September 16th 2021

# Revolution Wind

A Joint Venture of Ørsted and Eversource

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Revolution Wind Fisheries Monitoring Plan

# Agenda

- FMP Approach
- Trawl Survey
- Acoustic Telemetry
- Ventless Trap Surveys
- Benthic Monitoring

# Data Sources Evaluated During Plan Development

## Fisheries Independent Data

- NEFSC trawl survey, SNECVTS, BIWF surveys, other fishery-independent surveys, Malek (2015), Friedland et al. (2021)
- Essential Fish Habitat

## Fisheries Dependent Data

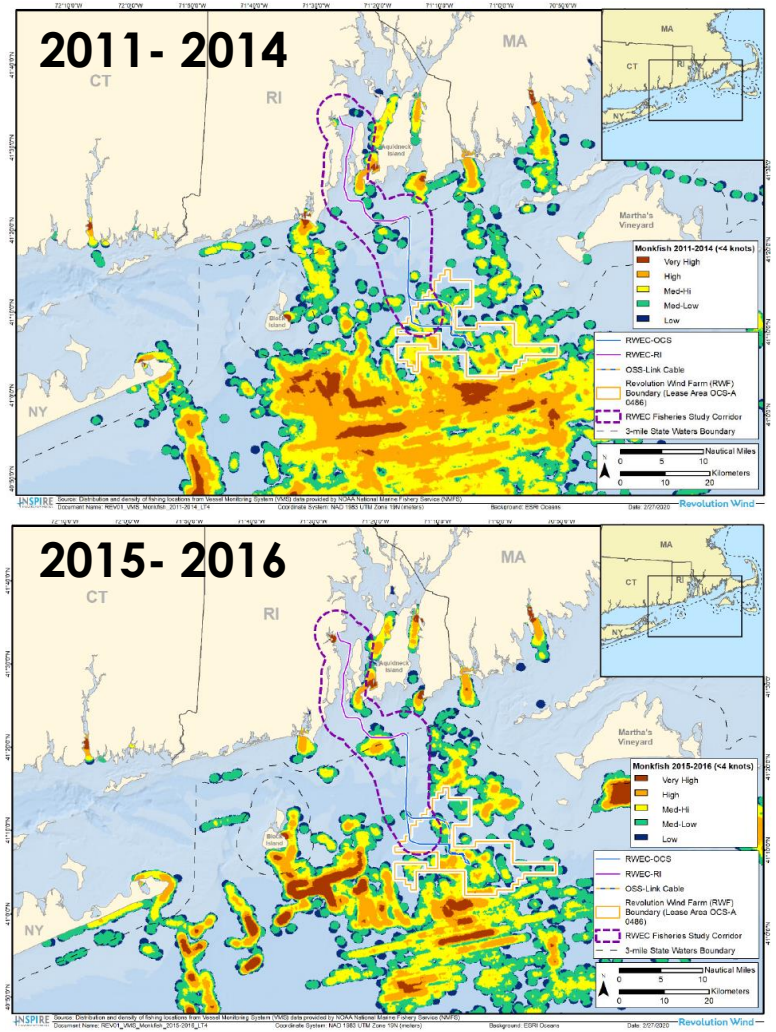
- VMS, VTR, information from Ørsted fishery liaisons

## Prior Regional Offshore Wind Reports

- Guida et al., 2016
- MADMF, 2018
- Petruny-Parker et al., 2015
- Northeast Regional Habitat Assessment Prioritization Working Group (2015)

## BOEM, RICRMC, and ROSA Guidelines for Fisheries Monitoring

### Monkfish Fishery



# Baseline Data – Regional Fisheries

| | Annual Average Revenue and Landings from within RWF | | Annual Average of Total Revenue and Landings | | Percent of Total Gear Values from RWF | |
|---|---|---|---|---|---|---|
| Gear | Revenue | Landings | Revenue | Landings | % of Revenue | % of Landings |
| Bottom Trawl | 330,811 | 805,298 | 10,345,534 | 17,650,034 | 3.20 | 4.56 |
| Pot | 309,044 | 97,245 | 45,170,421 | 23,622,011 | 0.68 | 0.41 |
| Sink Gillnet | 263,817 | 383,264 | 4,587,604 | 6,446,946 | 5.75 | 5.95 |
| Dredge | 174,324 | 20,636 | 35,344,833 | 15,083,131 | 0.49 | 0.14 |
| All Others | 45,641 | 380,191 | 1,630,016,690 | 1,281,322,761 | <0.01 | 0.03 |
| Midwater Trawl | 25,900 | 259,659 | 2,388,786 | 19,750,762 | 1.08 | 1.32 |
| By Hand | 5,776 | 1,652 | 566,211 | 236,037 | 1.02 | 0.70 |

Source: NOAA Fisheries, 2019c.

Notes:

Values are sorted from largest to smallest revenue values for landings data.

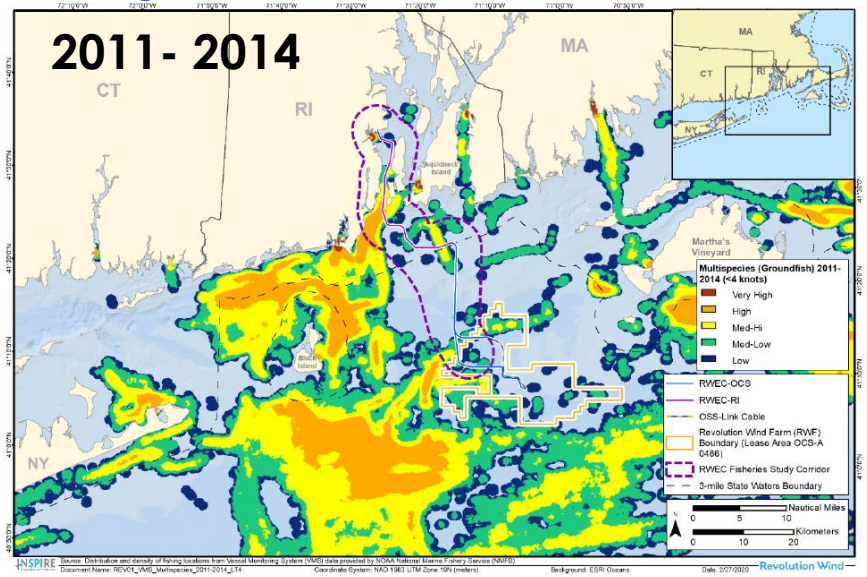
Landings are reported in landed pounds.

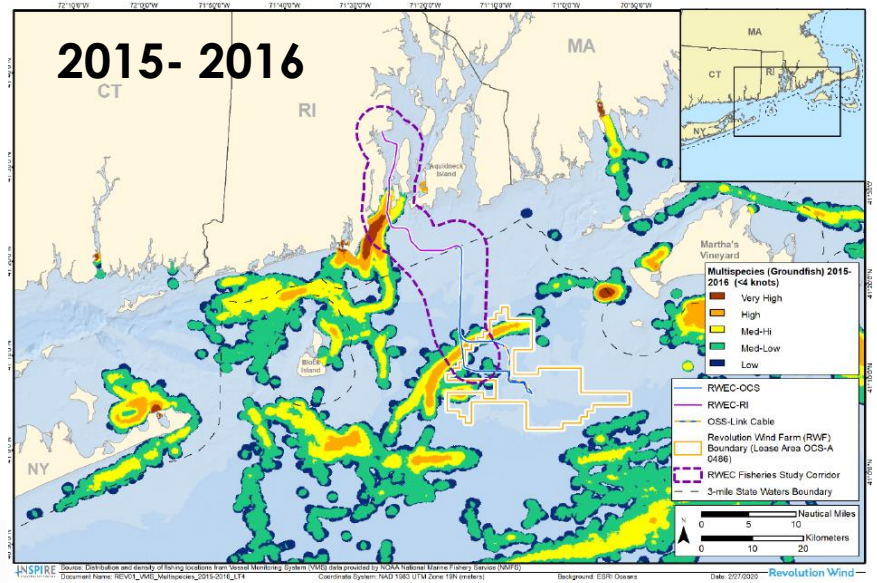
Revenue is in USD deflated to 2010 for consistency.

