# Changes in residency and connectivity of Atlantic cod (*Gadus morhua*) on its southernmost spawning ground

**Alison Frey and Steve Cadrin**

UMass Dartmouth School for Marine Science and Technology

PICES 2026 Annual Meeting

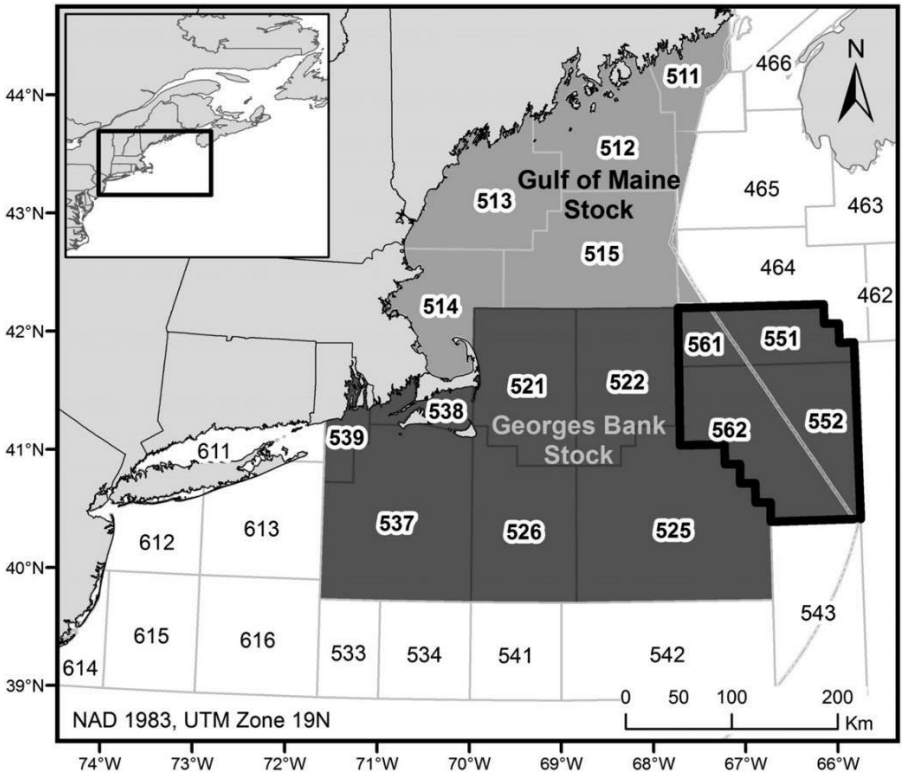
October 26, 2026

# Overview

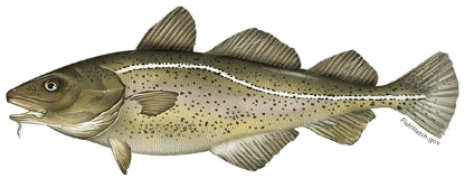
1. Atlantic cod in Southern New England
2. Project motivation and objectives
3. Phase I: Pre-construction assessment methods and results
4. Phase II: Post-construction assessment
5. Conclusions and future work

