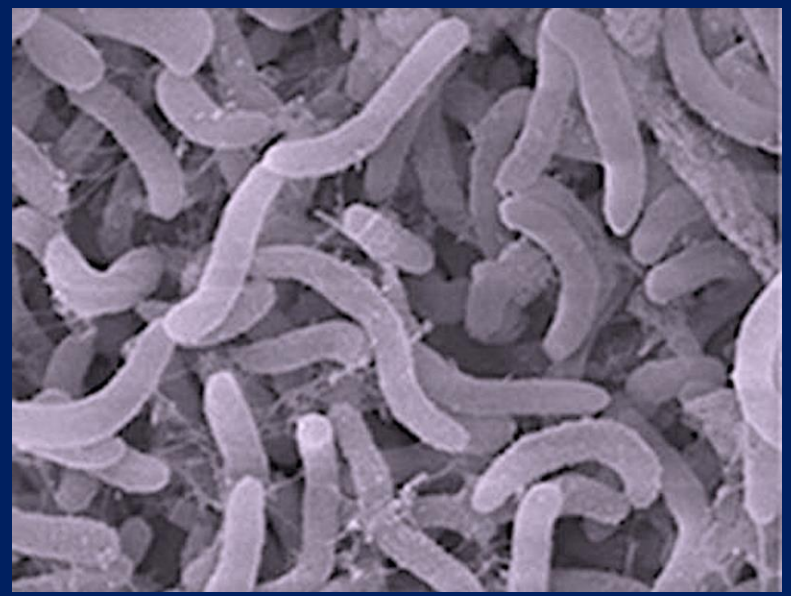
Objectives

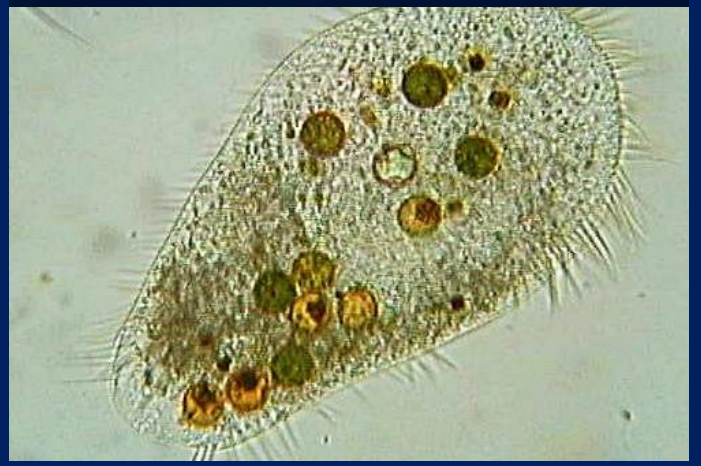
- Goal: Describe plankton community structure and identify environmental drivers
- Water samples collected Aug 2022 (n=38) and Aug 2023 (n=34) aboard M/V William Kennedy
- 16S (bacteria) and 18S (eukaryotic) rRNA amplicon sequencing provides a comprehensive view of microbial diversity

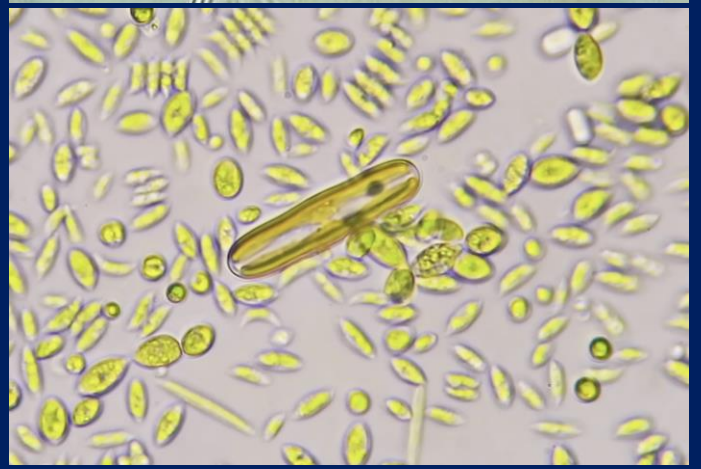


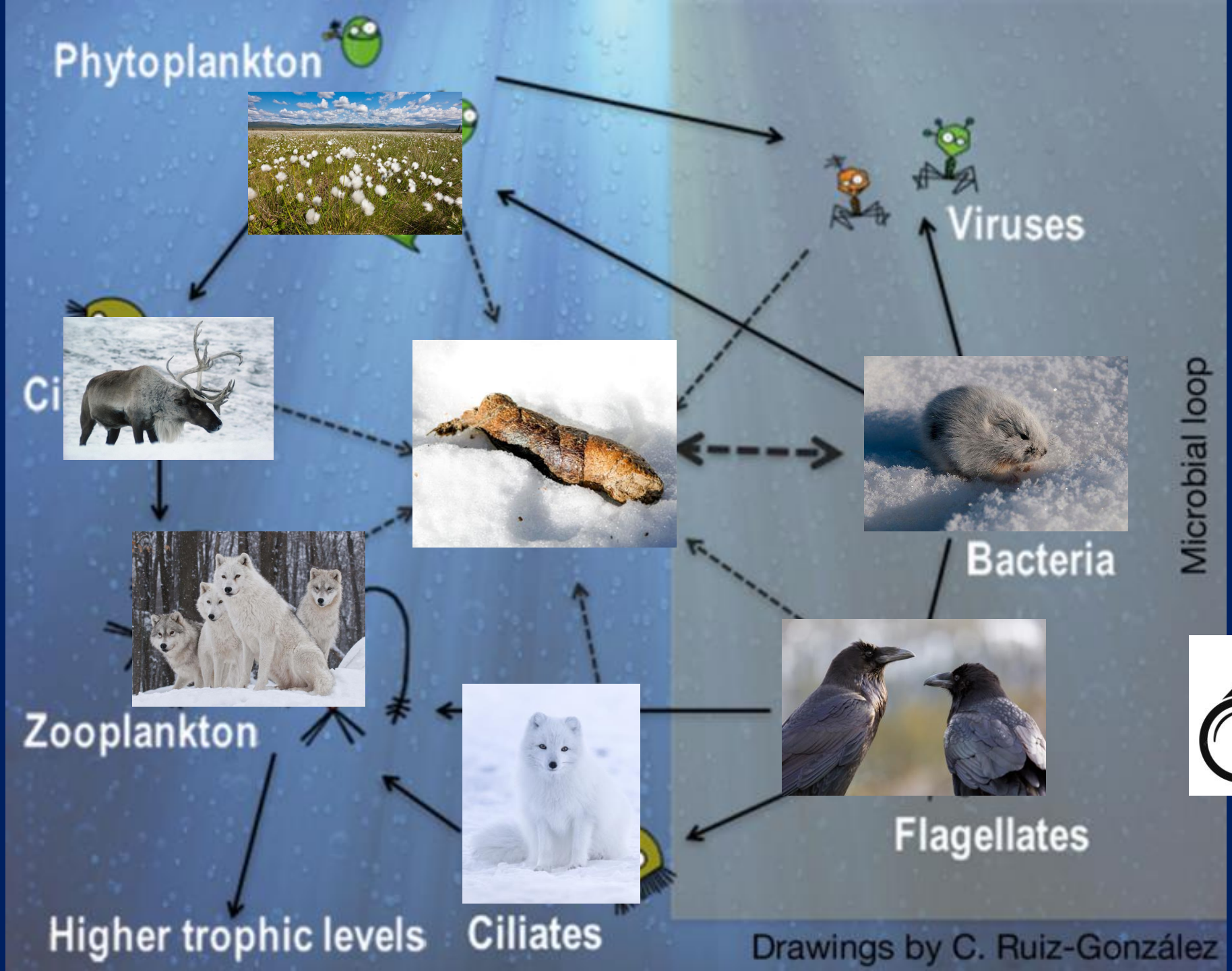
Plankton


Phytoplankton
Viruses
Ciliates
Dissolved Organic Carbon
Bacteria
Microbial loop
Zooplankton
Flagellates
Higher trophic levels
Ciliates
Drawings by C. Ruiz-González



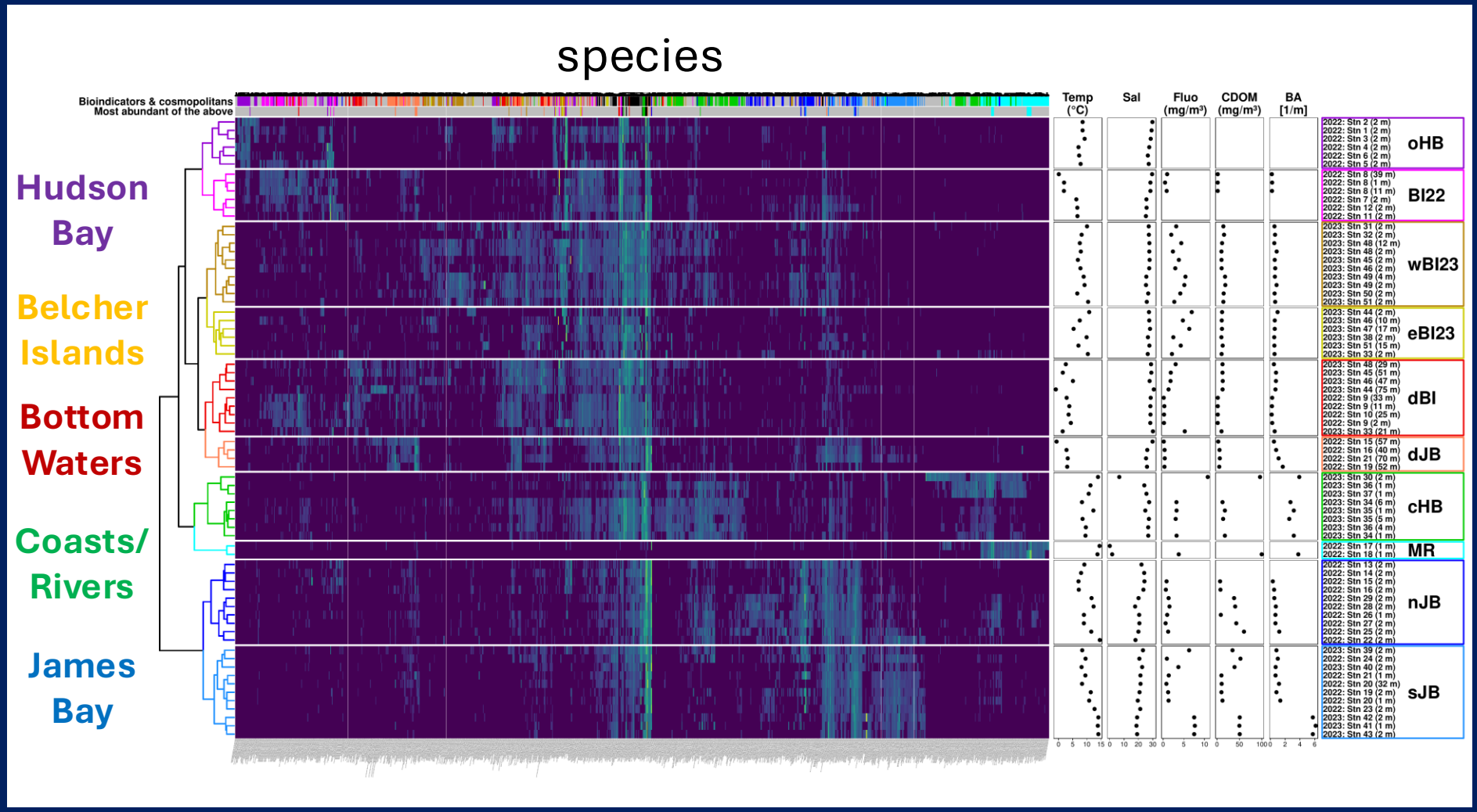





Phytoplankton
Viruses
Ci
Bacteria
Microbial loop
Zooplankton
Flagellates
Higher trophic levels
Ciliates
Drawings by C. Ruiz-González

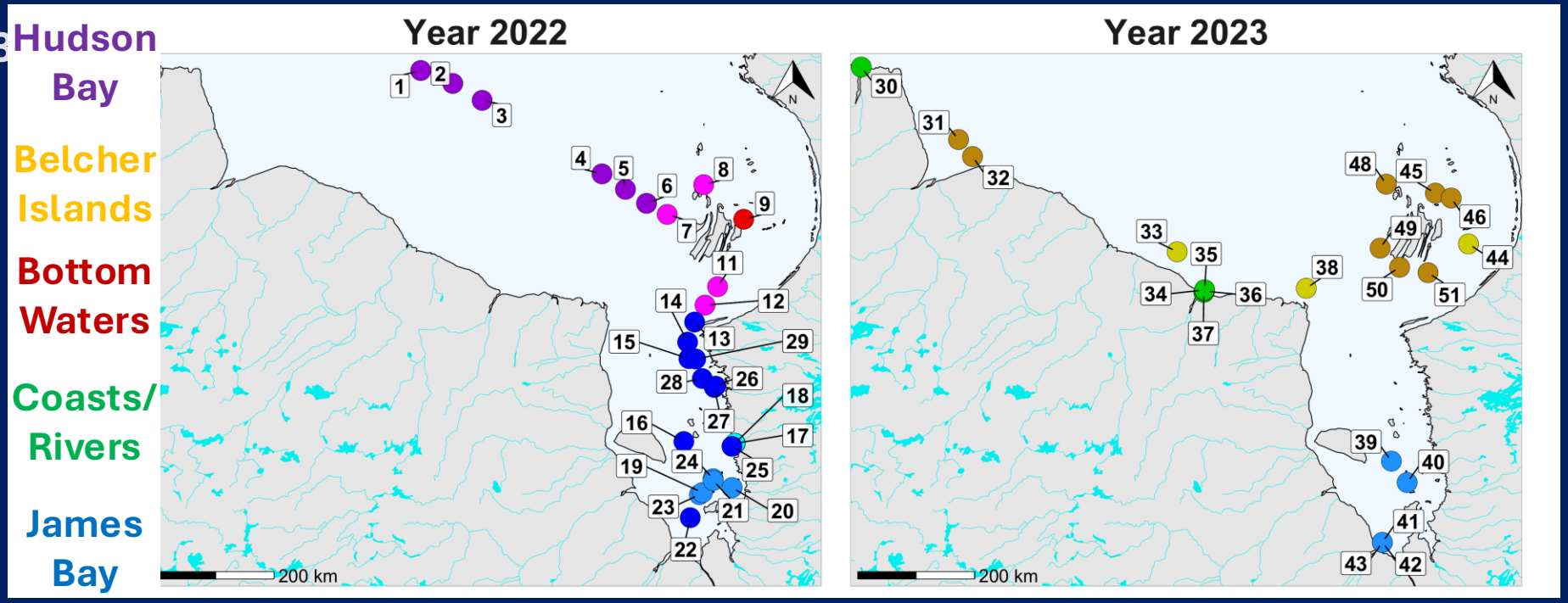
We Found Five Distinct Plankton Communities

- Detected over 1000 species of plankton
- Identified 5 significant clusters segregated by area, depth, and year
- **James Bay clusters form a distinct group from Hudson Bay clusters**



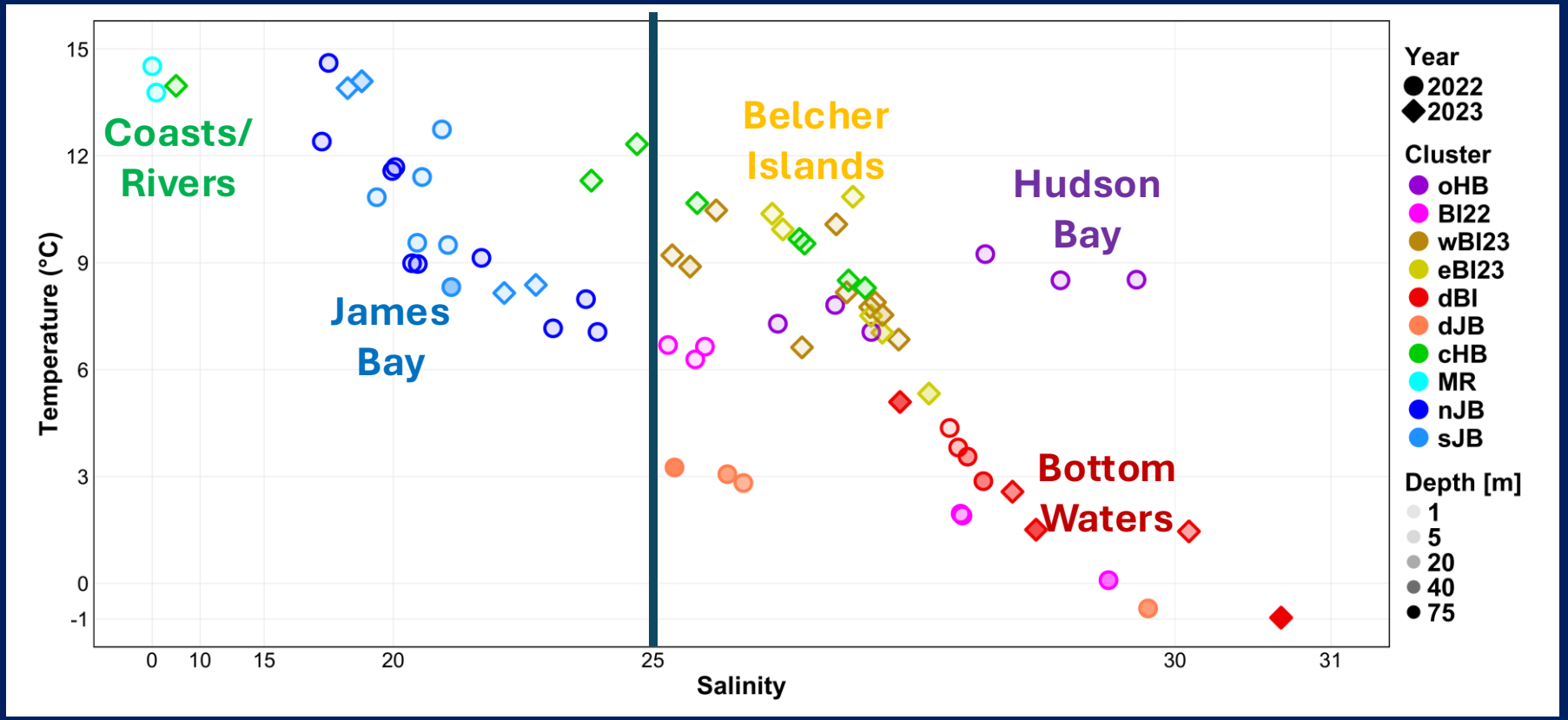
Communities Were Specific to Each Place

- **Belcher Islands communities different between 2022 and 2023**
- Transition between Southern and Northern James Bay
- Transition between James Bay and Belcher Islands
- Transition between Belcher Islands and Hudson Bay



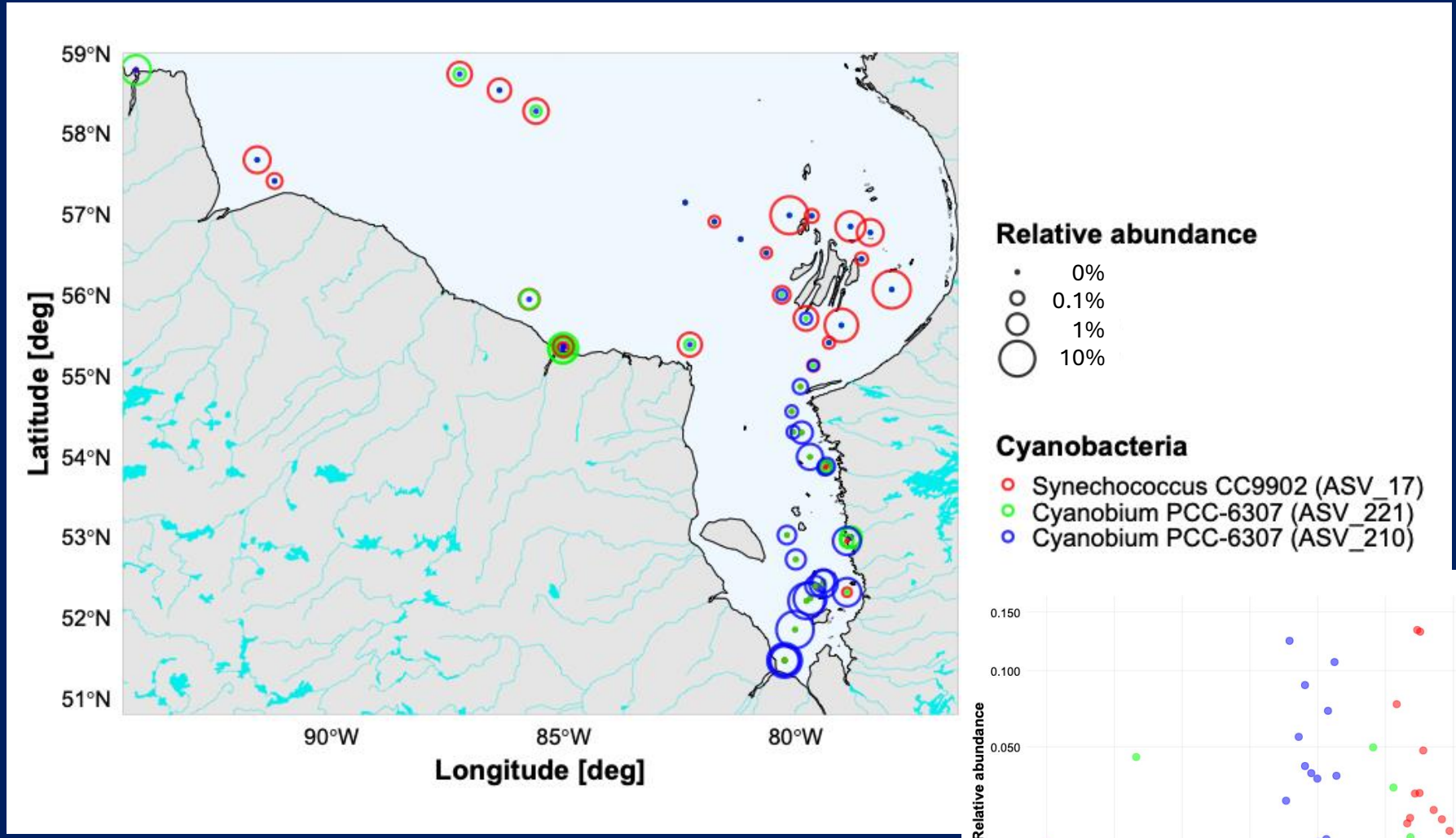
Temperature and Salinity Are Important Qualities

- Strong temperature–salinity gradient separates clusters
- **Large community transition at a salinity of 25**
- Large community transition between surface and deep waters



Cyanobacteria Species Distribution

- These are harmless species that don't cause Harmful Algae Blooms
- **Large community transition at a salinity of 25**
-



