Passive acoustic and oceanographic moorings to support baseline data collection and modelling efforts in proposed wind energy areas off Nova Scotia

Net Zero Atlantic Nova Scotia
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Photo: H. Moors-Murphy

Acknowledgements

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- Joy Stanistreet (DFO)
- Jinshan Xu (DFO)
- Doug Schillinger (DFO)
- Alex Normandeau (NRCan)

Other Collaborators and Contributors:

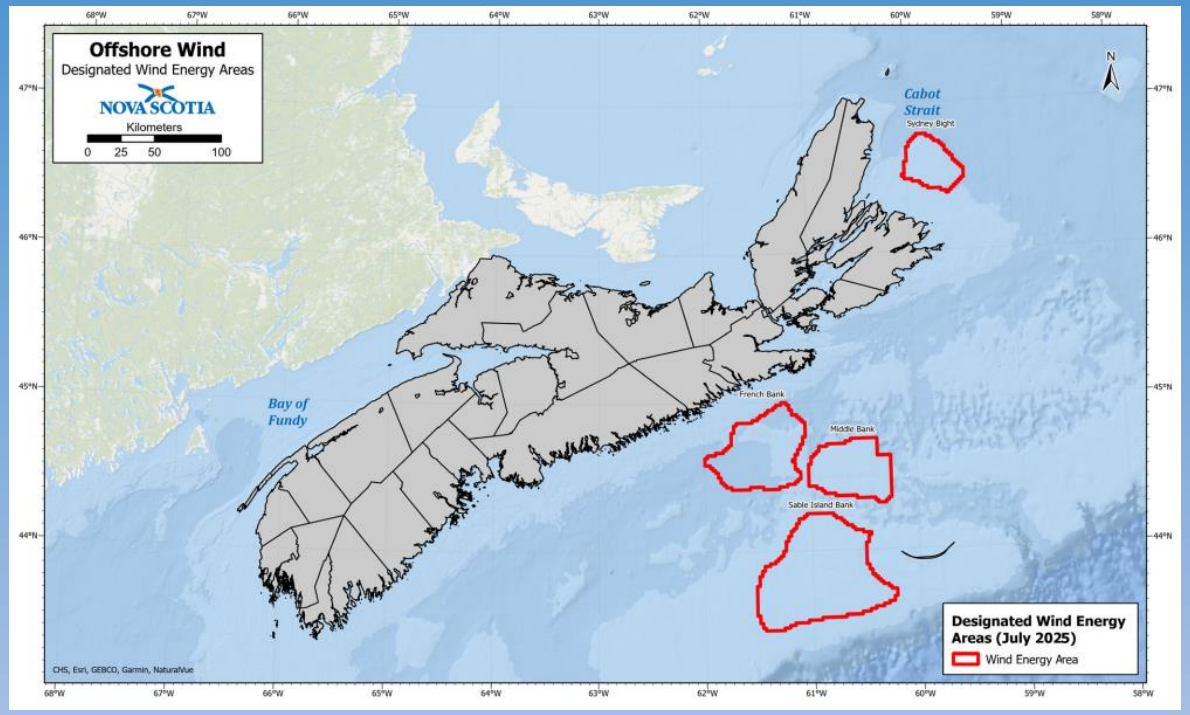
- (DFO): Jay Barthelotte, Mat Lawson, Mike Vining, Jen Field, Mike Adams, Pamela Emery, Nell den Heyer, Damian Lidgard, Yongsheng Wu, Catalina Gomez, Andrew Cogswell, Marc Skinner, Colleen Smith
- (NRCan): Jordan Eamer
- (OTN Dalhousie University): Sara Iverson, Rob Lennox

Photo: H. Moors-Murphy

Photos: H. Moors-Murphy

Background

- Many marine mammal species regularly occur on the Scotian Shelf and off eastern Cape Breton
- Broad-scale species range and distribution patterns known to overlap with designated Wind Energy Areas (WEAs) off Nova Scotia
- Information on fine-scale movement patterns and habitat use in the WEAs is limited



Background

- IAAC Regional Assessment of Offshore Wind Development in Nova Scotia Final Report (published January 2025):
  - Highlighted the need for increased efforts to collect environmental data, including on marine mammal behavior and habitat use, in potential wind development areas (Recommendation T1-6: Prioritize and expand the general collection of environmental data, especially in the vicinity of the PDAs, within the RA Study Area)

- NetZero Offshore Wind R&D Priorities Roadmap (published August 2025):
  - Specifies need to synthesize current knowledge, to develop a standardized framework and protocol for data collection and analysis, and to collect new data on marine species, including marine mammals, to address knowledge gaps and establish a baseline for designated wind development areas (Priority 6: Baseline Data Summaries – Environmental Data & Priority 12: Baseline Data Collection – Environmental Data)

Photo: H. Moors-Murphy

Background

- Baseline data prior to construction and operation of wind energy farms is needed to support assessments of risk, impacts, and effectiveness of mitigation measures

