Southern New England Habitat Area of Particular Concern Framework

Northeast Multispecies Fishery Management Plan

Framework Adjustment 64

Atlantic Sea Scallop Fishery Management Plan

Framework Adjustment 35

Monkfish Fishery Management Plan

Framework Adjustment 14

Northeast Skate Complex Fishery Management Plan

Framework Adjustment 10

Atlantic Herring Fishery Management Plan

Framework Adjustment 10

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FRAMEWORK ADJUSTMENT 64 TO THE NORTHEAST MULTISPECIES FISHERY MANAGEMENT PLAN

FRAMEWORK ADJUSTMENT 35 TO THE ATLANTIC SEA SCALLOP FISHERY MANAGEMENT PLAN

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Abstract: The New England Fishery Management Council, in consultation with NOAA's National Marine Fisheries Service, has prepared this framework adjustment to multiple Council Fishery Management Plans (FMP). Through this action, the Council will develop Habitat Area of Particular Concern designation alternatives for the Southern New England region.

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To be completed.

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2.3 ACRONYMS

AC	Alternating current
BOEM	Bureau of Ocean Energy Management
CFR	Code of Federal Regulations
DC	Direct current
EFH	Essential Fish Habitat
FMP	Fishery management plan
FW	Framework
GARFO	Greater Atlantic Regional Fisheries Office
GB	Georges Bank
GOM	Gulf of Maine
HAPC	Habitat Area of Particular Concern
NEFMC	New England Fishery Management Council
NEFSC	Northeast Fisheries Science Center
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
PAM	Passive Acoustic Monitoring
SNE	Southern New England

3.0 INTRODUCTION

This framework considers a new Habitat Area of Particular Concern (HAPC) designation within the Southern New England region, which could apply to one or multiple NEFMC FMPs depending on focus species. HAPCs are designated subsets of essential fish habitat (EFH) that receive additional attention from Fishery Management Councils and NOAA Fisheries when commenting on Federal and state actions and for establishing higher conservation standards and restoration efforts. In this way, the HAPC designation will support the EFH consultation process which provides non-binding conservation recommendations to mitigate the impacts of projects. Specifically, the Council's HAPC designations underscore and emphasize the importance of specific locations and habitat features. The Council's designations and the associated documentation and information sources used to support the designation can be referenced during EFH consultations completed for all proposed fishing and non-fishing activities that might affect the HAPC. Proposed activities include offshore wind and aquaculture development, commercial and recreational fishing activity, port/harbor development and maintenance, installation of cables for energy or telecommunication, etc.

HAPCs designations do not directly restrict on offshore development. However, EFH consultations identify measures to avoid, reduce, or compensate for adverse impacts to fish habitat if an action might adversely affect EFH, and NOAA Fisheries may choose to recommend additional mitigation and conservation measures within designated HAPCs given the level of importance of the designated areas. Furthermore, specific areas or habitat features within an HAPC may receive particular conservation focus with more restrictive recommendations on offshore development activities (e.g., no development or time-of-year restrictions for areas of known cod spawning activity) compared to the HAPC more broadly (e.g., cable burial depth recommendation). While action agencies must respond in writing to conservation recommendations, adoption of these measures is not required. Additional information on the EFH consultation process can be found in Appendix A and in NMFS Procedure 03-201-11[1].

NOAA Fisheries regulations and guidance for HAPCs

NOAA Fisheries has issued both regulations and guidance related to designation of EFH and HAPCs. From the 2002 EFH regulations, specific habitat types or areas with EFH are denoted as HAPC based on one or more of the following criteria (50 CFR Part 600.815(a)(1)(i)):

1. Importance of:
    a. Historic Ecological Function – area or habitat feature previously provided an ecological function for managed species such as predation protection, increased food supply, and spawning sites but no longer provides this function due to degradation.
    b. Current Ecological Function – area or habitat feature currently provides an ecological function for managed species.
2. Sensitivity to Anthropogenic Stresses – area or habitat feature is particularly sensitive to adverse anthropogenic fishing or non-fishing activities; sensitivity level determined by absolute value or relative to other areas/habitat features for a particular managed species.
3. Extent of Current or Future Development Stresses – area or habitat feature facing an existing or foreseeable on-going development-related threat such as offshore wind development.
4. Rarity of the Habitat Type – habitat feature is considered rare (occurs infrequently, is uncommon, highly valued; spatially or temporally very limited or a unique combination thereof) within New England or for a life history stage of a managed species.

[1] NMFS Guide to EFH Consultations, December 2004. Available at https://media.fisheries.noaa.gov/2022-01/03-201-11_GUIDE%20to%20EFH%20CONSULTATIONS_final%20for%20signature%20%281%29_0.pdf.

NMFS Procedure 03-201-15[2] (2006, renewed 2018) provides additional guidance on implementation of the EFH and HAPC provisions of the MSA. The guidance includes the following recommendations for HAPC identification:

- HAPCs should be identified using a process that maximizes public input, allows for a systematic evaluation of existing HAPCs, and can be built upon and be responsive to any HAPC identification needs.
- Areas designated as HAPCs should be based on at least one of the four HAPC criteria provided in the EFH regulatory guidelines (50 CFR 600.815(8)).
- The description of each potential HAPC should state the purpose of identifying a particular HAPC and how that identification will focus conservation efforts.
- Actions should be identified to encourage the conservation and enhancement of HAPCs including recommendations to avoid, minimize, or compensate for adverse effects from fishing and/or non-fishing activities.
- HAPCs should be discrete areas with clearly defined geographic boundaries. Councils should strive to use geographically specific information to identify HAPCs. The description of each HAPC should include geographic coordinates (latitude/longitude), area size for each HAPC in text or tables, and a map of the HAPC depicting its location. In circumstances where there is not sufficient information on the spatial distribution of habitat features comprising an HAPC, a thorough qualitative description of the HAPC boundaries should be provided. The identification of specific areas with geographically explicit boundaries will clarify where priority conservation action should be applied for both fishing and non-fishing management actions.
- Descriptions of individual HAPCs in FMPs should include:
    - a thorough discussion of the analysis that occurred during the HAPC designation process;
    - a detailed description of the physical, chemical, and biological characteristics of the HAPC, as well as its geographic location;
    - a description of the link between HAPC designations and the biological and ecological needs of a particular management unit (assemblage), species, or life stage;
    - the rationale for why a specific area deserves special designation as a HAPC based on the four criteria found in the EFH Regulations and any additional priority issues identified by the Council for fishery conservation and management; and
    - a description of any monitoring and/or evaluation frameworks that may be called for to determine the effectiveness of the HAPC in achieving stated objectives.

Problem statement and objectives

The Council identified the following problem statement and objectives for this action.

Problem statement: A new Habitat Area of Particular Concern (HAPC) in Southern New England is needed to provide conservation focus for specific New England Council-managed species with EFH in the area. This is due to concerns about impacts from offshore development, specifically offshore wind in the near term, and possibly offshore aquaculture in the future.

Objectives:

1. Encompass locations and habitat features that are important to NEFMC-managed species, including coordinates that spatially bound the designation, and a list of habitat features, i.e., sediment types, associated structures, and/or prey species that are part of the designation.

2. Identify life history stages (e.g., juvenile, adult) or activities (e.g., feeding, spawning) that the

[2] https://media.fisheries.noaa.gov/dam-migration/03-201-15.pdf

HAPC supports.

3. Be more specific and focused than overlapping EFH designations so that the HAPC adds value to the EFH consultation process.
4. Support development of conservation recommendations that lead to improved groundfish spawning protection, including protection of localized spawning contingents or sub-populations of stocks (e.g., Atlantic cod).
5. Support development of conservation recommendations that lead to improved protection of critical groundfish habitats, especially refuge for critical life history stages.
6. Support development of conservation recommendations that will avoid and minimize other impacts to fish habitats.