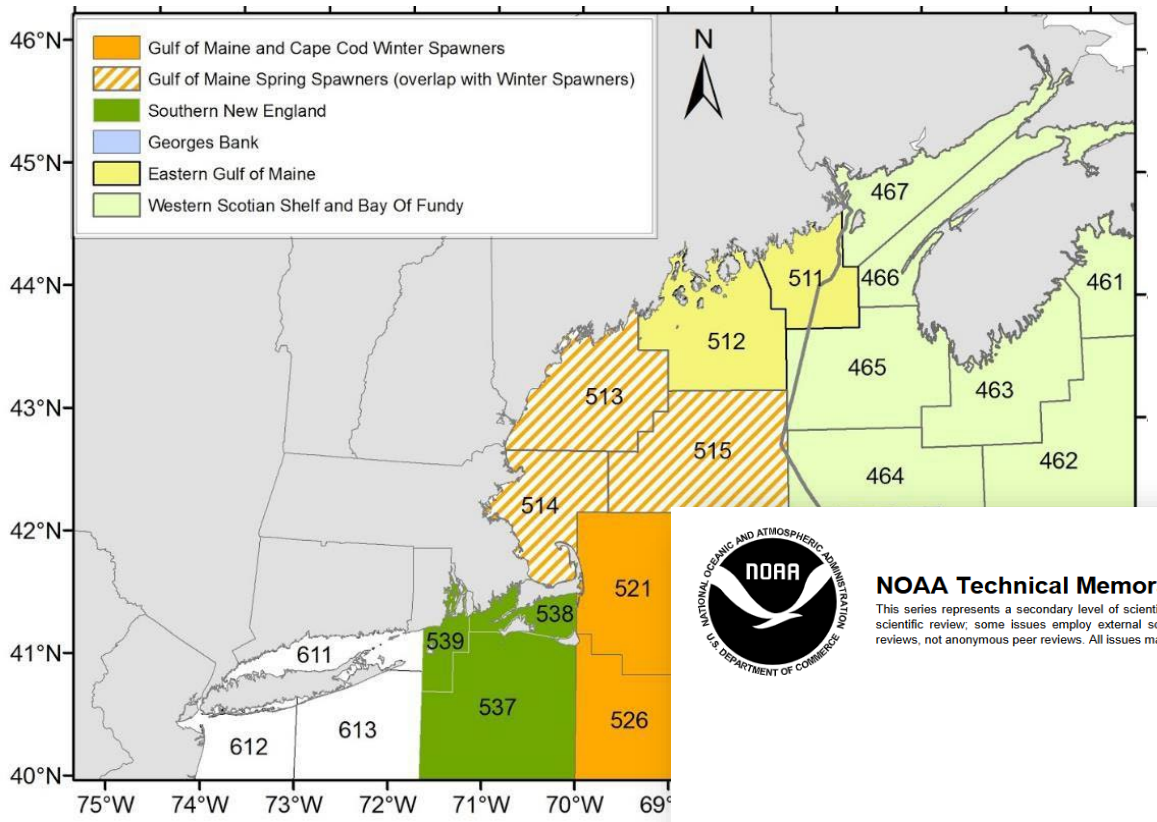


# Atlantic cod (*Gadus morhua*) in the Northwest Atlantic Ocean



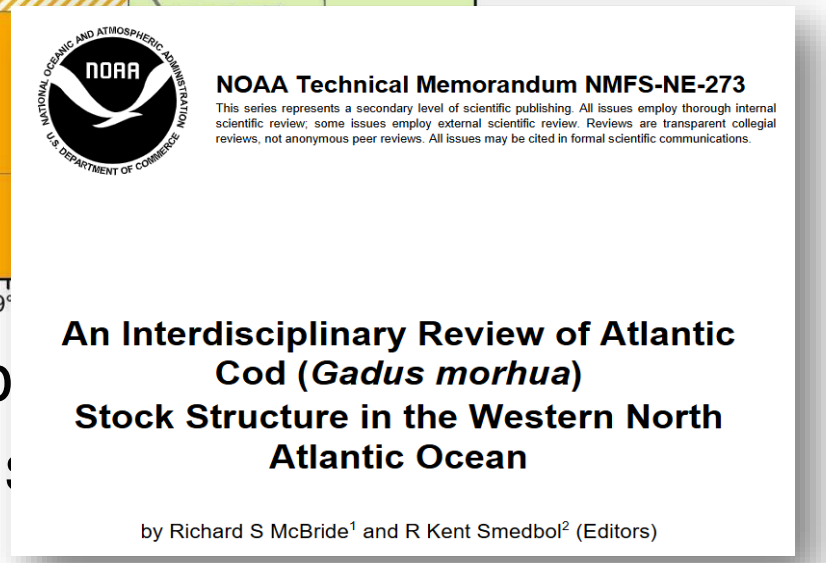

2 stock units



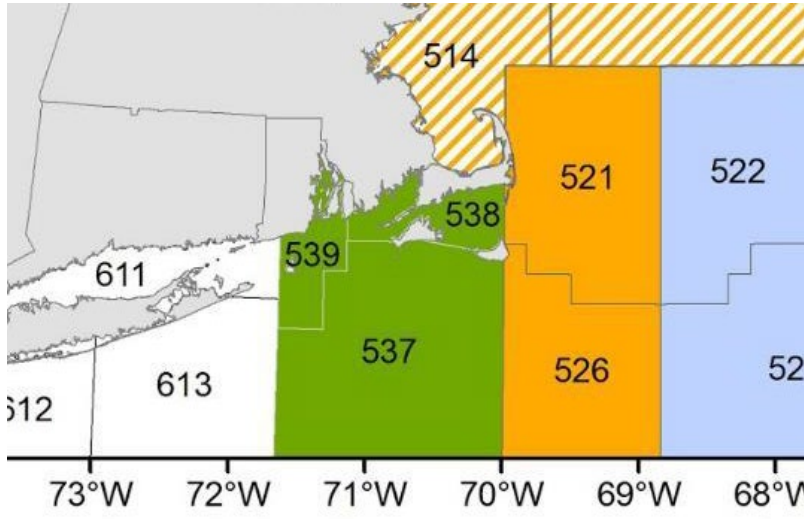



5 biological pop

4 management



# Southern New England Atlantic cod



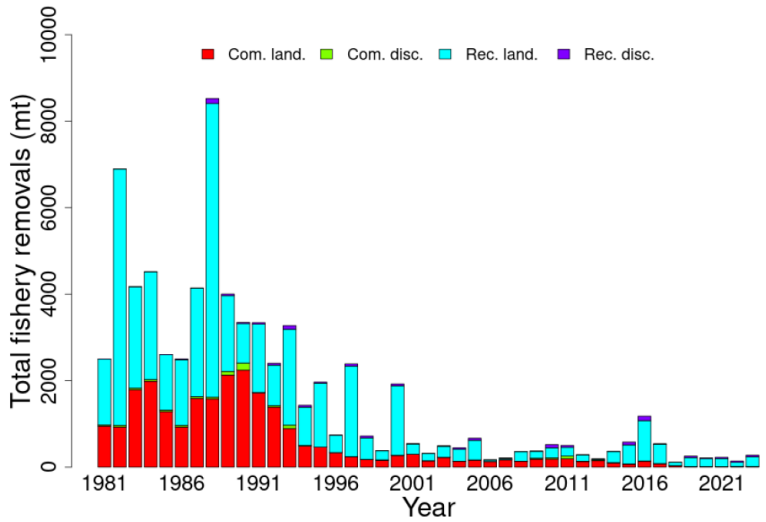




Figure 4: Total catch of Southern New England Cod between 1981 and 2023 by fleet (commercial, recreational) and disposition (landings and discards).