Photo: P. Emery

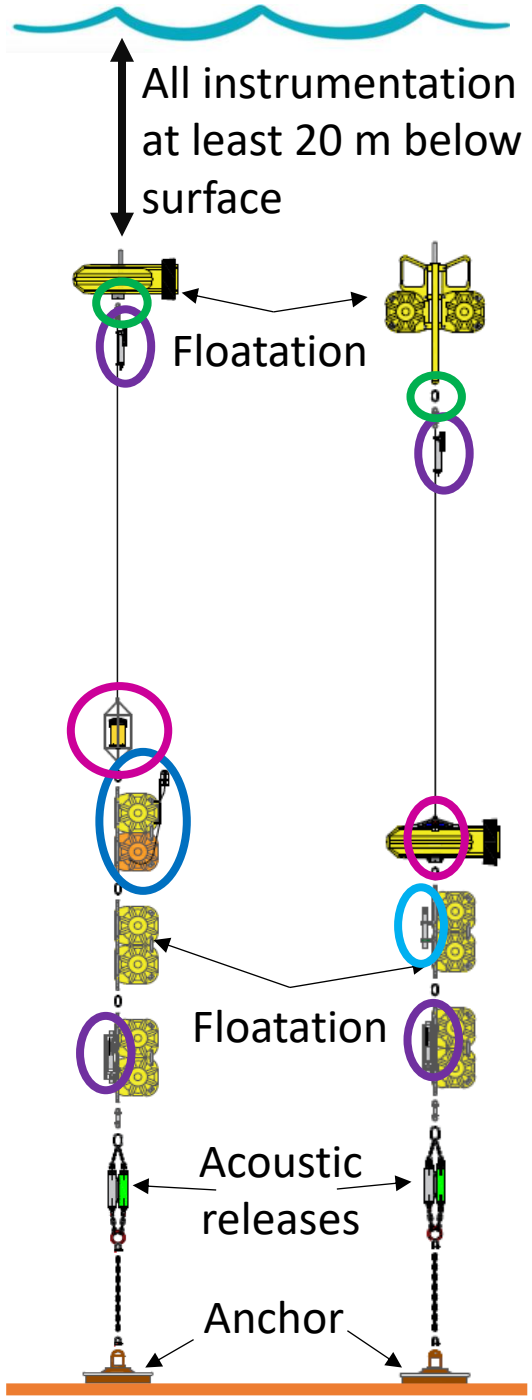
Study Objectives

- This project aims to collect passive acoustic and oceanographic data over a 2-yr period within and near WEAs to:
  - Assess the presence of cetaceans via acoustic detections (presence of their calls)
  - Characterize ambient and anthropogenic noise
  - Examine oceanographic variability
  - Investigate potential relationships between cetacean occurrence and environmental variables (which may impact cetacean prey and influence habitat use)