Other HAPCs and fishery management areas in Southern New England

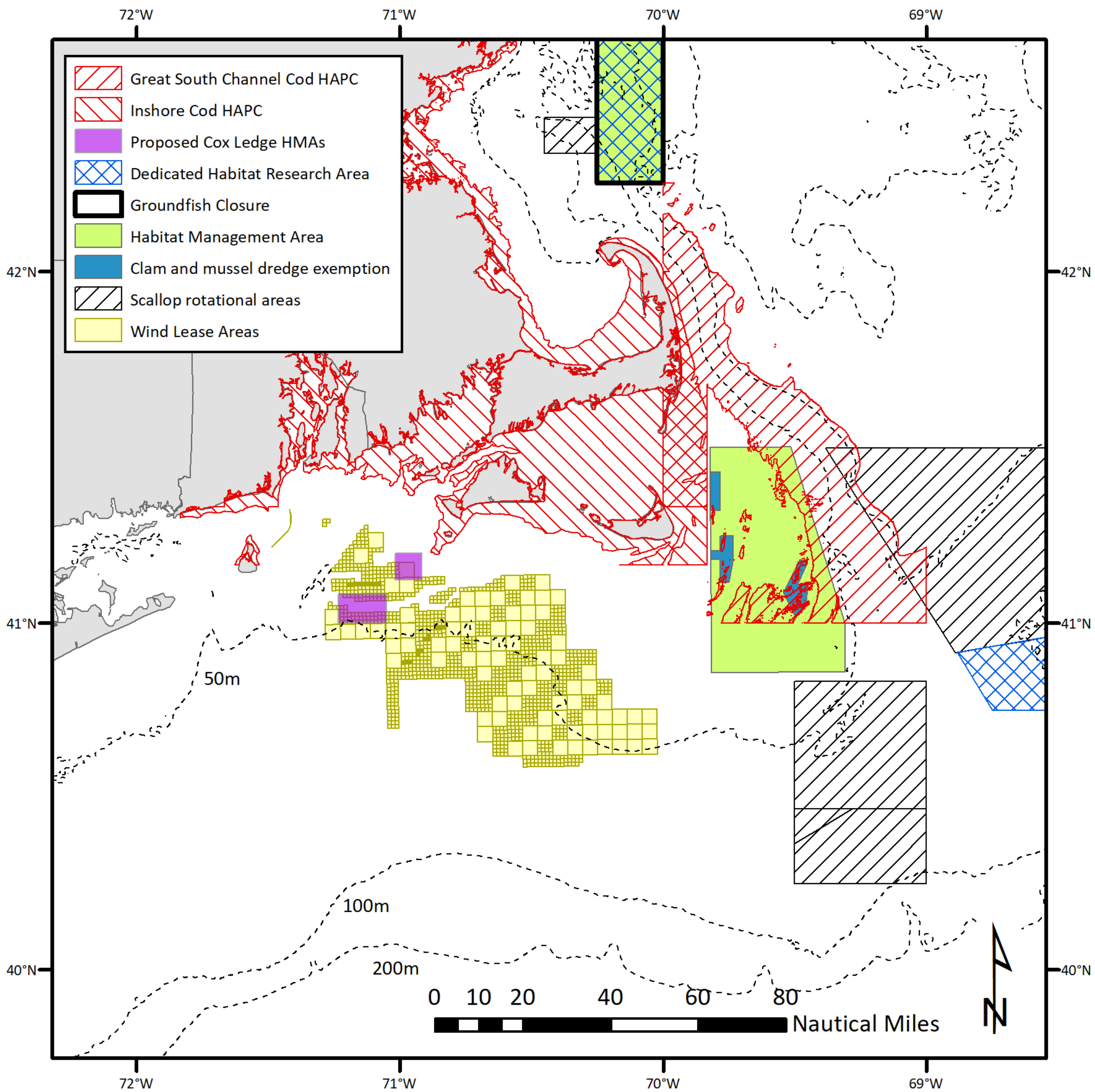
Per NOAA's HAPC regulations and guidance, HAPC designations do not inherently require a fishing closure in the area. The NEFMC uses HAPC designations to emphasize the ecological importance of an area or its sensitivity to anthropogenic stress that is currently occurring or likely to occur in the future. The NEFMC uses Habitat Management Areas (HMAs) to implement fishing restrictions that are intended to minimize the adverse effects of fishing on EFH. Sometimes HAPCs and HMAs overlap spatially, either fully or partially such that portions of HAPCs are often subject to HMA-based gear restrictions.

In the Southern New England region, there is an Inshore Juvenile Cod HAPC in state waters, which is a subset of juvenile cod EFH. The HAPC was approved by the New England Council during Omnibus Habitat Amendment 2 because of the area's important historic and current ecological function (protection from predators and prey resource readily available for cod), the habitat's sensitivity to anthropogenic activities, and the importance of the habitat for other fish species. There is also a Juvenile Cod HAPC in the Great South Channel (Figure 1).

In addition to these HAPCs, there are other habitat, groundfish, and scallop management areas designated or previously proposed in SNE (Figure 1). The Cox Ledge HMA (purple) was recommended in Omnibus Habitat Amendment 2 but disapproved by NOAA Fisheries as the limits on ground cable length measure did not clearly demonstrate minimization of adverse effects from fishing and thus did not comply with the Magnuson-Stevens Act. The recommendation would have also created an HMA prohibiting hydraulic clam dredges but was disapproved due to lack of information on gear performance, how habitat impacts would change from a potential change in area swept, and how industry costs would change with a change in fishing time.

The Great South Channel HMA (light green) prohibits the use of mobile bottom-tending gear, except for three exemption areas (blue) that allow surfclam and mussel dredging (McBlair, Fishing Rip, Old South). The area was designated because it has complex benthic habitat, is important for juvenile cod and other groundfish species, and is particularly susceptible to fishing impacts. Scallop rotational management areas are shown in black hatching, and wind lease areas are shown in yellow. Other research, habitat management, and groundfish areas in effect following Omnibus Habitat Amendment 2 implementation are also shown.

Figure 1. Map of Great South Channel and inshore juvenile cod HAPCs, Cox Ledge proposed HMA, current HMAs, research areas, and scallop rotational areas, and overlapping wind lease areas.



4.0 ALTERNATIVES UNDER CONSIDERATION

Under Alternative 1 (No Action), no new HAPCs would be designated. Alternatives 2 and 3 consider an HAPC designation based on the presence of spawning grounds for Atlantic cod. The alternatives include the Cox Ledge spawning ground (Alternative 2) or the Cox Ledge, Nantucket Shoals, and potential future spawning grounds determined using new data (Alternative 3). Alternative 4 considers an alternative for an HAPC encompassing complex habitat, focused on multiple NEFMC species managed under various FMPs.

4.1 ALTERNATIVE 1 – NO ACTION

Under No Action, no new Habitat Area of Particular Concern would be designated in Southern New England to focus on cod spawning site conservation, or on the protection of habitats used by a mix of NEFMC-managed species, in relation to offshore wind development. Essential Fish Habitat designations and the existing inshore juvenile cod HAPC designated via OHA2 would remain the foundation for the EFH consultation process and related Council engagement in offshore energy and other projects.

Rationale: NOAA Fisheries will continue to conduct EFH consultations absent the designation of new HAPCs. These consultations will be based on the Council's EFH designations and on existing and emerging scientific information on fish and habitat distributions and use, and on the impacts of offshore development on fish and habitats.

4.2 ALTERNATIVE 2 – COD SPAWNING HAPC ON AND AROUND COX LEDGE

This alternative would designate an area representing the intersection of adult Atlantic cod EFH and currently active cod spawning grounds on and surrounding Cox Ledge as a Habitat Area of Particular Concern (see Figure 2). These spawning sites are demarcated spatially based on positive detections of cod mating sounds (grunts) and detections of tagged adult cod in recent acoustic surveys, release locations of tagged cod in ripe, running, or spent condition, and catches of ripe, running, or spent cod during the recent cod spawning surveys.

This entire area shown in the figure would be designated as an HAPC because this area is a cod spawning ground. Within this HAPC, discrete locations of high cod spawning activity are identified. During the EFH consultation process, these specific areas of spawning activity within the HAPC could be considered a higher priority when providing conservation recommendations as compared to the HAPC as whole. For example, time of year restrictions on construction could be recommended for the specific spawning sites within the HAPC, while measures that minimize alteration of habitat could be recommended for the entire HAPC. Conservation recommendations will vary by development activity, and activities within and outside the HAPC could affect cod spawning within the HAPC. More information on offshore wind development impacts is provided in section 5.4.1, and possible mitigation measures are outlined in section 5.4.2.

Rationale

The purpose of this HAPC designation is to provide additional conservation focus on important cod spawning grounds within and adjacent to offshore development areas. This HAPC designation meets all four EFH Final Rule HAPC criteria: importance of ecological function, sensitivity to anthropogenic stresses, extent of current and future development stresses, and rarity (Table 1).

The importance of protecting these spawners is underscored by the poor status of cod stocks in the region, and the evidence that these spawners exhibit site fidelity to Southern New England, and based on multiple metrics, constitute a separate biological stock (McBride, et al. in review, see section 5.3.2 for additional details). At present, cod in Southern New England are part of the Georges Bank cod stock, which is overfished and experiencing overfishing. Contrary to expectations, based on temperature increases for this cold-water species, cod abundance appears to be increasing in Southern New England (Langan et al. 2020, see section 5.2 for further details).