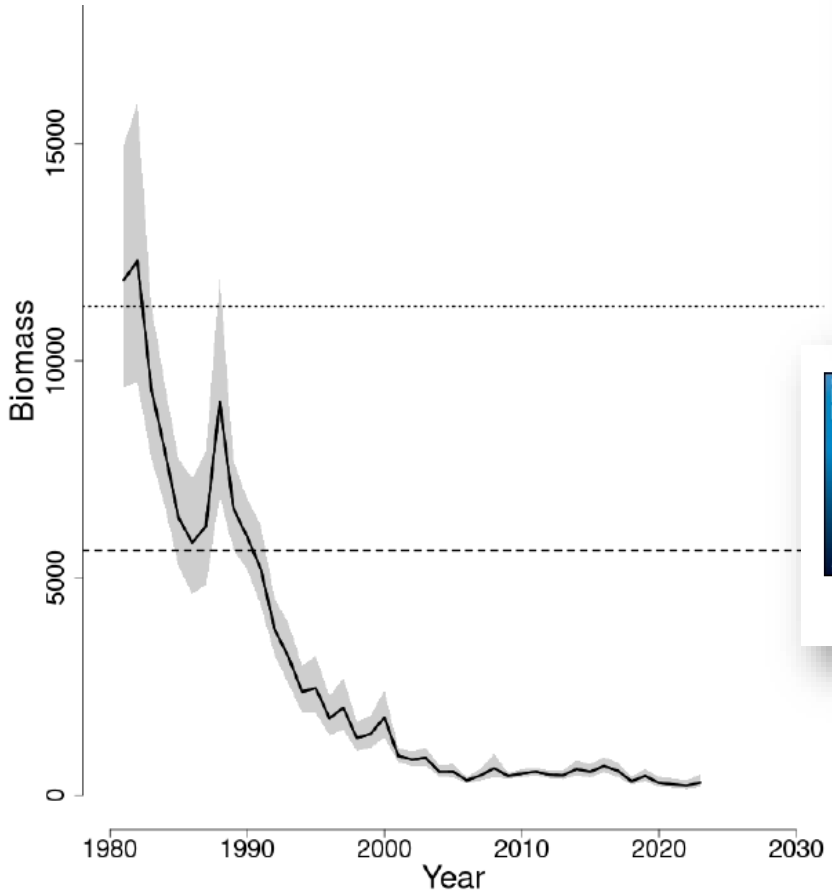



Figure 1: Trends in spawning stock biomass of Southern New England Cod between 1981 and 2023 from the current (solid line) assessment and the corresponding $SSB_{Threshold}$ ($\frac{1}{2}$ $SSB_{MSY}$ *proxy*; horizontal dashed line) as well as $SSB_{Target}$ ($SSB_{MSY}$ *proxy*; horizontal dotted line) based on the 2024 assessment. The approximate 90% lognormal confidence intervals are shown.



North American Journal of Fisheries Management

ISSN: 0275-5947 (Print) 1548-8675 (Online) Journal homepage: https://www.tandfonline.com/loi/ujfm20

**Spawning Dynamics and Associated Management Implications for Atlantic Cod**

Douglas R. Zemeckis, Micah J. Dean & Steven X. Cadrin

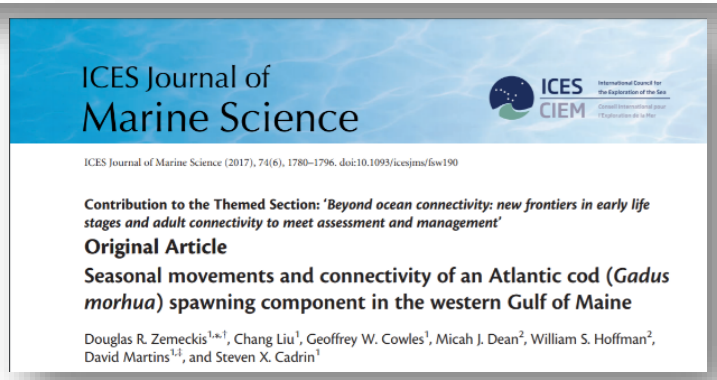


**North American Journal of Fisheries Management**
Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/ujfm20

**Disruption of an Atlantic Cod Spawning Aggregation Resulting from the Opening of a Directed Gill-Net Fishery**

Micah J. Dean [a] , William S. Hoffman [a] & Michael P. Armstrong [a]
[a] Massachusetts Division of Marine Fisheries, Annisquam River Marine Fisheries Station, 30 Emerson Avenue, Gloucester, Massachusetts, 01930, USA

Available online: 01 Mar 2012



ICES Journal of Marine Science

ICES Journal of Marine Science (2017), 74(6), 1780–1796. doi:10.1093/icesjms/fsw190

**Contribution to the Themed Section: *'Beyond ocean connectivity: new frontiers in early life stages and adult connectivity to meet assessment and management'***

**Original Article**

**Seasonal movements and connectivity of an Atlantic cod (*Gadus morhua*) spawning component in the western Gulf of Maine**