"Total" revenue and landings values refer to all fishing activity as reported by VTRs for fisheries active in state and federal waters from Maine to North Carolina.

% = percent

## Large-mesh Multispecies Trawl



# Baseline Data – Regional Fisheries

| | Annual Average Revenue and Landings from within RWF | | Annual Average of Total Revenue and Landings | | Percent of Total Species Values in RWF | |
|---|---|---|---|---|---|---|
| Species | Revenue | Landings | Revenue | Landings | % of Revenue | % of Landings |
| Lobster, America | 214,904 | 50,374 | 507,710,672 | 138,232,706 | 0.04 | 0.04 |
| Flounders | 88,240 | 33,976 | 53,080,045 | 23,015,911 | 0.17 | 0.15 |
| Hakes | 60,136 | 141,855 | 15,760,216 | 20,652,426 | 0.38 | 0.69 |
| Herring, Atlantic | 42,852 | 455,959 | 26,499,546 | 166,320,214 | 0.16 | 0.27 |
| Scup | 36,987 | 63,108 | 9,280,444 | 14,364,599 | 0.40 | 0.44 |
| Squids | 34,084 | 30,416 | 38,571,711 | 48,152,606 | 0.09 | 0.06 |
| Sea Bass, Black | 32,211 | 7,547 | 8,045,522 | 2,477,656 | 0.40 | 0.31 |
| Whelk, Channeled | 31,673 | 4,512 | 7,175,012 | 1,232,408 | 0.44 | 0.37 |
| Mackerel, Atlantic | 20,008 | 198,560 | 3,889,243 | 16,596,797 | 0.51 | 1.20 |
| Dogfish, Spiny | 14,296 | 81,592 | 3,619,191 | 18,787,974 | 0.40 | 0.43 |
| Crab, Jonah | 14,121 | 23,578 | 10,983,269 | 14,424,939 | 0.13 | 0.16 |
| All Others | 11,886 | 21,067 | 946,435,275 | 407,953,101 | 0.00 | 0.01 |
| Butterfish | 9,141 | 16,100 | 2,180,724 | 3,340,689 | 0.42 | 0.48 |
| Bass, Striped | 4,425 | 1,131 | 18,797,974 | 5,984,307 | 0.02 | 0.02 |
| Bluefish | 2,811 | 5,382 | 2,796,095 | 4,627,112 | 0.10 | 0.12 |
| Tautog | 381 | 128 | 926,176 | 273,651 | 0.04 | 0.05 |
| Weakfish | 263 | 142 | 319,712 | 207,805 | 0.08 | 0.07 |
| Dogfish, Smooth | 231 | 464 | 976,231 | 2,039,068 | 0.02 | 0.02 |
| Bonito | 191 | 86 | 112,986 | 53,480 | 0.17 | 0.16 |
| Cunner | 138 | 97 | 20,410 | 6,394 | 0.68 | 1.52 |
| Spot | 88 | 175 | 3,139,254 | 2,828,116 | <0.01 | 0.01 |
| Eel, Conger | 40 | 61 | 49,241 | 68,105 | 0.08 | 0.09 |
| Sea Robins | 13 | 33 | 20,812 | 124,470 | 0.06 | 0.03 |
| Whiting, King | 1 | 1 | 902,941 | 810,033 | <0.01 | <0.01 |

Source: NOAA Fisheries, 2019c. ACCSP, 2019.
Notes:
Values are sorted from largest to smallest revenue values for landings data.
Landings are reported in landed pounds.
Revenue is in USD deflated to 2010 for consistency.
"Total" revenue and landings values refer to all fishing activity as reported by VTRs for fisheries active in state and federal waters from Maine to North Carolina.
% = percent

# Stakeholder Engagement To Date

- Rhode Island Coastal Resources Management Council
- Rhode Island Department of Environmental Management
- Bureau of Ocean Energy Management
- National Oceanic and Atmospheric Administration/National Marine Fisheries Service
- Massachusetts Division of Marine Fisheries and Massachusetts Office of Coastal Zone Management
- Responsible Offshore Science Alliance, Responsible Offshore Development Alliance

# Revolution Wind Survey Approach – Trawl Survey

- **Cooperative trawl survey**
  - Sampling will occur seasonally (i.e., every 3 months). Efforts will be made to coordinate timing with other regional surveys.
  - Asymmetrical BACI design - Two control sites have been proposed with consideration to depth, habitat, consistency with NEFSC trawl survey strata, and proximity to future offshore wind development.
  - Pre-construction monitoring will allow for the characterization of community structure, including relative abundance, spatial distribution, and demographics (size, weight, maturity).
  - Primary objective is to determine whether the construction and operational activities associated with the Project lead to a change in the relative abundance of fish and invertebrates within the Project Area.
    - $H_{\emptyset:}$ Changes in relative abundance (CPUE) in both the control and impact sites will be identical over time (2-tailed)
  - Species composition and biological characteristics (e.g., size structure, fish condition, and diet composition) will be compared between pre-construction and post-construction periods.

# Revolution Wind Survey Approach – Trawl Survey

- **NEAMAP Trawl Survey Protocol**
  - NEAMAP trawl net will be used:
    - 400 x 12cm three-bridle four-seam trawl
    - Sweep is constructed of 3" cookies ('flat' sweep)
    - Thyboron Type IV 66" trawl doors
    - 2.5cm (1") knotless codend liner
  - All tows will be completed during daylight hours
  - 20 minute tows at target speed of 2.9 to 3.3 knots
  - Net mensuration equipment to measure net geometry in real time