Cod spawning in Southern New England, as in other regions, occurs in specific locations and at specific times. A known spawning site is the area east of Block Island on and around Cox Ledge. This area is used from late fall through early spring. In addition to making physical displays, the males make low-frequency grunting noises during mating to attract females. A cod spawning ground is a general region that supports one or more cod spawning aggregations. Cod spawning activity is defined as presence of cod in spawning condition (ripe, ripe and running, or spent), evidence of mating behavior such as recording of spawning grunts, and skewed sex ratios. The presence of early life stages (eggs or larvae) are indicative of successful spawning. Important spawning sites are indicated by a higher number of fish detections across various sources of data and/or consistent use of an area across years. This is different than cod spawning aggregation which is defined as typically dense, localized schools in either ripe or ripe and running condition that persistently forms at a specific time and area. Large geographic surveys are unlikely to find these aggregations given the aggregations are very localized. Haystack is a colloquial term used to also describe a spawning aggregation (cod spawning aggregations look like haystacks on a fish finder).

Various data sources are used as evidence of cod spawning activity in the vicinity of Cox Ledge. The data sources used to identify this HAPC are indicative of cod spawning grounds and activity and, in some instances, show cod spawning aggregations.

Acoustic telemetry and passive acoustic monitoring (PAM) techniques are being used in combination to help define the spatial and temporal extent of this spawning ground (Van Hoeck et al. in review; Van Parijs 2022). This work is ongoing. Data presented here were collected during 2019-20 and 2020-21; results from the 2021-22 field season are not yet available. Telemetry is used to detect tagged cod at the study site and PAM is used to listen for cod grunts. Cod were tagged at the site during the spawning season. The absence of cod detections in the acoustic data does not indicate that an area is not used for spawning. The fixed and mobile acoustic receivers detect acoustically tagged cod and listen for cod grunts, but the detection radii of these devices are small. For detections to occur, cod must be close to the receivers in both space and time. One or a few tag detections or grunts could indicate low spawning activity, or a mismatch between the location of grunting fish and the hydrophones. Absent additional data, the size of the aggregation cannot be fully known. However, given these small detection radii, if a single fixed acoustic receiver detects numerous grunts then that is likely an indicator of spawning aggregation with many fish. Repeated use of a site across years is also an indicator of the area’s importance. An advantage of the acoustic data is that they show the exact location of the tagged or vocalizing cod.

Additional evidence for spawning at this site comes from 2007-2011 tagging studies (Loehrke 2014, Cadrin, et al. in review). Tagging data show release locations, each of which may represent a few to dozens of cod. These tagging studies were not intended as synoptic surveys of the region, so the absence of releases at a location may simply indicate an absence of fishing effort at that location. Recapture data are not presented here, but an analysis of cod movement indicated by data storage tagging indicates that cod in Southern New England exhibit site fidelity (Cadrin et al., in review). If tagged cod are regularly recaptured within the area then that suggests spawning site fidelity (Zemeckis, et al., 2014).

In addition, surveys were conducted in spring 2018 and winter 2018 - spring 2019 for the South Fork Wind Farm targeting spawning cod (Balouskus, et al. 2019, Gervelis and Carey 2020). These 2018 and 2018-19 surveys were aimed at identifying the locations of any cod spawning aggregations encountered and characterized the cod by spawning condition. These surveys are not a comprehensive evaluation of all cod spawning aggregations within the region but do indicate locations where fish in spawning condition occurred during two recent spawning seasons.

Considering the above data sources, discrete locations around Cox Ledge might be considered locations of high activity. These are numbered on Figure 3.

For mitigating the impacts of offshore development on spawning behaviors, it is important to understand the duration of the spawning season. Overall, based on multiple sources of information, cod spawning in Southern New England occurs between November through April. The ongoing acoustic research described above has found that cod grunts are most prevalent from November through January. However, note that cod spawn over a period of one to two months, and the mating behaviors associated with grunting occur during the earlier portion of the spawning season. Other studies have sampled adult cod at these sites to look for ripe and running fish, i.e., cod that are about to spawn or are actively spawning (see Table 7 for a description of maturity stages). Gonad data collected during these studies indicate that fish remain in spawning condition through April (Dean, et al, in review). Egg and larval cod abundance data indicate the success of spawning. Early-stage eggs cannot be distinguished from those of haddock or witch flounder, so larval data are a clearer indicator that spawning occurred in the weeks prior to the detection of larvae. Dean et al. (in review) examine cod larval data from multiple long-term ichthyoplankton surveys (MARMAP, GLOBEC, EcoMon, etc.). Because eggs and larvae move with the currents, spatial data on where larvae are captured is not a precise indicator of the location where spawning occurred, but these data are useful for indicating the temporal extent of the spawning season. The presence of early-stage larvae indicates that spawning near Cox Ledge continues through April (Dean, et al., in review).

Various activities could impact cod spawning, and a range of conservation recommendations may be appropriate depending on the mechanism of impact. During the spawning season, noises associated with the construction, operations, and maintenance phases of offshore development can mask cod communication. Mechanical disturbance is also of concern. Once a spawning aggregation is disturbed, it might not reform during that spawning season (Dean et al. 2012). However, van der Knaap (2022) found that resident Atlantic cod in the North Sea did not relocate out of the study area during pile driving associated with construction of a new wind farm (see section 5.4.1 for additional discussion of this work).

Beyond disturbance of spawning activities during the spawning season, permanent habitat alterations at spawning sites could render the site less suitable or perhaps unsuitable for spawning. Evidence from Massachusetts Bay indicates that cod return to very specific and small-scale seafloor features to perform courtship displays (Dean, et al. 2014). Placing wind turbines or substations on or near to these features could lead to their abandonment as spawning sites. Finally, protecting egg and larval stages is also important for mitigating impacts of offshore development on the entire reproductive cycle. Conservation recommendations that would be appropriate for minimizing impacts on eggs and larvae include avoidance of water entrainment and minimizing effluent discharge by using closed loop cooling techniques at conversion stations.

While Atlantic cod is the focus of this designation, additional species of concern should also benefit from conservation measures recommended based on this HAPC (see section 6.2).

Table 1. Description of whether and how Alternative 2 meets one or more of the EFH Final Rule HAPC criteria.

HAPC qualifying criteria	Does alternative meet HAPC criteria?	How does the alternative meet HAPC criteria?
Importance of historic and/or current ecological function	Yes	Area(s) is currently a spawning site for Georges Bank Atlantic cod, which is in poor stock condition (overfished, experiencing overfishing), and is a genetically distinct sub-population. The sub-population also contributes to the Georges Bank cod stock, thus, any impacts to the SNE stock could also detrimentally impact the GB stock.
Sensitivity to anthropogenic stresses	Yes	Cod spawning activities are particularly sensitive to adverse impacts from non-fishing activities, namely from offshore wind development (construction, operations, and maintenance).
Extent of current or future development stresses	Yes	This area is facing an existing on-going development-related threat from offshore wind.
Rarity of habitat type	Yes	Cod spawning habitats (based on acoustic environment, seafloor and water column setting) are rare with only one known grouping of active sites in Southern New England.

Figure 2. Alternative 2 HAPC designation (red polygon). Also shown: Atlantic cod adult EFH and wind lease areas.