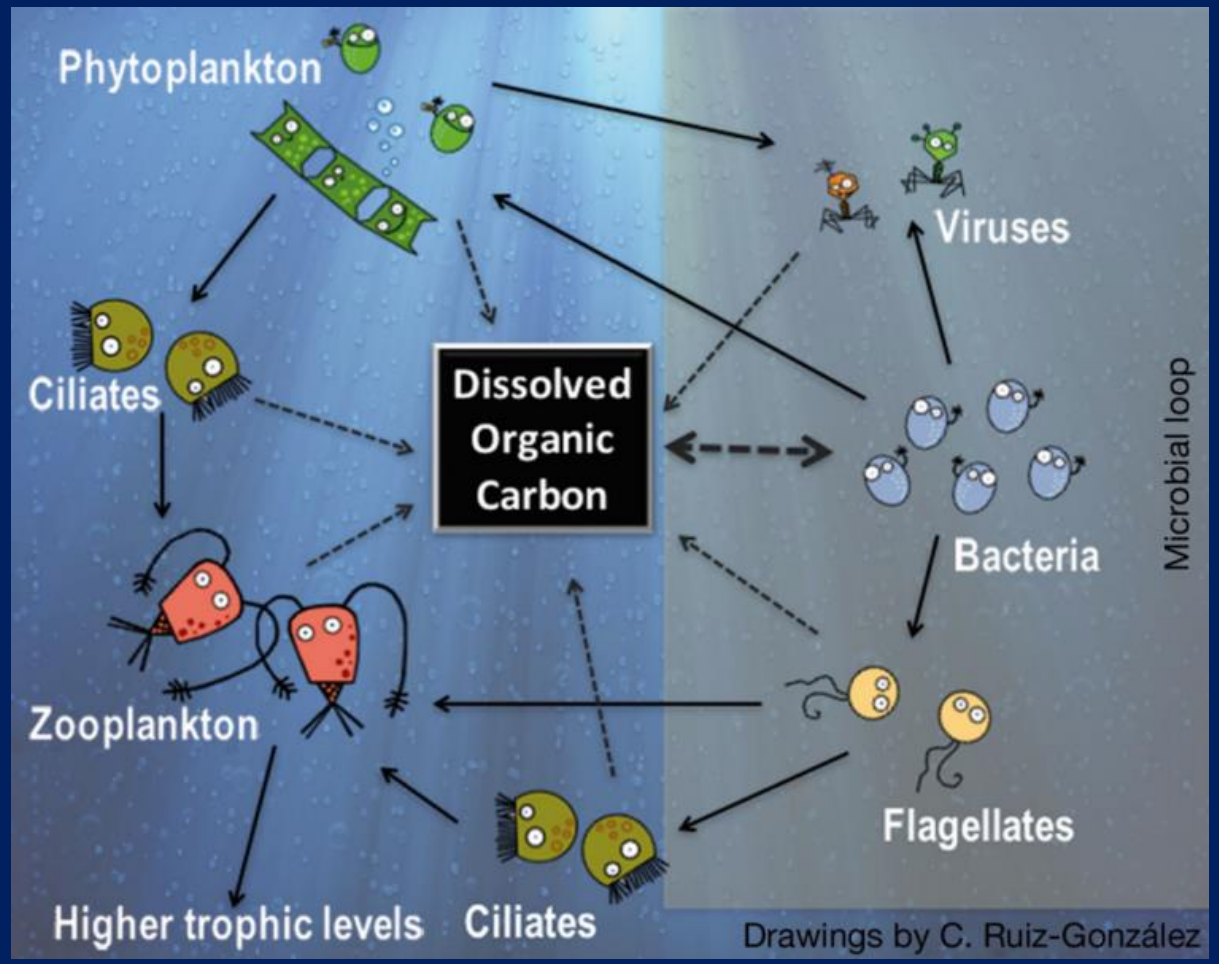
Conclusions

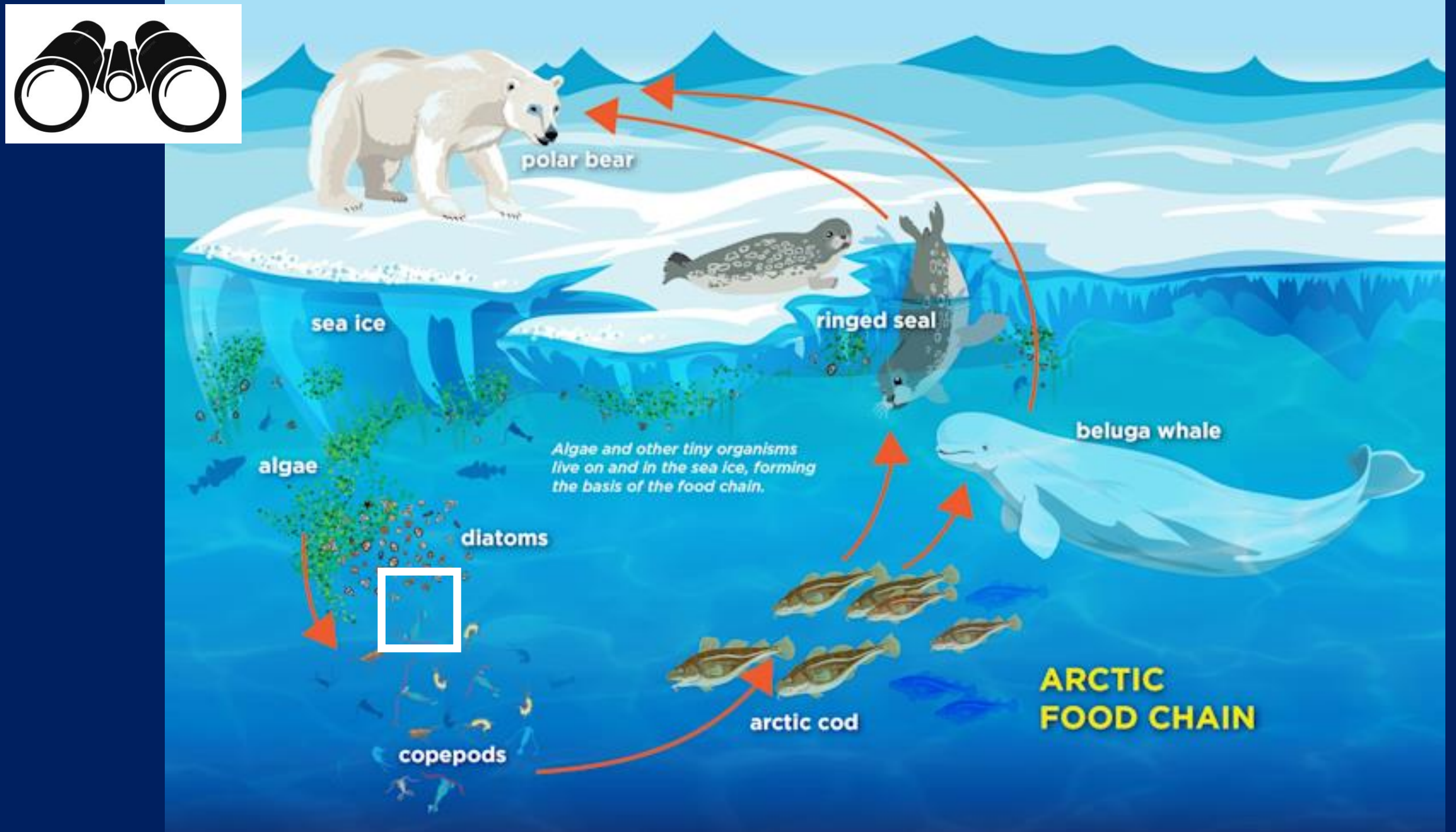
What We Learned:

- Five distinct plankton communities identified across southern HB and JB
- Salinity and temperature are the primary environmental drivers, reflecting the freshwater–marine gradient
- River-influenced waters harbor unique freshwater-associated taxa absent elsewhere

Future Research:

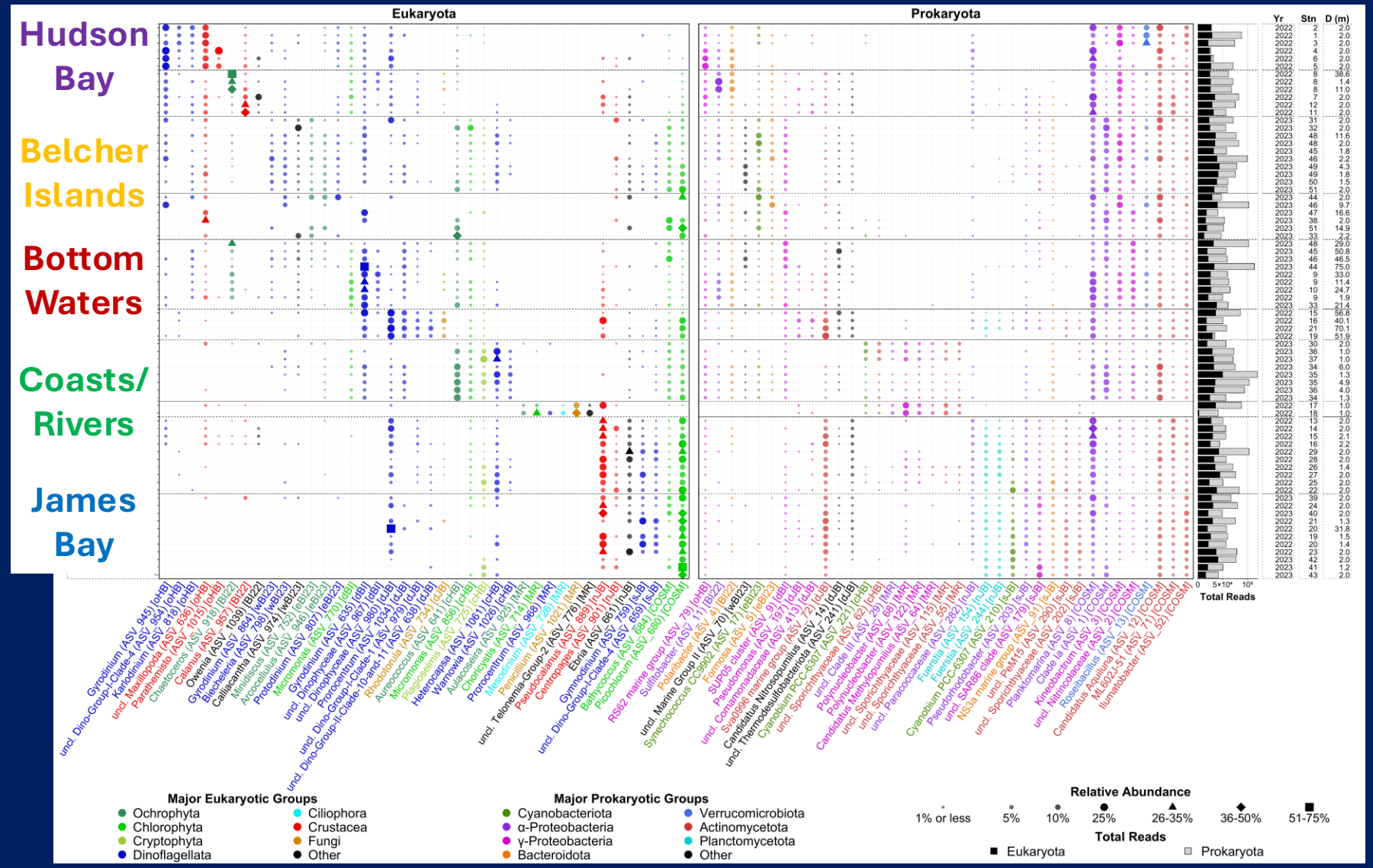
- Interannual shifts observed around Belcher Islands (2022 vs 2023 communities differ markedly)
- Most variability remains unexplained — biological interactions, nutrients, and sea ice history likely contribute




polar bear
sea ice
ringed seal
beluga whale
algae
Algae and other tiny organisms live on and in the sea ice, forming the basis of the food chain.
diatoms
copepods
arctic cod
ARCTIC FOOD CHAIN

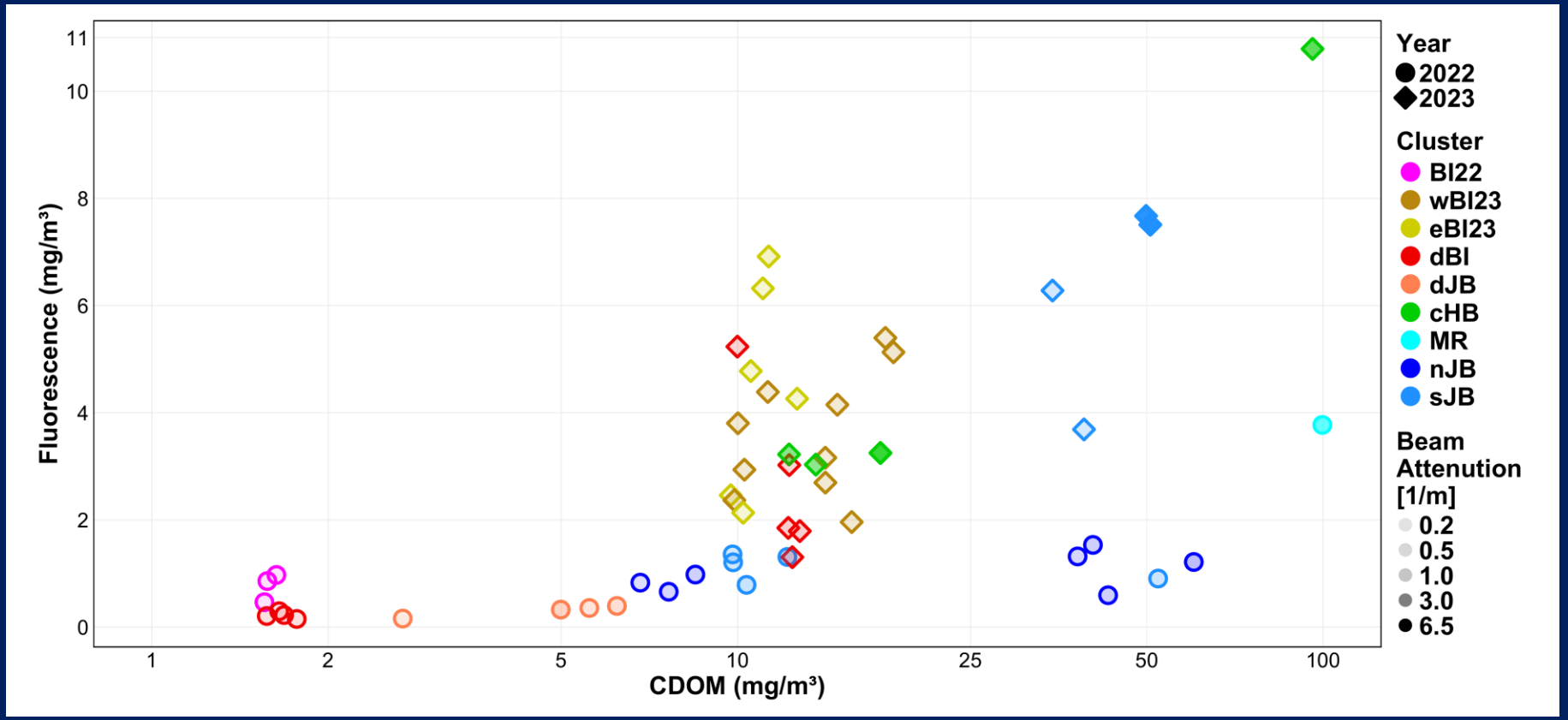
Bioindicators – Species to Monitor

- Each cluster has signature protist and bacterial taxa
- oHB: Gyrodinium, Karlodinium; BI22: Chaetoceros, Calanus
- cHB: Aureococcus (**harmful alga**?), Plagioselmis, Cyanobium
- MR: Aulacoseira, Polynucleobacter — exclusive to this freshwater
- Cosmopolitans: Bathycoccus,

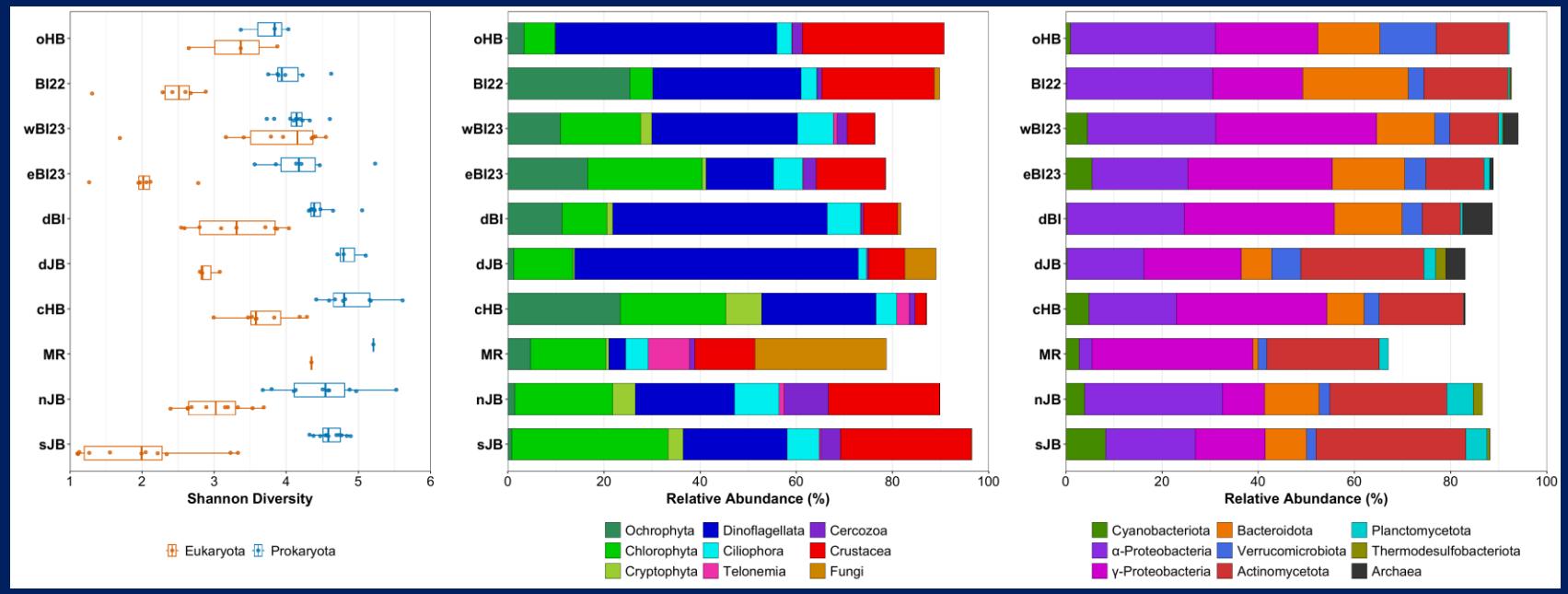


Optical Properties: CDOM and Fluorescence

- River-influenced clusters (MR, cHB, sJB) have highest CDOM (10–100 mg/m^3)
- 2023 Belcher Islands (wBI23, eBI23, cHB) showed elevated fluorescence
- cHB and sJB have highest beam attenuation — turbid, productive waters
- Positive CDOM–fluorescence relationship across all clusters



Plankton Diversity and Community Composition



- Eukaryotic diversity varies by geography, not broad gradients

  — wBI23 > eBI23; nJB > sJB (>2× and >1.5× median Shannon)

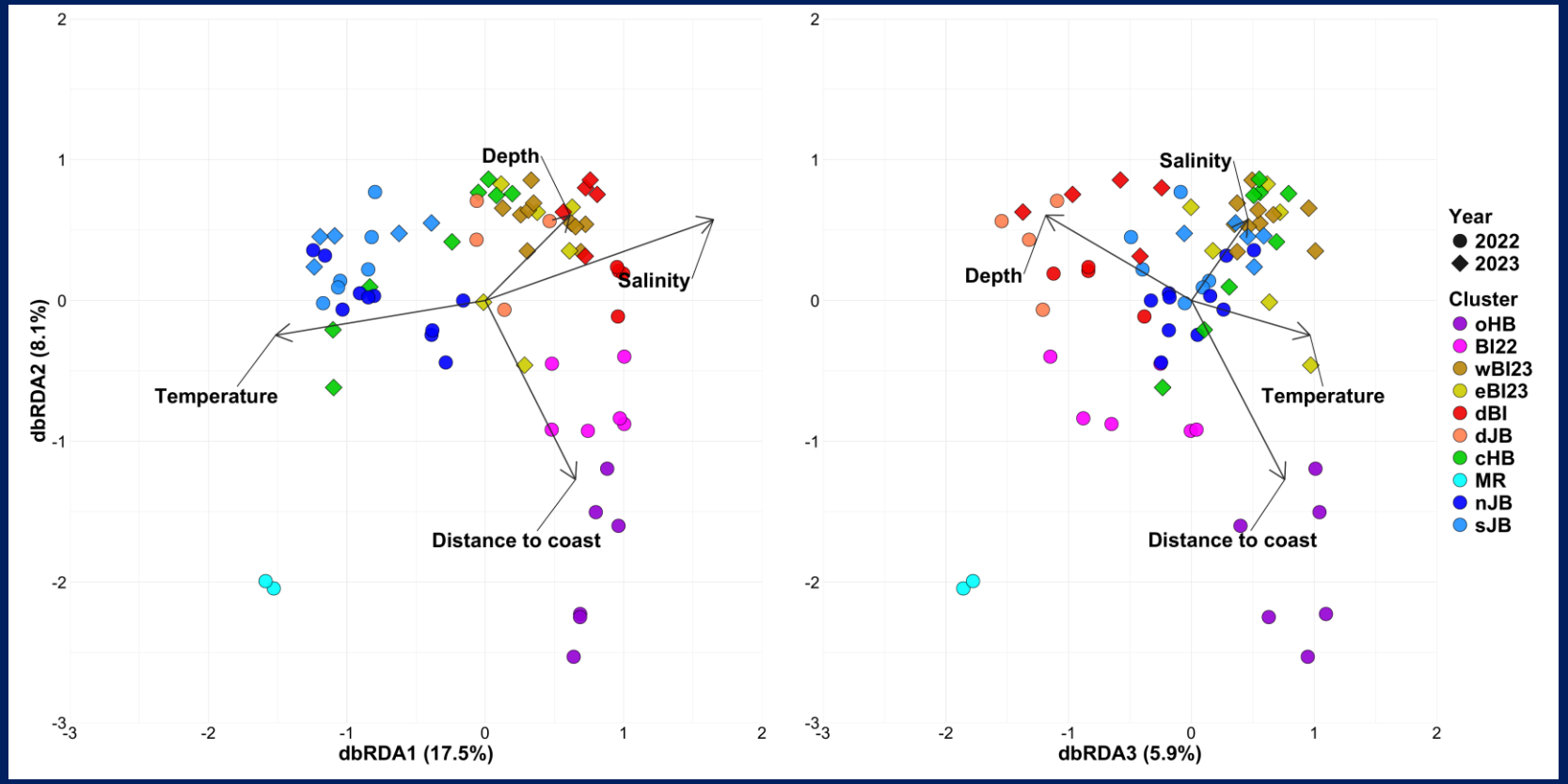
- Prokaryotic diversity increases toward coast (ρ = −0.47 with distance)

- Dinoflagellates dominate offshore/deep (45–59%); Chlorophyta peak in sJB (33%)

- Proteobacteria prevalent in HB (49–60%); Actinomycetota dominant in

Environmental Drivers (db-RDA)

- Model explains 34% of total variance (adj. R^2)
- dbRDA1 (17.5%): Temperature vs. salinity — separates JB from HB
- dbRDA2 (8.1%): Distance to coast — separates offshore oHB
- MR strongly associated with low salinity
- nJB↔sJB and wBI23↔eBI23 overlap — unmeasured drivers at play
- cHB transitional between JB and BI23 communities

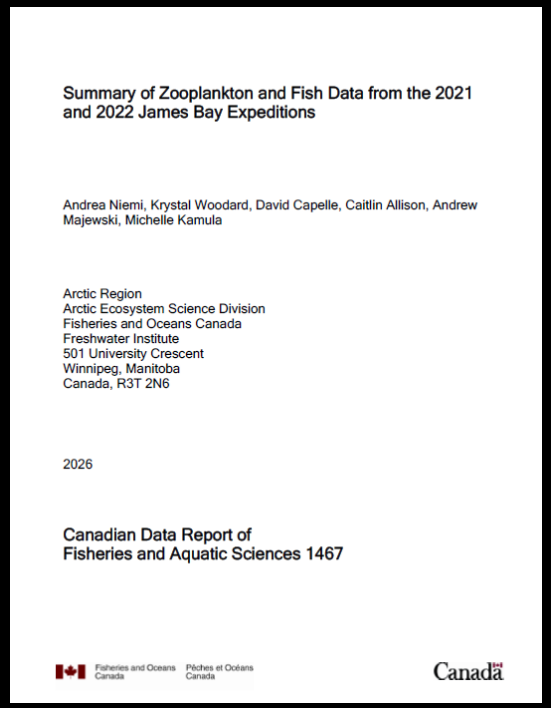


2021 & 2022 FISH & ZOOPLANKTON

James Bay

Fisheries and Oceans Canada

Presented by Krystal Woodard



Summary of Zooplankton and Fish Data from the 2021 and 2022 James Bay Expeditions

Andrea Niemi, Krystal Woodard, David Capelle, Caitlin Allison, Andrew Majewski, Michelle Kamula

Arctic Region
Arctic Ecosystem Science Division
Fisheries and Oceans Canada
Freshwater Institute
501 University Crescent
Winnipeg, Manitoba
Canada, R3T 2N6

2026

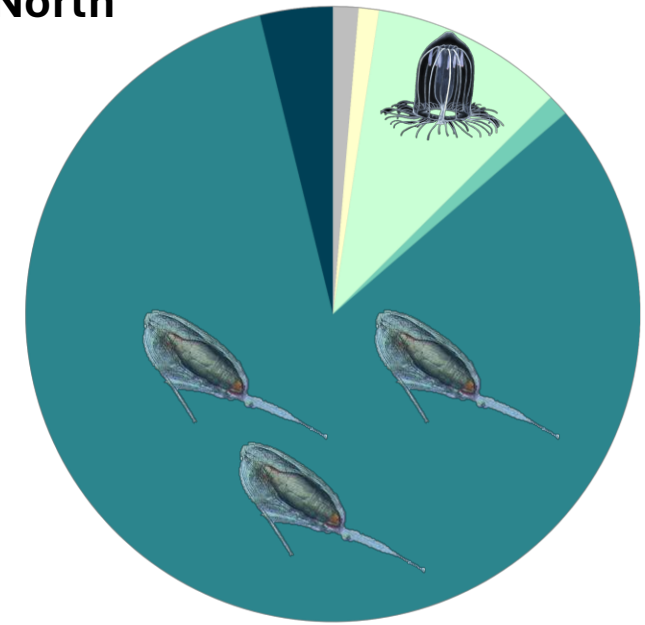
Canadian Data Report of
Fisheries and Aquatic Sciences 1467