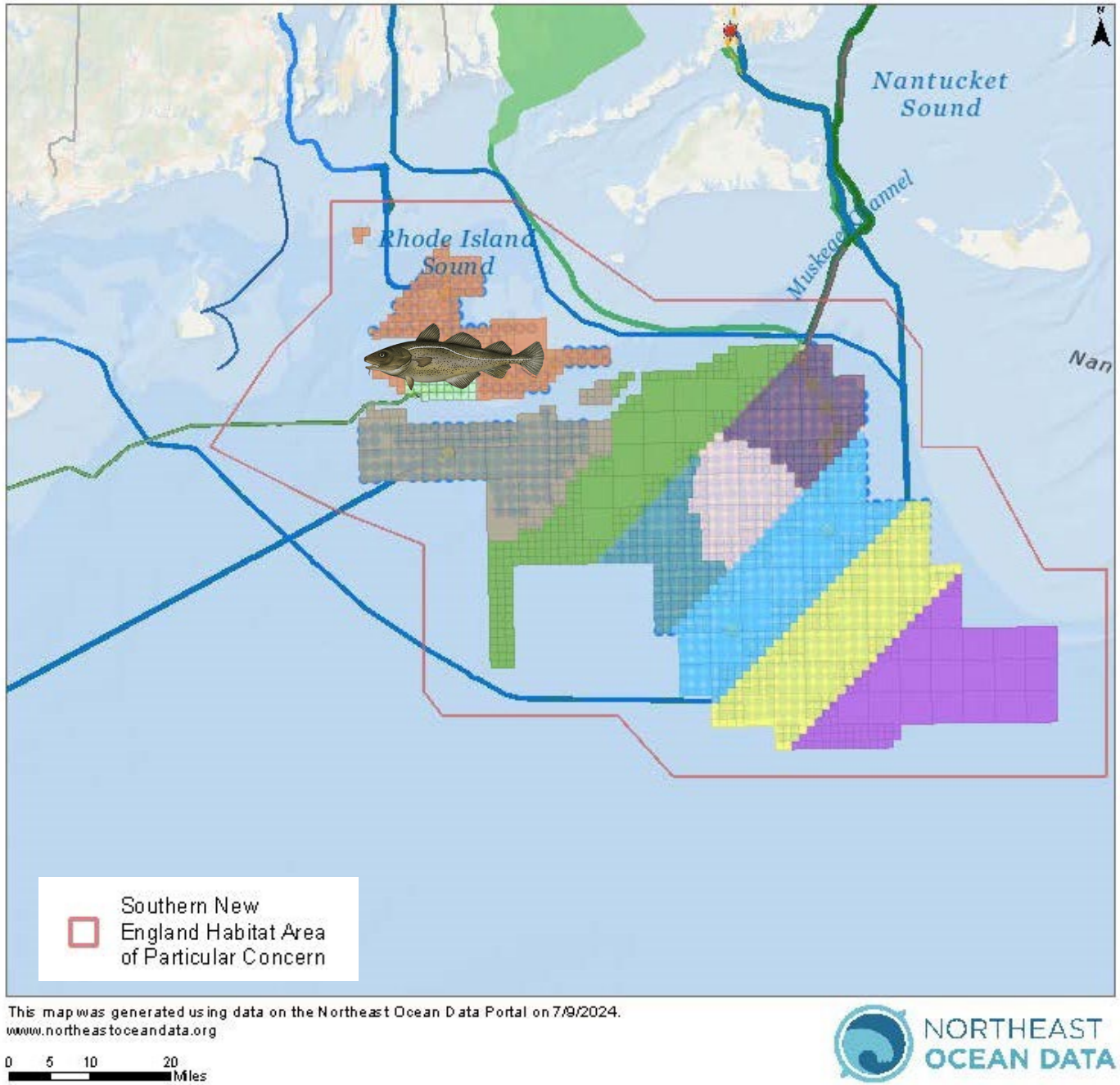
Douglas R. Zemeckis[1,*,†], Chang Liu[1], Geoffrey W. Cowles[1], Micah J. Dean[2], William S. Hoffman[2], David Martins[1,‡], and Steven X. Cadrin[1]

NOAA NEFSC, 2024

# Cod Essential Fish Habitat and Habitat Area of Particular Concern (HAPC) & Southern New England offshore wind development areas

approved July, 2022

New England Fishery Management Council



# Objectives:

1. Broaden our knowledge of Southern New England cod biology, spawning dynamics, and fine-scale connectivity and movement on and around a spawning ground

   *Map the spatiotemporal distribution of spawning, residence times, movement patterns, habitat use during spawning, and demographics of cod on Cox Ledge*

2. To determine potential effects of offshore wind energy development on cod movement and habitat use

# Approach

Acoustic telemetry

Two phase study to capture:

1. Baseline state of 4 consecutive spawning seasons (2019 – 2023)
2. Post-construction/ operational state of 3+ consecutive spawning seasons (2026 – 2029…)



# Acoustic Telemetry

| Fish Tag ID # | Date Time | Receiver Station | Receiver Station Latitude | Receiver Station Longitude |
|---|---|---|---|---|
| **1** | 2026-10-26 16:00 | A | 41.8724 | -71.8263 |
| **1** | 2026-10-26 17:30 | B | 42.9311 | -71.2740 |
| **2** | 2026-10-26 16:45 | A | 41.8724 | -71.8263 |