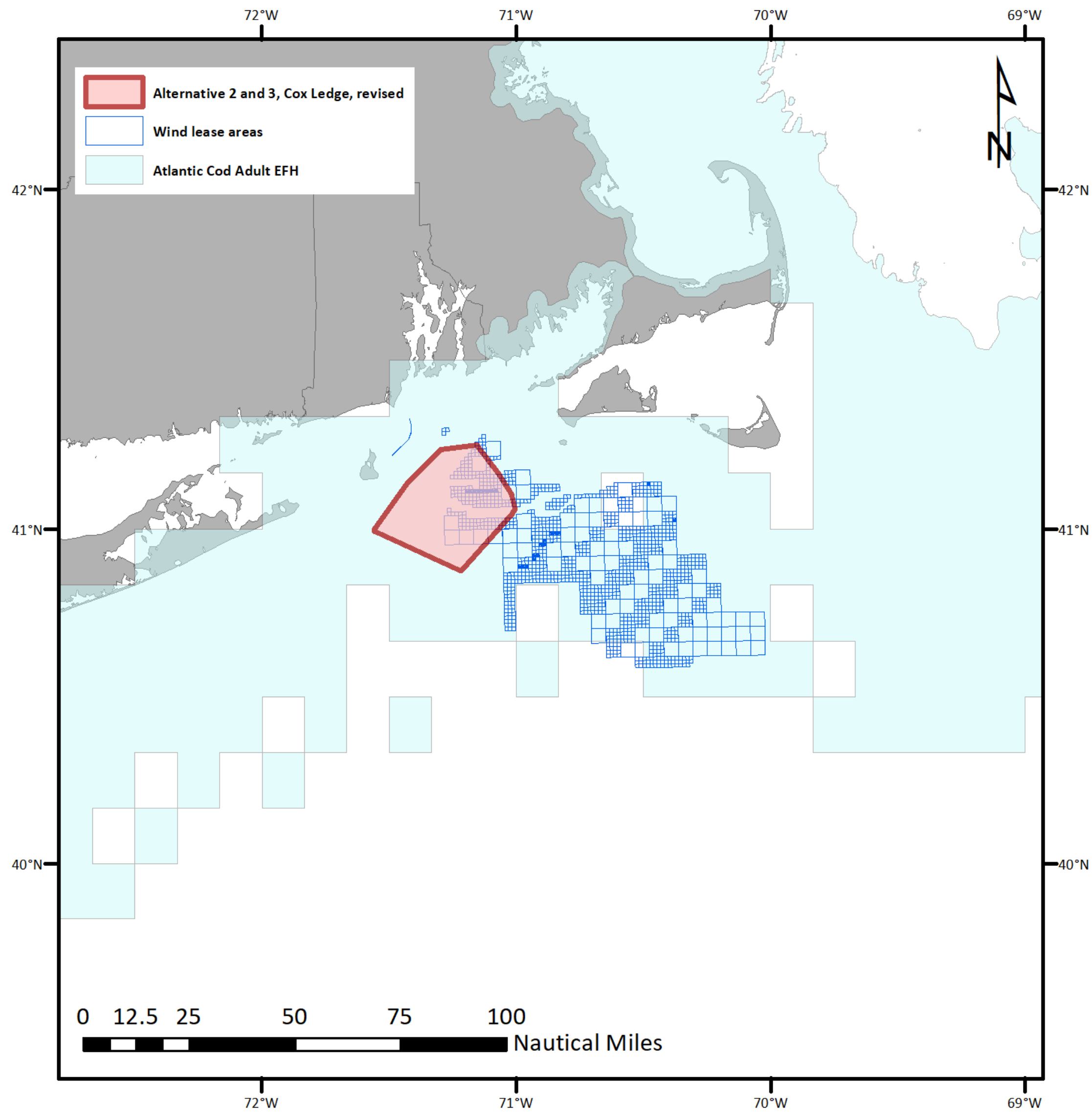
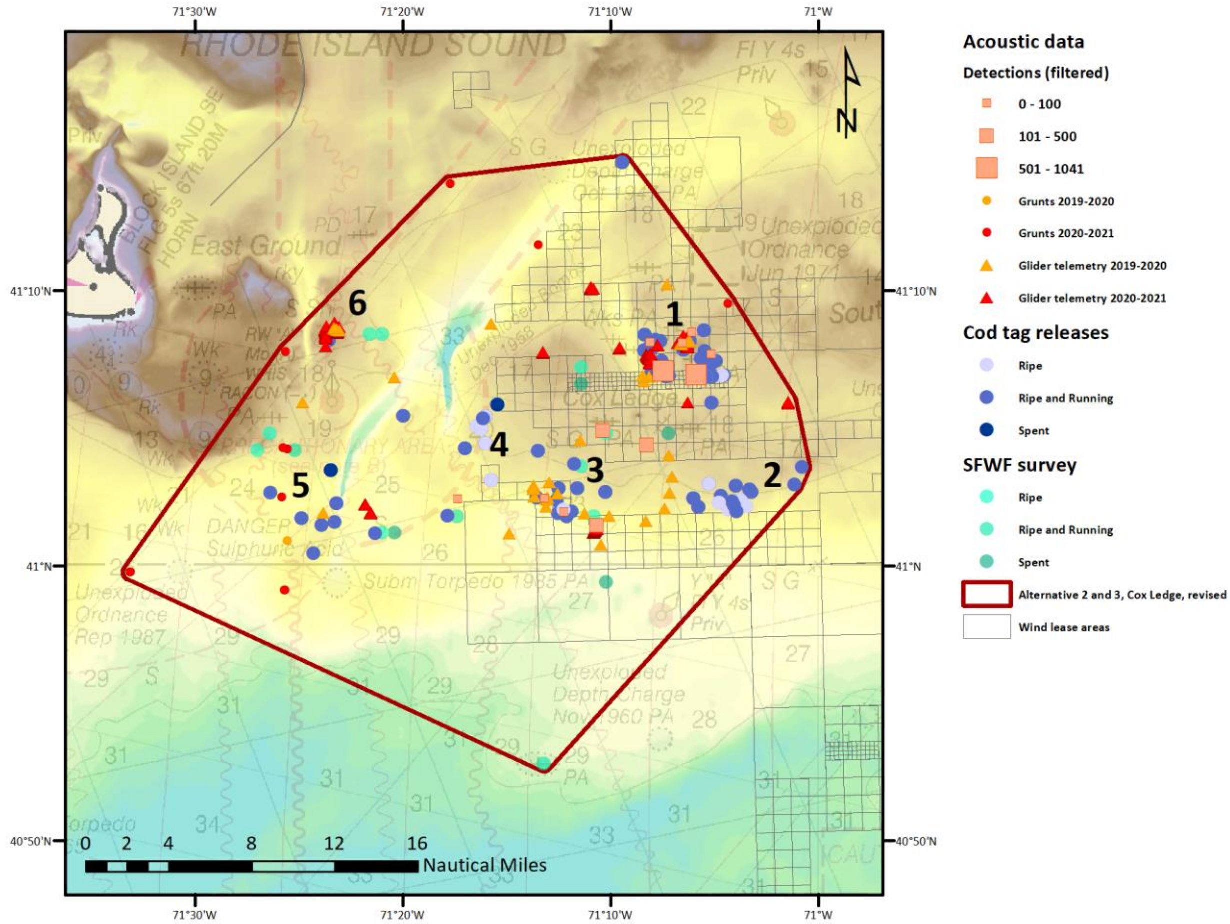


Figure 3. Alternative 2 HAPC showing various data sources as described in the text. Clusters of observations are numbered.



4.3 Alternative 3 – Cod spawning HAPC encompassing current Cox Ledge, Nantucket Shoals, and sites identified in the future based on new data

This alternative would designate the intersection of Adult cod EFH with (1) the spawning grounds on and around Cox Ledge, as described for Alternative 2, (2) spawning grounds on Nantucket Shoals, and (3) any future cod spawning grounds identified in Southern New England as Habitat Areas of Particular Concern (see Figure 4). The red polygon represents the Cox Ledge spawning grounds and the green polygons represent the Nantucket Shoals spawning grounds.

The hatched area represents the intersection between a larger polygon encompassing the Southern New England region and the adult cod EFH map area. This hatched area encompasses locations where additional spawning grounds might be identified in the future. EFH consultation on activities within the hatched area is recommended when evidence of cod spawning is identified by the Council or NOAA Fisheries (details below).

Rationale

The purpose of this HAPC designation is to provide additional conservation focus on important cod spawning grounds within and adjacent to offshore development areas. This HAPC designation meets all four EFH Final Rule HAPC criteria: importance of ecological function, sensitivity to anthropogenic stresses, extent of current and future development stresses, and rarity (Table 2).

The rationale for Alternative 2 applies equally to Alternative 3 and is not repeated here. Alternative 3 is more precautionary in that it includes the consensus spawning grounds on Nantucket Shoals where spawning occurred historically (DeCelles, et al. 2017). Their study identified consensus grounds documented by 3+ fishermen, also considering data from trawl surveys (U.S. and Canada), Canadian observer program data, ichthyoplankton sampling, and MARMAP data. Tag release data from 2001, 2006, 2009, and 2010 indicate the presence of fish in spawning condition around these consensus spawning grounds (Loehrke 2014, Cadrin, et al. in review).

In addition, Alternative 3 allows for identification of cod spawning grounds in areas that have previously not been the focus of research related to spawning site identification. For example, the acoustic work described under Alternative 2 and in Section 5.3.1 is ongoing, and additional sampling is planned for areas east of the existing Cox Ledge spawning ground. If further research identifies new cod spawning grounds and areas of spawning activity and/or aggregations within any of the hatched area of Alternative 3, then EFH consultations should give attention to these additional areas.

The active Cox Ledge spawning grounds included in Alternative 2 and the historic Nantucket Shoals spawning grounds included in Alternative 3 may not capture all cod spawning aggregations that are currently active in Southern New England. Thus, it will be important to protect and give additional conservation focus to any newly identified areas as new data and research become available within the hatched area of Alternative 3. For the purpose of applying the HAPC designation, evidence of cod spawning activity at a site could be based on:

- Capture of ripe, running, or spent cod during fishery independent surveys,
- Detections of acoustically tagged fish between November and April,
- Detections of cod grunts in acoustic surveys,
- Capture of cod larvae in ichthyoplankton surveys,
- Evidence of eggs in ichthyoplankton surveys (not species specific but indicative of spawning success).

The following are examples of data sources that can be used to indicate cod spawning. This list is not comprehensive.

- Project-related survey data collected before, during, or after construction,
- State or federal fishery independent surveys,
- Acoustic surveys and tagging studies, or
- Traditional survey tagging studies.