Photo: H. Moors-Murphy

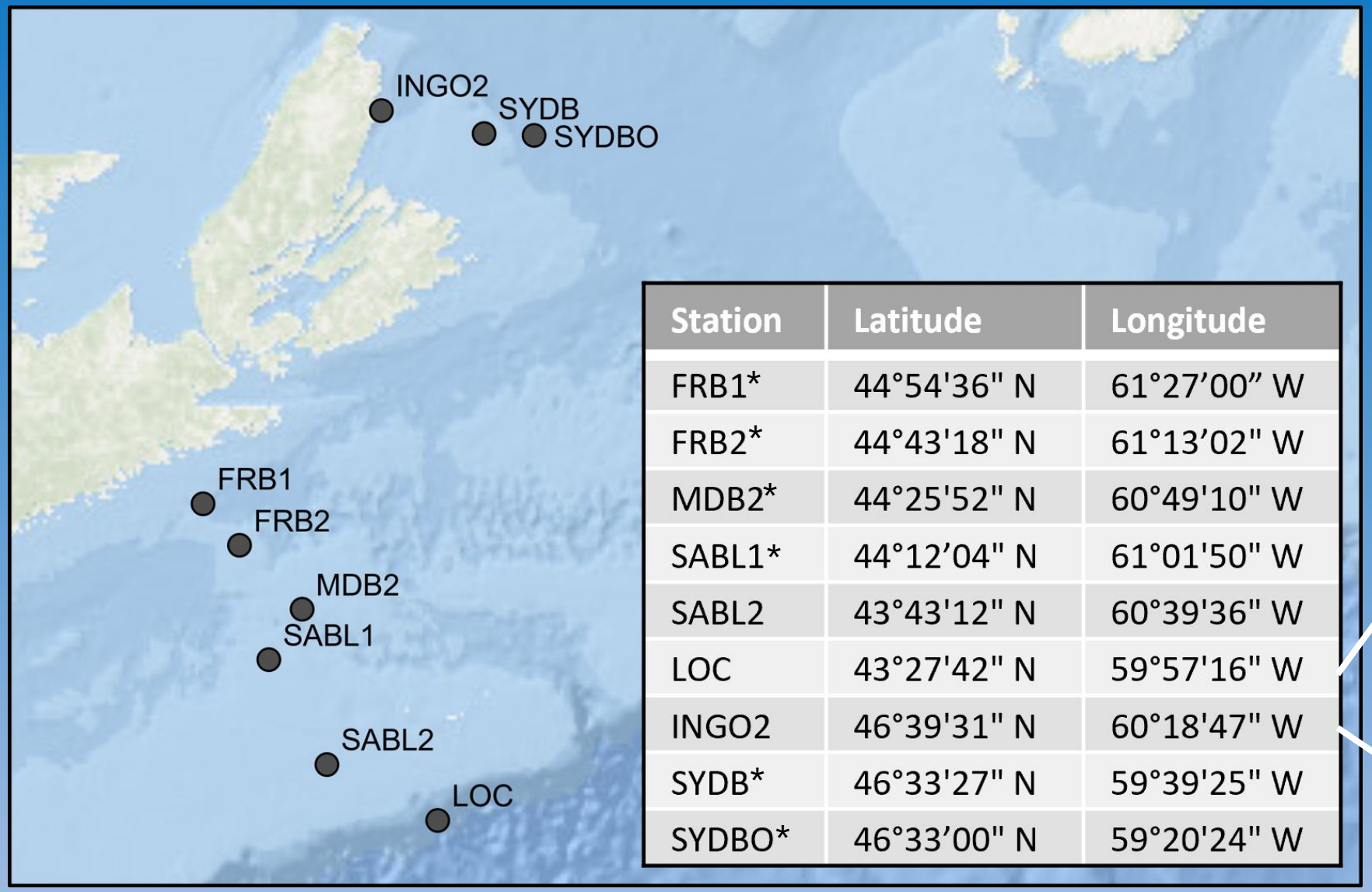
Methods – Mooring Design

- Moorings equipped with multiple scientific instruments:
  - Archival passive acoustic recorders (**JASCO AMARs** or **Ocean Instrument SoundTraps**)
    - Records ambient sound, including cetacean calls, other biological sounds, and anthropogenic noise
  - Acoustic Doppler Current Profiler (**ADCPs**)
    - Measures water current velocities
  - CTDs (**Sea-Bird MicroCATs**)
    - Measures salinity, temperature, and depth
  - Acoustic monitoring receivers (**Vemco VR2AR**)*
    - Track tagged fish and seals in the vicinity of the mooring
- Moorings extend to 20 m below the surface
- Designed to be deployed and collect data over ~ 1 yr



Collaboration with the Ocean Tracking Network

Methods – Mooring Locations



Station	Latitude	Longitude
FRB1*	44°54'36" N	61°27’00” W
FRB2*	44°43'18" N	61°13’02" W
MDB2*	44°25'52" N	60°49'10" W
SABL1*	44°12’04" N	61°01'50" W
SABL2	43°43'12" N	60°39'36" W
LOC	43°27'42" N	59°57'16" W
INGO2	46°39'31" N	60°18'47" W
SYDB*	46°33'27" N	59°39'25" W
SYDBO*	46°33’00" N	59°20'24" W