Fisheries and Oceans Canada Pêches et Océans Canada

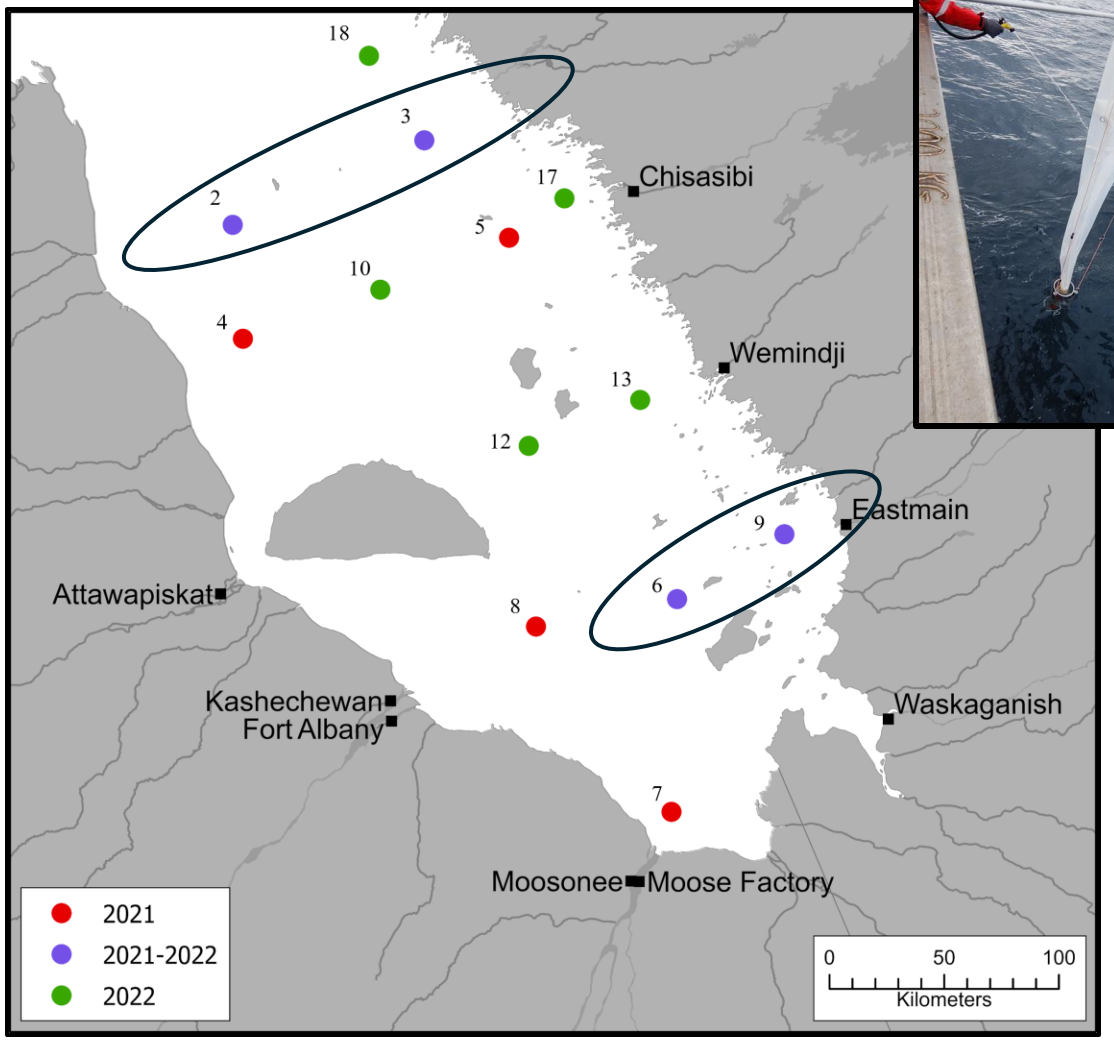
Canada

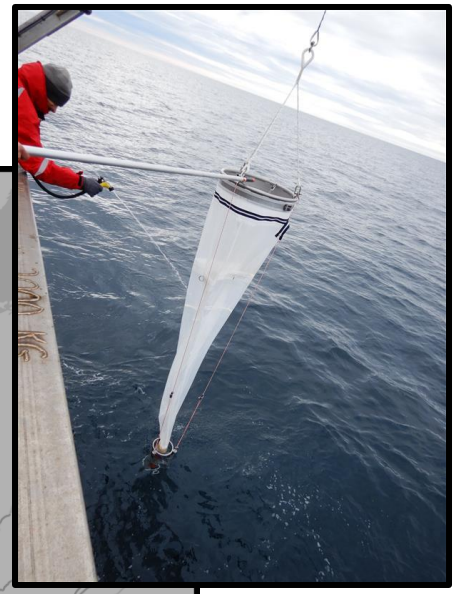
Zooplankton 2021

North

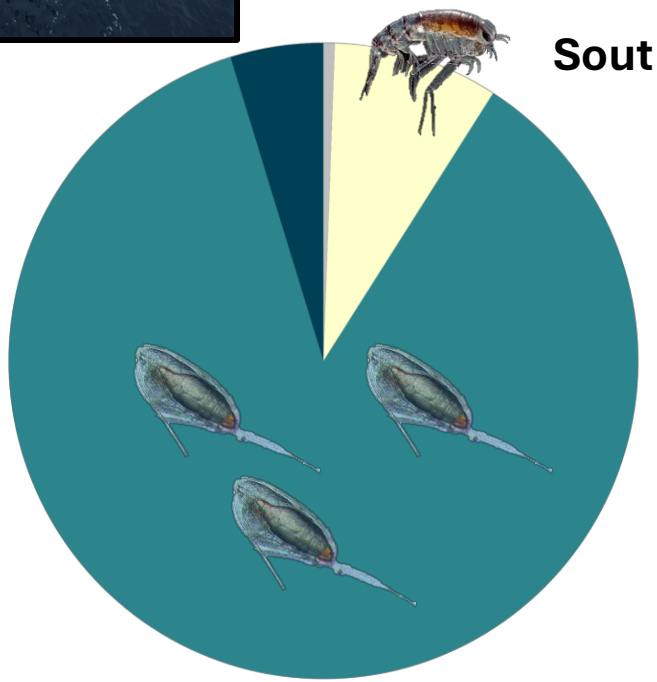


N species = 16
Total biomass = 44.55 mg/m^3





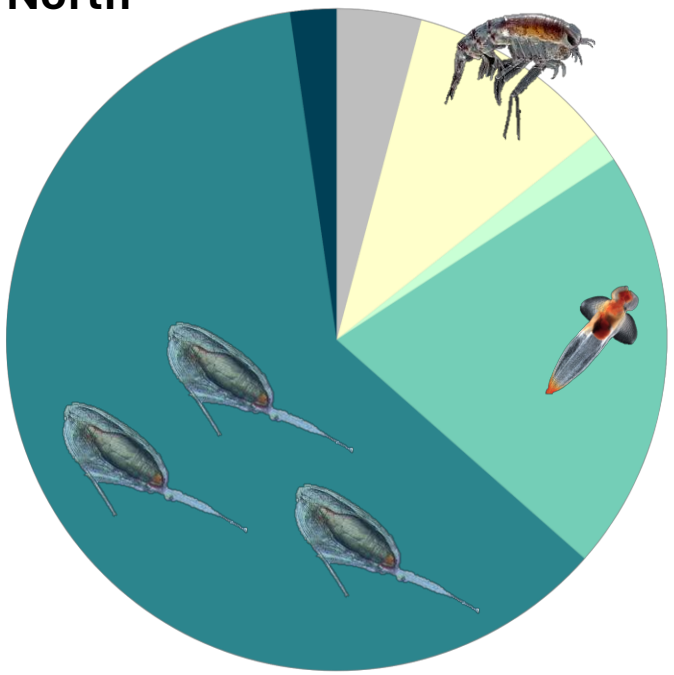
South



N species = 16
Total biomass = 74.97 mg/m^3

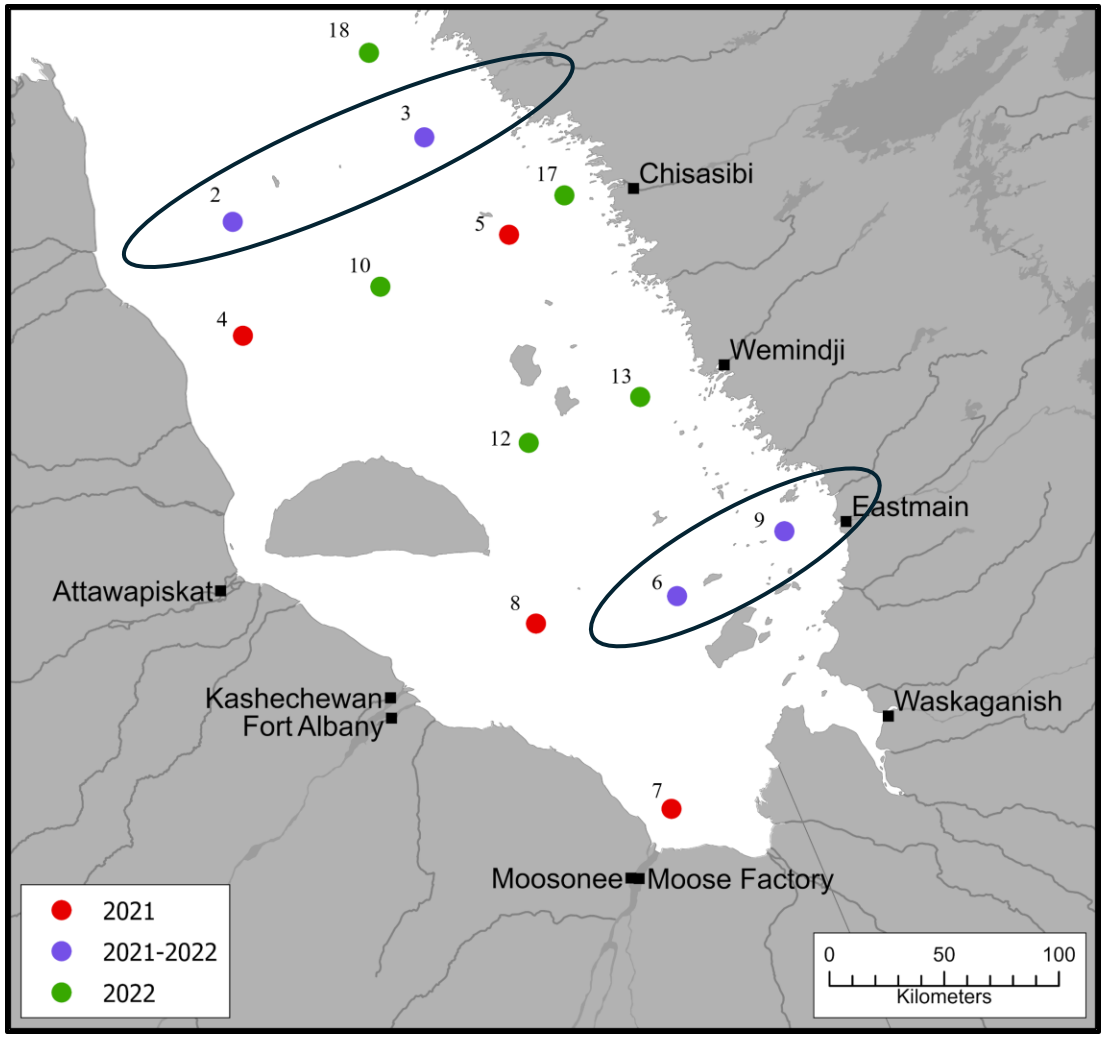
Zooplankton 2022

North



N species = 26

Total biomass = 92.15 mg/m^3



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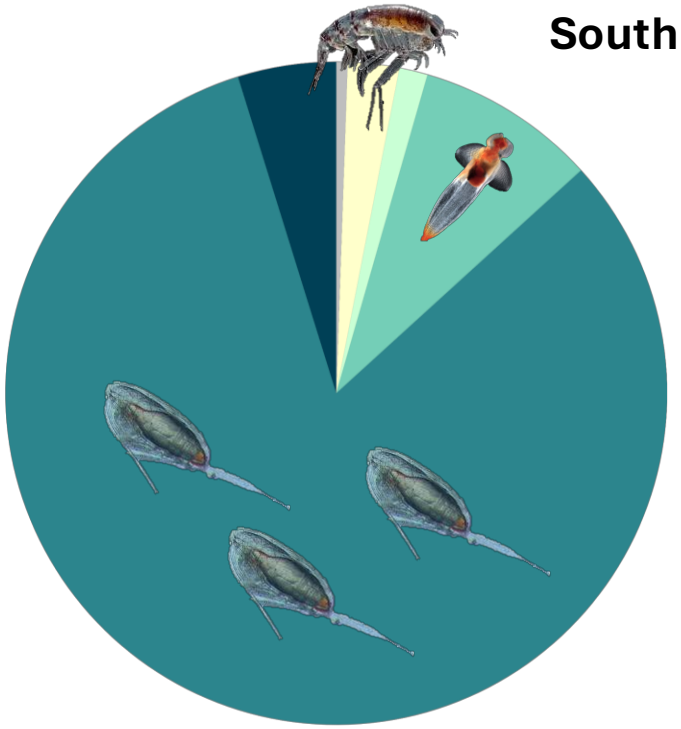
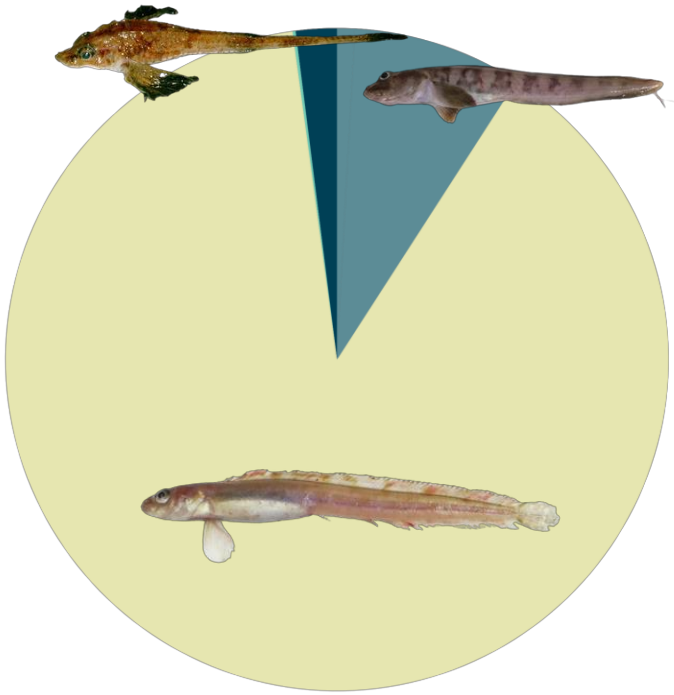


N species = 25

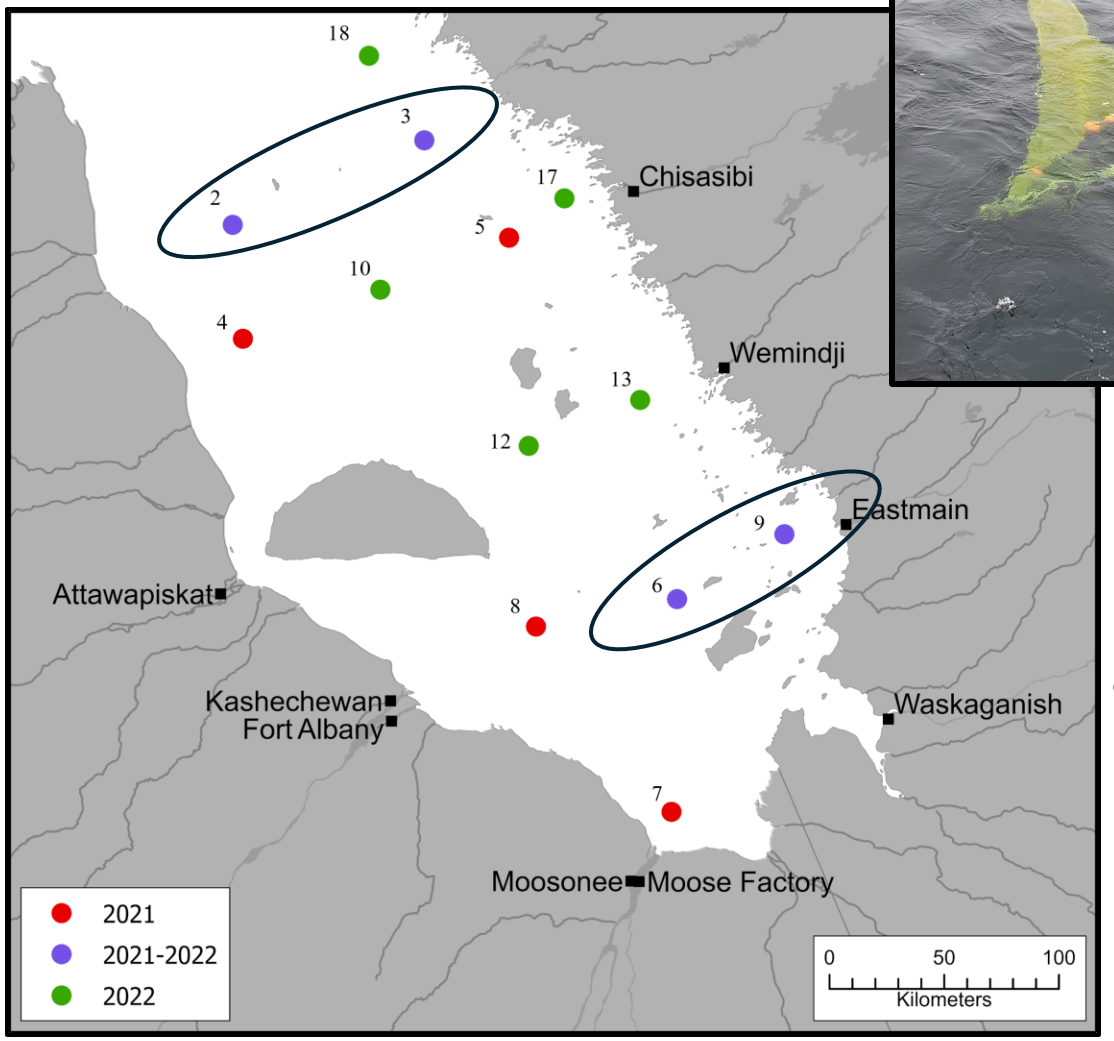
Total biomass = 119.27 mg/m^3

Fish 2021

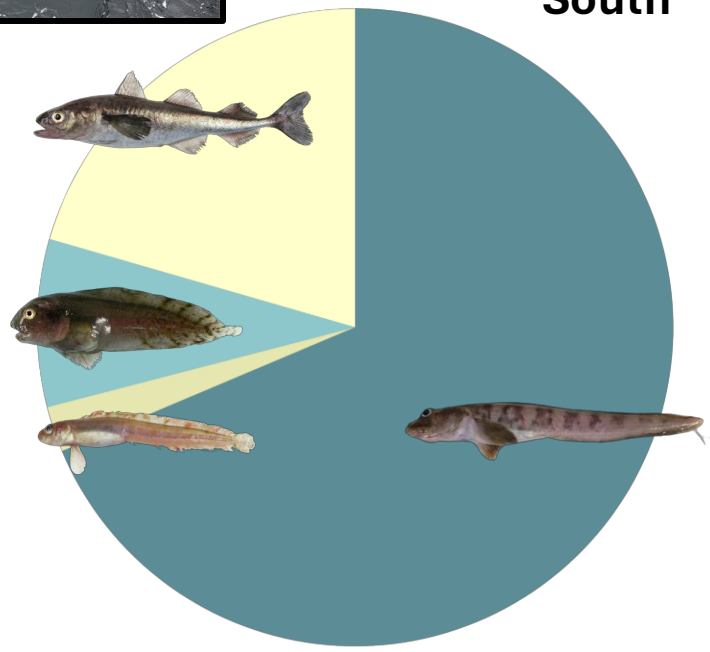
North



N species = 4



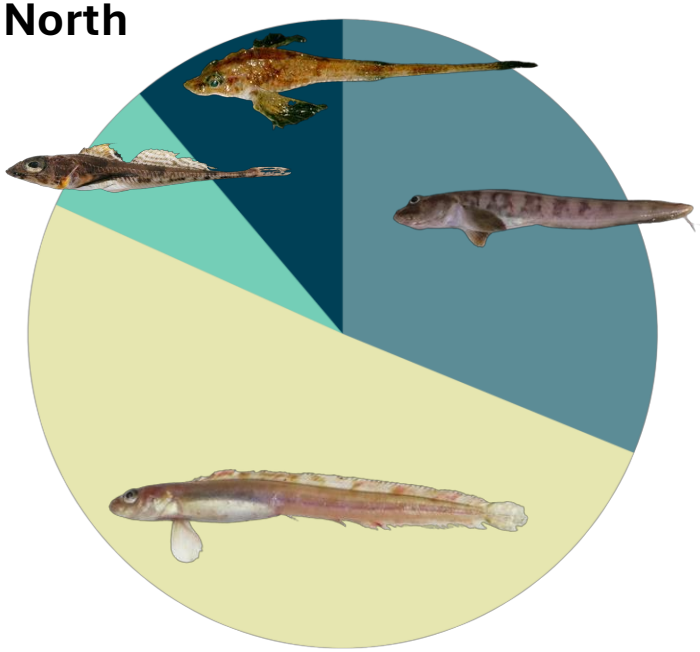
South



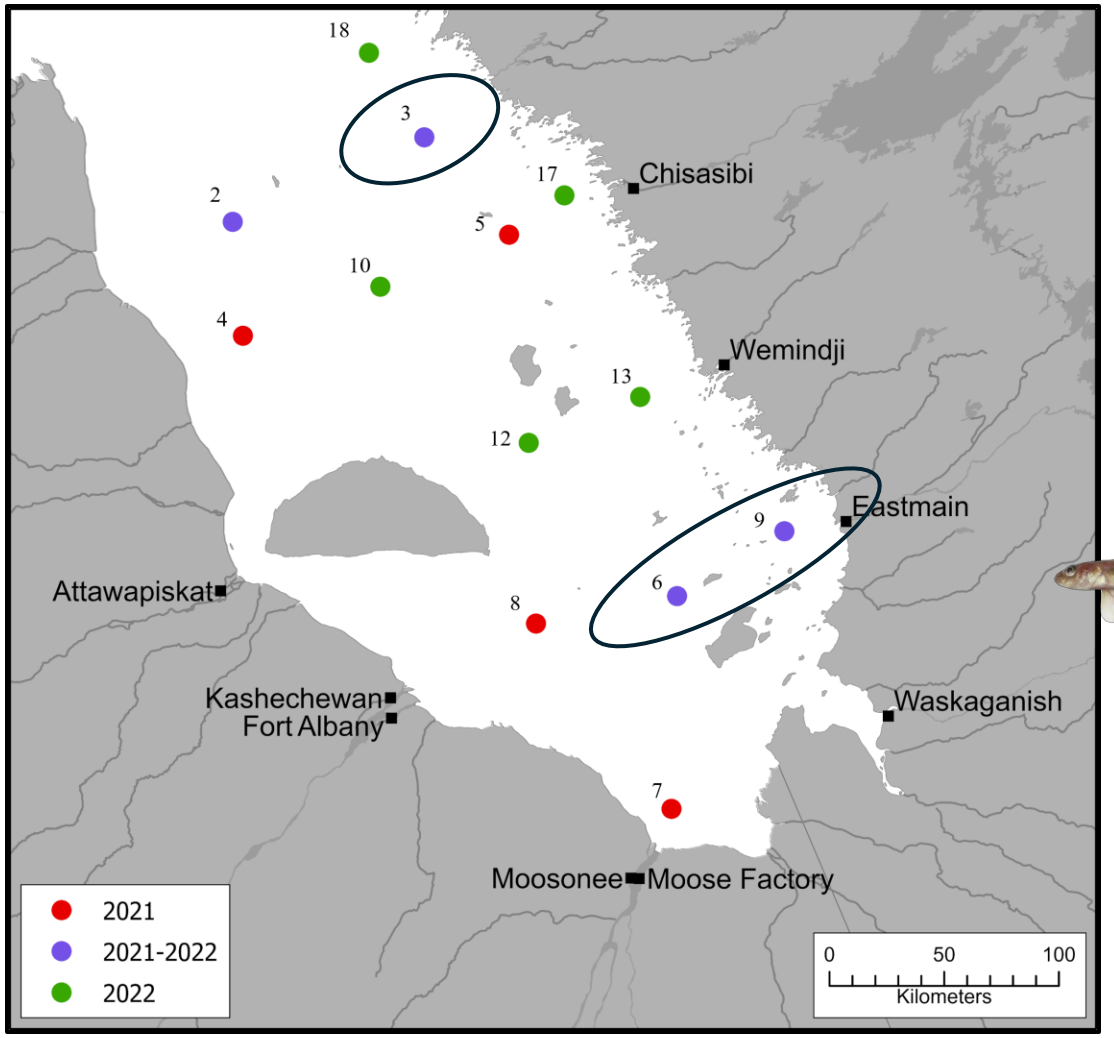
N species = 6

Fish 2022

North



N species = 6



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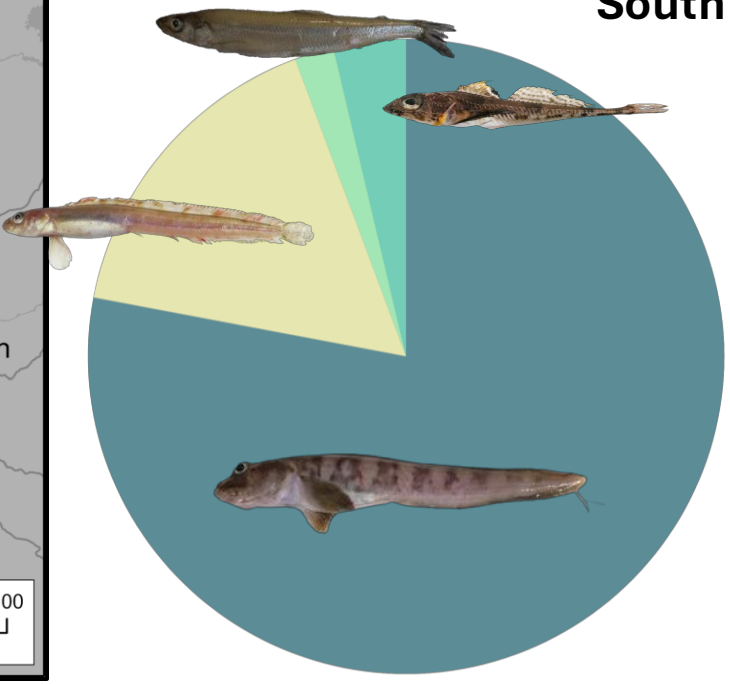