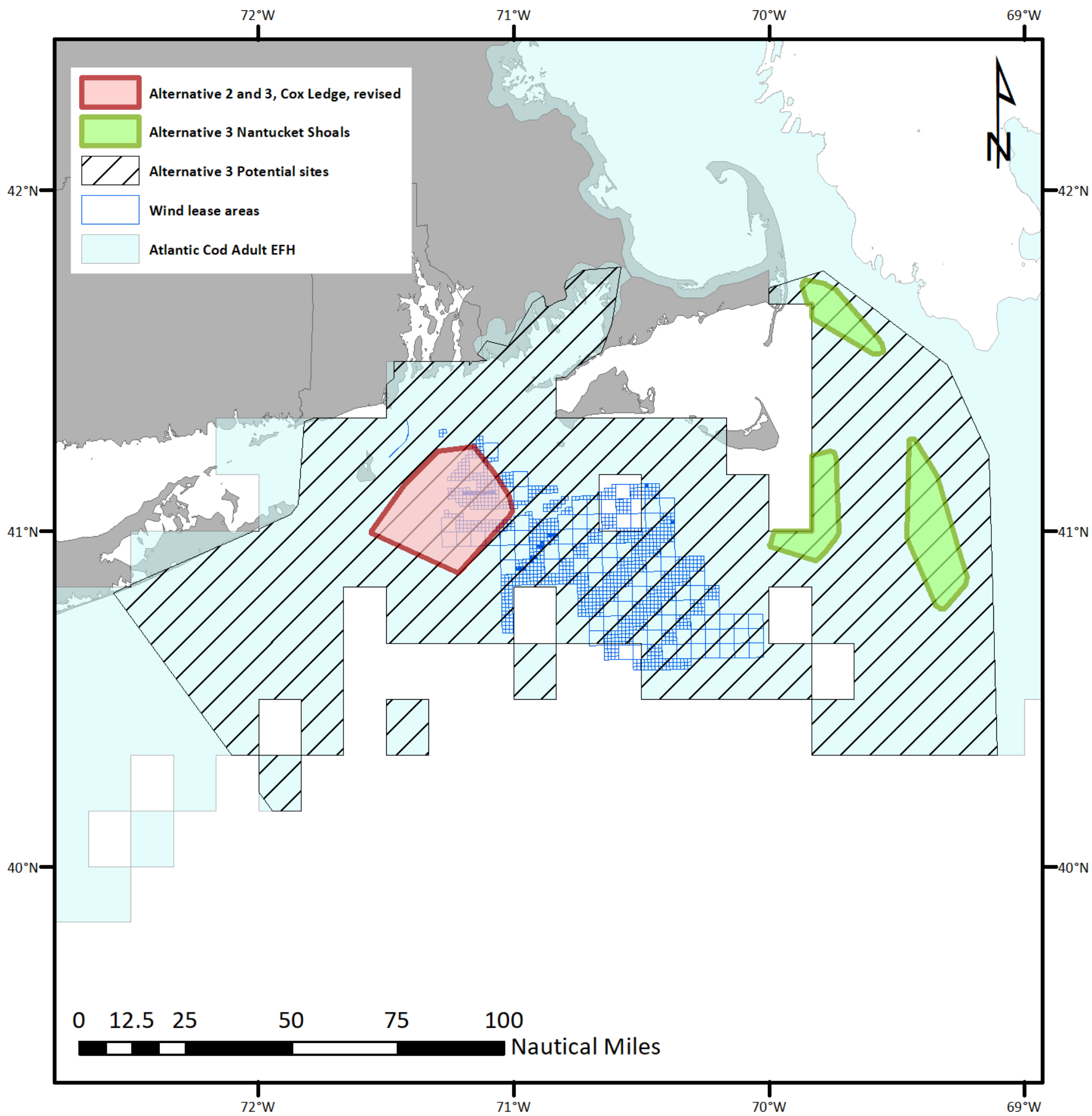
A challenge with acoustic work is that tagged cod need to pass within a few hundred meters of a glider or fixed receiver to be detected. Similarly, cod grunts are relatively quiet, and the sounds must be produced within a few hundred meters of a receiver to be heard. These realities indicate that targeted sampling is required to use acoustic techniques for detection of a localized spawning site. Overall, cod spawning aggregations are difficult to find when conducting broad-scale surveys.

Protecting egg and larval stages is also important for mitigating impacts of offshore development on the entire reproductive cycle. Cod eggs cannot be distinguished from certain other species, though larvae can, and the spatial distribution of larvae could be used to generally indicate the locations of spawning sites. Conservation recommendations that would be appropriate for minimizing impacts on eggs and larvae include avoidance of water entrainment and minimizing effluent discharge by using closed loop cooling techniques at conversion stations.

Table 2. Description of whether and how Alternative 3 meets one or more of the EFH Final Rule HAPC criteria.

HAPC qualifying criteria	Does alternative meet HAPC criteria?	How does the alternative meet HAPC criteria?
Importance of historic and/or current ecological function	Yes	Subset(s) of area is currently a spawning site for Atlantic cod (see Alternative 2). Additional areas would only be considered HAPC if discrete cod spawning grounds are identified based on future data.
Sensitivity to anthropogenic stresses	Yes	Subset(s) of area include cod spawning grounds which are particularly sensitive to adverse non-fishing activities, namely from offshore wind development (construction, operations, maintenance). Additional areas would only be considered HAPC if discrete cod spawning grounds are identified based on future data.
Extent of current or future development stresses	Yes	Subset of area is facing an ongoing development-related threat from offshore wind. Additional areas would only be considered HAPC if discrete cod spawning grounds are identified based on future data.
Rarity of habitat type	Yes	Cod spawning habitats are rare with only one grouping of active sites in Southern New England, and another cluster of sites based on historical data that may or may not currently be used.

Figure 4. Alternative 3 HAPC designation (red and green polygons and black hatching). Also shown: Atlantic cod adult EFH, and wind lease areas.



4.4 ALTERNATIVE 4 – HAPC IN SOUTHERN NEW ENGLAND FOR MULTIPLE NEFMC SPECIES THAT USE COMPLEX HABITATS

Alternative 4 would designate all areas in Southern New England with complex habitats as a Habitat Area of Particular Concern (the HAPC would be defined as complex habitat areas within the shaded area shown in Figure 5). Complex habitats are defined as:

- Hard bottom substrates, defined by the Coastal and Marine Ecological Classification Standard (CMECS) as Substrate Class Rock Substrate and by the four Substrate Groups: Gravels, Gravel Mixes, Gravelly, and Shell. This CMECS modifier was developed by NOAA Fisheries for their habitat mapping recommendations, including both large-grained and small-grained hard habitats.
- Hard bottom substrates with epifauna or macroalgae cover.
- Vegetated habitats (e.g., submerged aquatic vegetation and tidal wetlands).

This designation would apply within EFH designated for the following species and lifestages: Atlantic cod juveniles and adults, Atlantic herring eggs, Atlantic sea scallop eggs, juveniles, and adults, little skate juveniles and adults, monkfish juveniles and adults, ocean pout eggs, juveniles, and adults, red hake juveniles and adults, winter flounder eggs, juveniles, and adults, and winter skate juveniles and adults.

Note – an evaluation of additional information on the distribution of complex habitat in Southern New England is underway that may help to refine the HAPC map area; maps from various construction and operations plans are shown in Appendix B.

Rationale

Complex habitat provides shelter for certain species during their early life history, refuge from predators and feeding opportunities for juvenile fish. Designating complex habitats in Southern New England as a HAPC would provide conservation focus for multiple species with EFH in Southern New England that are likely to be impacted by offshore wind development. The alternative would inherently account for any climate-related spatial shifts in stocks within the Southern New England region. This HAPC designation meets at least three of the four EFH Final Rule HAPC criteria: importance of ecological function, sensitivity to anthropogenic stresses, and extent of current and future development stresses (

Table 3Table 2).