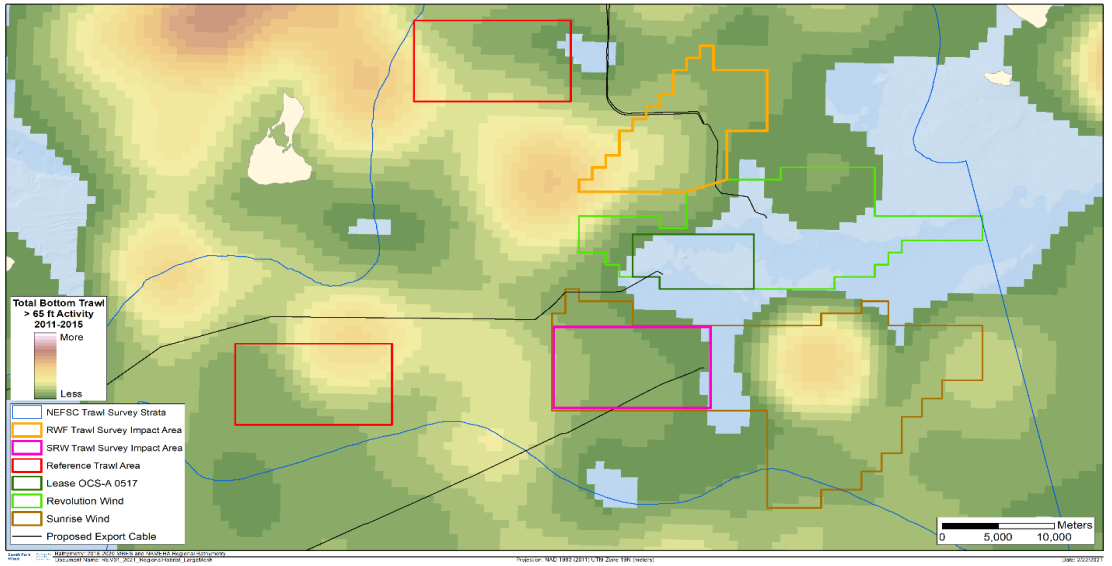

# Revolution Wind Survey Approach – Trawl Survey

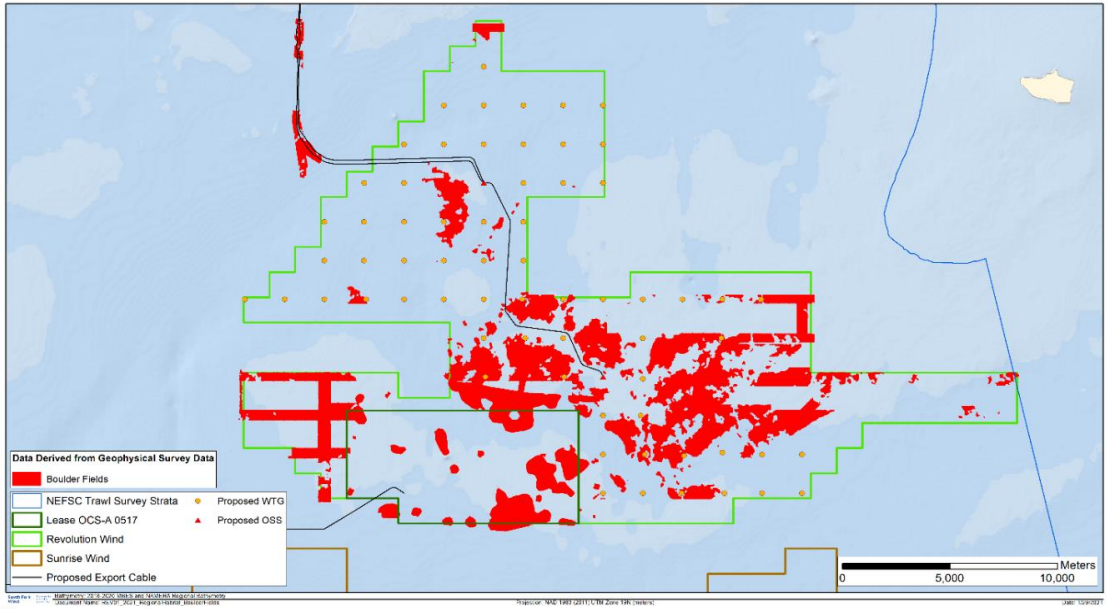
## Survey design

- Trawl survey impact area in northern portion of REV lease site.
- Spatially balanced survey design.
- Target sample size (n=15 tows per season) in the control and impact areas. Sample density is 1 station per 8.3km$^2$. 180 tows per year.
- Design informed by power analysis. Adaptive sampling strategy will be employed.

## Data Collection

- **Station data**
  - Latitude/longitude, time, vessel heading, vessel speed
  - Net geometry using net mensuration
- **Environmental data**
  - Sea state, wind speed, depth, bottom T logger
  - Vertical CTD profile
- **Biological data**
  - Total weight of each species (CPUE; kg/tow)
  - Individual lengths and weights for priority species
  - Biological samples (individual weights and gonads) for priority species using a length-stratified design.
  - Diet content analysis for black sea bass and summer flounder

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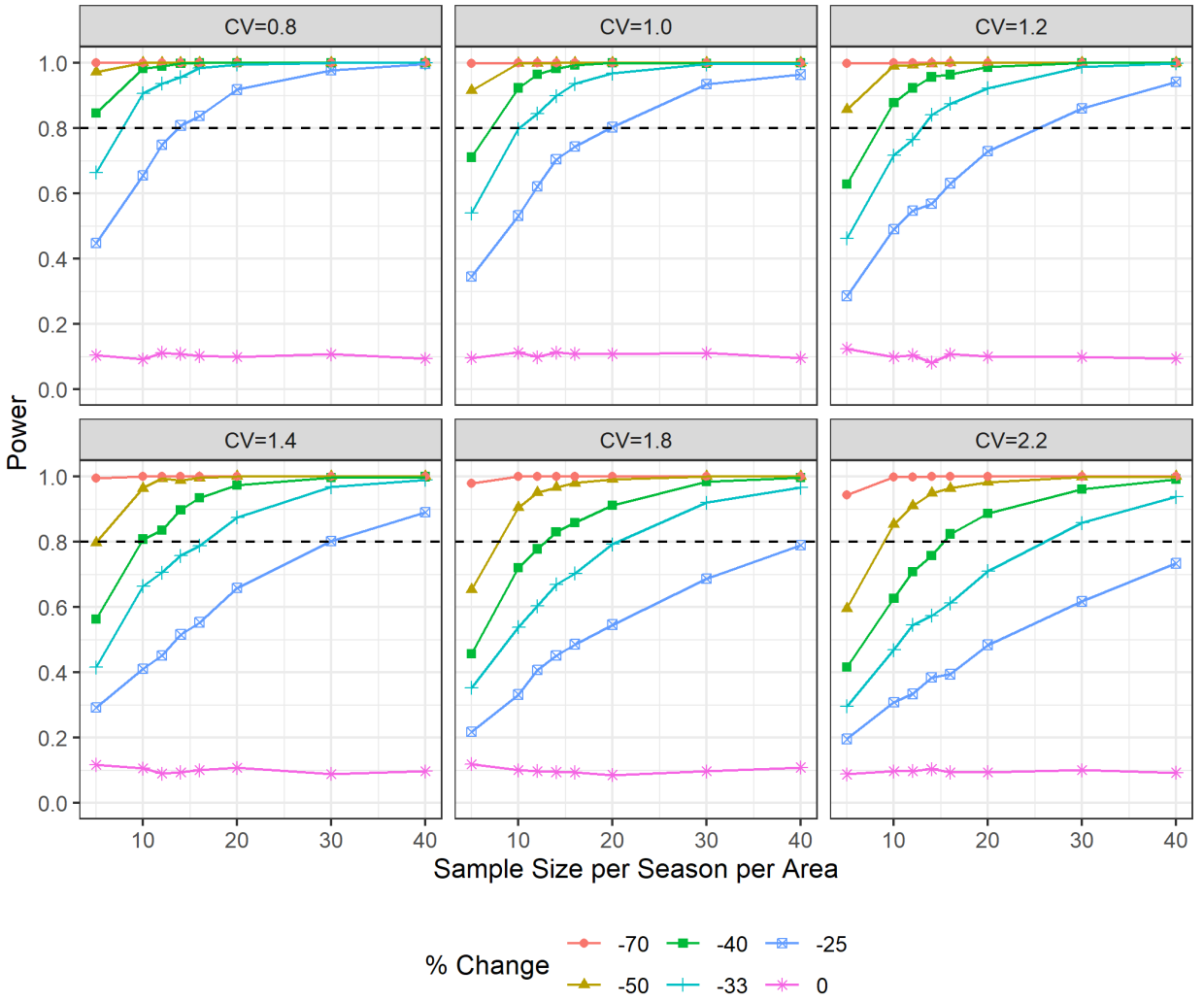
# Power Analysis – Trawl Survey