N species = 10

2023 FISH, BENTHOS & ZOOPLANKTON

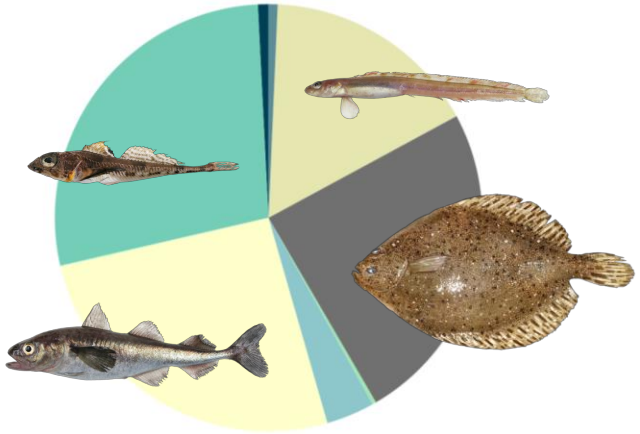
Southern Hudson Bay

Fisheries and Oceans Canada

Presented by Natalie Vachon

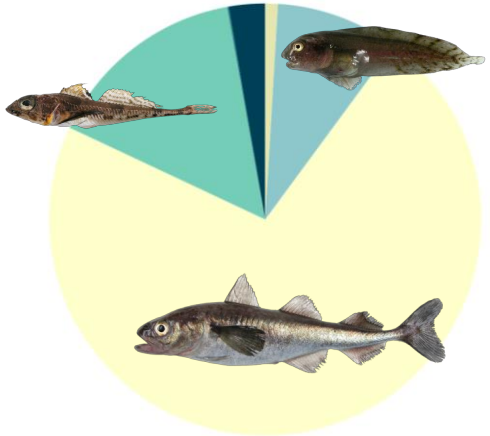
Fish 2023

North

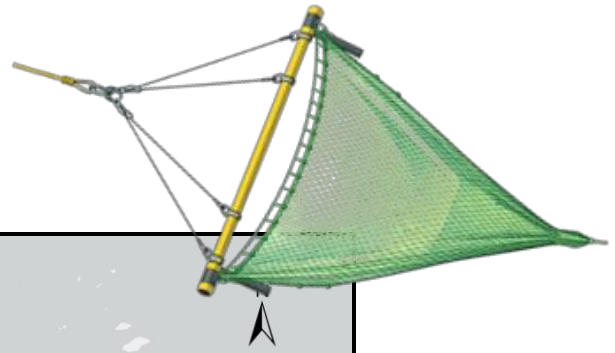


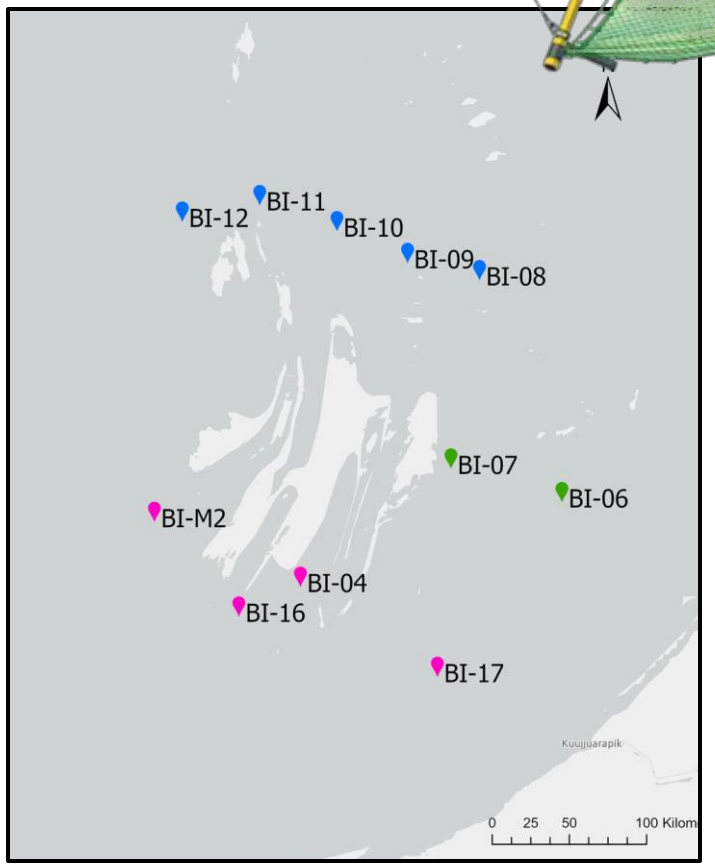
N species = 21
Total biomass = 92.33 mg/m^2

South

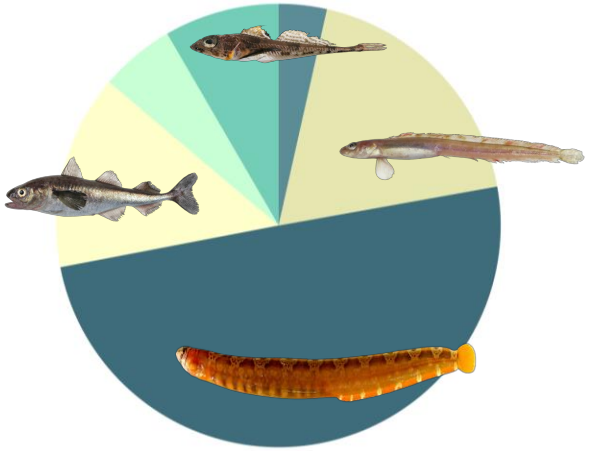


N species = 9
Total biomass = 259.36 mg/m^2





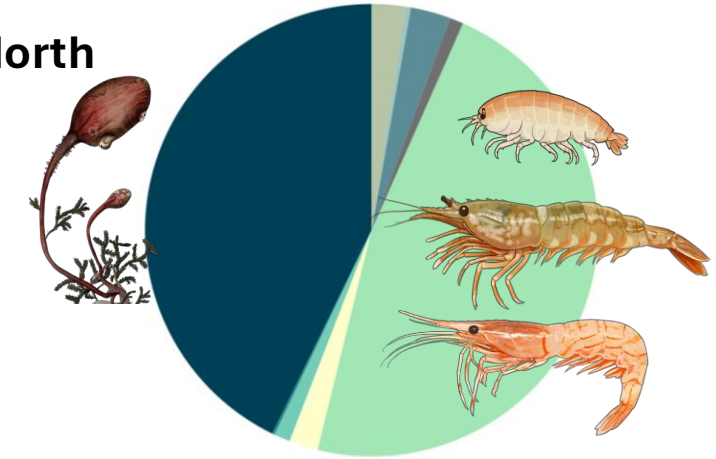
East



N species = 6
Total biomass = 11.31 mg/m^2

Invertebrates 2023

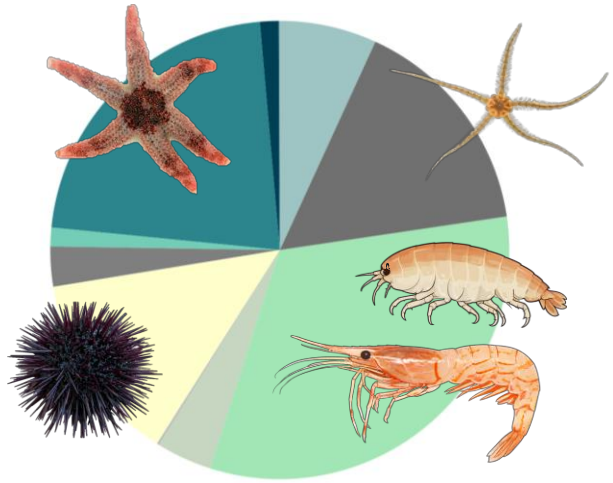
North



N species = 51

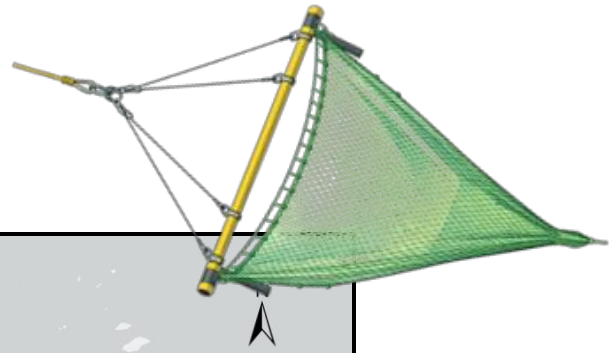
Total biomass = 362.53 mg/m^2

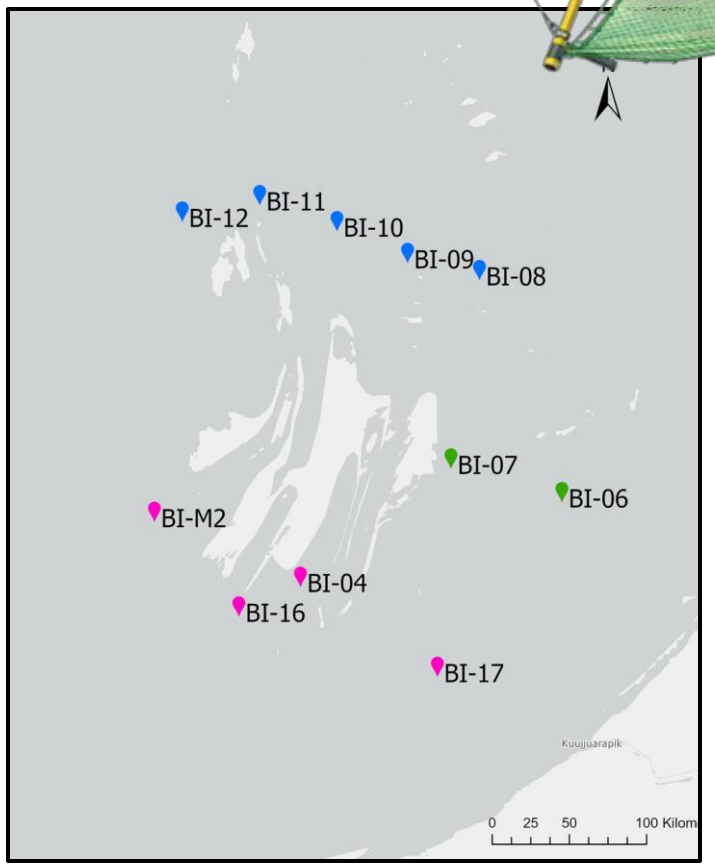
South



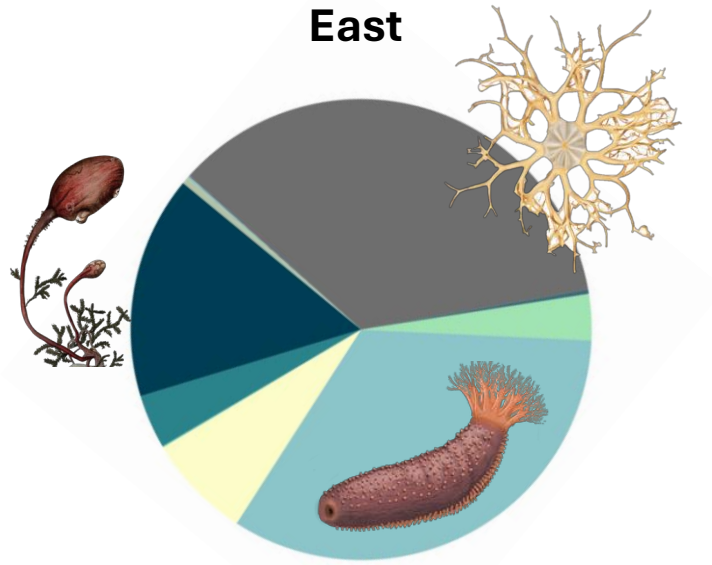
N species = 53

Total biomass = 336.25 mg/m^2





East

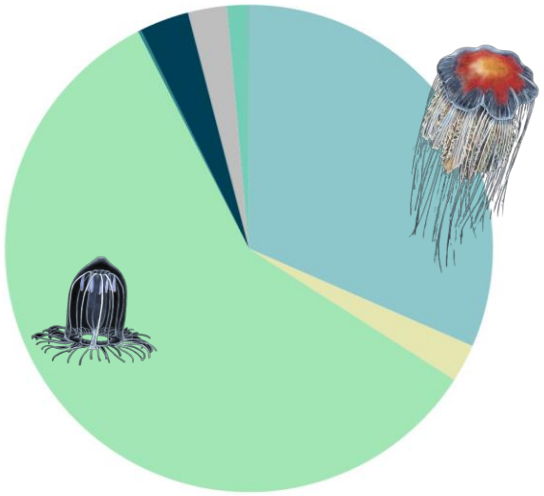


N species = 49

Total biomass = 1391.14 mg/m^2

Zooplankton 2023

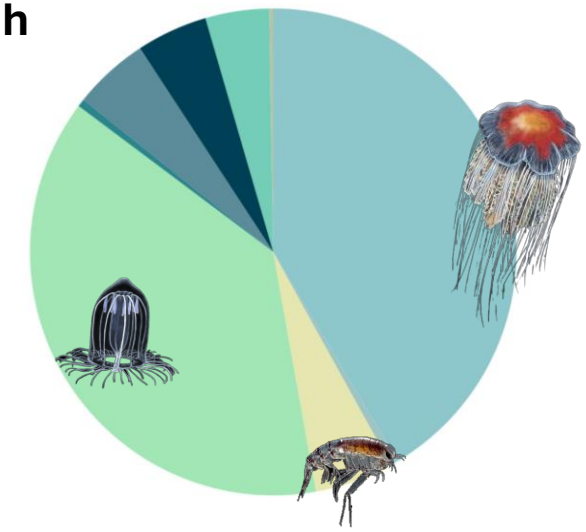
North



N species = 16

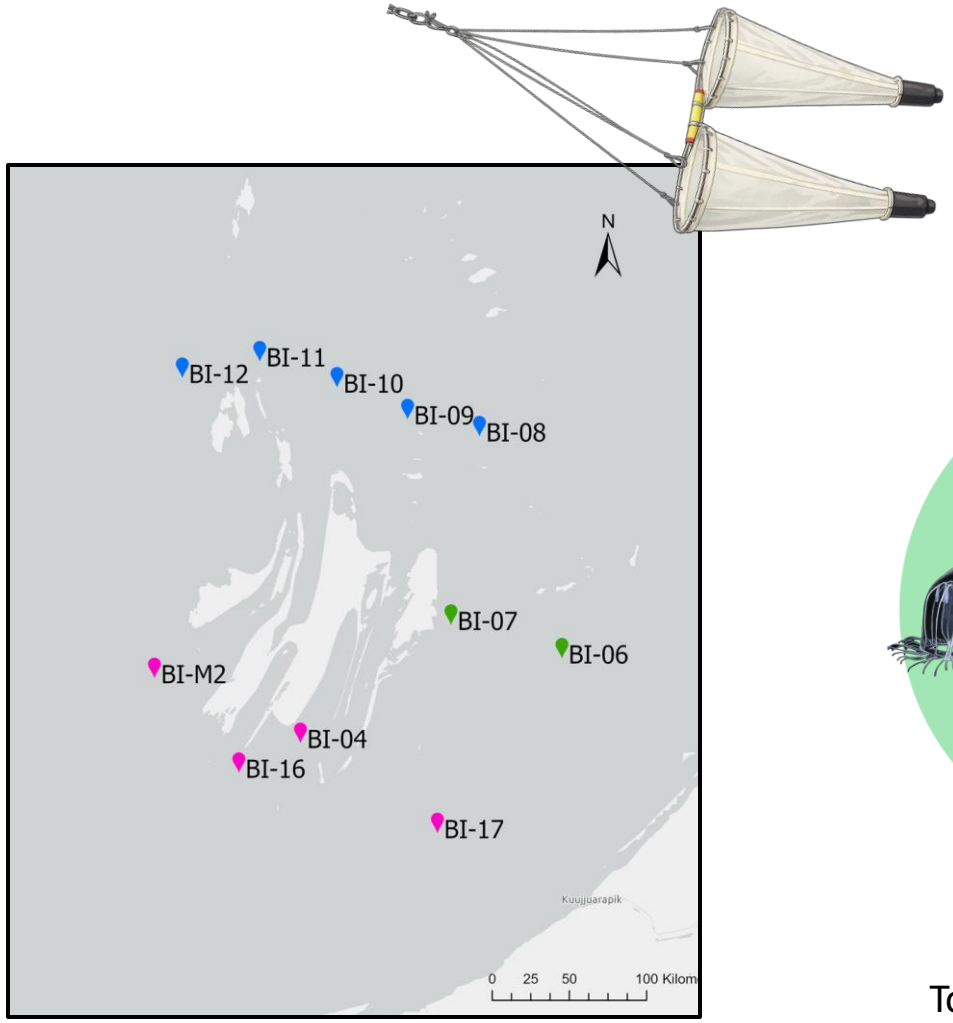
Total biomass = 140.61 mg/m^3

South

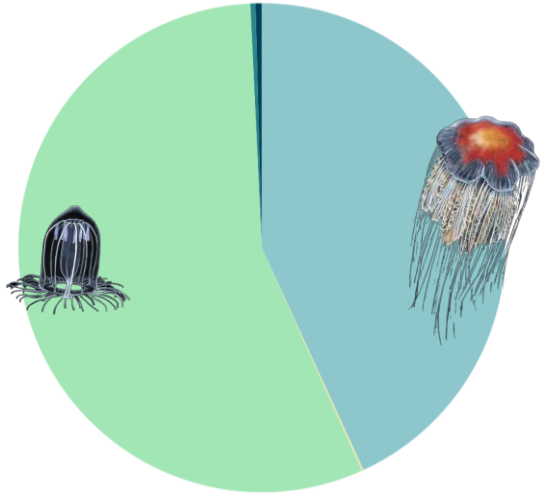


N species = 20

Total biomass = 45.67 mg/m^3



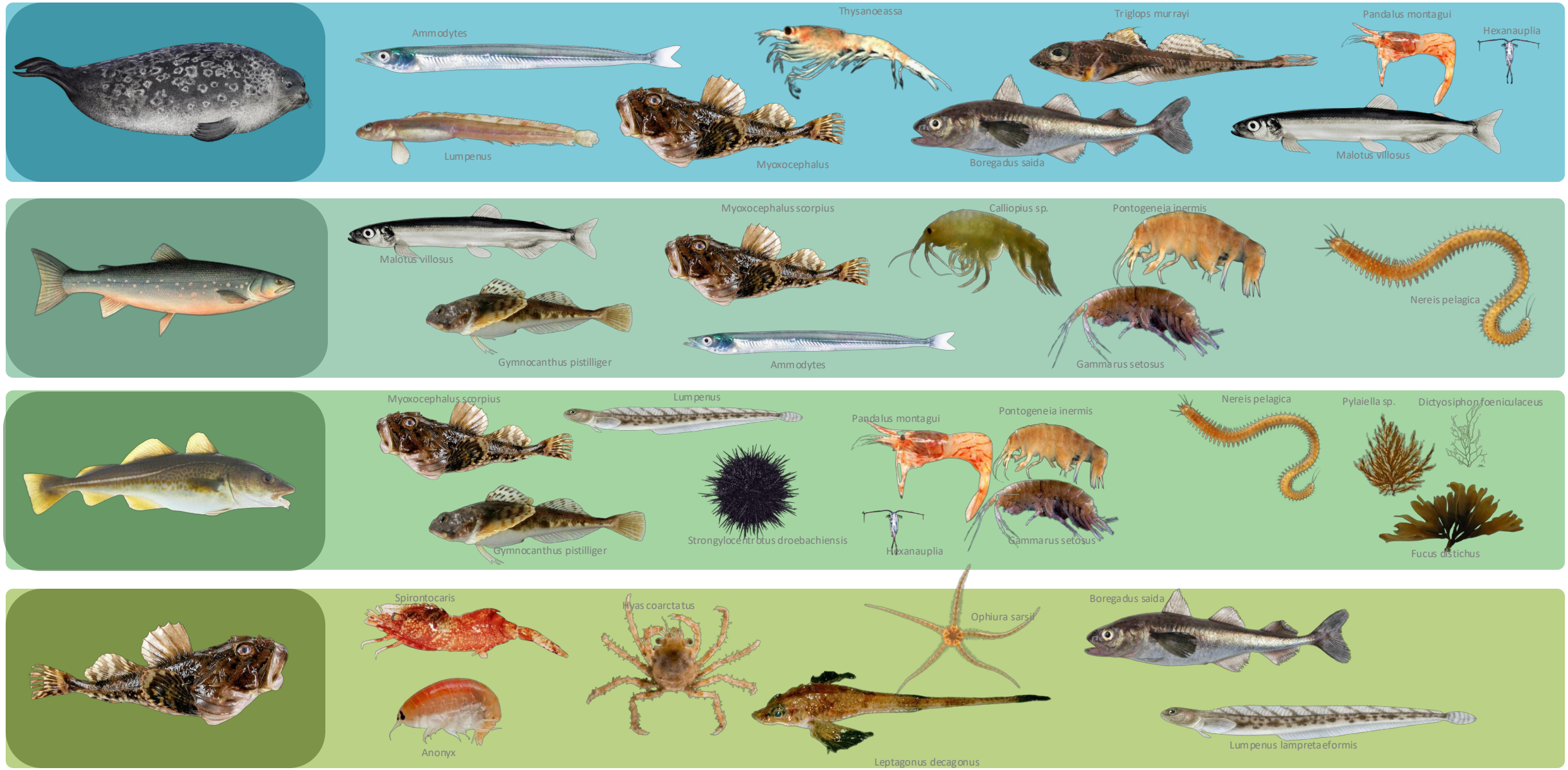
East



N species = 8

Total biomass = 123.15 mg/m^3

Stomach contents



What did we learn?

- Annual variation observed in zooplankton biomass in James Bay
- Fish and zooplankton diversity differs between James Bay and southern Hudson Bay
- Fish and invertebrates are using more ice algae north of the islands

What's next?

- Continue studying how changing ice and environmental conditions affect the food webs

Assessing the James Bay beluga whale population through passive acoustic monitoring to outline seasonal presence

Presented by: Abigail Long

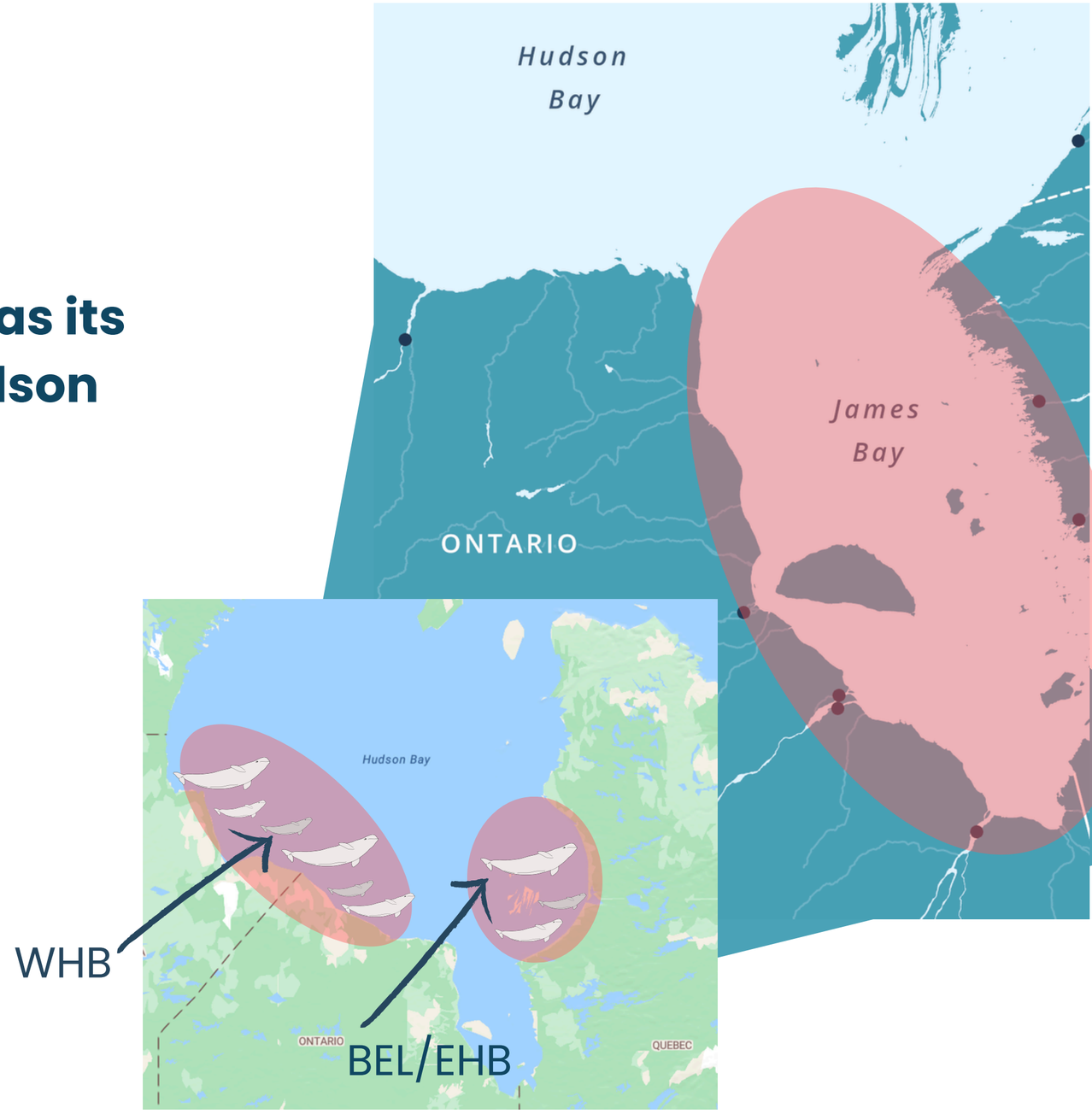
Photo by Bryanna Sherbo

University of Manitoba
Centre for Earth Observation Science
Fisheries and Oceans Canada
Pêches et Océans Canada

The James Bay beluga were declared as its own, separating from the western Hudson Bay population.

The new population structure was officially accepted by The Committee on the Status of Endangered Wildlife in Canada, and renamed in November **2020**.