Deep-water mooring, does not extend to 20 m below surface

Shorter PAM-only mooring

**Equipped with OTN acoustic receivers*

Methods – Planned Data Collection

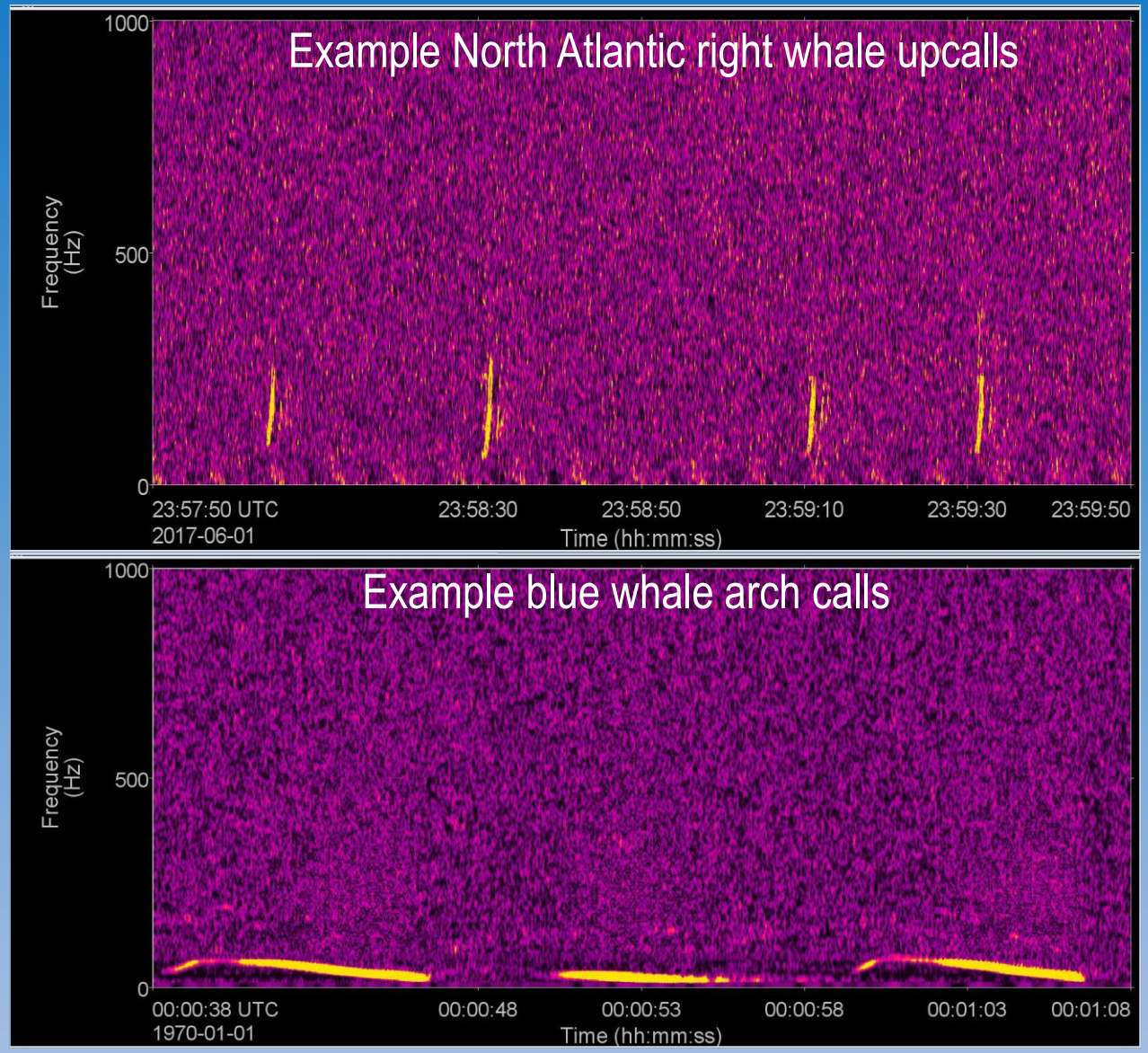
- Proposed 3-year study:
  - Year 1 (2025-2026):
    - Mooring deployments in Sept/Oct 2025
  - Year 2 (2026-2027):
    - Mooring recoveries and deployments in Sept/Oct 2026
    - Data downloads, archiving, and backups
    - Processing and analysis of data
  - Year 3 (2027-2028):
    - Mooring recoveries and deployments in Sept/Oct 2027
    - Data downloads, archiving, and backups
    - Processing and analysis of data
    - Compile results into a preliminary report on project activities

Photo: Glasgow Science Centre


Photo: Team Whale, DFO

Methods – Passive Acoustic Data

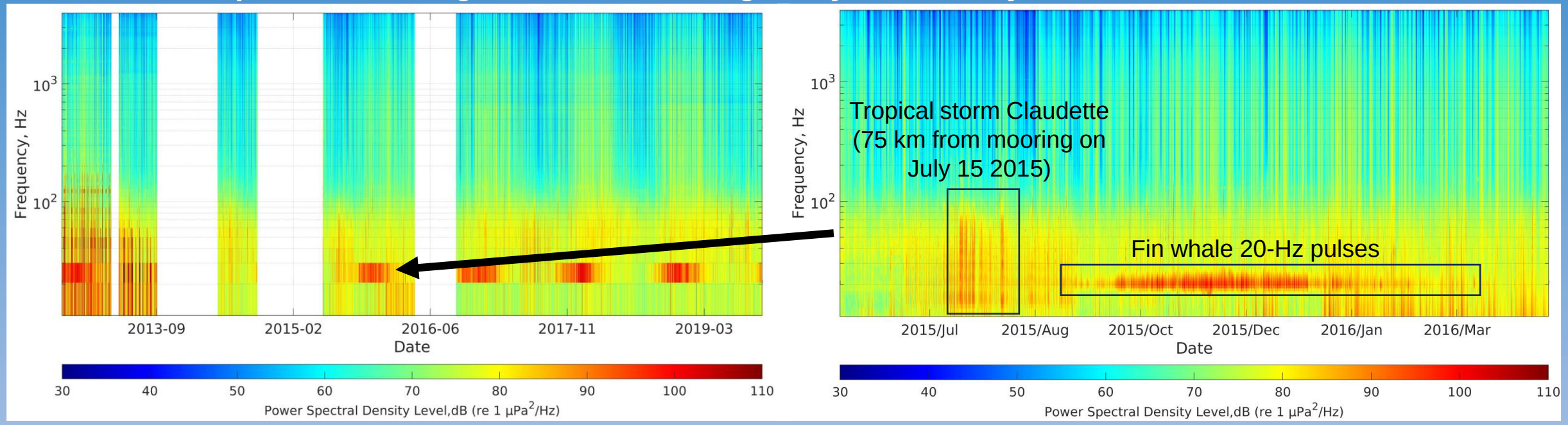
- Lead: H. Moors-Murphy
- Passive acoustic monitoring (PAM) using bottom-moored acoustic recorders allows for year-round collection of data on cetacean occurrence
  - Used to examine species presence through detection of their calls
  - Provides data on minimum occurrence over space and time
  - May provide information on movement patterns, habitat use, and behavior
- Analysis focused on daily presence of:
  - North Atlantic right whales (upcalls)
  - Blue whales (A, B, AB, D, arch calls)
  - Fin whales (20 Hz pulses)
  - Sei whales (downsweeps)
  - Minke whales (pulse trains)
  - Humpback whales (moans)
  - Harbor porpoise (clicks)