- Power analysis was informed by trawl survey data from the NEFSC (stratum 1050) and the BIWF monitoring trawl survey.
- Median CVs for commonly sampled species ranged from 0.8 to 2.1. There is significant interannual variability in relative abundance for many species in the region.
- For median CV's (e.g., 0.8-1), 10 tows/area/season would yield >80% power of detecting an effect size of 33% relative decrease or greater.
- For higher median CV's (e.g., 1.2 – 1.4), 10 tows/area/season would yield >80% power of detecting an effect size of 40% relative decrease or greater.
- For higher variability in trawl survey catch rates (e.g., CVs > 1.4) 10 tows/area/season would only be capable of detecting larger changes in catch rates (e.g., ≥50% relative decrease).
- Using two control sites increases the statistical power of the survey.
- This power analysis will be re-visited after the first year of the RWF trawl survey. The observed CV values will be evaluated to determine whether sampling intensity needs to be modified to achieve the desired level of statistical power.



# Questions

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# Revolution Wind Survey Approach – Acoustic Telemetry

## Ongoing Telemetry Studies in MA/RI WEA

### 1. BOEM funded study for Atlantic Cod

- Study started in November 2019. Tagging is ongoing and the goal is to deploy 100 transmitters (2019-2021).
- 10 receivers were deployed in locations where spawning cod have been captured in the past.
- Cod are also being tracked during the spawning season using an autonomous glider with an acoustic receiver.

### 2. MassCEC funded telemetry study for Highly Migratory Species

- Tagging started in 2020, and the focal species are bluefin tuna, blue sharks, and shortfin mako sharks. Goal is to deploy 60 transmitters (2020 and 2021).
- 15 acoustic receivers deployed on popular HMS fishing grounds

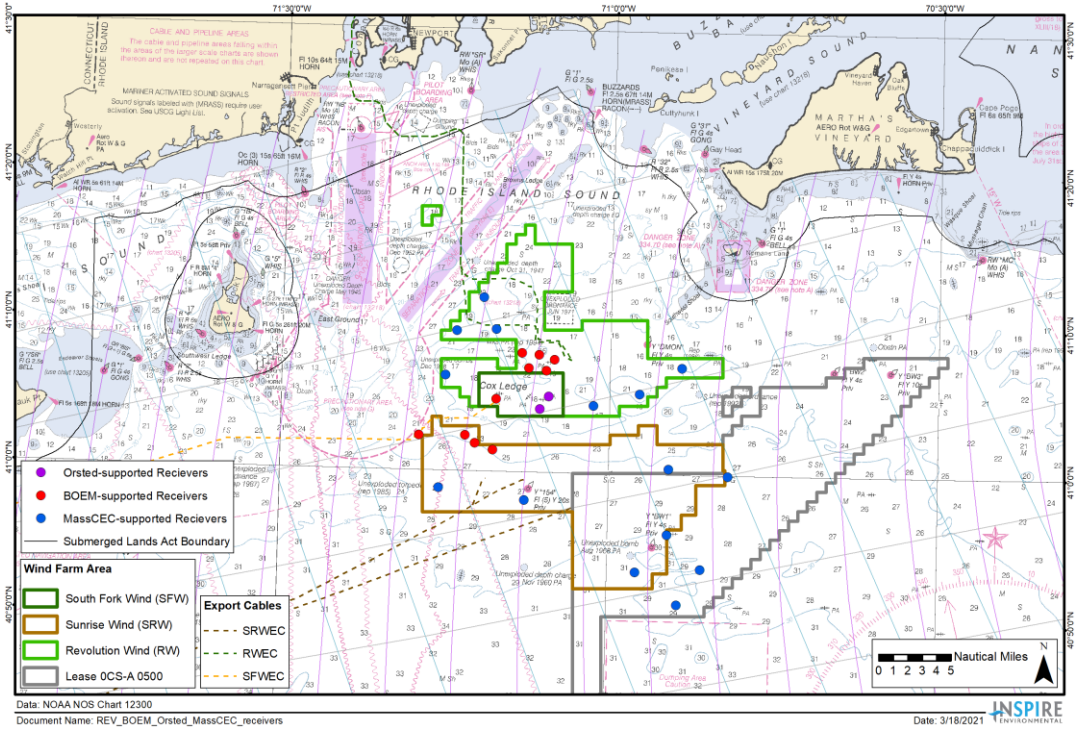
# Revolution Wind Survey Approach – Acoustic Telemetry

**New England Aquarium and Inspire Environmental will carry out a five-year acoustic telemetry monitoring project.**

## Project Timeline

- **Winter 2021** – workshop on data sharing
- **2022 - 2026** – 36 receivers deployed in Orsted lease areas. Receiver array will be downloaded and maintained three times per year.
  - Receiver locations to be determined.
- **2023-2025** – 50 transmitters deployed each year on HMS species.
- **2026** – Project ends and final report is delivered.

- Acoustic release receivers will be used (no vertical lines).
- Detection data will be shared publicly through MATOS.
- Local commercial vessel to assist with receiver deployment and maintenance.

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# Revolution Wind Survey Approach – Acoustic Telemetry

## Objective 1 – Evaluate changes in HMS presence, residency, and movements between the pre-construction, construction, and operational periods.

- Environmental factors (e.g., day length, temperature) will be accounted for when evaluating species behavior.
- $H_0$: HMS presence and movements are driven by environmental features (e.g., water temperature, prey distribution) and animal biology or physiology and are not affected by construction or operation of offshore wind turbines or the presence and activity of electrical transmission cables.

## Objective 2 – Evaluate HMS connectivity among Ørsted project areas

- $H_0$: HMS presence and movements are driven by environmental features (e.g., water temperature, prey distribution) and animal biology or physiology and are not affected by construction or operation of offshore wind turbines or the presence and activity of electrical transmission cables.

## Objective 3 – Monitor tagged HMS at spatial scales greater than the Ørsted project areas

- Other developers are planning to carry out acoustic telemetry monitoring in their lease areas.
- Data sharing amongst developers will facilitate a regional and consistent approach to monitoring the movements and behaviors of these Highly Migratory Species, allowing for a greater understanding of cumulative impacts.