.... observed that these beluga were NOT migrating

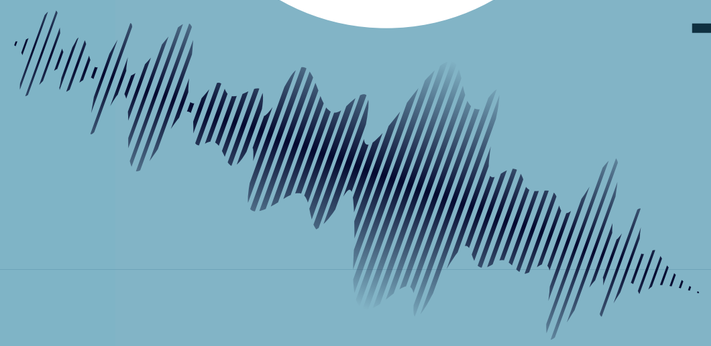


MOORING

Attached to the mooring is a **hydrophone**, which functions as an underwater microphone

→ **recorded for 7 mins every hour**

→ **192 kHz**



belugas can vocalize betwwen 0 and 120 kHz

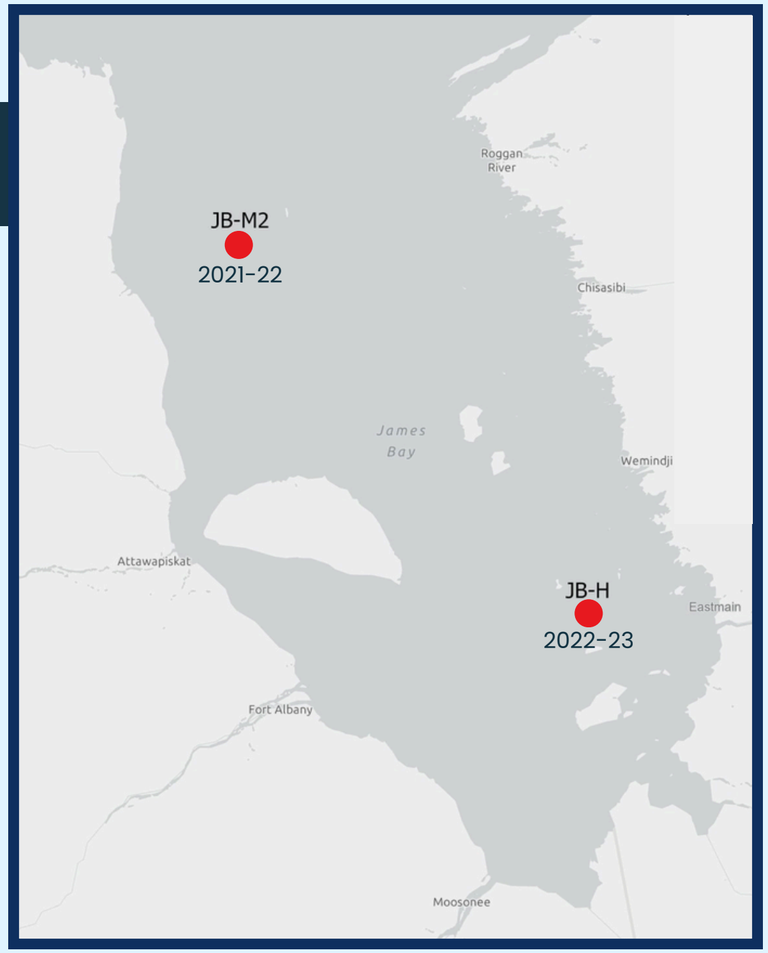
Also attached can be environmental sensors to understand the surrounding environment such as salinity

Determining the year-round presence of the James Bay beluga whale population through click detections

O B J E C T I V E S

1. **Determine the year round presence** of beluga using click vocalizations.

2. Examine the **effects of sea ice concentration, sea surface temperature and salinity on presence.**

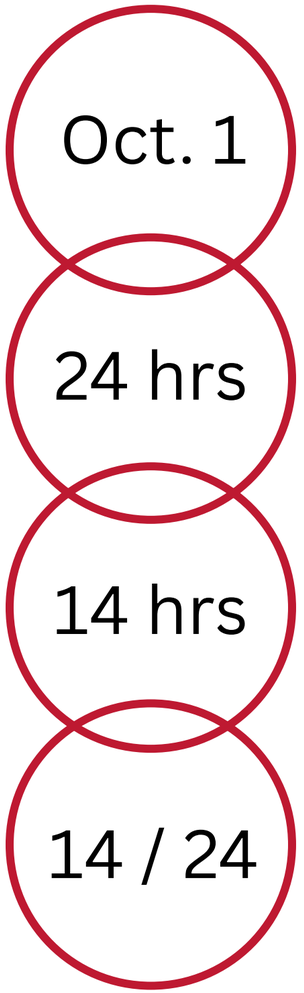


to understand presence per day we calculated: daily proportion of presence

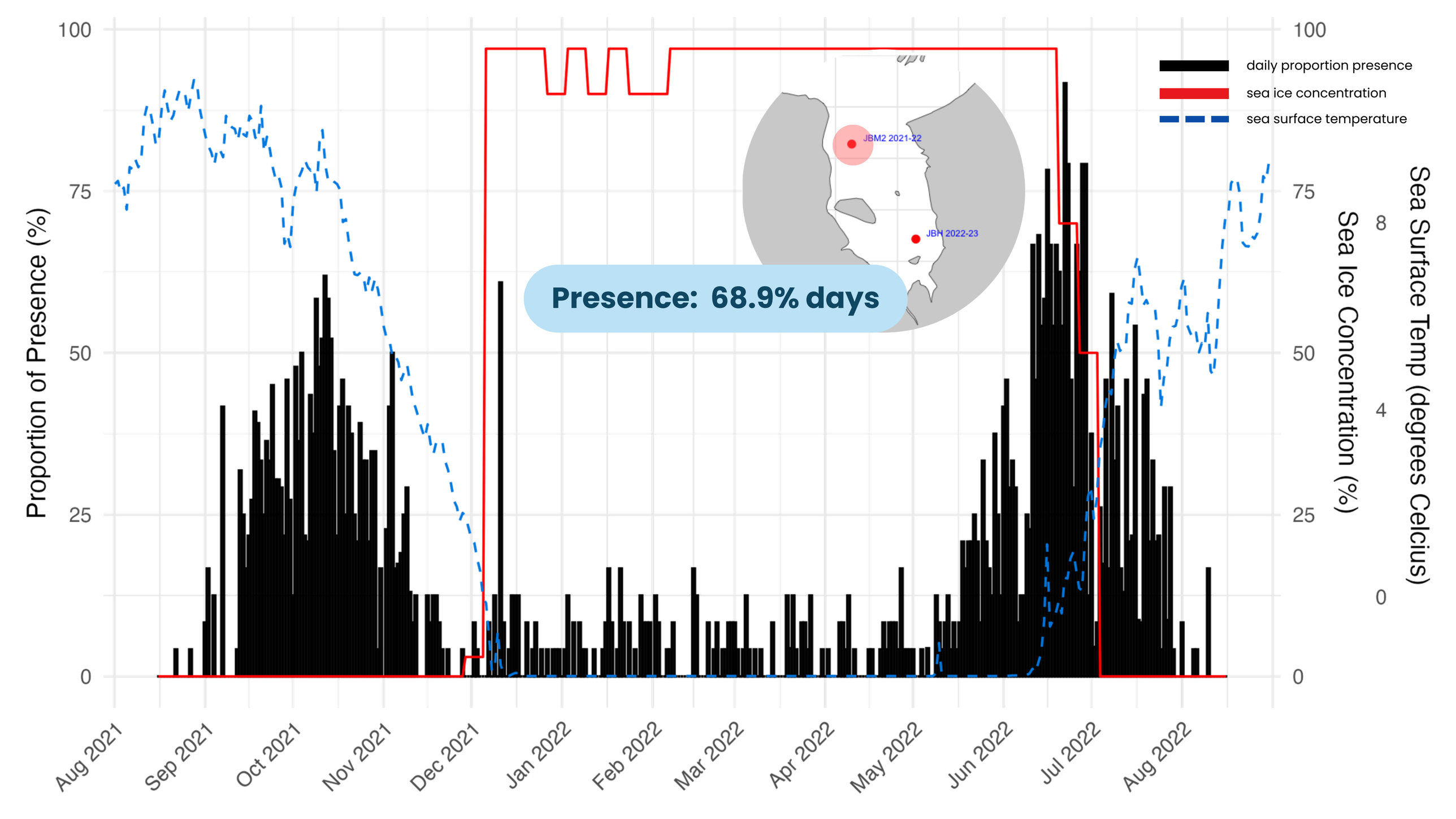
1. Takes all recording hours in the day (should be 24)

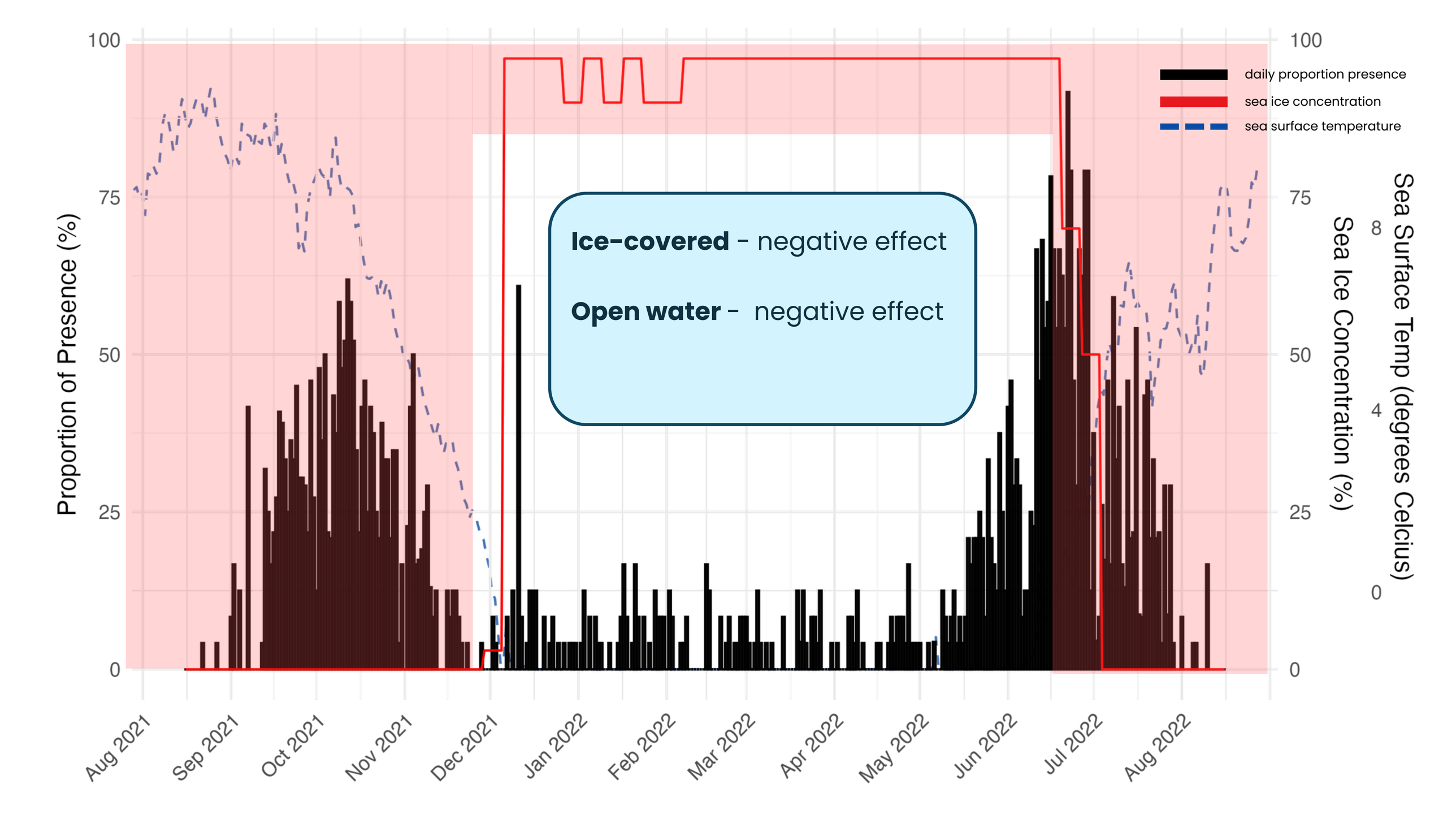
2. Count the number of hours that had beluga present

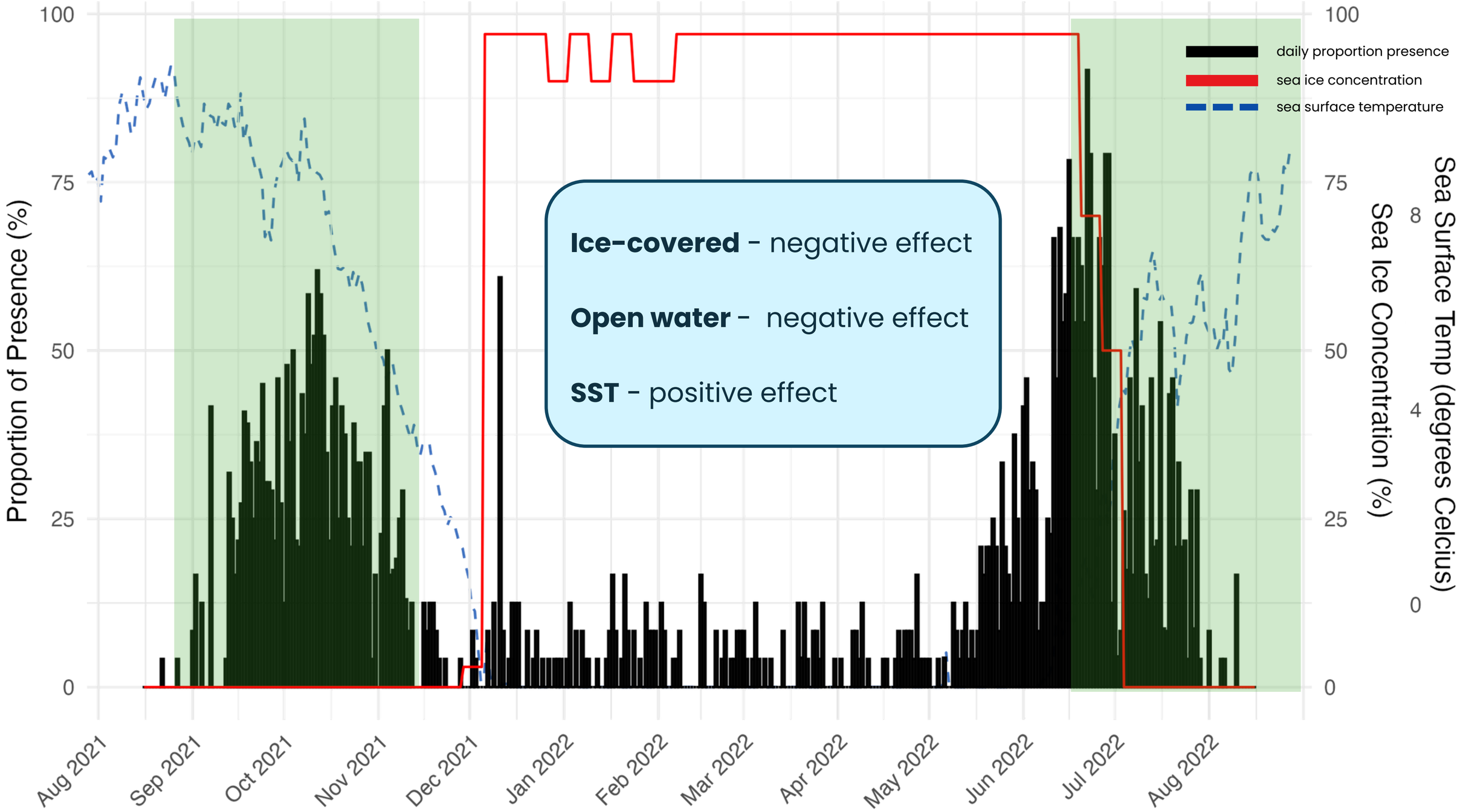
3. Proportion of presence = # of hrs with vocals / total hours recorded

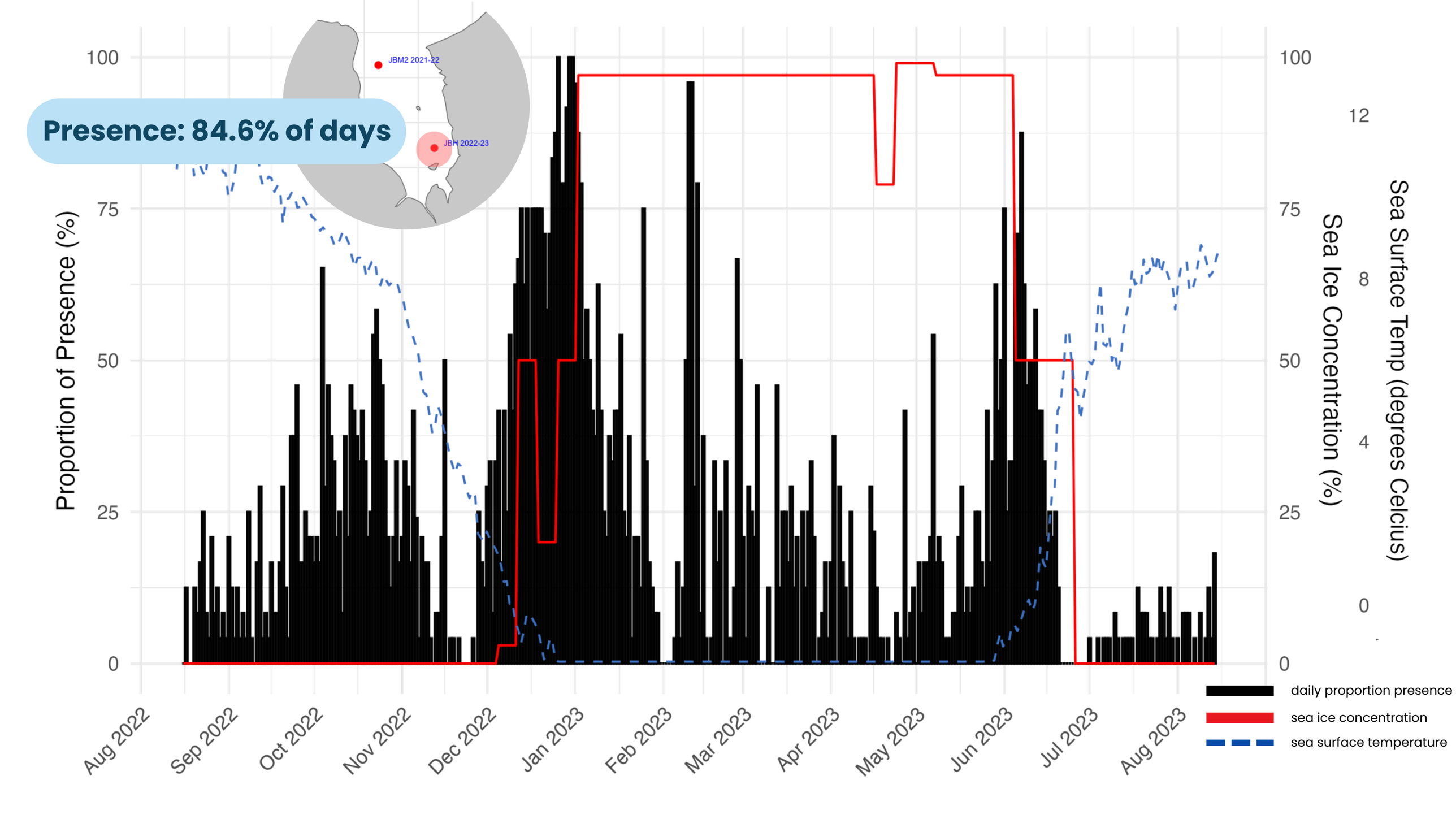


=0.583 = 58.3% presence

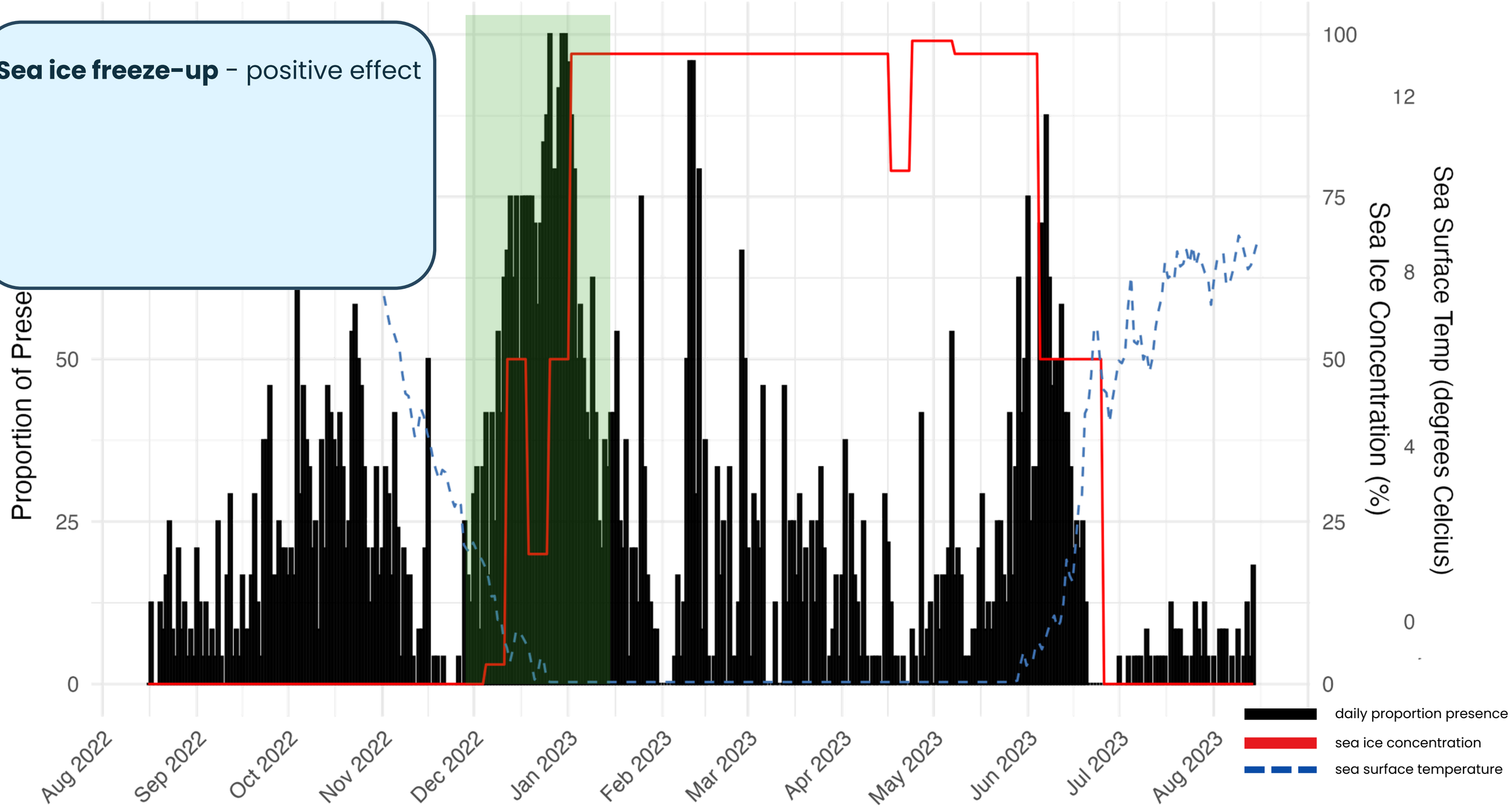

daily proportion presence
sea ice concentration
sea surface temperature
Proportion of Presence (%)
Sea Ice Concentration (%)
Sea Surface Temp (degrees Celcius)
100
75
50
25
0
8
4
JBM2 2021-22
JBH 2022-23
Presence: 68.9% days
Aug 2021
Sep 2021
Oct 2021
Nov 2021
Dec 2021
Jan 2022
Feb 2022
Mar 2022
Apr 2022
May 2022
Jun 2022
Jul 2022
Aug 2022


daily proportion presence
sea ice concentration
sea surface temperature
Ice-covered - negative effect
Open water - negative effect
Proportion of Presence (%)
Sea Ice Concentration (%)
Sea Surface Temp (degrees Celcius)
100
75
50
25
0
8
4
0
Aug 2021
Sep 2021
Oct 2021
Nov 2021
Dec 2021
Jan 2022
Feb 2022
Mar 2022
Apr 2022
May 2022
Jun 2022
Jul 2022
Aug 2022


daily proportion presence
sea ice concentration
sea surface temperature
Ice-covered - negative effect
Open water - negative effect
SST - positive effect
Proportion of Presence (%)
Sea Ice Concentration (%)
Sea Surface Temp (degrees Celcius)
100
75
50
25
0
8
4
0
Aug 2021
Sep 2021
Oct 2021
Nov 2021
Dec 2021
Jan 2022
Feb 2022
Mar 2022
Apr 2022
May 2022
Jun 2022
Jul 2022
Aug 2022


Presence: 84.6% of days
JBM2 2021-22
JBH 2022-23
Proportion of Presence (%)
Sea Ice Concentration (%)
Sea Surface Temp (degrees Celcius)
100
75
50
25
0
12
8
4
0
Aug 2022
Sep 2022
Oct 2022
Nov 2022
Dec 2022
Jan 2023
Feb 2023
Mar 2023
Apr 2023
May 2023
Jun 2023
Jul 2023
Aug 2023
daily proportion presence
sea ice concentration
sea surface temperature