Methods – Passive Acoustic Data

- Lead: J. Xu
- PAM data also provides information on ambient and anthropogenic noise levels
  - Used to assess baseline ambient noise conditions within WEAs, including contributions from natural (e.g., wind, biological) and anthropogenic (e.g., vessels) sources
  - Will support validation of noise modelling studies

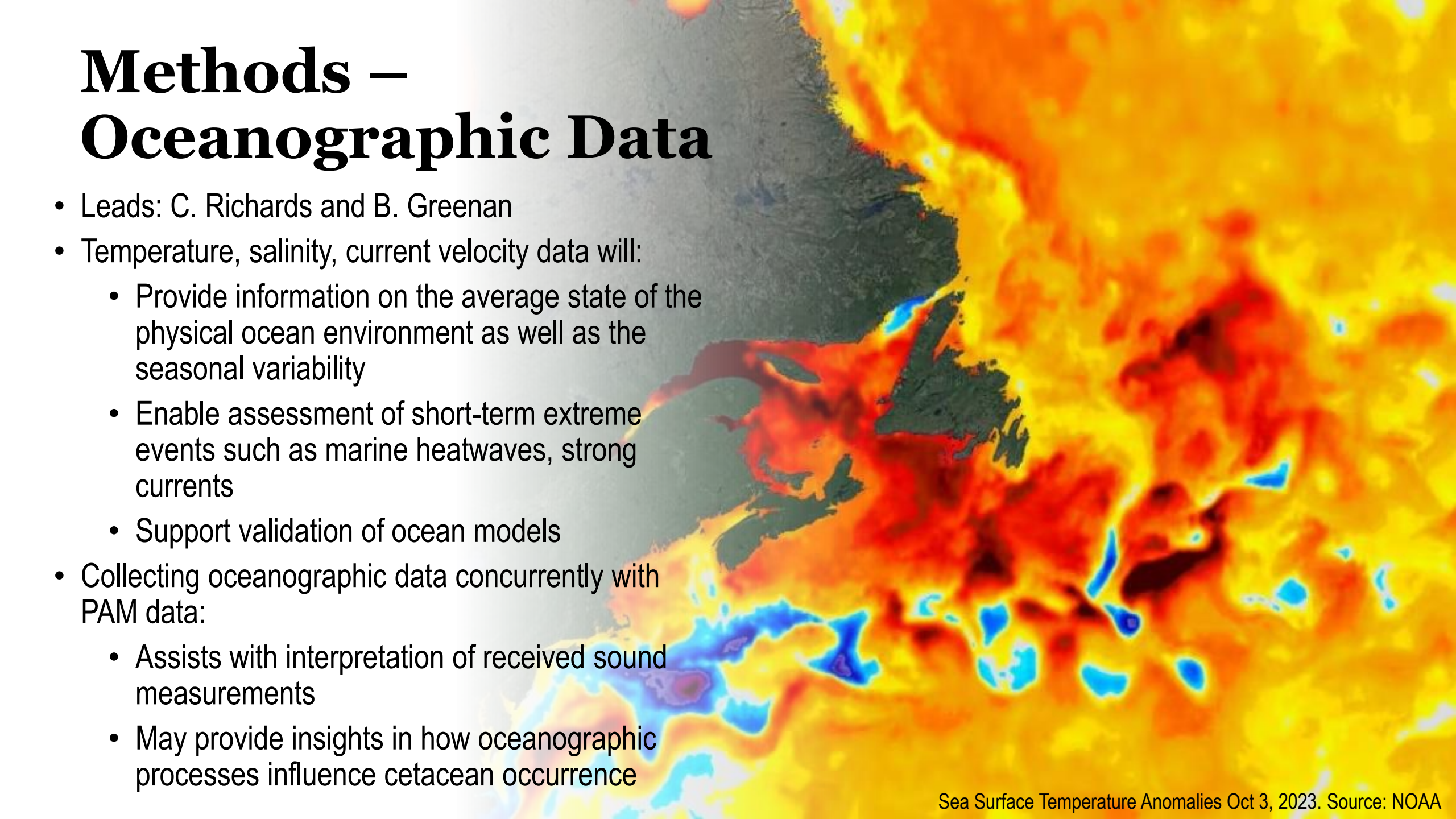
Examples from a long-term PAM mooring study in the Gully Marine Protected Area



Figures provided by J. Xu

Methods – Oceanographic Data

- Leads: C. Richards and B. Greenan
- Temperature, salinity, current velocity data will:
  - Provide information on the average state of the physical ocean environment as well as the seasonal variability
  - Enable assessment of short-term extreme events such as marine heatwaves, strong currents
  - Support validation of ocean models
- Collecting oceanographic data concurrently with PAM data:
  - Assists with interpretation of received sound measurements
  - May provide insights in how oceanographic processes influence cetacean occurrence