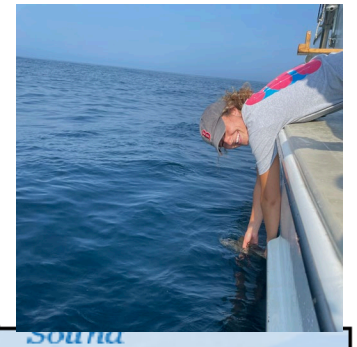

https://innovasea.com

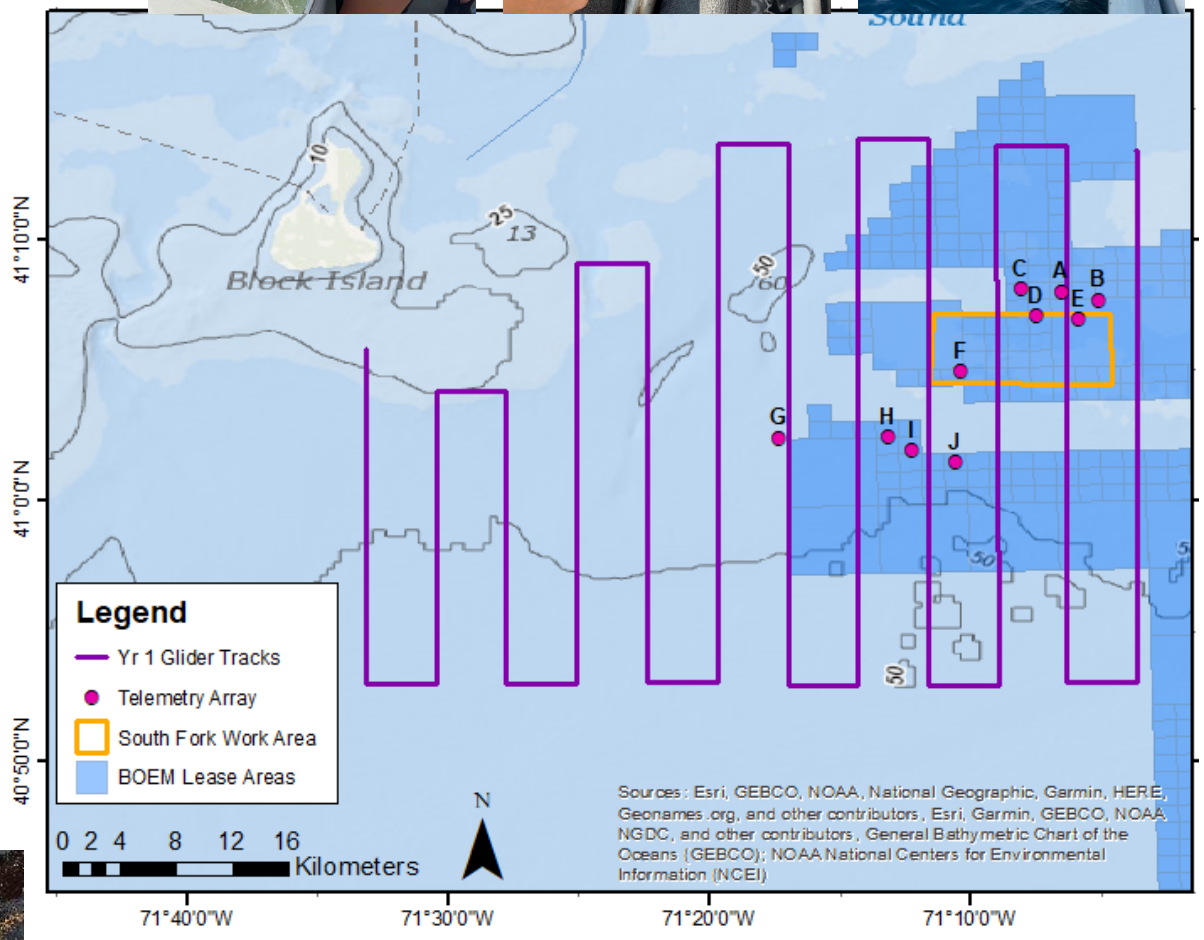
# Phase I: Methods

- Pre-construction: November 2019 – May 2023
- Cooperative approach with Rhode Island fishermen
- Tag large, reproductively mature cod with VEMCO V16 transmitters (n=100)
- Monitoring:
  - Cox Ledge year-round with 10+ fixed VEMCO telemetry receivers
  - Broader region with receiver deployed on autonomous glider