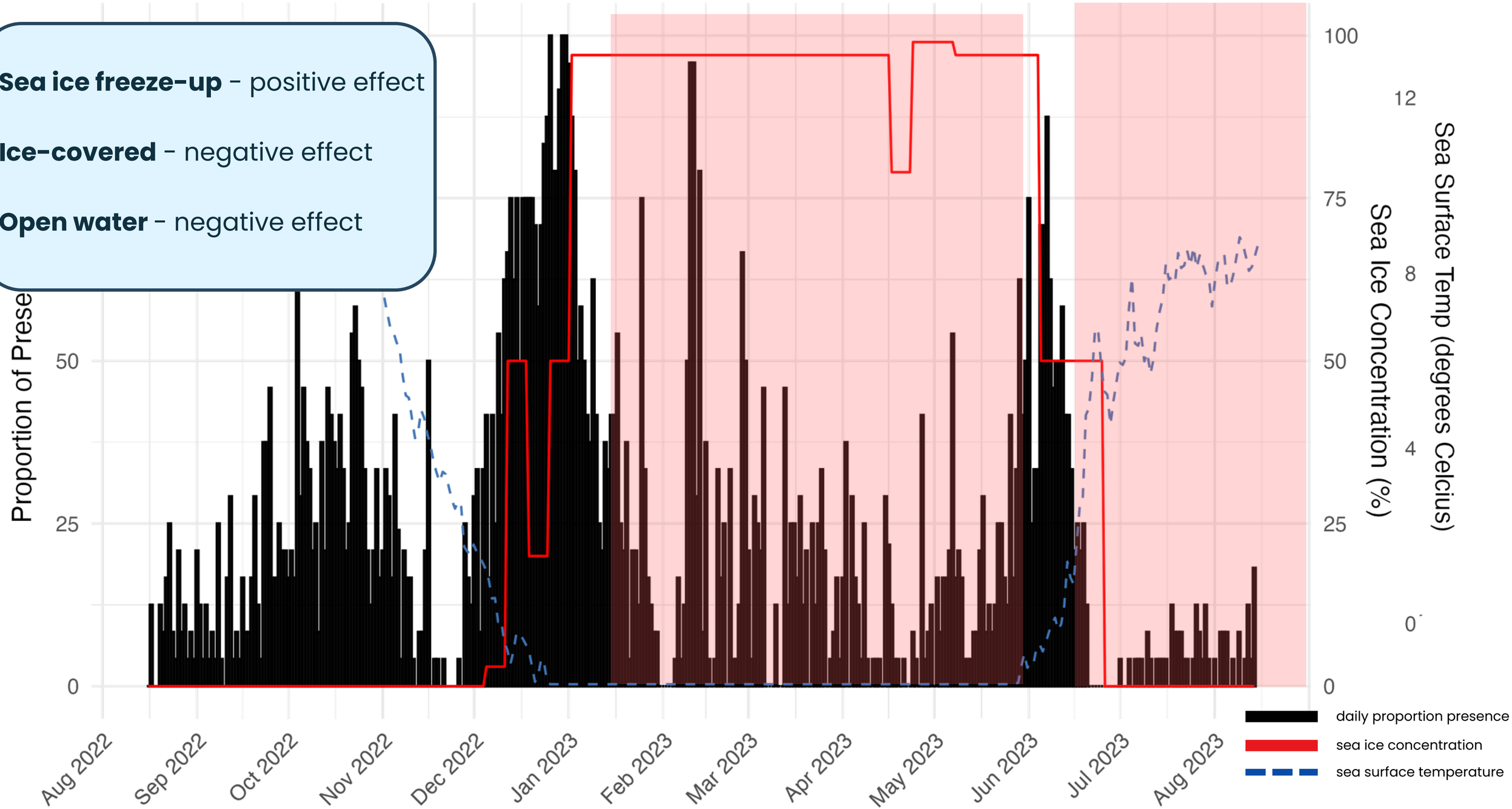
Sea ice freeze-up - positive effect

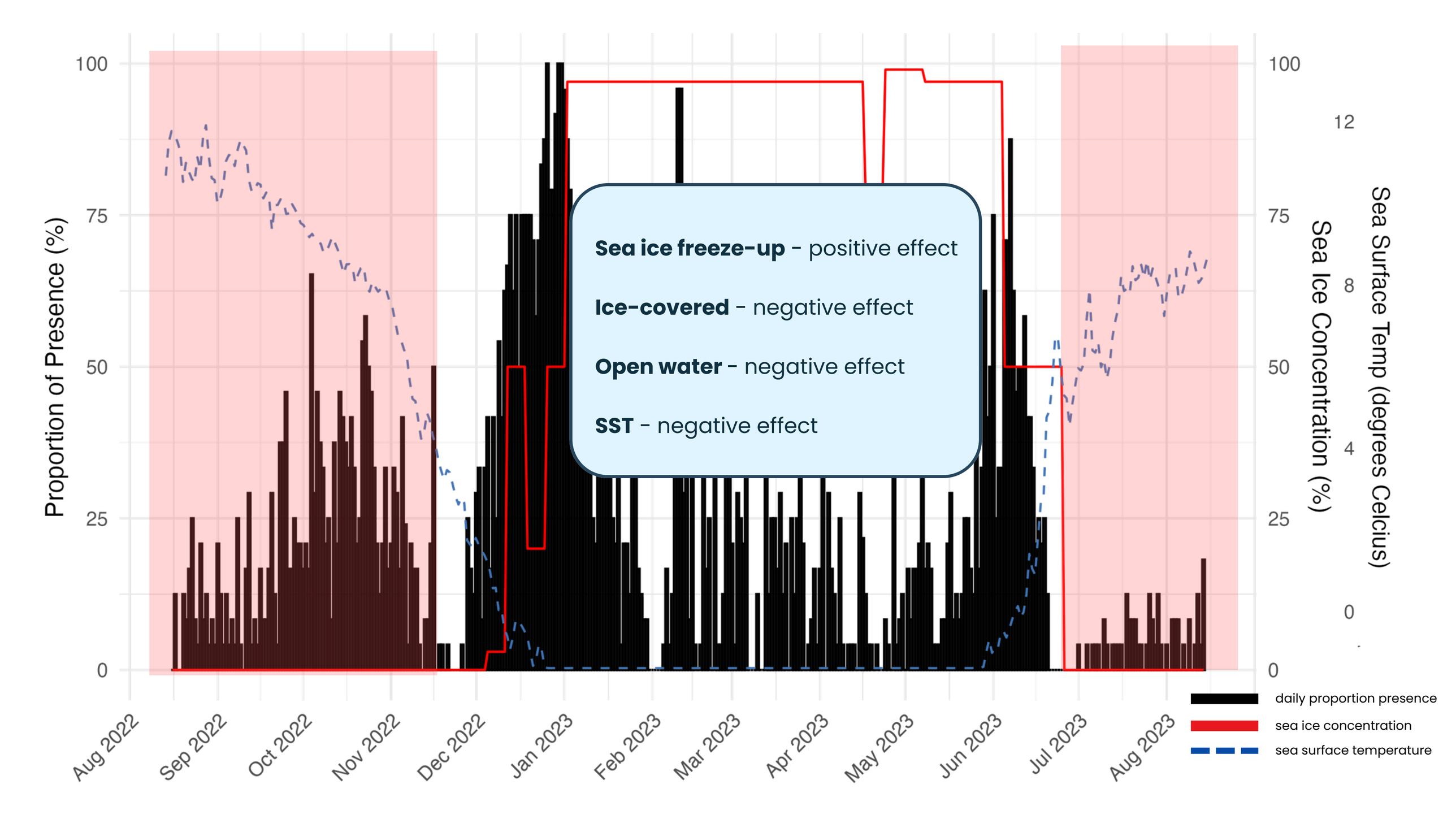


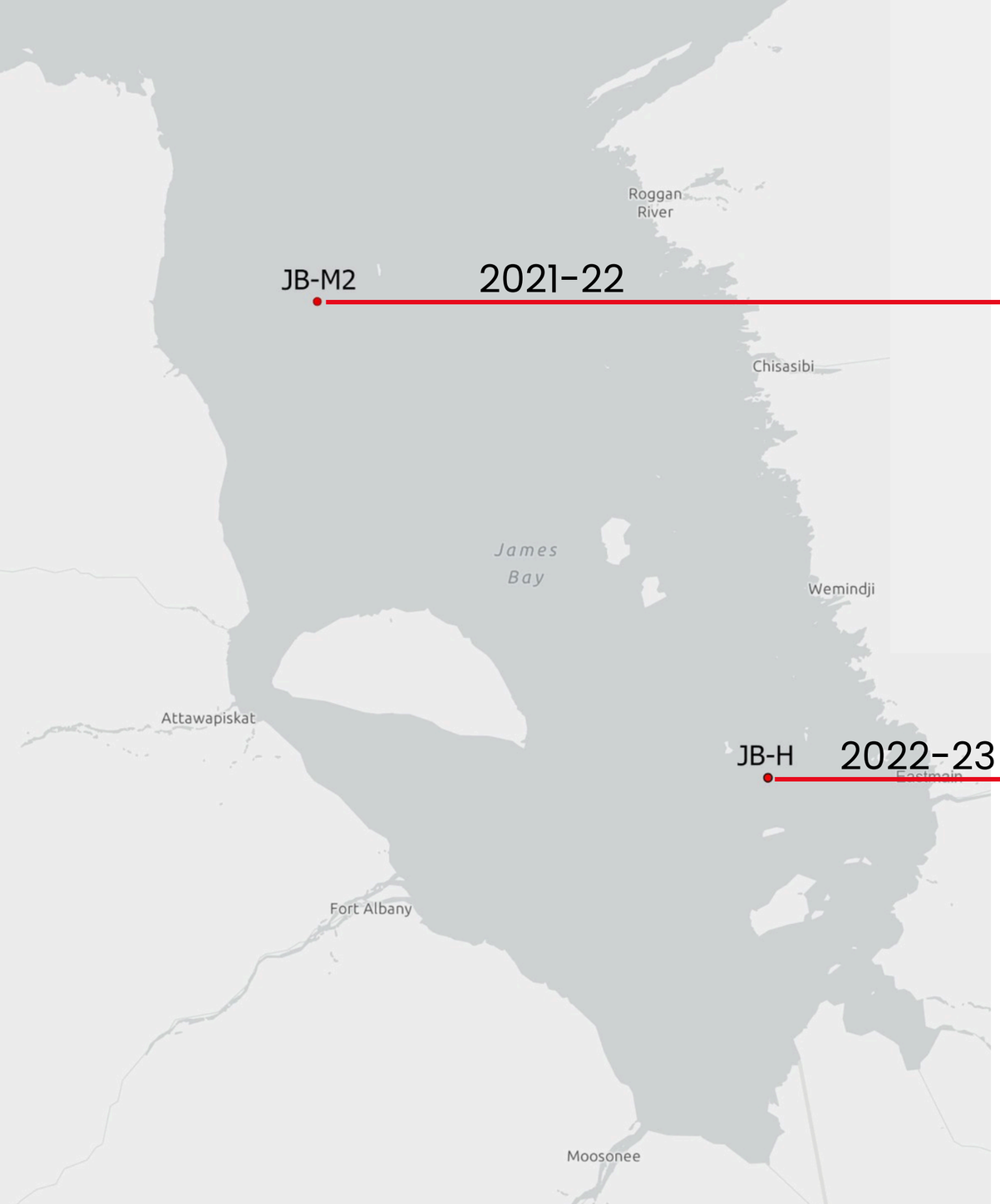
Sea ice freeze-up - positive effect

Ice-covered - negative effect

Open water - negative effect



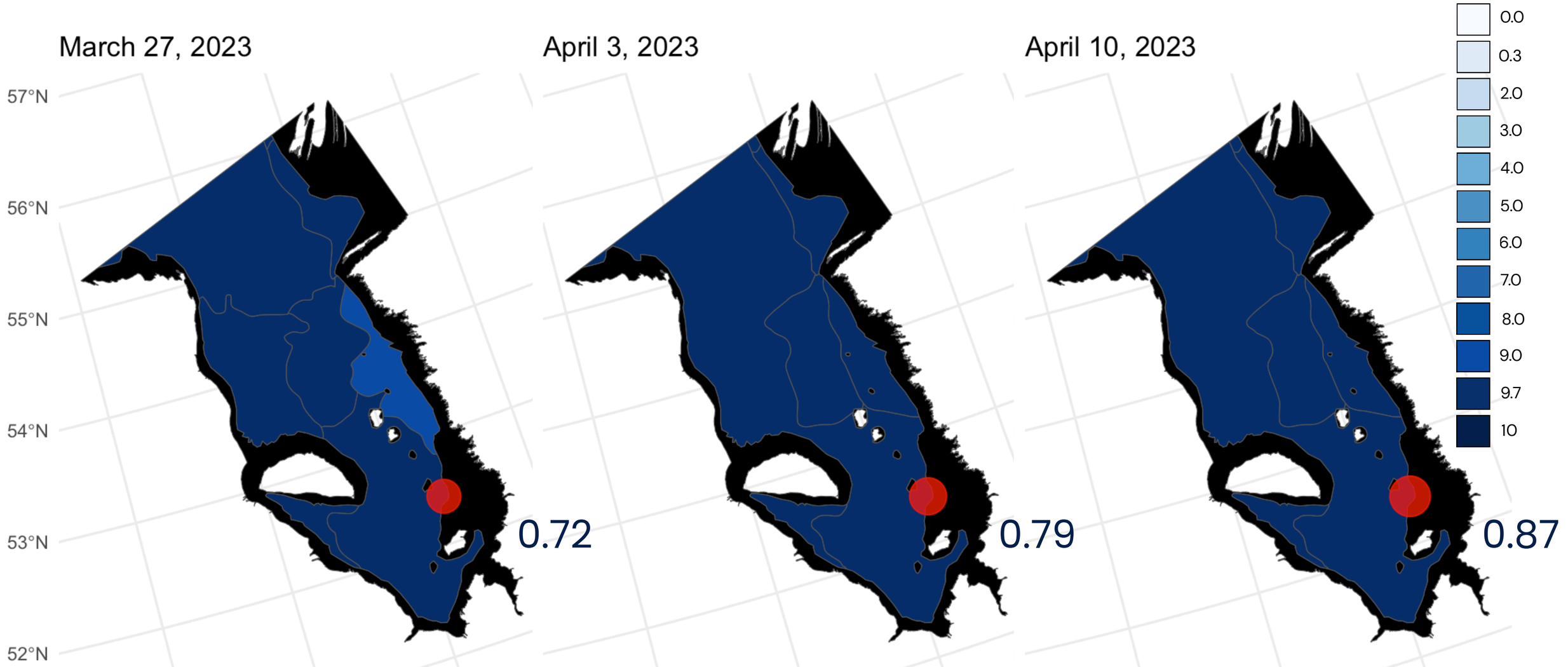

Proportion of Presence (%)
100
75
50
25
0
Sea Ice Concentration (%)
Sea Surface Temp (degrees Celcius)
12
8
4
0
Aug 2022
Sep 2022
Oct 2022
Nov 2022
Dec 2022
Jan 2023
Feb 2023
Mar 2023
Apr 2023
May 2023
Jun 2023
Jul 2023
Aug 2023
Sea ice freeze-up - positive effect
Ice-covered - negative effect
Open water - negative effect
SST - negative effect
daily proportion presence
sea ice concentration
sea surface temperature



- **Less beluga click activity** but this can be due to location, distance from beluga etc.
- Based on past DFO surveys, the population in summer months is typically around Akimiski Island
- Vocalizations **drop significantly from November to May**

- **Higher click presence** compared to North, especially in ice covered months
- An area where the **population may be able to overwinter**

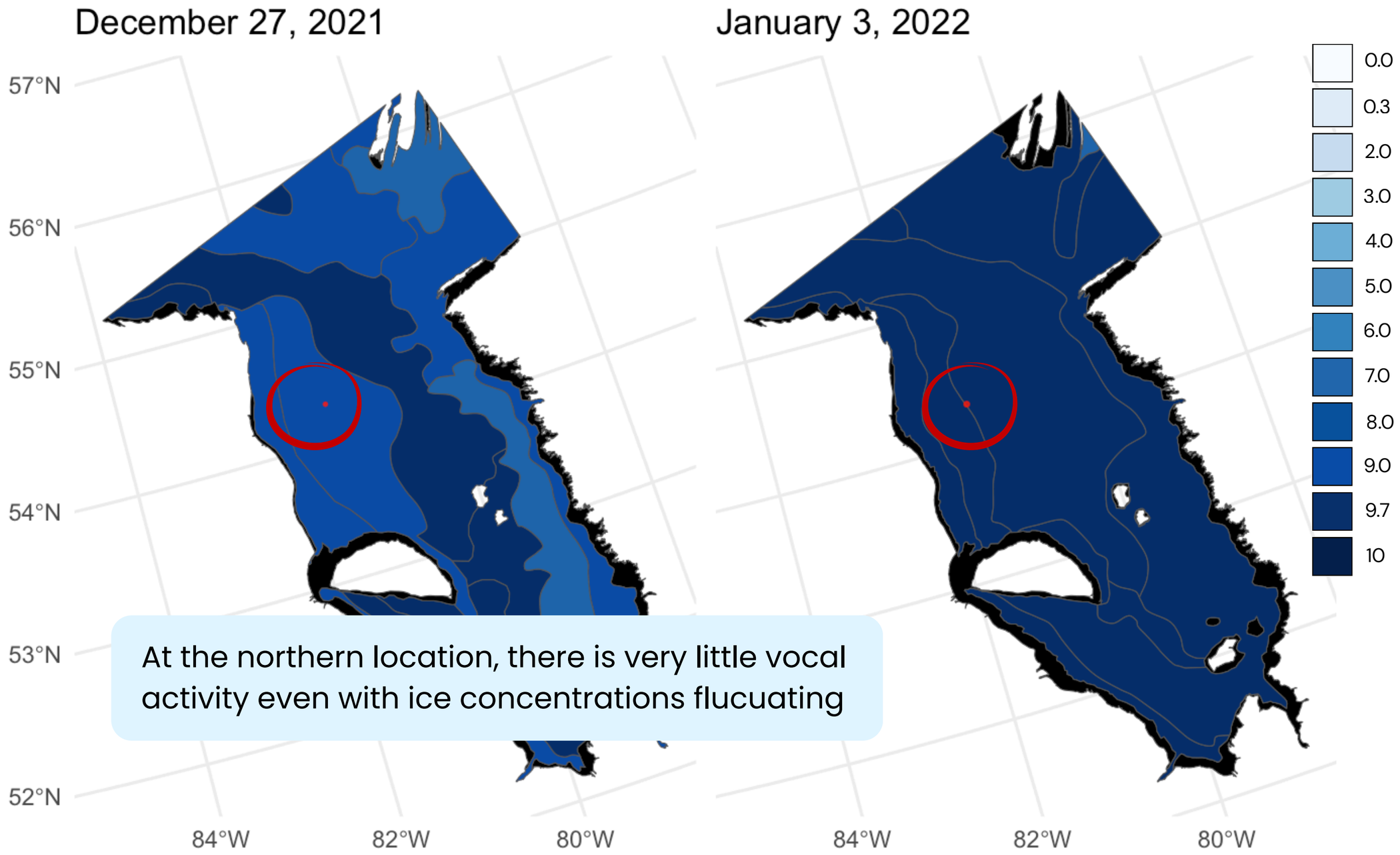
Based on a sea ice analysis, distinct movement patterns were observed specifically along the eastern coast of the Bay



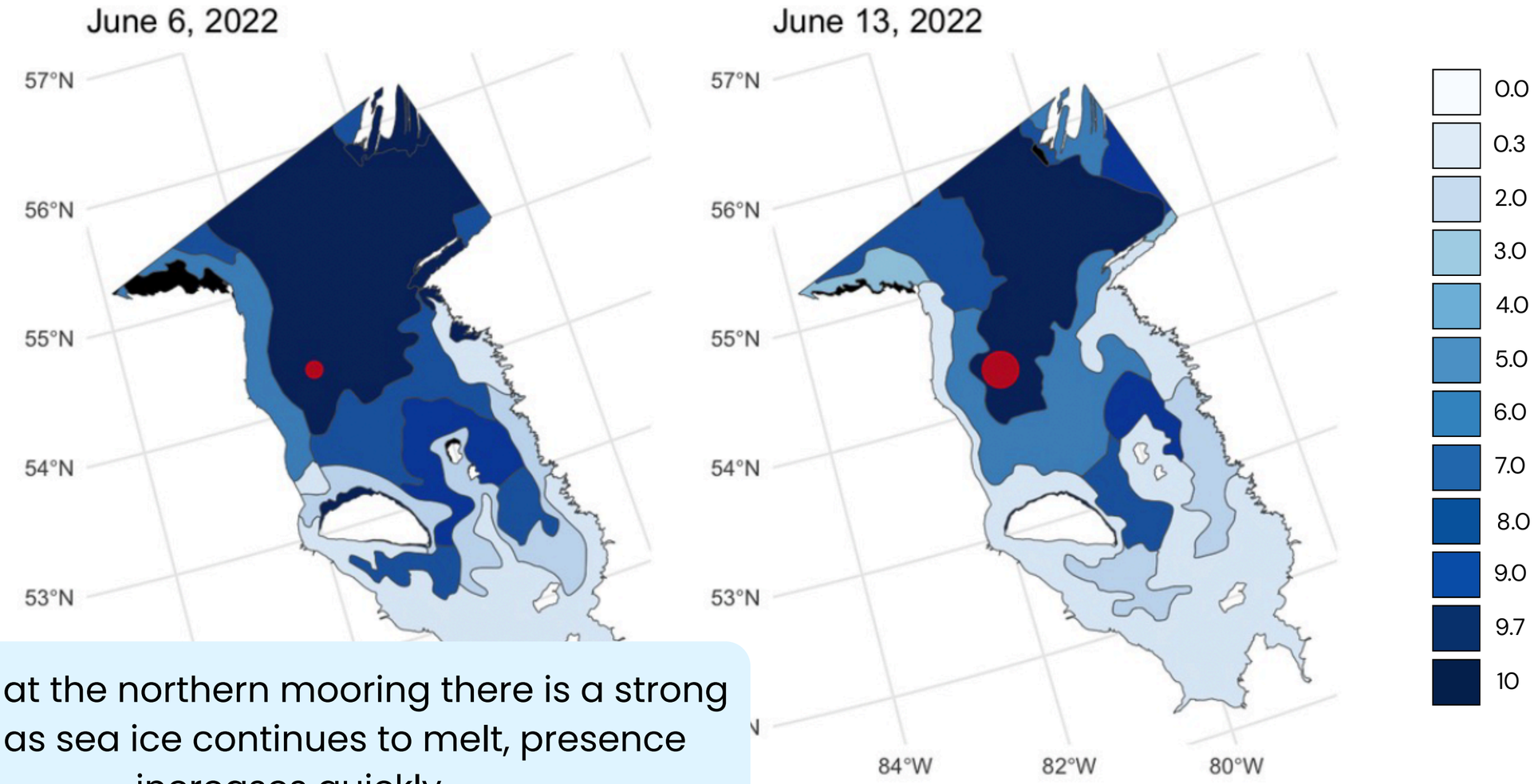
Presence slightly lower when a lower ice concentration north

As it freezes back over, presence increased at hydrophone location slightly

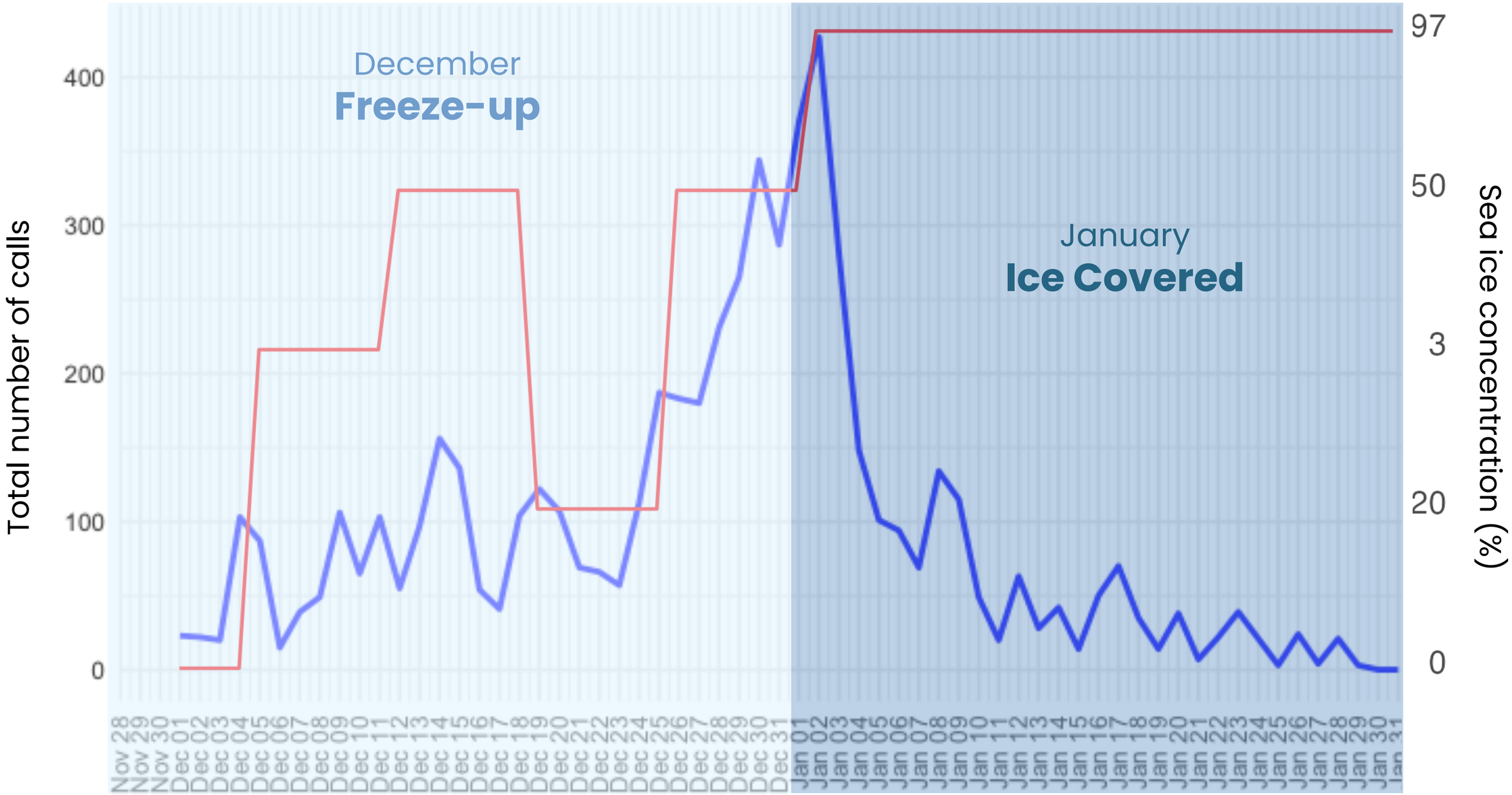
A week after the freeze over occured, presence grew even more