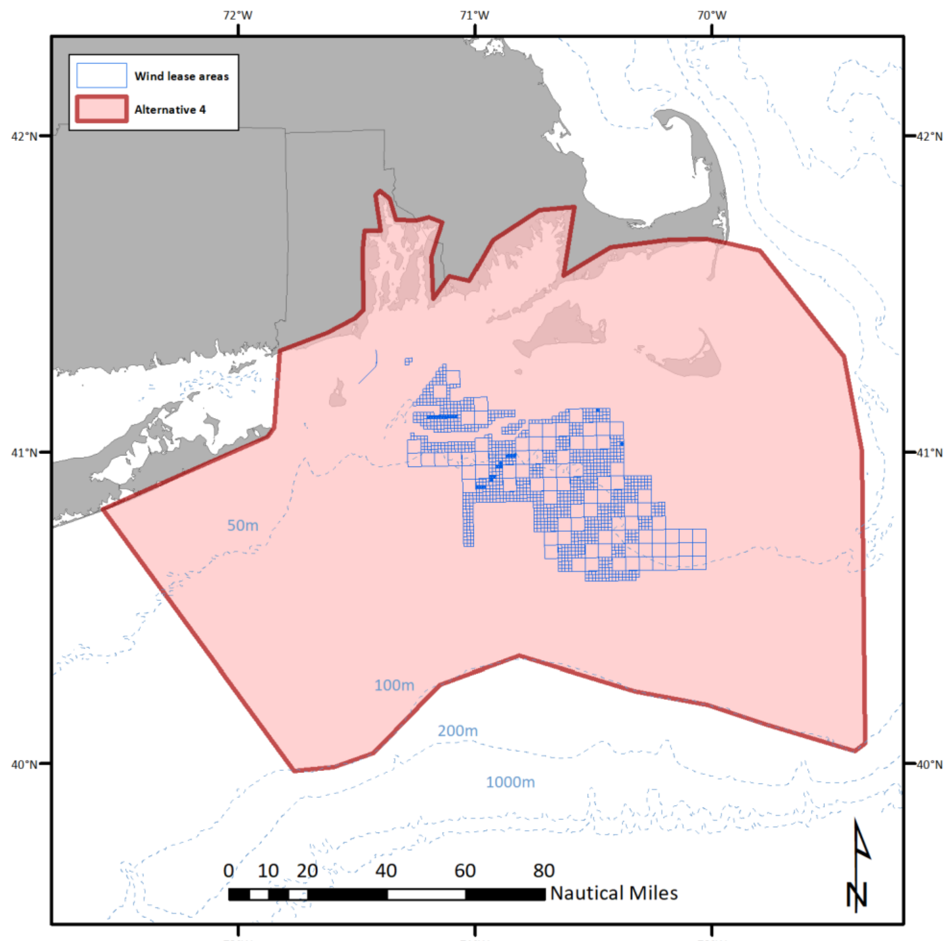
Effects of wind development may include physical habitat conversions and losses, scour and sedimentation, construction and operational noise, electromagnetic fields, micrometeorological effects, water entrainment effects, and water-column hydrodynamic effects (including thermal changes and changes in currents that influence pelagic habitats). These impacts may occur during installation and operation of turbines, substations, offshore conversion stations, inter-array cables, and export cables, and as a result of survey and maintenance operations. See section 5.4.1 for further information on potential impacts of offshore development.

Some of the focal species for this HAPC have overfished stocks in Southern New England. These include Georges Bank Atlantic cod, ocean pout, Southern New England/Mid-Atlantic winter flounder, southern red hake, and Atlantic herring (Section 5.1). Other species are at higher levels of abundance and are important to regional fisheries, including monkfish, little skate, winter skate, and sea scallops. Even though these species are not overfished and are not experiencing overfishing, they are still important to protect from offshore development impacts. Based on NMFS Socioeconomic Impacts of Atlantic Offshore Wind Development data, the most impacted species found within the SNE lease areas (in terms of landings and revenue) include skates (data are not broken down by individual skate species given the difficulty in species identification), monkfish, Atlantic herring, Atlantic cod, and sea scallop.

Table 3. Description of whether and how Alternative 4 meets one or more of the EFH Final Rule HAPC criteria.

HAPC qualifying criteria	Does alternative meet HAPC criteria?	How does the alternative meet HAPC criteria?
Importance of historic and/or current ecological function	Yes	Area includes spawning site, juvenile settlement areas, and feeding areas for species with EFH in the area.
Sensitivity to anthropogenic stresses	Yes	Complex habitats are susceptible to conversion, sedimentation
Extent of current or future development stresses	Yes	Area(s) facing an on-going development-related threat from offshore wind
Rarity of habitat type	Maybe	Area does not contain/specify a particular habitat feature that is considered rare, spatially or temporally very limited.

Figure 5. Alternative 4 SNE Complex Habitat HAPC designation (red polygon). The HAPC would apply where complex habitat occurs, as defined in the text.



4.5 CONSIDERED AND REJECTED ALTERNATIVES

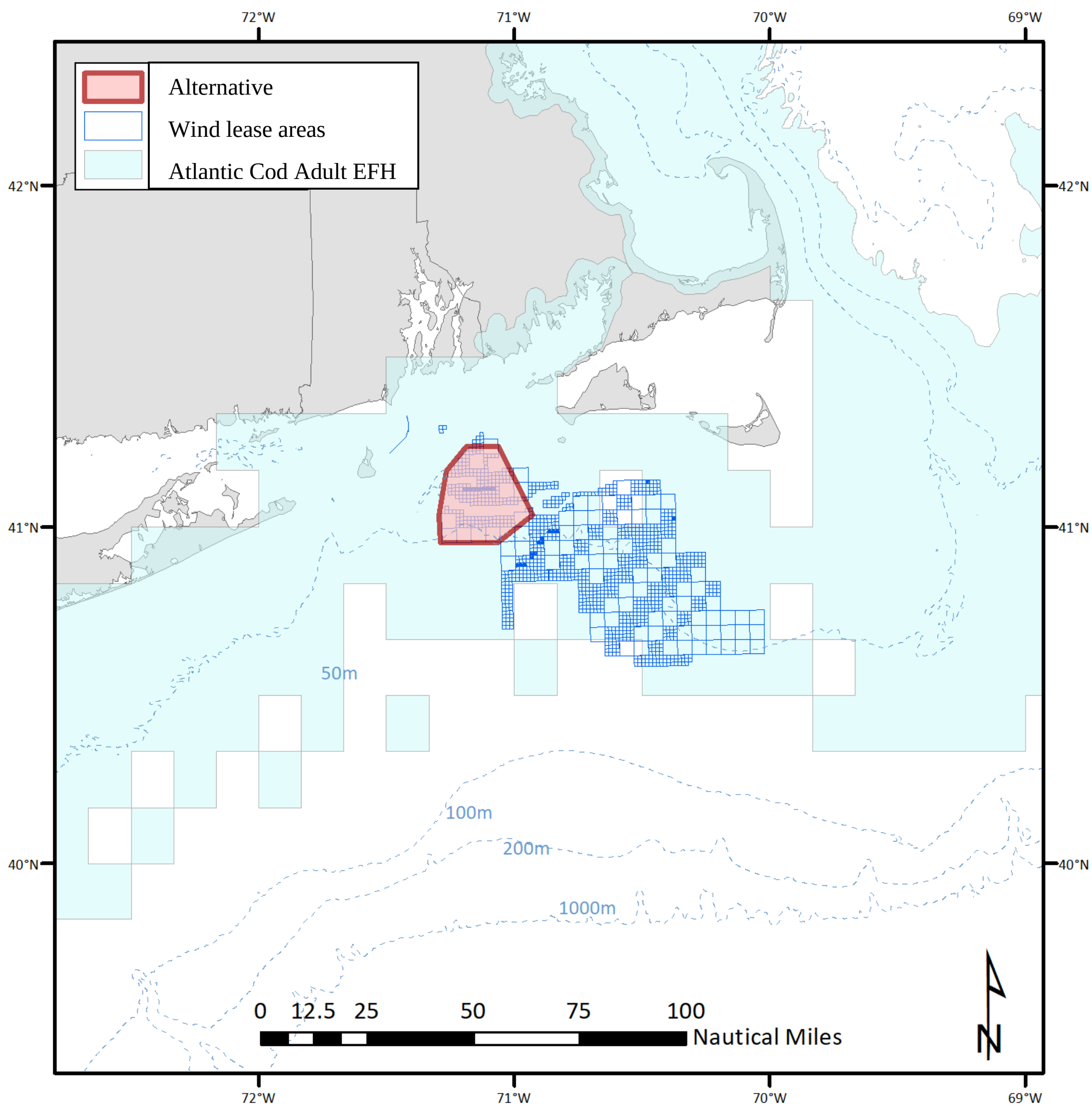
The Habitat Committee did not recommend further development of HAPC designations constrained to the footprint of offshore wind lease areas only.

Alternative: Currently used cod spawning sites within wind lease areas only

This alternative would designate the area described and mapped in Figure 6 as an HAPC. This represents the intersection of adult cod EFH in Southern New England with current spawning grounds (red area) and wind lease areas (blue).

Rationale: As compared to the corresponding alternative that designates an HAPC inside and outside wind lease areas, this smaller geographic area would place conservation focus on cod spawning activity within offshore wind development areas, which is our main concern.

Figure 6. Alternative HAPC designation within wind lease areas only (red). Also shown: Atlantic cod adult EFH, and wind lease areas.