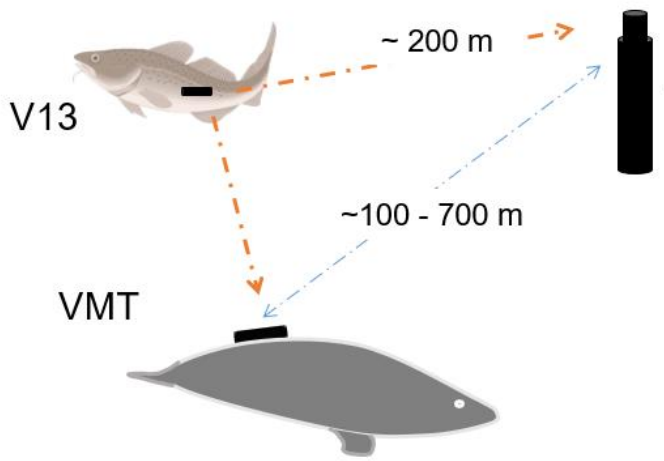
Sea Surface Temperature Anomalies Oct 3, 2023. Source: NOAA

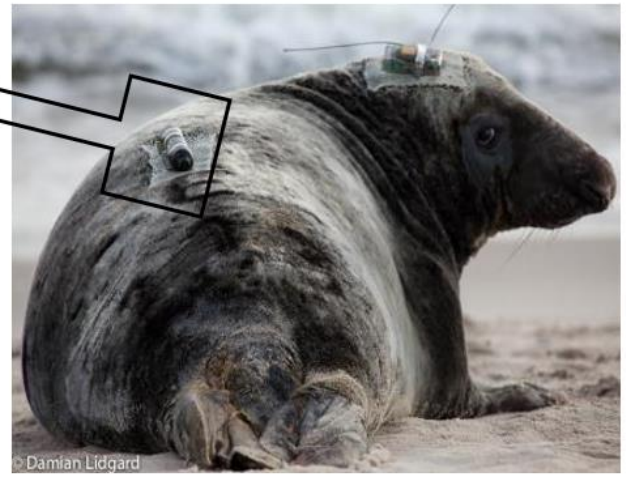
Methods - Telemetry Data

- Leads: Nell den Heyer and Damian Lidgard
- Six VR2AR receivers provided by Dalhousie Ocean Tracking Network (OTN)
  - Receive acoustic signals from transmitter and transceiver tags
  - Tags deployed on seals and other marine wildlife through other projects/programs
- Detect presence of acoustically tagged invertebrates, fish, sharks, and seals
- Inform animal tracking and habitat mapping studies

DFO MAR Region's Sable Island Grey Seal Research Program seal tagging efforts in July 2025

The Vemco Mobile Transceiver (VMT) transforms the grey seal into animal oceanographers





Alternates between transmitting acoustic signals and listening for acoustics transmissions from other Vemco transmitters