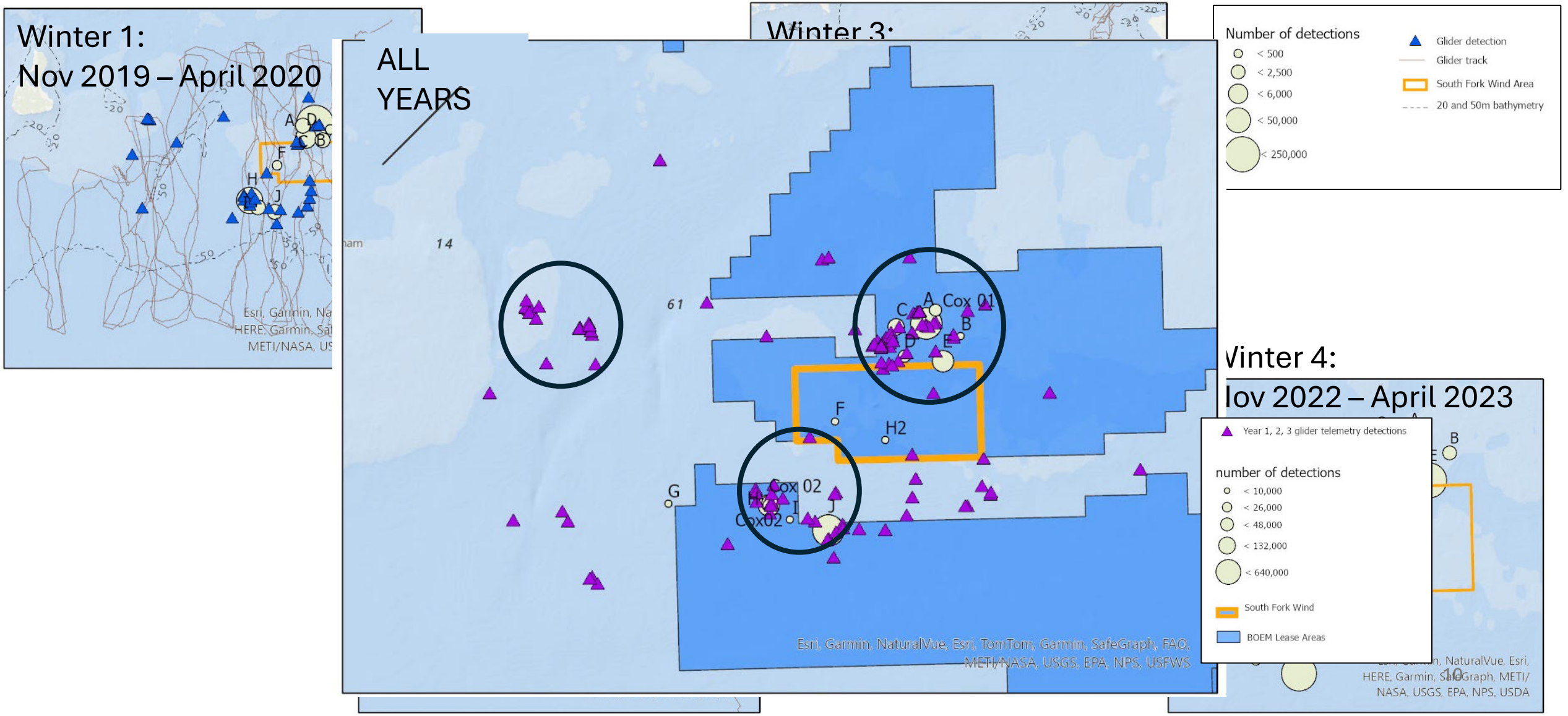




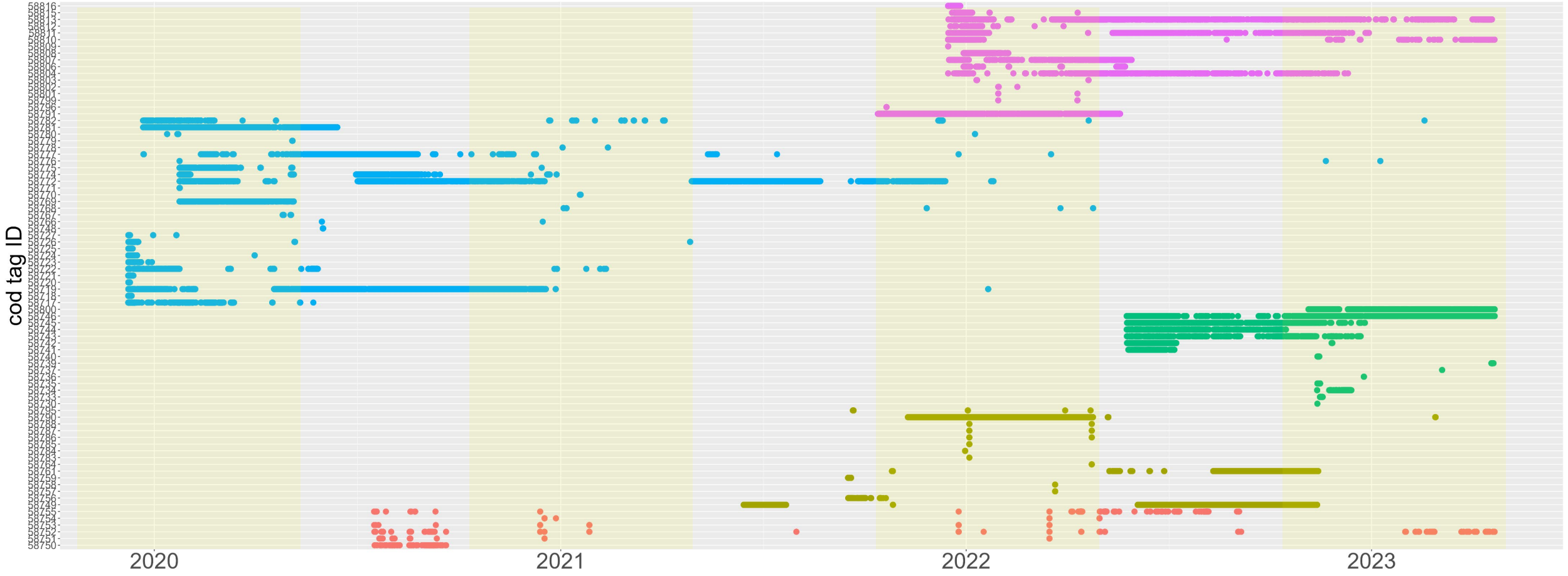





# Phase I: Preliminary Results



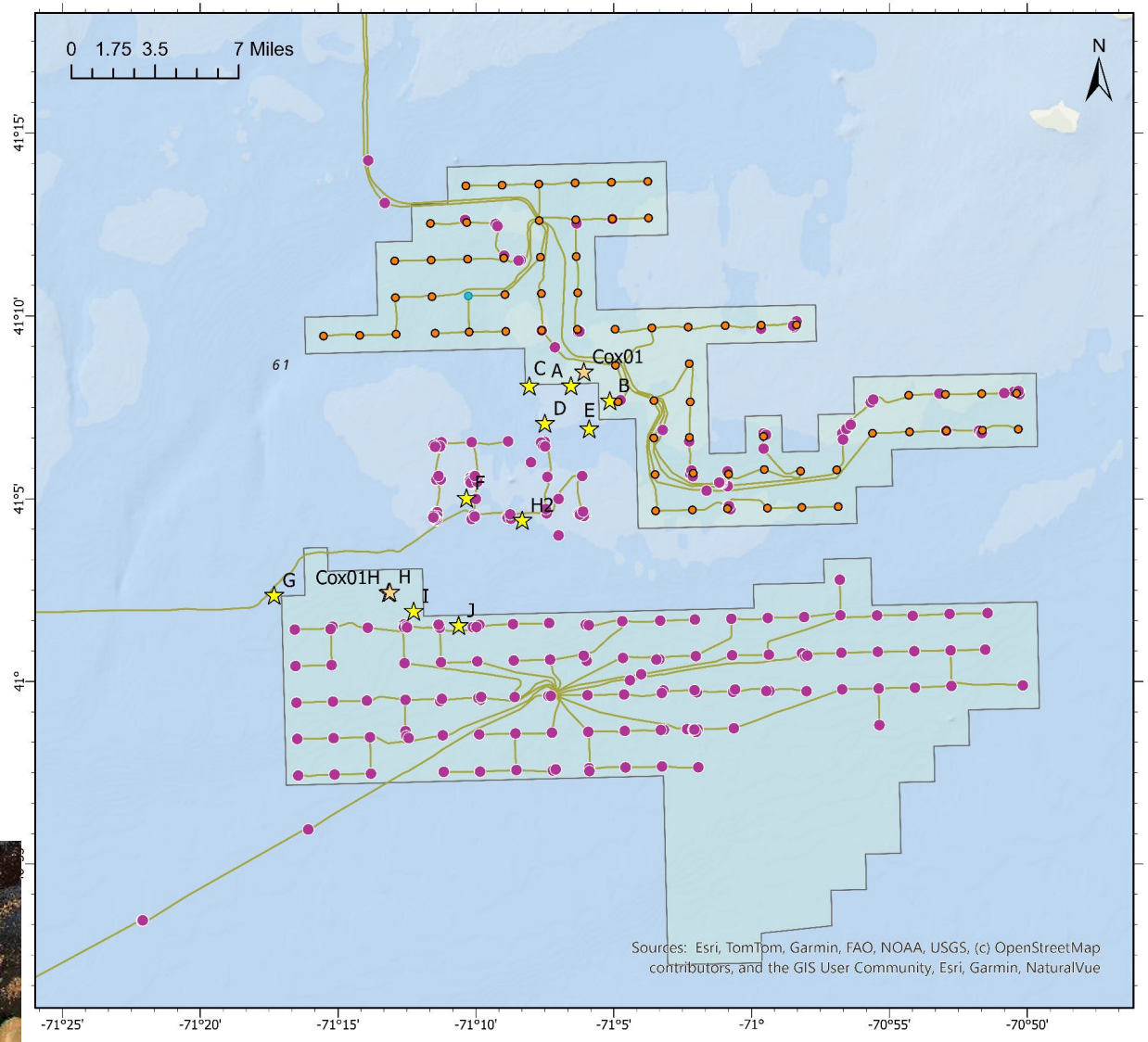
# Phase I: Preliminary Results




Detection histories for individual cod fish at bottom-mounted receivers and glider-mounted receiver. Data was filtered for mortality and fish presumed to be dead were excluded. Colored points discern tag release season. Yellow highlighted portions indicate winter spawning seasons.