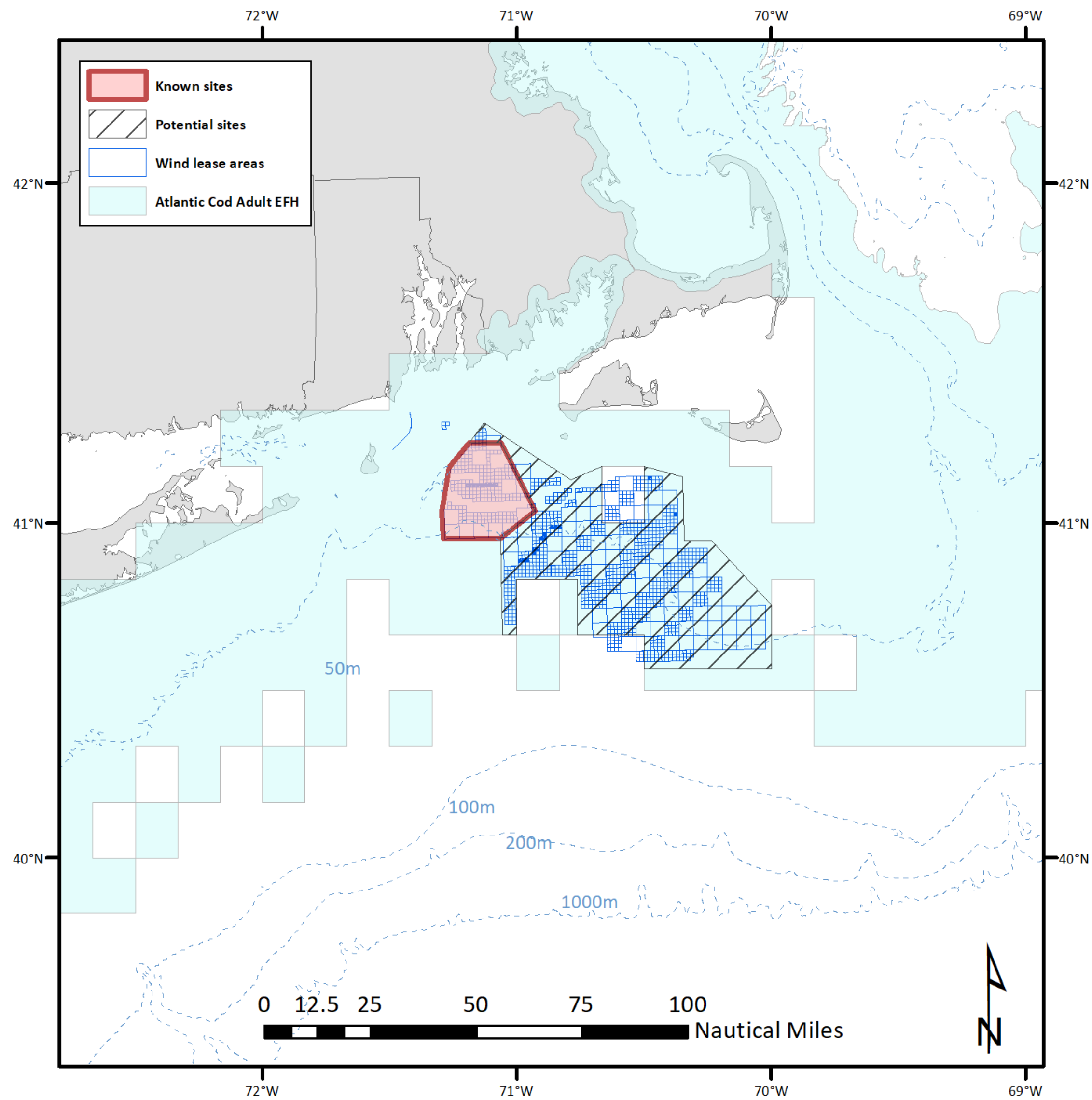


Alternative: Current and potential cod spawning sites within wind lease areas only

This alternative would designate the area described and mapped in Figure 7 as an HAPC. This represents the intersection of adult cod EFH in Southern New England with current and potential future spawning grounds (red area and hatched area, respectively) and wind lease areas (blue).

Rationale: As compared to the corresponding alternative that designates an HAPC inside and outside wind lease areas, this smaller geographic area would place conservation focus on cod spawning activity within offshore wind development areas, which is our main concern.

Figure 7. Alternative HAPC designation within wind lease areas only (red polygons and black hatching).



Alternative: Multispecies HAPC within wind lease areas only

This alternative would have designated a HAPC for multiple species, but only in locations that overlap wind lease areas. A map for this alternative had not been developed when the Committee discussed it, but they recommended developing HAPCs both within and outside wind lease areas as an overall approach.

Rationale: As compared to the corresponding alternative that designates a multispecies HAPC inside and outside wind lease areas, this smaller geographic area would place conservation focus on habitats within offshore wind development areas, which is the Council's main concern.

5.0 SUPPORTING INFORMATION

Southern New England is part of the Northeast Shelf Large Marine Ecosystem and is located at the boundary of the Virginian and Acadian regions (Cook and Auster, 2007, Costa-Pierce 2010), such that both Mid-Atlantic and North-Atlantic species occur in the area.

5.1 ESSENTIAL FISH HABITAT DESIGNATIONS

Note – remove species not associated with complex habitat that are not part of Alternative 4 as refined.

Species that have EFH in Southern New England that are included in one or more of the HAPC designation alternatives are listed below. The designation because offshore development can affect both benthic and water column habitats, all lifestages for each species are considered a focus of the HAPC designation. Little skate, winter skate, and ocean pout do not have larval stages, and egg EFH is not designated for skate species. Habitat characteristics for each of these species and lifestages are summarized in Table 4 and maps of EFH for these species with recent survey catches are included in Figure 8 - Figure 19. Collectively, these designations and survey catches encompass the entirety of Southern New England, from the coastline to the edge of the continental shelf, including pelagic and benthic habitats. Substrates ranging from mud to sand to gravels and rocky habitats are included.

- Large mesh multispecies
    - Atlantic cod, Georges Bank stock*
    - Ocean pout*
    - Winter flounder, Southern New England/Mid-Atlantic stock*
    - Windowpane flounder, Southern New England/Mid-Atlantic stock
    - Yellowtail flounder, Southern New England/Mid-Atlantic stock*
- Small mesh multispecies
    - Silver hake, southern stock
    - Red hake, southern stock*
- Monkfish
    - Southern Fishery Management Area stock
- Skate complex
    - Little skate
    - Winter skate
- Sea scallop
- Atlantic herring*

**Indicates overfished stock*

NEFMC species with EFH in Southern New England that are not included in the HAPC designation alternatives include barndoor skate, haddock, pollock, white hake, and witch flounder. Species with minimal EFH in Southern New England, also not included in the HAPC designation alternatives, include Acadian redfish, American plaice, Atlantic halibut, Atlantic wolffish, offshore hake, and rosette skate. The alternatives proposed in this framework are for New England managed species and thus do not include Mid-Atlantic species that have EFH in the area that are also likely to be impacted by offshore wind development in the region (e.g., longfin squid). Some of these species might nonetheless derive conservation benefits from conservation recommendations related to protection of habitats in the HAPC.

Table 4. Habitat characteristics by species and lifestage that occur in Southern New England. Abbreviations used throughout: MAB = Mid-Atlantic Bight; MHW = mean high water; NA = not appropriate; YOY = Young-of-the-year juveniles.

Species	Life Stage	Depth (m)	Habitat Type and Description
Atlantic cod	Eggs	NA	Pelagic
	Larvae		
	Juveniles	MHW-120	Structurally complex intertidal and sub-tidal habitats, including eelgrass, mixed sand and gravel, and rocky habitats (gravel pavements, cobble, and boulder) with and without attached macroalgae and emergent epifauna
	Adults	30-160	Structurally complex sub-tidal hard bottom habitats with gravel, cobble, and boulder substrates with and without emergent epifauna and macroalgae, also sandy substrates and along deeper slopes of ledges
Atlantic herring	Eggs	5-90	Sub-tidal benthic habitats on coarse sand, pebbles, cobbles, and boulders and/or macroalgae
	Larvae	NA	Inshore and offshore pelagic habitats
	Juveniles	To 300	Intertidal and sub-tidal pelagic habitats
	Adults		Sub-tidal pelagic habitats
Atlantic sea scallop	Eggs	18-110	Inshore and offshore benthic habitats (see adults)
	Larvae	NA	Inshore and offshore pelagic and benthic habitats: pelagic larvae (“spat”), settle on variety of hard surfaces, including shells, pebbles, and gravel and to macroalgae and other benthic organisms such as hydroids
	Juveniles	18-110	Benthic habitats initially attached to shells, gravel, and small rocks (pebble, cobble), later free-swimming juveniles found in same habitats as adults
	Adults		Benthic habitats with sand and gravel substrates
Little skate	Juveniles	MHW-80	Intertidal and sub-tidal benthic habitats on sand and gravel, also found on mud
	Adults	MHW-100	
Monkfish	Eggs	NA	Pelagic habitats
	Larvae		
	Juveniles	50-400 in the MAB and to 1,000 on the slope	Sub-tidal benthic habitats on a variety of habitats, including hard sand, pebbles, gravel, broken shells, and soft mud, also seek shelter among rocks with attached algae
	Adults		Sub-tidal benthic habitats on hard sand, pebbles, gravel, broken shells, and soft mud, but seem to prefer soft sediments, and, like juveniles, utilize the edges of rocky areas for feeding
Ocean pout	Eggs	<100	Sub-tidal hard bottom habitats in sheltered nests, holes, or rocky crevices