20 VMTs deployed on adult greys seals on Sable in July 2025

Figure provided by N. den Heyer

WEA Specific Data Collection Efforts within the Bigger Picture

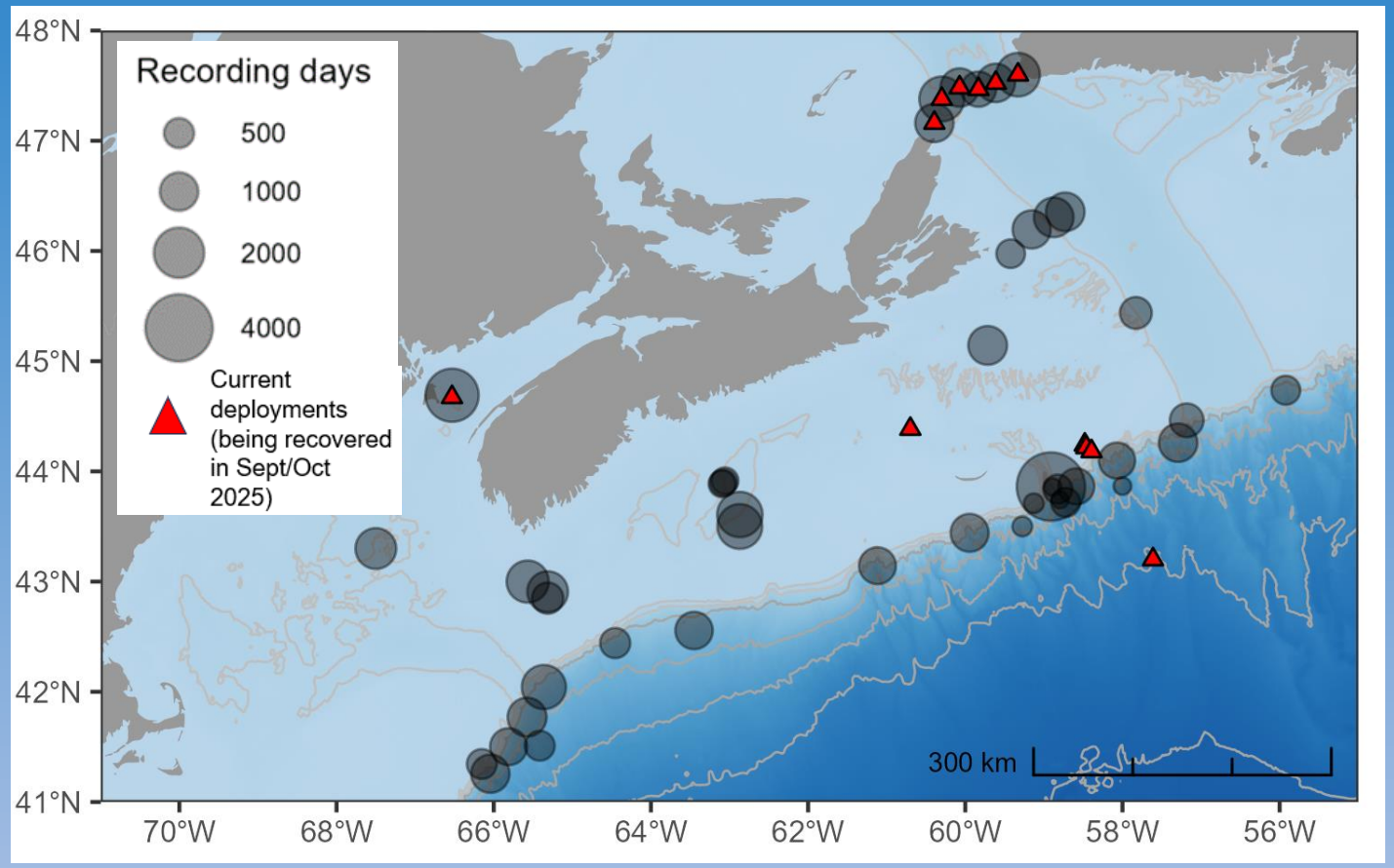
- WEA data collection efforts are part of longer-term science programs led by DFO Maritimes Region
- Continued collection of data from broader areas will help interpret data collected from within designate WEA

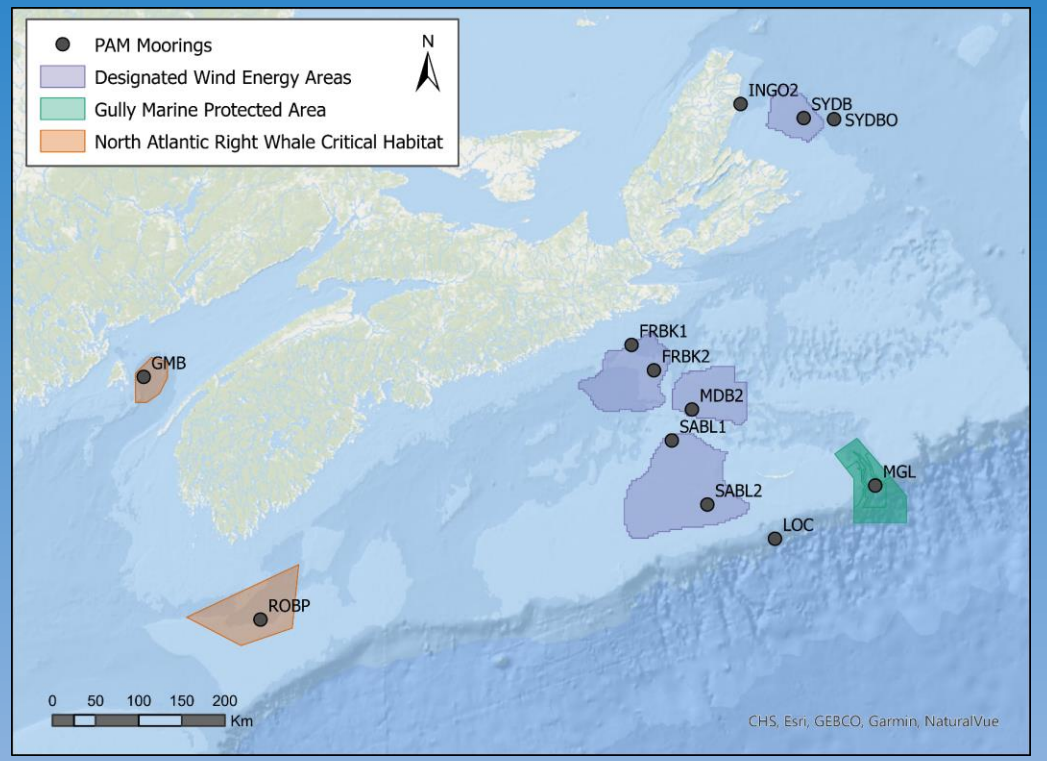
Photo: H. Moors-Murphy

DFO Maritimes Region's PAM Mooring Program

Data collection efforts from 2012 to present

(data collection under multiple projects/programs and funded by various sources including by SARA Implementation Funds, NCP, MCT, OPP-MEQ, OPP-WDCA, Whales 2.0, TC, NRCan)