# Phase II: Methods

- Post-construction, operational phase: November 2026 – March 2029…?
- Cooperative approach with Rhode Island fishermen
- Tag large, reproductively mature cod with VEMCO V16P transmitters (n=100)
- Monitoring:
  - Cox Ledge year-round with 10+ fixed VEMCO telemetry receivers



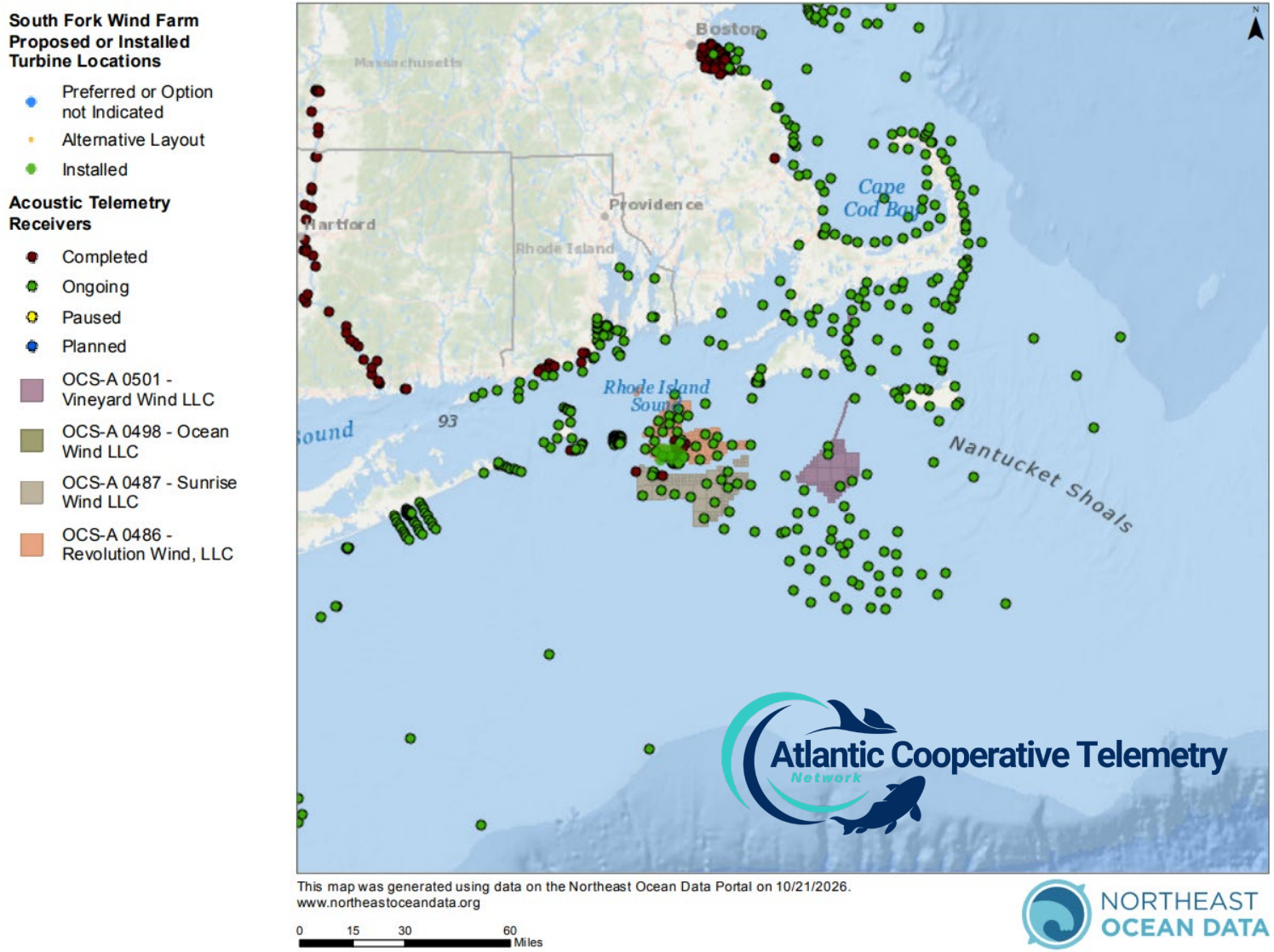



MASSACHUSETTS CLEAN ENERGY CENTER®

NOAA NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION U.S. DEPARTMENT OF COMMERCE