At the northern location, there is very little vocal activity even with ice concentrations flucuating



Notably, at the northern mooring there is a strong visual as sea ice continues to melt, presence increases quickly

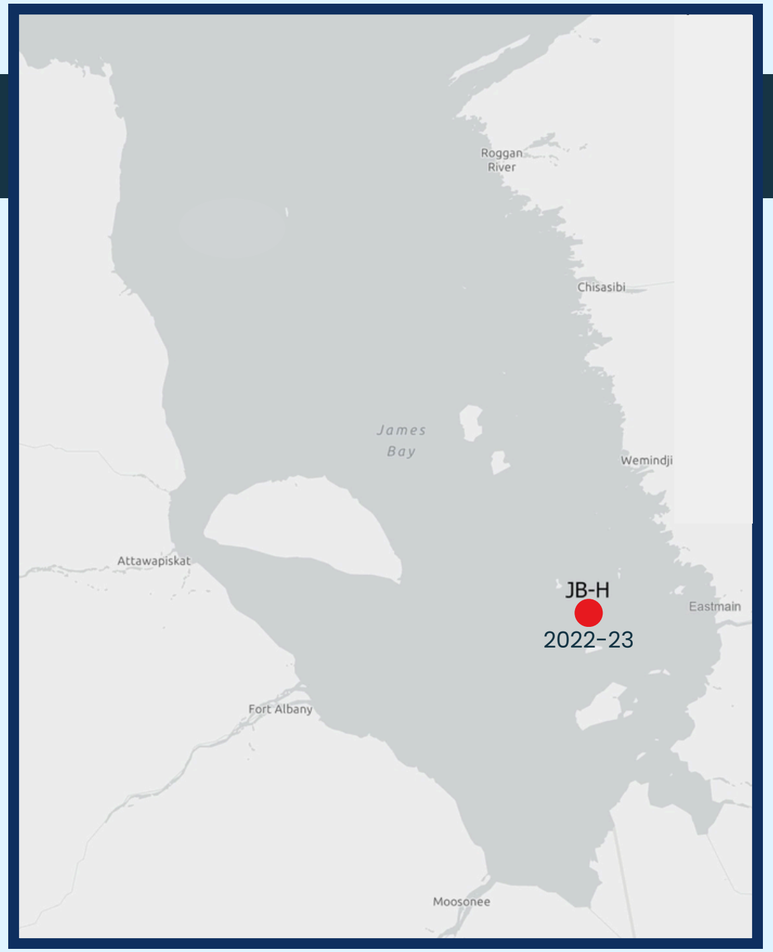

December
Freeze-up
January
Ice Covered
Total number of calls
Sea ice concentration (%)
0
100
200
300
400
0
20
3
50
97

Comparing foraging and communicative calls of beluga in southeastern James Bay during ice freeze up and ice cover

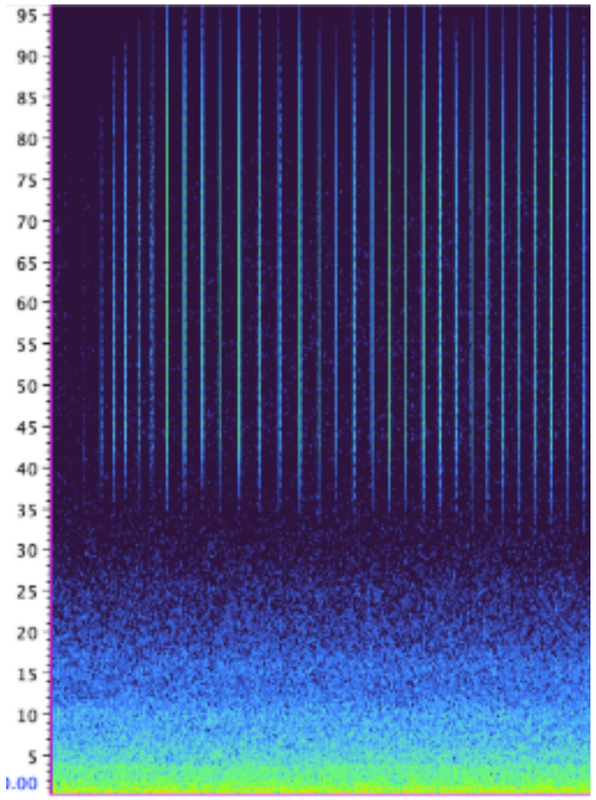
O B J E C T I V E S

1. **Determine the different call types in the associated sound files. What is effecting the total number of calls** in freeze up and ice covered months.

2. **Determine a foraging index for each month.**

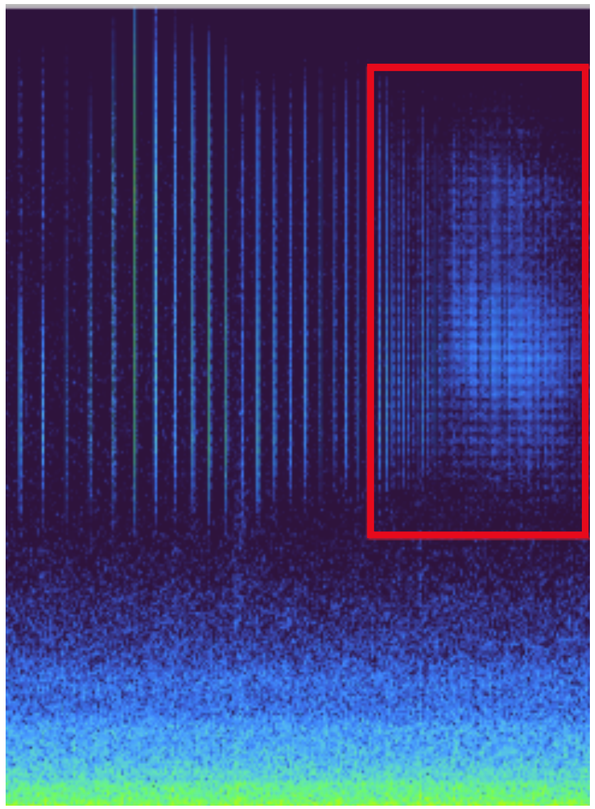


Click Trains



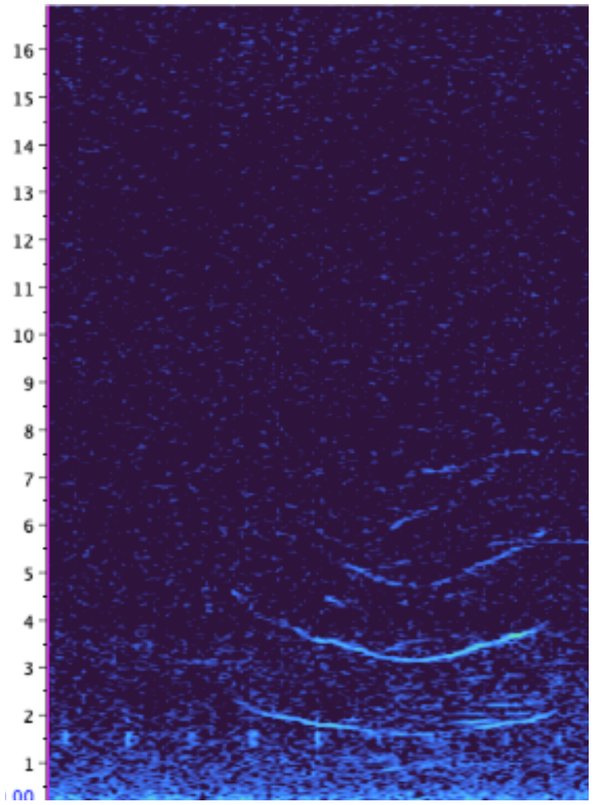
Rapid series of broadband clicks. Usually occurs at above human hearing range. **Used for navigating through ice or finding prey**

Buzz



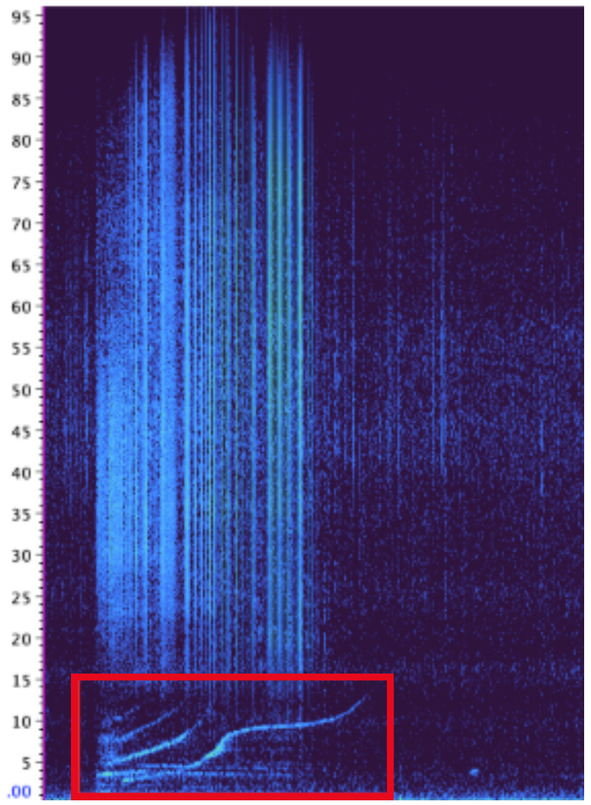
These clicks are more rapid and have a short interclick interval compared to the body of the click train. Most instances it is **following a click train** and indicates **feeding**.

Whistle

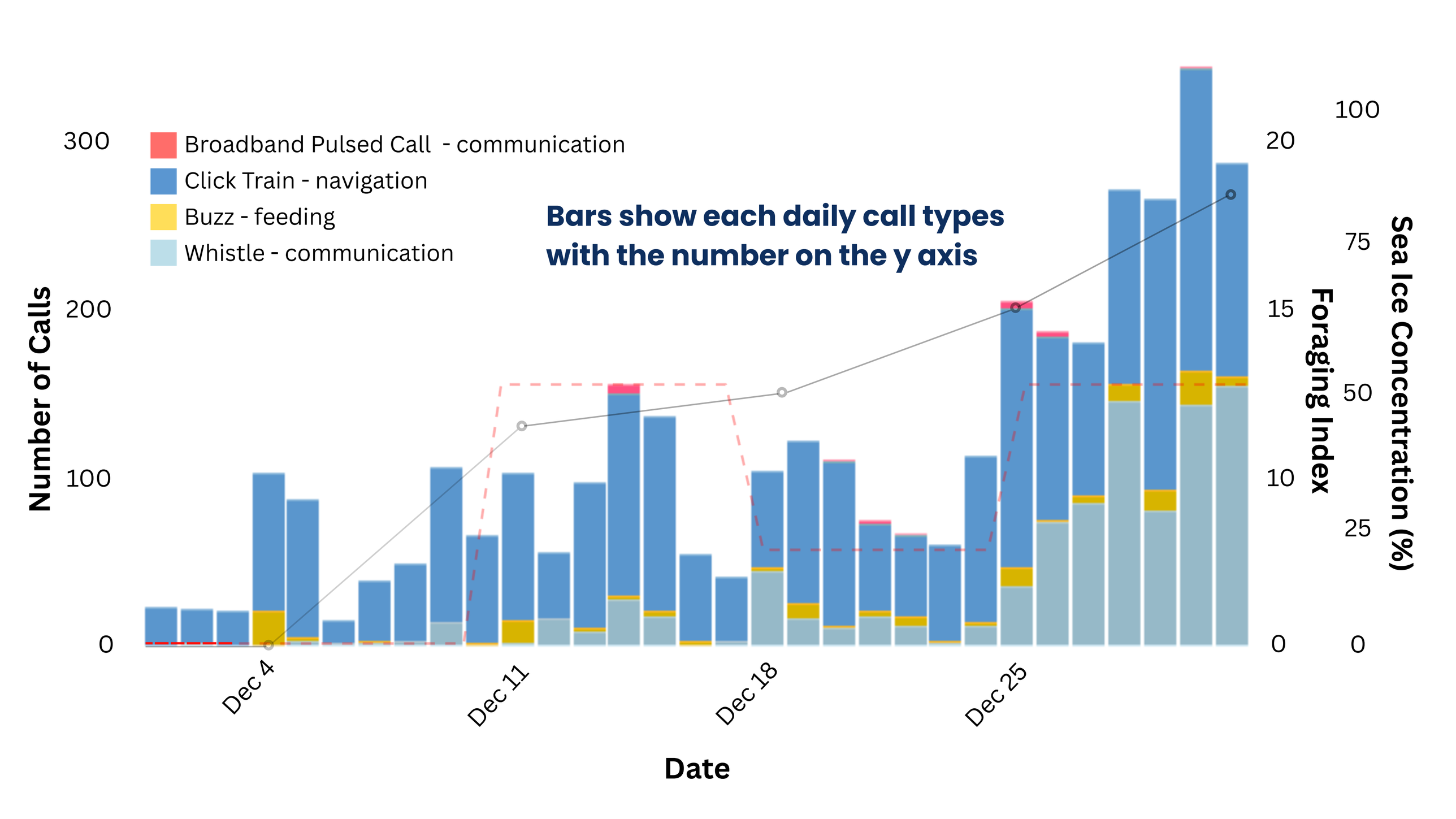


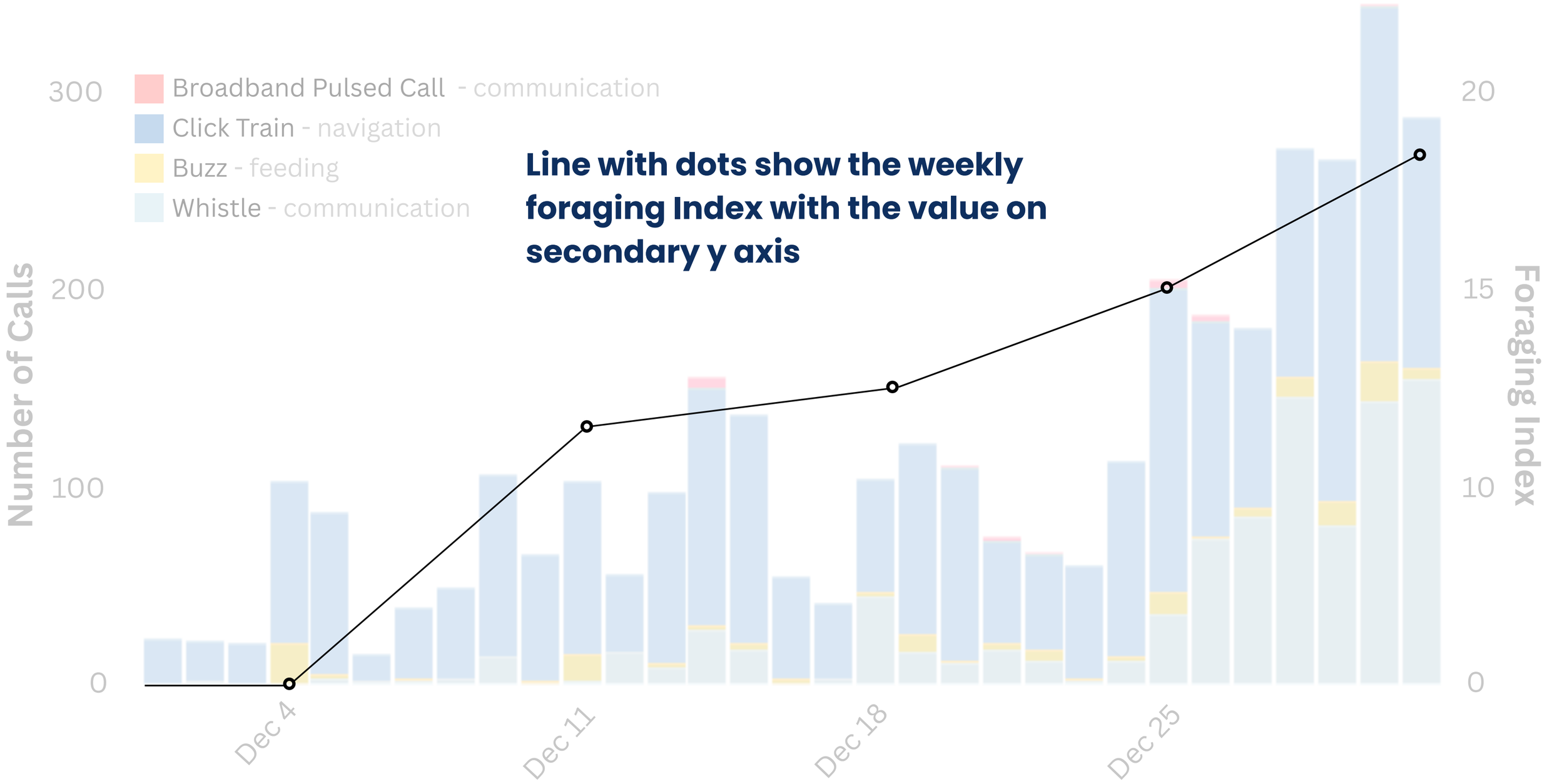
Type of **communicative** call, typically having a narrowband (small frequency), creating a unique, **contour shape** both ascending and descending.

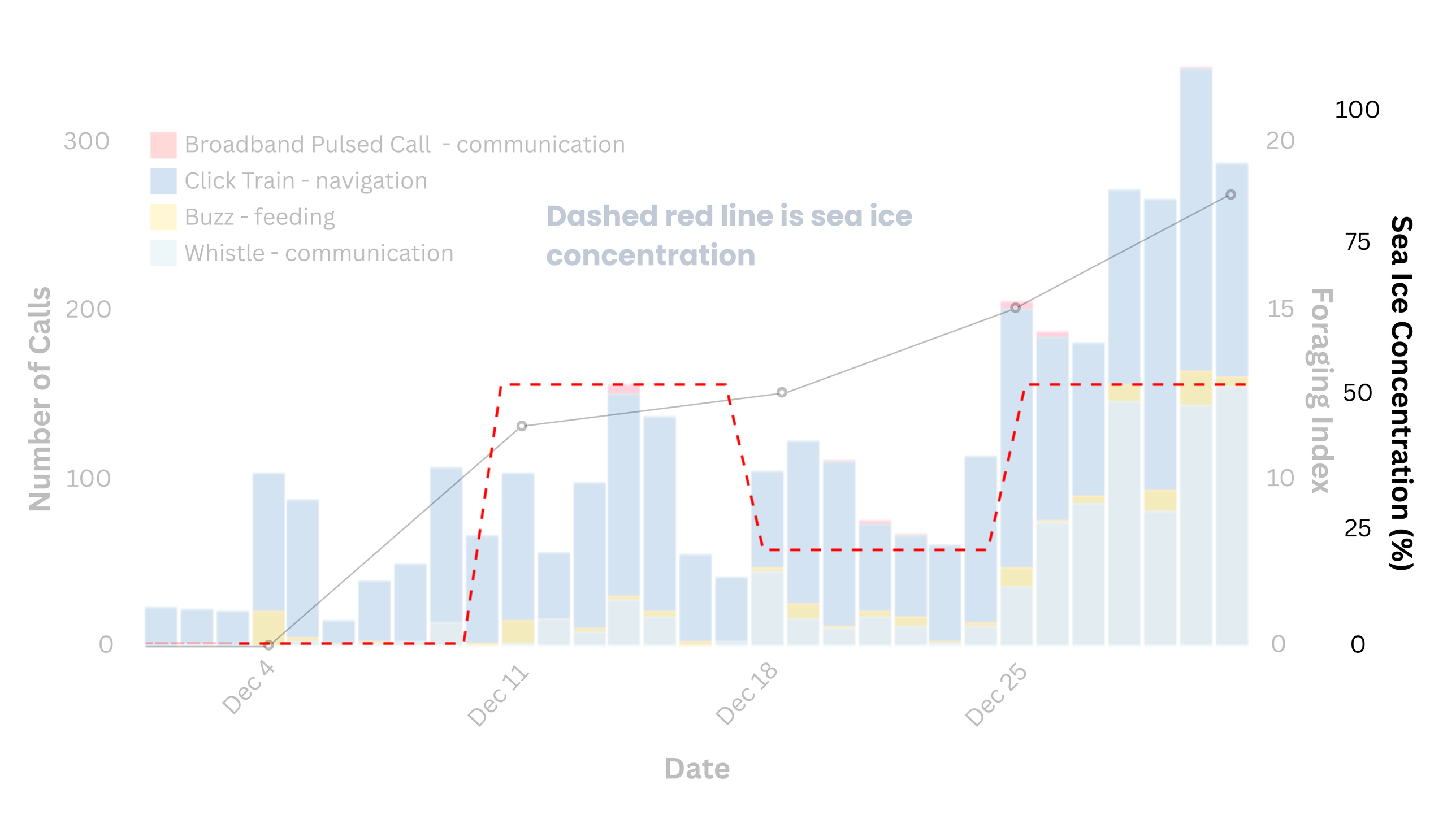
Broadband

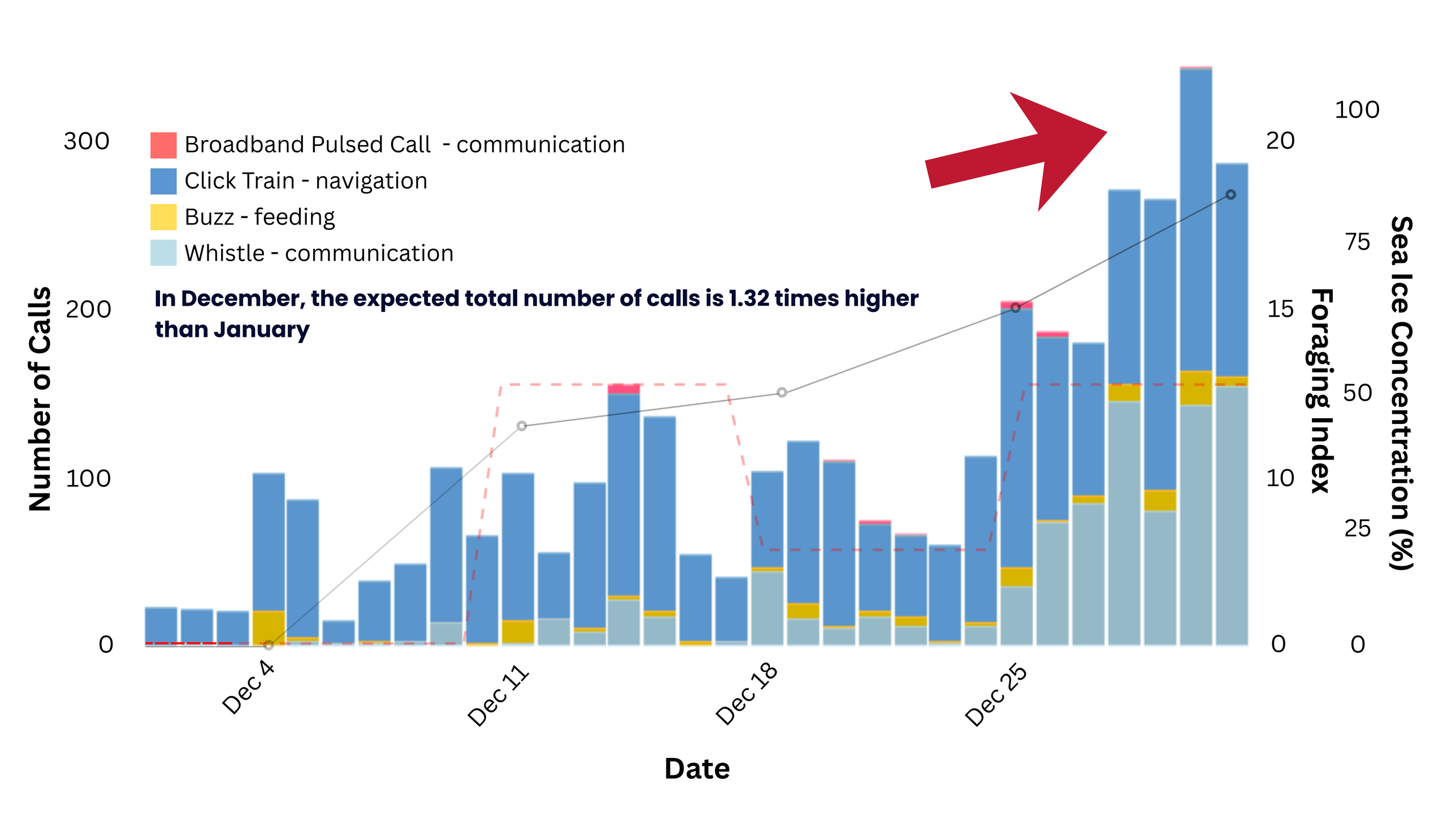


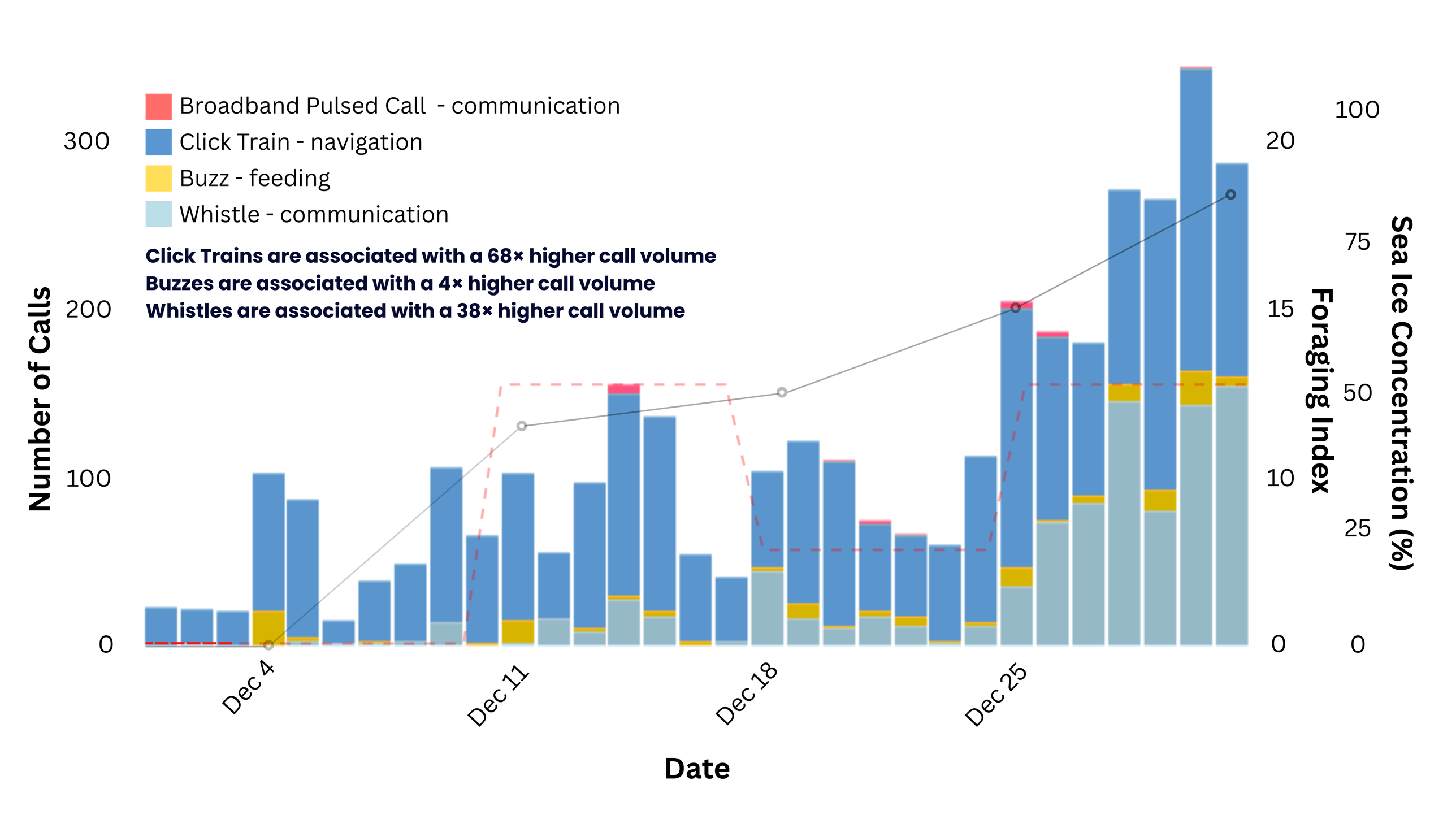
Pulsed calls consist of a series of rapid pulses, having a more broadband range