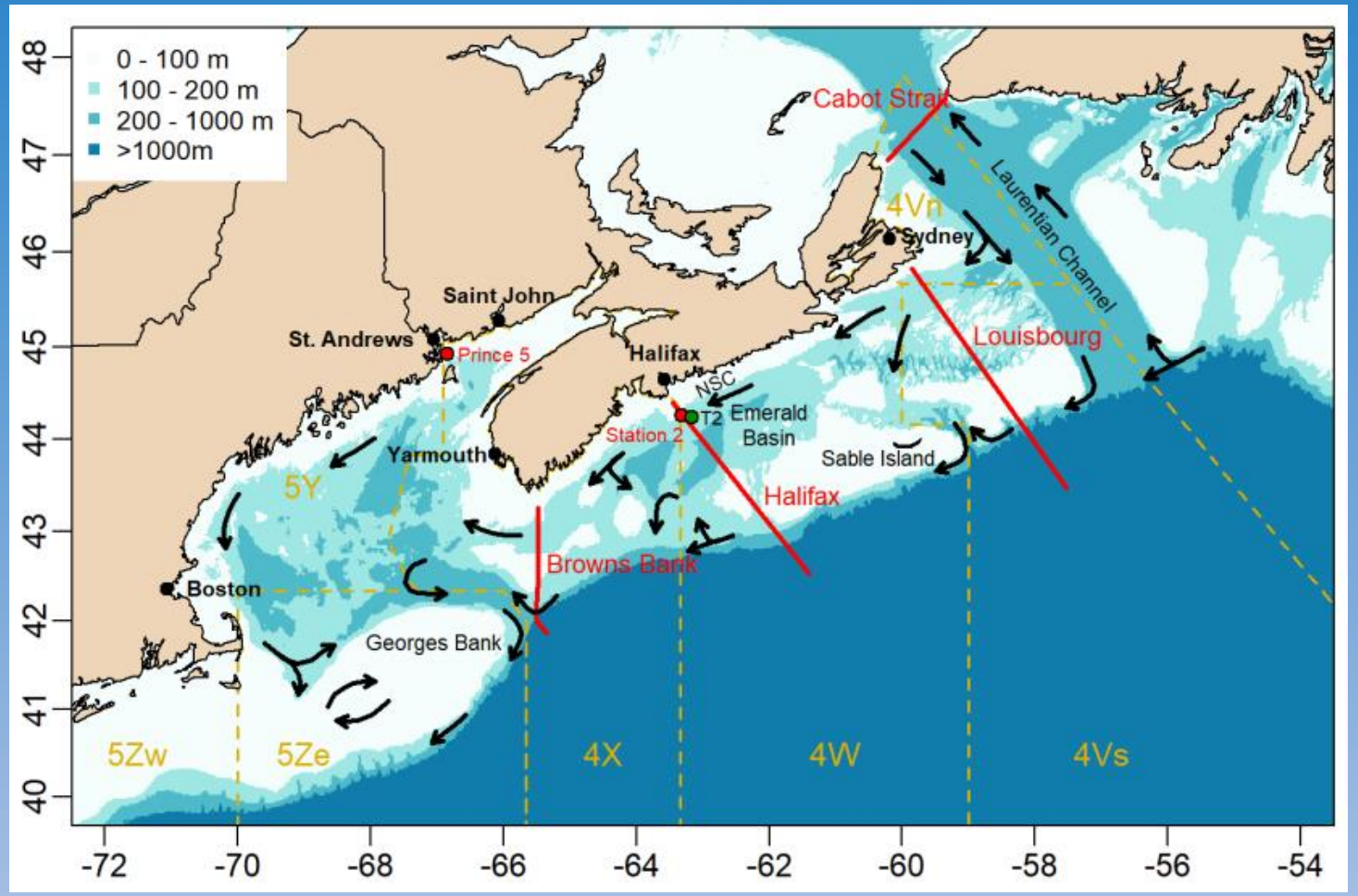




Planned mooring deployments in Fall 2025

DFO Maritimes Region's Atlantic Zonal Monitoring Program (AZMP)

Map summarizing general locations of Scotian Shelf and Gulf of Maine AZMP monitoring efforts (program first implemented in 1998)



- Core AZMP lines
- High frequency sampled hydrographic stations
- Nova Scotia Current mooring
- Weather stations
- Major current directions
- Boundaries of the Northwest Atlantic Fisheries Organization Divisions

Figure from: Layton, C., Brickman, D., Greenan, B., Galbraith, P.S., and Shaw, J.-L. 2025. Physical Oceanographic Conditions on the Scotian Shelf and in the Gulf of Maine during 2024. Can. Tech. Rep. Hydrogr. Ocean Sci. 403: vi + 82 p.

Collaboration is Key

- Deploying multipurpose moorings increases efficacy of mooring deployments and provides a multi-pronged approach in support of baseline environmental monitoring

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Thank You!

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