# Future work and broader regional connectivity

- Complete phase II
- Compare phase I and phase II residency, spatiotemporal distribution of fish, and fine-scale connectivity
- Regional connectivity and broader space use beyond Cox Ledge spawning ground



# Summary

- Phase I results show Atlantic cod are spawning on Cox Ledge and surrounding areas **November – March with year-round residence and fine-scale habitat preferences.**
- **SNE cod exhibit limited connectivity to other areas, but need to assess fine-scale connectivity within and around the primary spawning ground**
- Phase II will elucidate impacts of offshore wind development to movement and habitat use and fine-scale connectivity within the spawning ground

- Cooperative research for assessing fishery and offshore wind interactions with data sharing and regional management applications











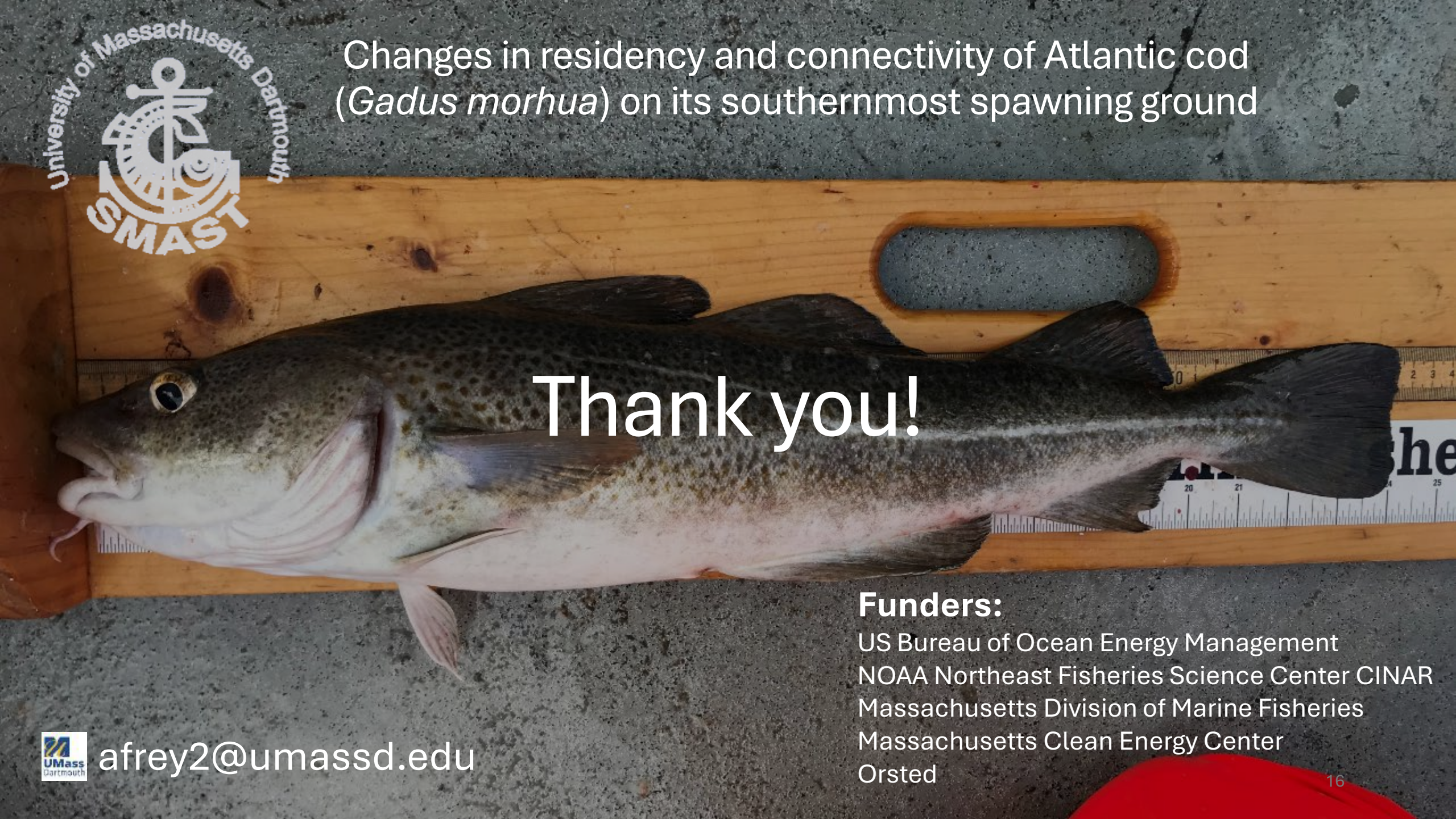




# Thanks to…

- F/V Cailyn and Maren
  Capt. G Mataronas
- Priority Too Charter
  Capt. Rick Bellavance
- Mass Div of Marine Fisheries & SMAST volunteers and grad students
- F/V Heather Lynn and SMAST/CFRF Orsted trawl survey
- New England Aquarium, Inspire Environmental, and RecBio Program

# Changes in residency and connectivity of Atlantic cod (*Gadus morhua*) on its southernmost spawning ground



## Thank you!

afrey2@umassd.edu

**Funders:**
US Bureau of Ocean Energy Management
NOAA Northeast Fisheries Science Center CINAR
Massachusetts Division of Marine Fisheries
Massachusetts Clean Energy Center
Orsted