# Questions

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# Revolution Wind Survey Approach – BACI Ventless Trap Survey

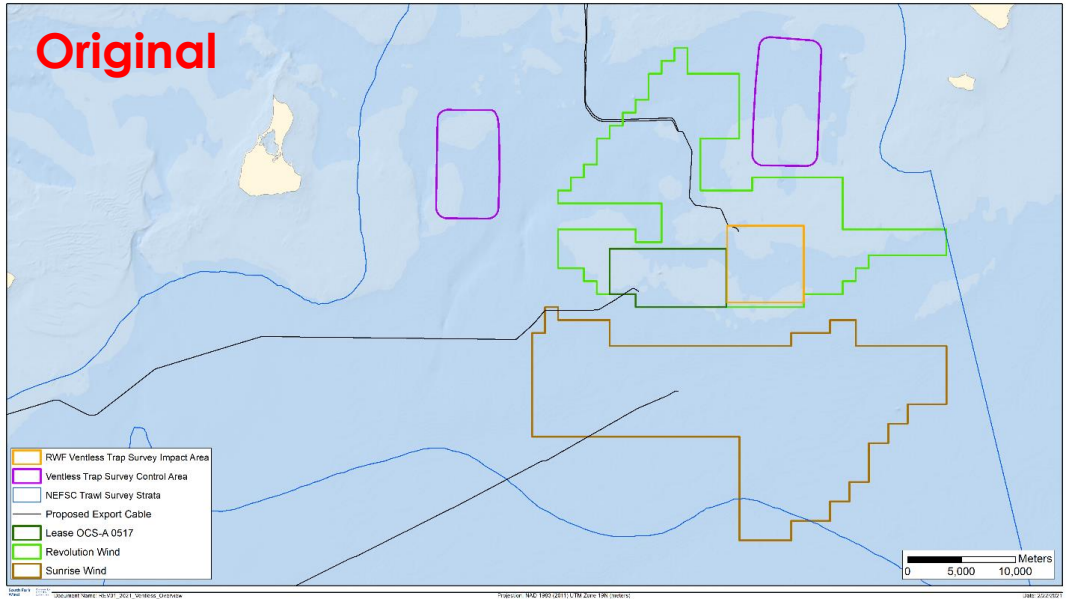
## Beyond-BACI study design

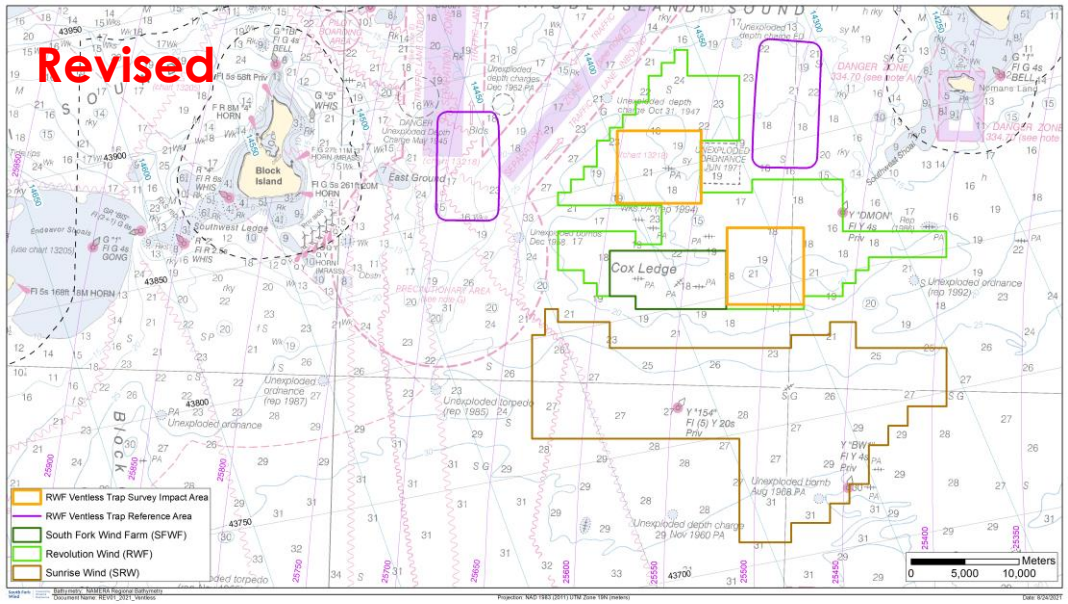
- Sampling will begin in May/June 2022.
- Sampling will occur twice per month from May/June – November, with two years of pre-construction monitoring planned. Monitoring during all three phases of construction.
- Field work will occur on a local lobster vessel(s), and will be executed by a local university or research institution.

- Use of reference control site(s) will ensure that broad-scale changes can be accounted for in the analysis.
- Pre-construction monitoring will allow for the characterization of relative abundance, spatial distribution, and demographics.
- Sampling during and after construction will allow for quantification of changes in relative abundance.
  - $H_{\emptyset:}$ Changes in relative abundance in both the control and impact sites will be identical over time (2-tailed)
- Biological characteristics and spatial distribution can be compared between pre-construction and post-construction periods.

# Revolution Wind Survey Approach – BACI Ventless Trap Survey

- **Survey design**
  - Survey will be designed following the protocols from the Southern New England Cooperative Ventless Trap Survey (SNECVTS) in 2014, 2015, and 2018.
  - Plan was revised to include two impact areas in RWF.
  - Impact and control sites will be divided into grid cells. Each grid cell will be further divided into aliquots. One aliquot in each grid cell will be randomly selected for sampling each year.
    - Coordination with control sites used for the South Fork ventless trap survey.
    - Impact areas divided into grid cells for sampling.
  - Each location will be sampled twice per month from May/June through November.
  - Ten trap trawls (6 ventless and 4 vented) will be fished on a five day soak time.

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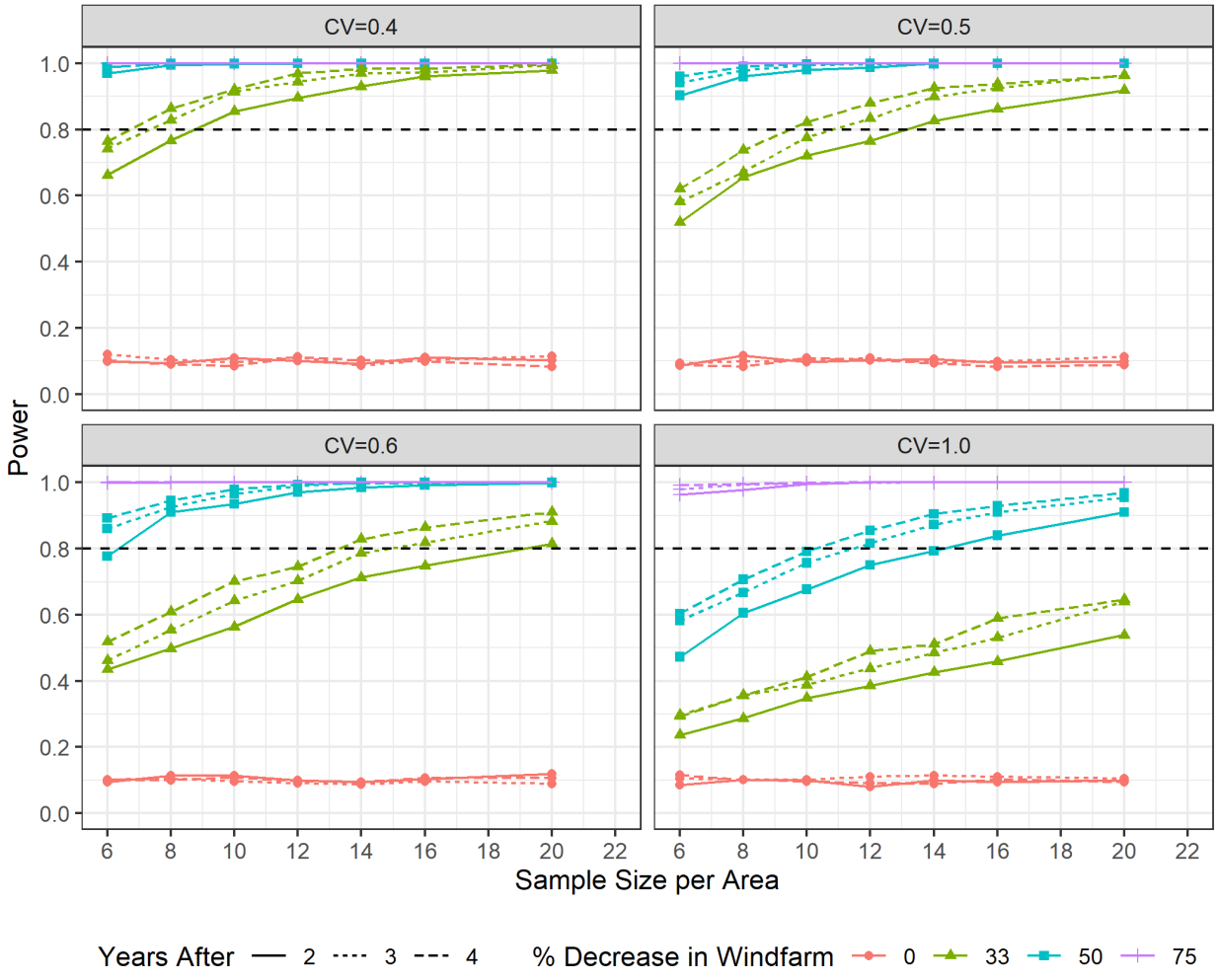
# Revolution Wind Survey Approach – BACI Ventless Trap Survey