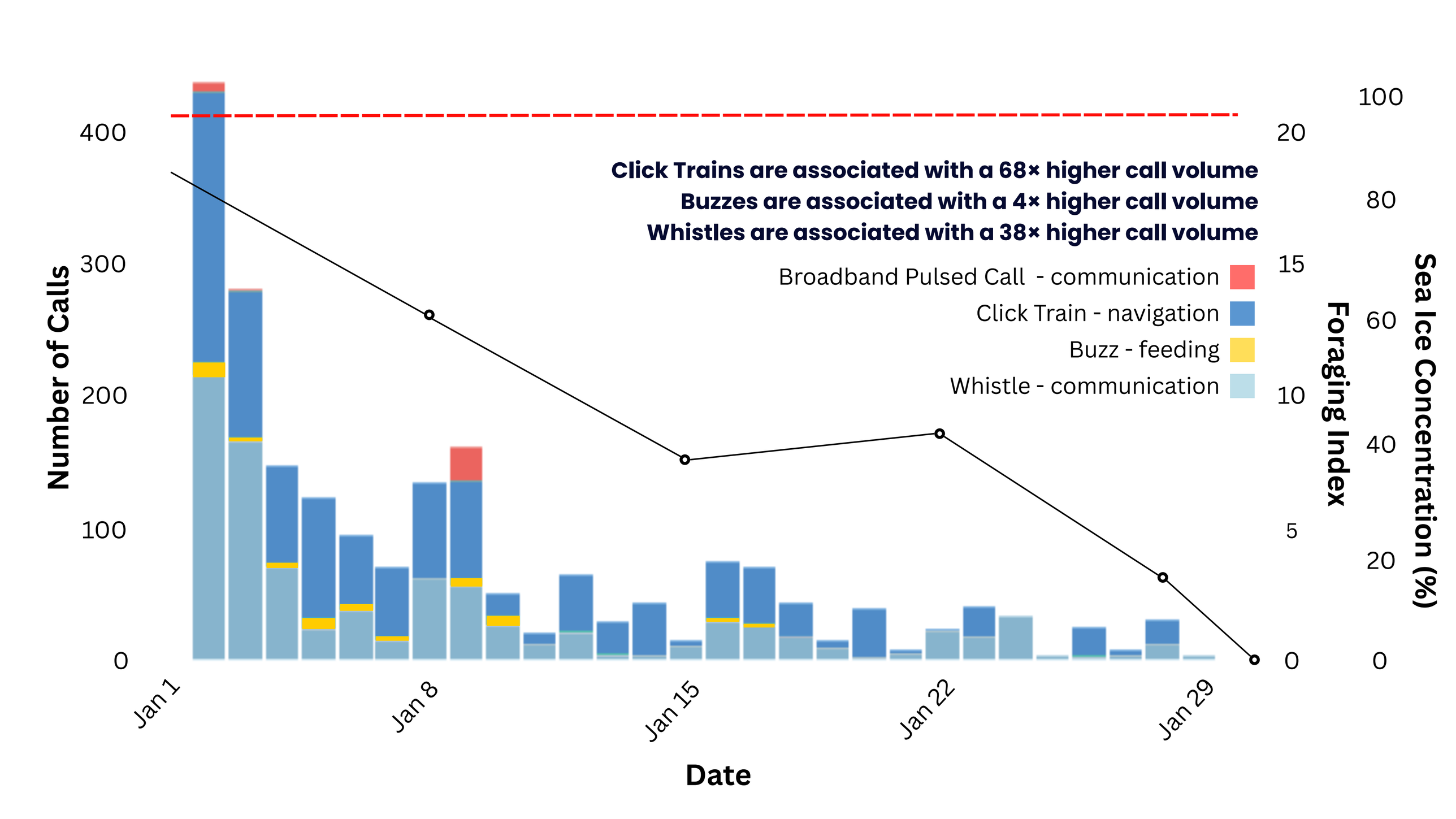

Broadband Pulsed Call - communication
Click Train - navigation
Buzz - feeding
Whistle - communication
Bars show each daily call types with the number on the y axis
Number of Calls
300
200
100
0
Foraging Index
20
15
10
0
Sea Ice Concentration (%)
100
75
50
25
0
Dec 4
Dec 11
Dec 18
Dec 25
Date

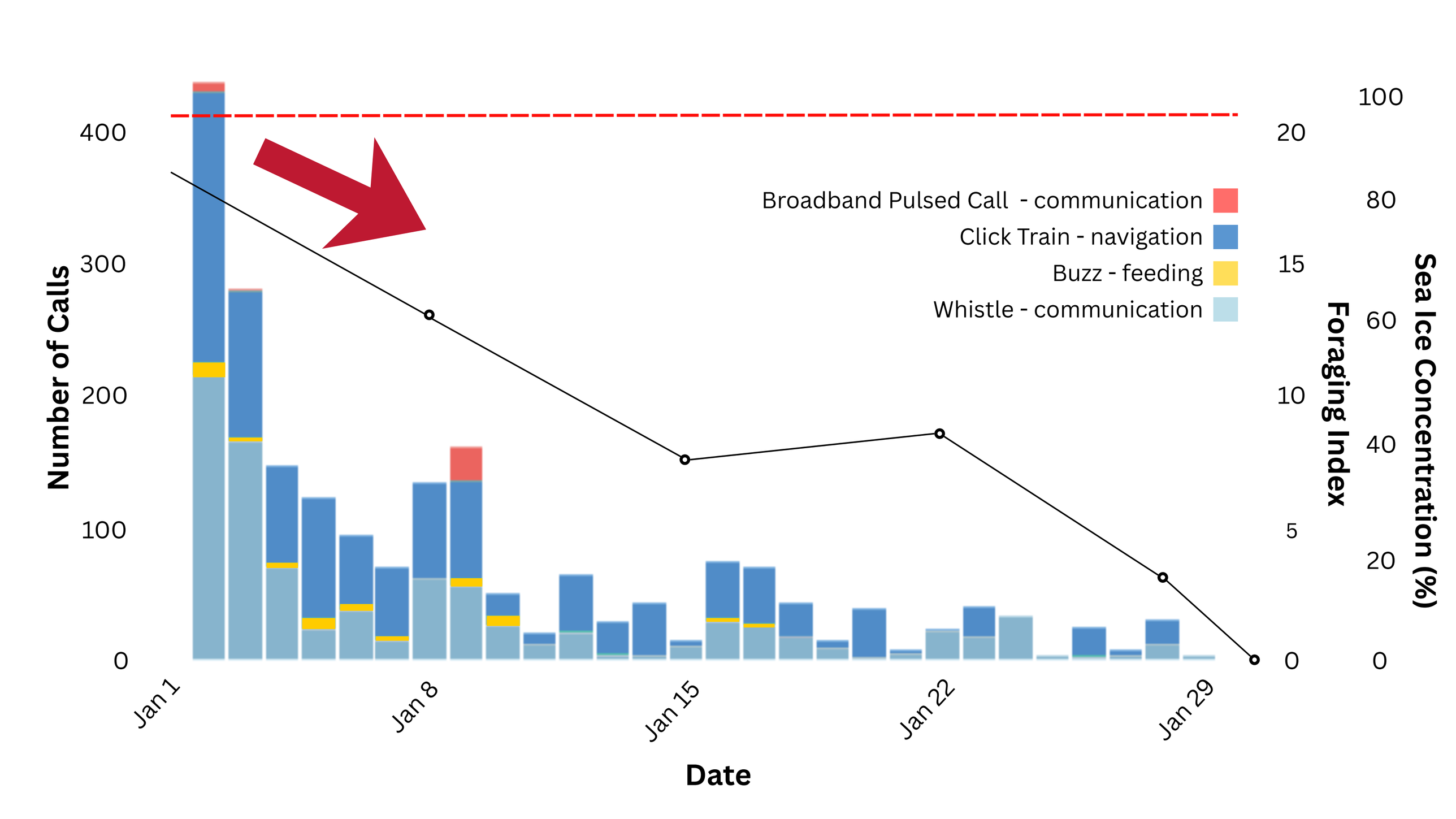

Broadband Pulsed Call - communication
Click Train - navigation
Buzz - feeding
Whistle - communication
Line with dots show the weekly foraging Index with the value on secondary y axis
Number of Calls
Foraging Index
300
200
100
0
20
15
10
0
Dec 4
Dec 11
Dec 18
Dec 25


Broadband Pulsed Call - communication
Click Train - navigation
Buzz - feeding
Whistle - communication
Dashed red line is sea ice concentration
Number of Calls
300
200
100
0
Foraging Index
20
15
10
0
Sea Ice Concentration (%)
100
75
50
25
0
Dec 4
Dec 11
Dec 18
Dec 25
Date


Broadband Pulsed Call - communication
Click Train - navigation
Buzz - feeding
Whistle - communication
In December, the expected total number of calls is 1.32 times higher than January
Number of Calls
300
200
100
0
Foraging Index
20
15
10
0
Sea Ice Concentration (%)
100
75
50
25
0
Dec 4
Dec 11
Dec 18
Dec 25
Date


Broadband Pulsed Call - communication
Click Train - navigation
Buzz - feeding
Whistle - communication
Click Trains are associated with a 68× higher call volume
Buzzes are associated with a 4× higher call volume
Whistles are associated with a 38× higher call volume
Number of Calls
300
200
100
0
Foraging Index
20
15
10
0
Sea Ice Concentration (%)
100
75
50
25
0
Dec 4
Dec 11
Dec 18
Dec 25
Date


Click Trains are associated with a 68× higher call volume
Buzzes are associated with a 4× higher call volume
Whistles are associated with a 38× higher call volume
Broadband Pulsed Call - communication
Click Train - navigation
Buzz - feeding
Whistle - communication
Number of Calls
Foraging Index
Sea Ice Concentration (%)
Date
0
100
200
300
400
0
5
10
15
20
0
20
40
60
80
100
Jan 1
Jan 8
Jan 15
Jan 22
Jan 29


Broadband Pulsed Call - communication
Click Train - navigation
Buzz - feeding
Whistle - communication
Number of Calls
Foraging Index
Sea Ice Concentration (%)
Date
0
100
200
300
400
0
5
10
15
20
0
20
40
60
80
100
Jan 1
Jan 8
Jan 15
Jan 22
Jan 29

Foraging Index = Foraging Positive Minute x 100 / Detection Positive Minutes

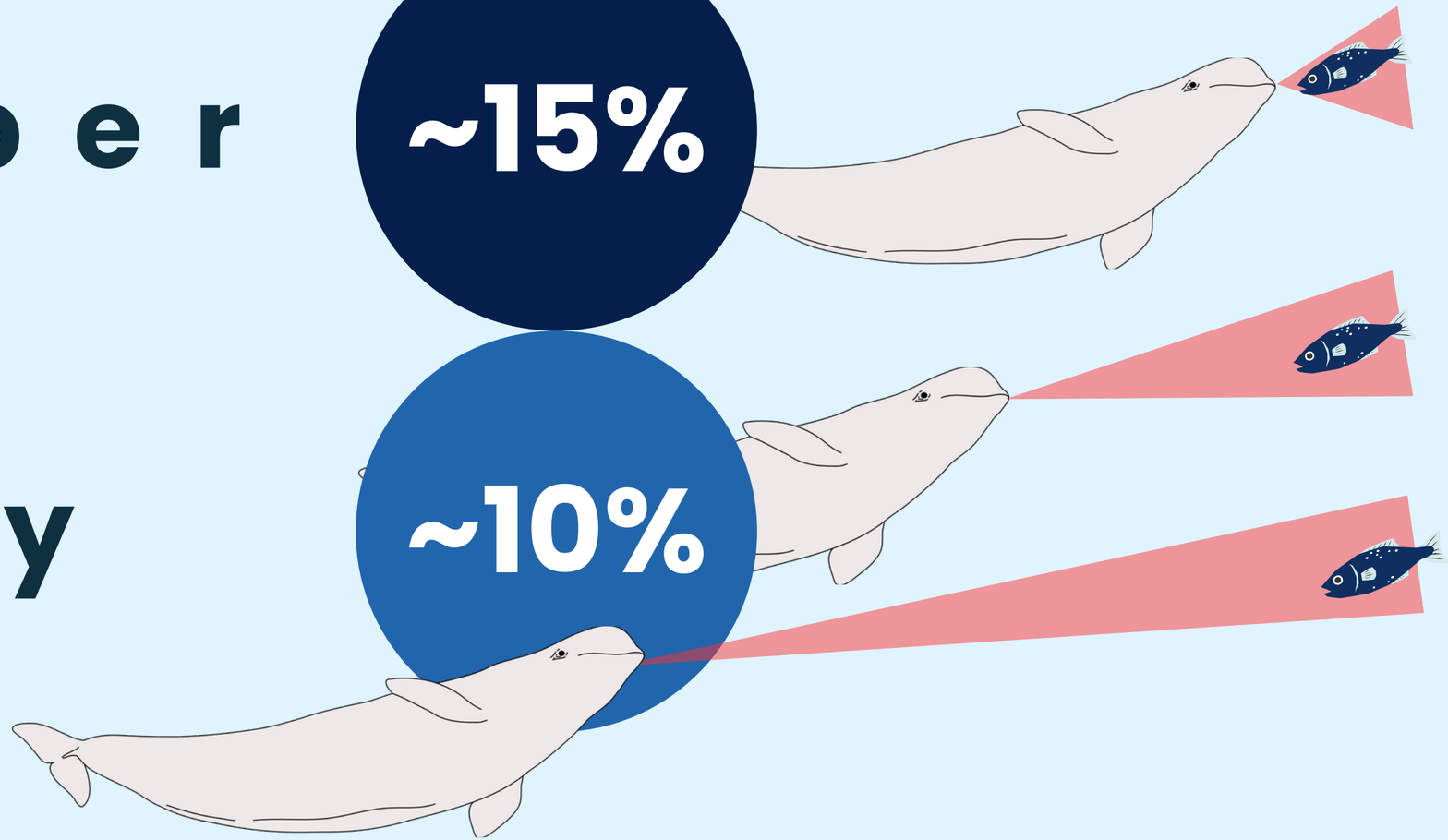
During periods of acoustic presence, foraging buzzes were detected in:

D e c e m b e r

~15%

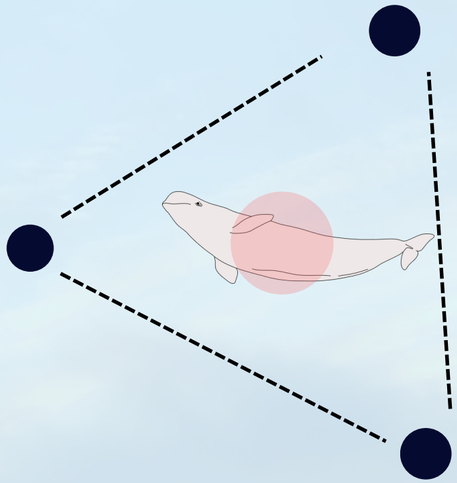
J a n u a r y

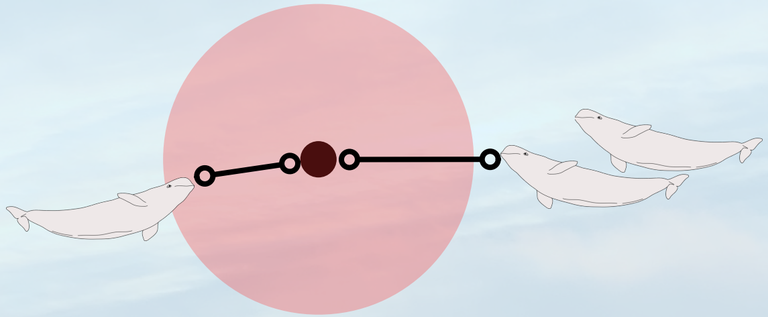
~10%

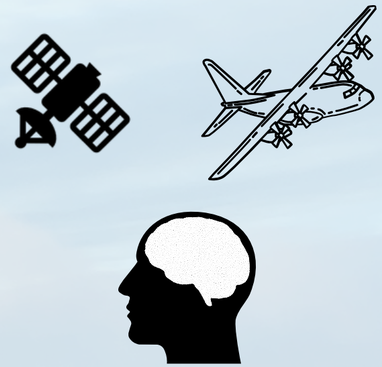


What did we learn?

- **Beluga presence year -round however areas of the Bay may be used based on seasonality**
- **Offshore feeding during winter is occurring** - based on our foraging index, it is occurring more in an ice-freeze up regime
- **Rivers** are an important and unique feature potentially providing enough terrestrial output and/or anadromous fish to support beluga
- **Climate change context:** Understanding beluga use now creates a baseline for detecting future changes in ice, temperature, and habitat suitability



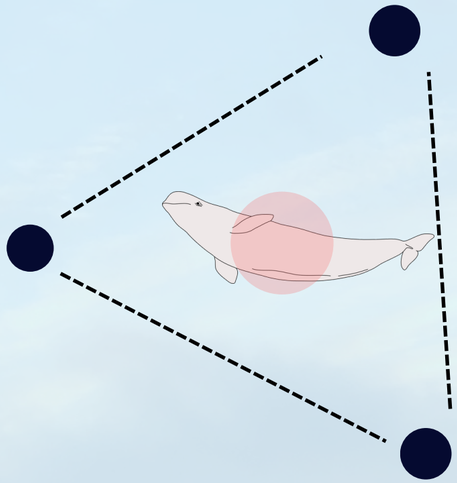


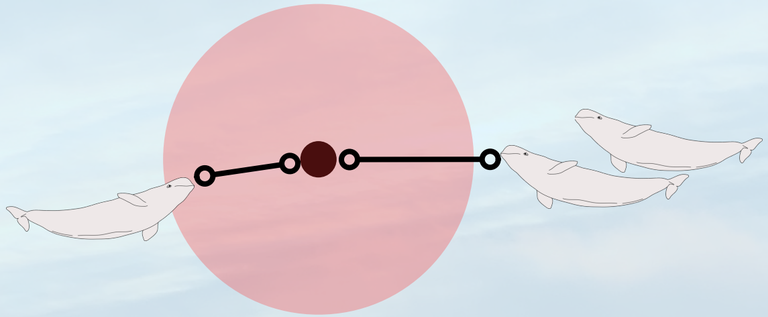


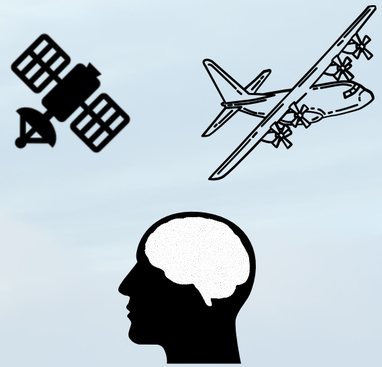
What's next - future suggestions

- To better understand more defined movements, we should consider using hydrophones in an array
  - **Using triangulation/ localization gives us the ability to understand the movement of beluga**

- **New locations for hydrophones** - rivers, coastal - this would give us a better indication of prey distribution







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consume ~ 9 -15 kg per day

last survey estimate 16 000 beluga

~140-240 metric tons of food every single day

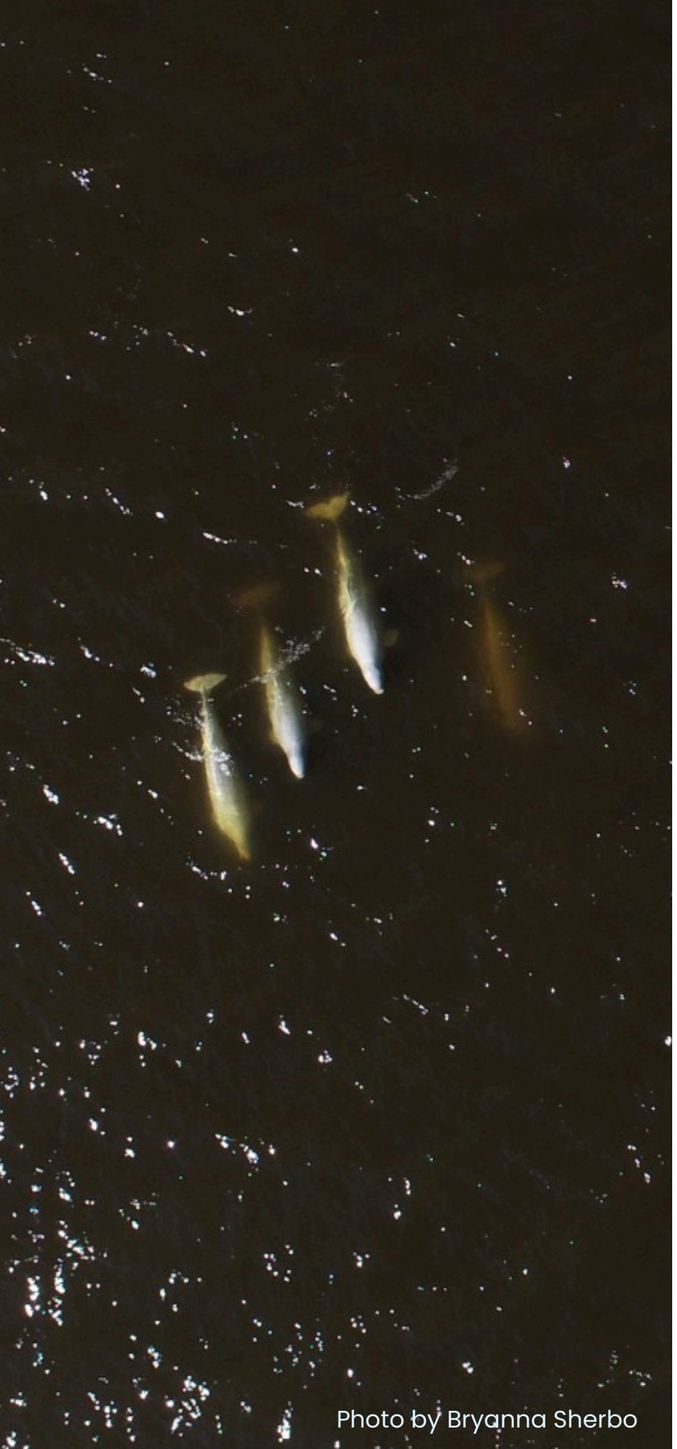
Photo by Bryanna Sherbo

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