Power analysis was completed to inform sampling intensity and study design for the ventless trap survey, based on an asymmetrical BACI design.

- SNECVTS data (2015, 2015, 2018) used to estimate expected range of variability (CV) for each species.
- Study design will have the ability to detect smaller changes in abundance for lobsters and Jonah crabs, while only relatively large changes can be detected for rock crabs.

| | | Lobster | | | Jonah Crab | | | Rock Crab | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Group** | **Summary Statistic** | **2014** | **2015** | **2018** | **2014** | **2015** | **2018** | **2014** | **2015** | **2018** |
| All (n=24) | Mean | 2.49 | 2.10 | 1.98 | 7.29 | 4.91 | 12.8 | 3.57 | 4.34 | 3.05 |
| | Std Dev | 1.60 | 0.83 | 0.95 | 3.27 | 1.84 | 5.39 | 3.59 | 4.11 | 2.46 |
| | CV | 64% | 40% | 48% | 45% | 37% | 42% | 100% | 95% | 80% |
| RWF (n=19) | Mean | 2.76 | 2.19 | 2.20 | 6.70 | 4.93 | 13.5 | 3.96 | 4.56 | 3.52 |
| | Std Dev | 1.68 | 0.88 | 0.92 | 2.31 | 2.07 | 5.85 | 3.94 | 4.59 | 2.56 |
| | CV | 61% | 40% | 42% | 35% | 42% | 43% | 100% | 101% | 73% |
| RWF Project Area (n=8) | Mean | 3.42 | 2.49 | 2.74 | 5.65 | 4.10 | 10.10 | 4.40 | 6.63 | 3.89 |
| | Std Dev | 2.31 | 1.2 | 1.17 | 1.78 | 2.37 | 4.57 | 5.85 | 6.62 | 2.22 |
| | CV | 68% | 48% | 43% | 32% | 58% | 45% | 133% | 100% | 57% |



# Revolution Wind Survey Approach – Gradient Ventless Trap Survey

## Gradient Survey Design

- Gradient survey will be executed during the operational phase of the project to assess whether lobsters, Jonah crabs, or rock crabs occur in higher abundance near the foundation locations, relative to other locations within the RWF.
- Methratta et al (2020) – 'habitat provision via turbine structures' and 'attraction to turbine foundations' classified as **local effects** (10s to 100s of meters).
- Four 10 pot trawls of ventless traps. Mid-point of the trawl will be set adjacent to the turbine foundation.
- Sampling from May/June – November for two years during operational phase. Same sampling protocols and field operations as the BACI study.
- Pilot-scale observational study to better understand the influence of introduced hard-bottom habitat on the distribution of commercially important invertebrates.
- **The primary research question whether the turbines and scour protection layers influence the distribution of lobster, Jonah crab, and rock crab within the RWF**.

# Revolution Wind Survey Approach – Ventless Trap Survey

- **Biological Data Collection**
  - The catch from each trap will be sorted and recorded at the species level.
  - Black sea bass and other fish will be measured.
  - Two traps will be selected at random from each trawl, and all of the rock crabs and Jonah crabs will be sampled.
  - Environmental data collection includes bottom T logger (every 30 minutes) and a CTD profile at each station.
  - Habitat data collected using Side Scan Sonar, grab samples, or optical techniques. Can be combined with existing data to classify habitat at each sampling location.

**Lobster sampling**:
- Carapace length (nearest mm)
- Sex
- Eggs (present/absent, if present record egg color)
- Cull status
- Shell disease (absent, light, moderate, heavy)
- V-notch status
- Mortality

**Jonah and rock crab sampling**:
- Carapace width (nearest mm)
- Sex
- Eggs (present/absent, if present record egg color)
- Cull status
- Shell disease (absent, light, moderate, heavy)
- Mortality

# Revolution Wind Survey Approach – BAG Ventless Trap Survey along the Export Cable Route

## Before-After Gradient study design

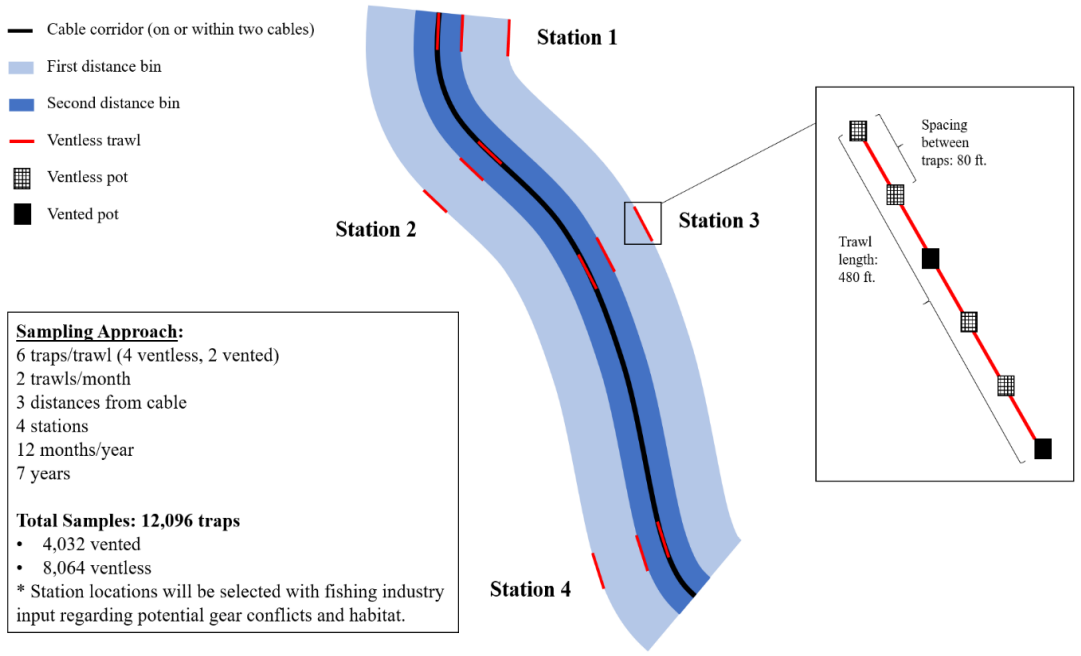
- Sampling coordinated and conducted by staff at RI DEM Division of Marine Fisheries, in collaboration with a local lobster vessel.
- Sampling will twice per month during all three construction phases. Two years of pre-construction monitoring planned. Monitoring planned during development with three years of post-construction monitoring.
- Similarities to the RIDEM DMF ventless trap study.

- **Objective** - evaluate the spatial and seasonal patterns of relative abundance of lobster and Jonah crab in the cable corridor area before, during, and after construction.
- **Objective** - classify the demographics of the lobster and Jonah crab resources including size structure, sex ratios, molt condition, reproductive status, and shell disease.

# Revolution Wind Survey Approach – BAG Ventless Trap Survey along the Export Cable Route

Four sampling stations, with three distance bins at each stations

- Three six-pot trawls per station (4V + 2S)
- Distance bins are 0m, 15-30m, and 50m
- Pots fished on a five night soak time
- Bottom water temperature monitored continuously
- Subset of lobsters (t-bar tags) and Jonah crabs (cinch tags) will be tagged to examine movements.
- Acoustic receivers placed on pots closest to the Export Cable.




**Sampling Approach:**
6 traps/trawl (4 ventless, 2 vented)
2 trawls/month
3 distances from cable
4 stations
12 months/year
7 years

**Total Samples: 12,096 traps**
- 4,032 vented
- 8,064 ventless

* Station locations will be selected with fishing industry input regarding potential gear conflicts and habitat.

# Questions

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# Revolution Wind Survey Approach – Benthic Monitoring of Hard-Bottom Habitats - Wind Turbine Locations

## Hypothesis

- Epifaunal community will vary with water depth (zonation)
- Successional development will occur over time

## Monitoring Approach

- Collect imagery (ROV/video) along segments of the monopiles, use photogrammetry to estimate % cover, identify key/dominant species, and estimate volume (biomass); compare results over time, across depths, and habitat types
- Stratified random selection of WTGs within benthic habitat strata
- Collection of non-native species (if needed)

## Survey Timeline

- YO, Y1, Y2, Y3, Y5 after construction

Degraer, Carey, et al. 2020

Pioneer stage Intermediate stage Climax stage

# Revolution Wind Survey Approach – Benthic Monitoring of Soft-Bottom Habitats – Turbine Locations

## Hypothesis

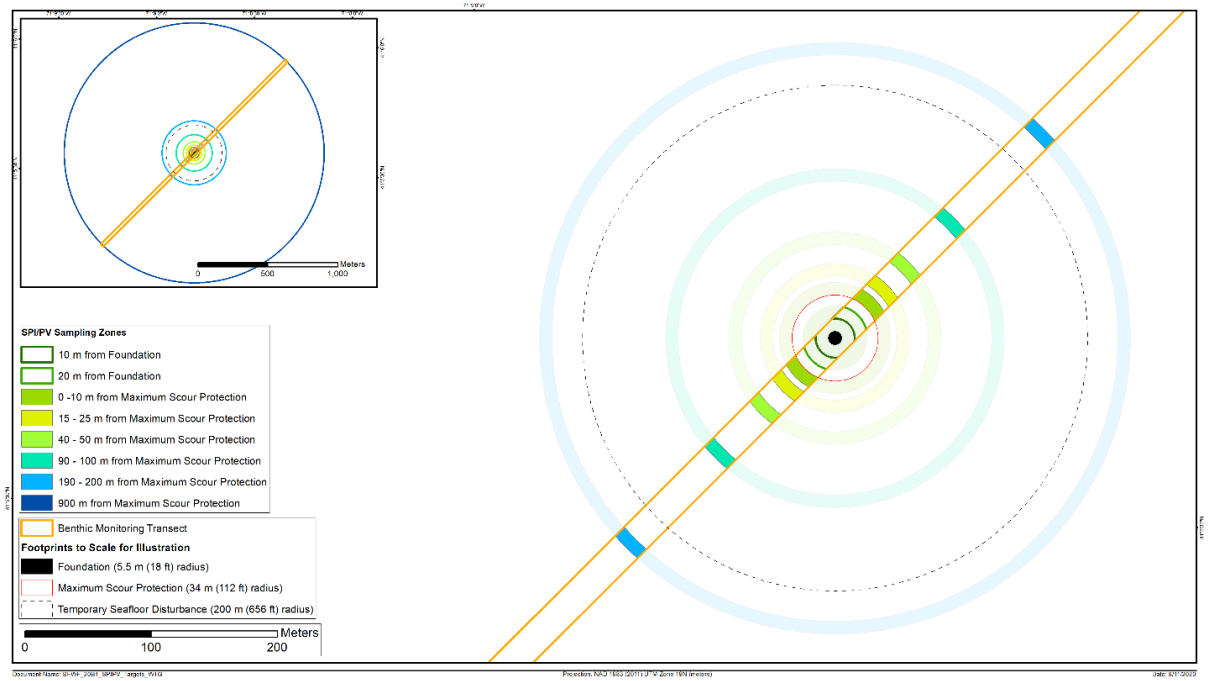
- Biodeposition and detritus from epifaunal growth on WTG foundation will result in sediment fining and higher organic content in surrounding soft bottom
- This organic matter will support deposit feeding benthic invertebrates
- Effects will decrease with increasing distance from WTG

## Monitoring Approach

- Use SPI/PV to measure changes in benthic function over time and with distance from WTGs
- First survey conducted 6 months prior to seabed preparation
- Post-construction surveying: Y0, Y1, Y2, Y3, Y5

## Design

- Before-after-gradient (BAG) design conducted at the stratified random selection of WTGs within benthic habitat strata



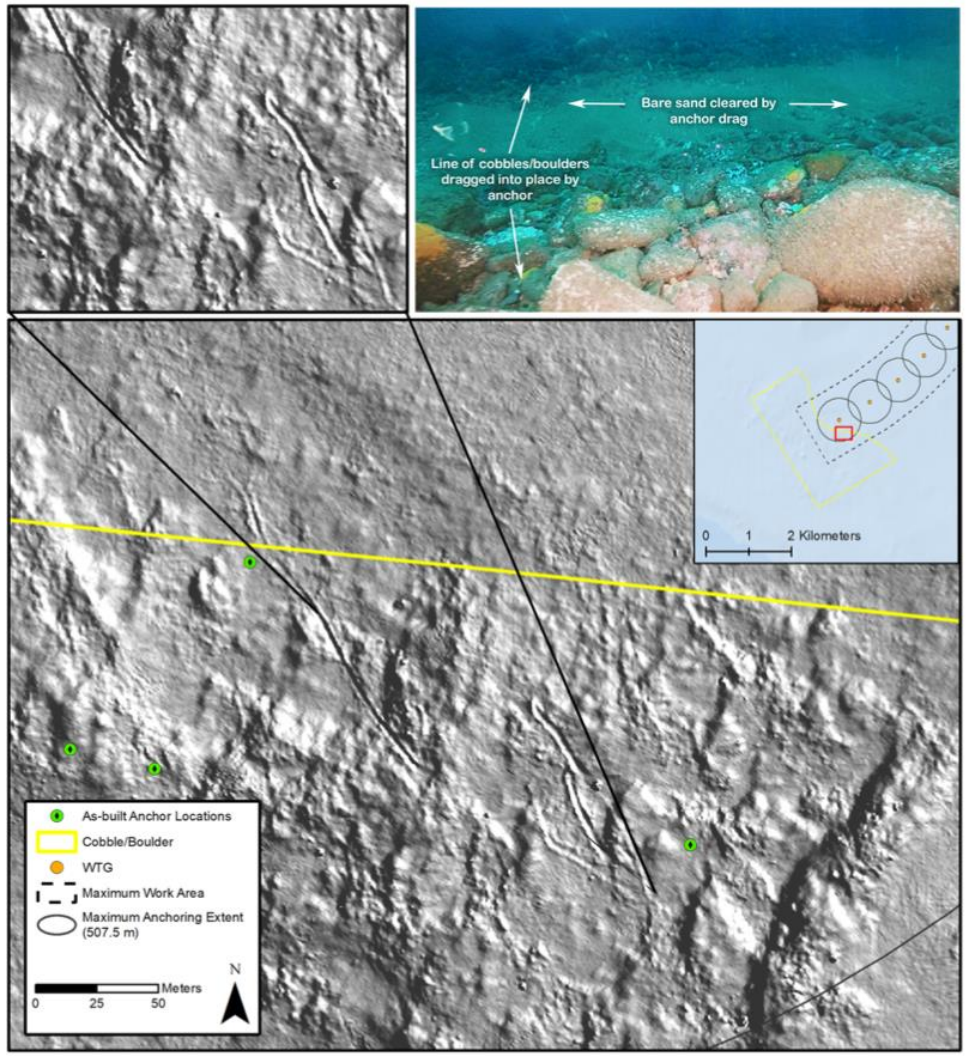
# Revolution Wind Survey Approach – Benthic Monitoring of Hard-Bottom Habitats – Relocated Boulders

## Hypothesis

- Boulder relocation will alter the physical attributes of the hard bottom (increase rugosity, complexity, boulder density)
- Potential for rapid re-colonization of epifauna on relocated boulders

## Monitoring Approach

- Coupled multi-beam echosounder and ROV/video data to document long-term changes in physical characteristics (rugosity, boulder density, orientation).
- Sampling at both disturbed and undisturbed locations.
- Photogrammetry to measure percent cover, biomass, identify key/dominant species
- **Timeline:**
  - Echosounder/ROV within 12 mo prior to seabed prep
  - Echosounder immediately following seabed prep (within 1 mo) ROV/video: Y0, Y1, Y2, Y3
  - Y5 (TBD)- If relocated boulders have coverage and composition comparable to undisturbed boulders then no further monitoring will be conducted. If coverage and composition deviate on average more than 20% continue monitoring at defined intervals until < 20% difference




Guarinello and Carey, 2020

# Revolution Wind Survey Approach – Benthic Monitoring of Soft-Bottom Habitats – Export Cable

## Hypothesis

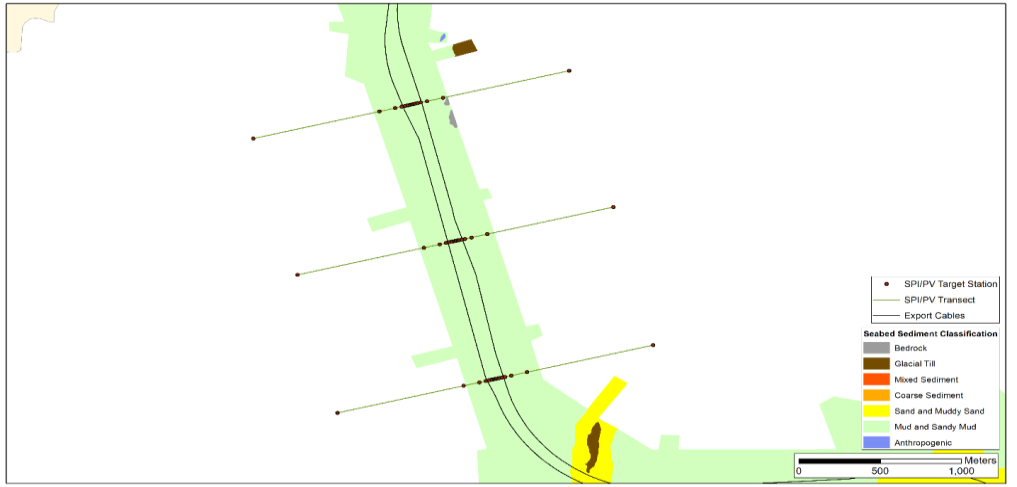
- After initial physical disturbance during construction, soft sediment community function is expected to return to pre-conditions

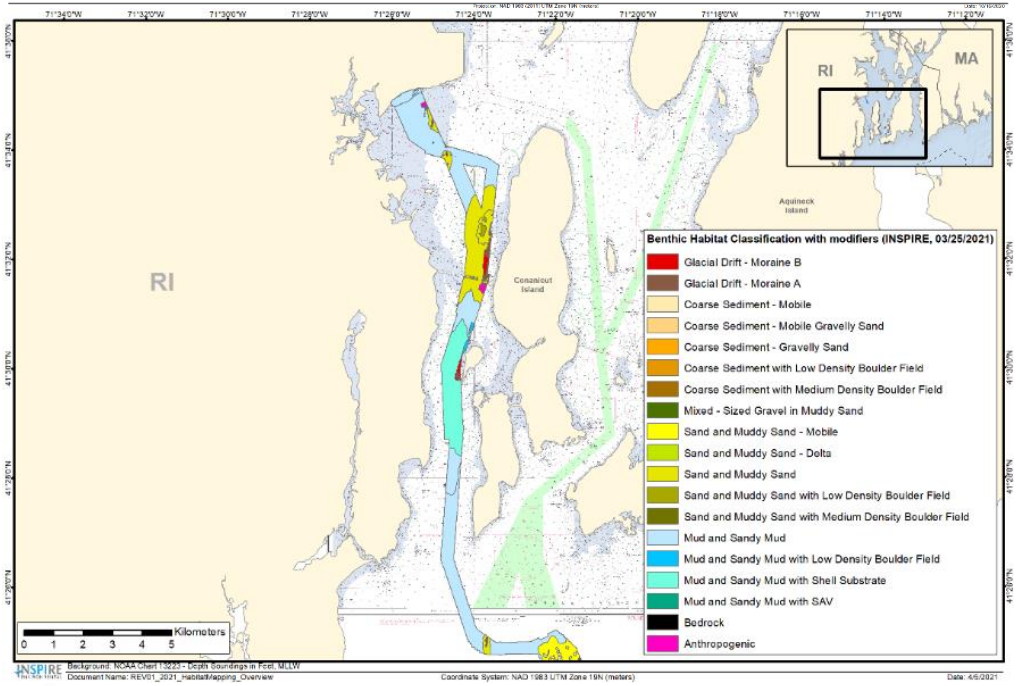
## Monitoring Approach

- Use SPI/PV to measure changes in benthic function over time and with distance from cable centerline
- Baseline data has already been collected.
- Post construction monitoring during Y0, Y1, Y2.  T3+ TBD
  - TBD, after RWEC installation if benthic function indistinguishable from baseline and no difference with distance from cable line, no further monitoring will be conducted

## Design

- Stratified random selection of cable segments within benthic habitat strata; Before-After-Gradient at each selected cable segment



# Questions

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THANK YOU

# Contact Us

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