Species	Life Stage	Depth (m)	Habitat Type and Description
	Juveniles	MHW-120	Intertidal and sub-tidal benthic habitats on a wide variety of substrates, including shells, rocks, algae, soft sediments, sand, and gravel
	Adults	20-140	Sub-tidal benthic habitats on mud and sand, particularly in association with structure forming habitat types: i.e. shells, gravel, or boulders
Red hake	Eggs	NA	Pelagic habitats
	Larvae		
	Juveniles	MHW-80	Intertidal and sub-tidal soft bottom habitats, especially those that provide shelter, such as depressions in muddy substrates, eelgrass, macroalgae, shells, anemone and polychaete tubes, on artificial reefs, and in live bivalves (e.g., scallops)
	Adults	50-750 on shelf and slope, as shallow as 20 inshore	Sub-tidal benthic habitats in shell beds, on soft sediments (usually in depressions), also found on gravel and hard bottom and artificial reefs
Silver hake	Eggs and larvae	NA	Pelagic habitats
	Juveniles	>10 in MAB	Pelagic and sandy sub-tidal benthic habitats in association with sand-waves, flat sand with amphipod tubes, shells, and in biogenic depressions
	Adults	70-400 in the MAB	Pelagic and sandy sub-tidal benthic habitats, often in bottom depressions or in association with sand waves and shell fragments, also in mud habitats bordering deep boulder reefs, on over deep boulder reefs in the SW GOM
Windowpane flounder	Eggs & Larvae	NA	Pelagic habitats
	Juveniles	MHW - 60	Intertidal and sub-tidal benthic habitats on mud and sand substrates
	Adults	MHW - 70	
Winter flounder	Eggs	0-5 south of Cape Cod	Sub-tidal estuarine and coastal benthic habitats on mud, muddy sand, sand, gravel, submerged aquatic vegetation, and macroalgae
	Larvae	0-70	Pelagic, but near bottom as they get older
	Juveniles	MHW - 60	Intertidal and sub-tidal benthic habitats on a variety of bottom types, such as mud, sand, rocky substrates with attached macro algae, tidal wetlands, and eelgrass; YOY juveniles on muddy and sandy sediments in and adjacent to eelgrass and macroalgae, in bottom debris, and in marsh creeks
	Adults	MHW - 70	Intertidal and sub-tidal benthic habitats on muddy and sandy substrates, and on hard bottom on offshore banks; for spawning adults, also see eggs

Species	Life Stage	Depth (m)	Habitat Type and Description
Winter skate	Juveniles	0-90	Sub-tidal benthic habitats on sand and gravel substrates, are also found on mud
	Adults	0-80	
Yellowtail flounder	Eggs	NA	Pelagic habitats
	Larvae		
	Juveniles	20-80	Sub-tidal benthic habitats on sand and muddy sand
	Adults	25-90	Sub-tidal benthic habitats on sand and sand with mud, shell hash, gravel, and rocks

Figure 8. Atlantic cod abundance (MA, NEAMAP, NMFS, and RI trawl survey data, 2000-2019) with juvenile and adult cod EFH. Also shown are wind lease areas, SNE analysis area, and consensus cod spawning grounds.

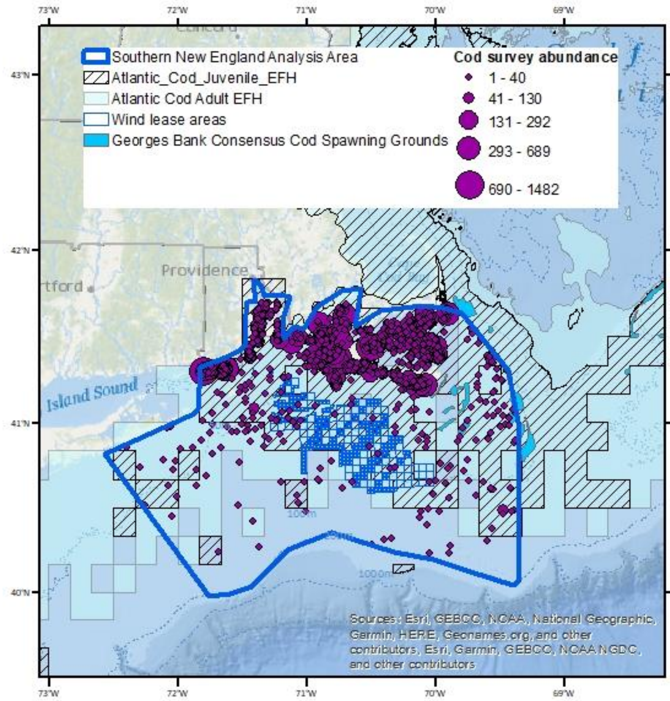


Figure 9. Atlantic herring abundance (MA, NEAMAP, NMFS, and RI trawl survey data, 2000-2019) with juvenile herring EFH. Also shown are wind lease areas and SNE analysis area.

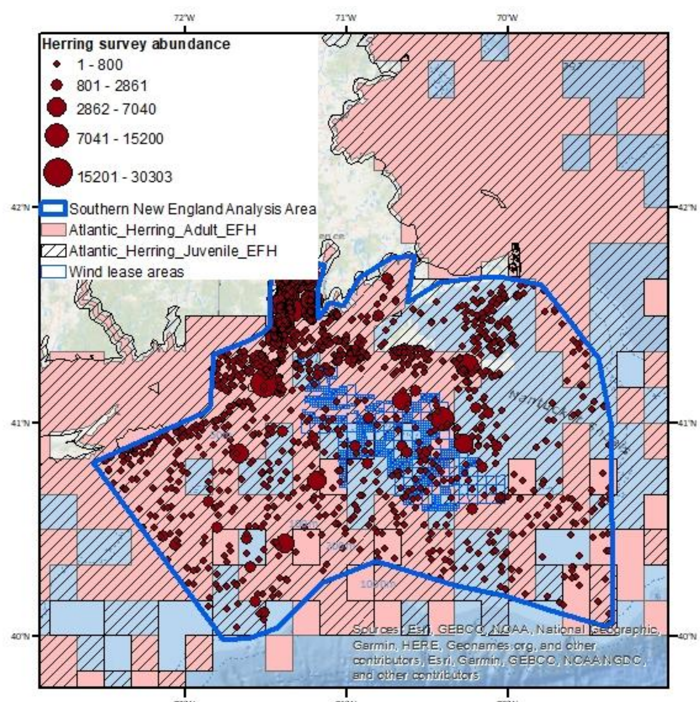


Figure 10. Atlantic sea scallop abundance (MA, NEAMAP, NMFS, and RI trawl survey data, 2000-2019) with all life stages EFH. Also shown are wind lease areas and SNE analysis area. Note: Removed tow with unusually high number of monkfish (48,366 monkfish).

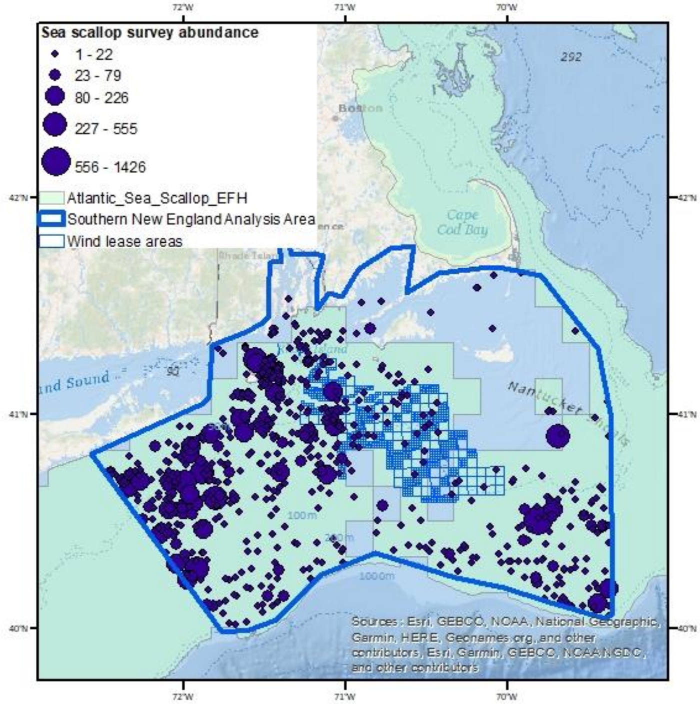


Figure 11. Little skate abundance (MA, NEAMAP, NMFS, and RI trawl survey data, 2000-2019) with juvenile and adult little skate EFH. Also shown are wind lease areas and SNE analysis area.

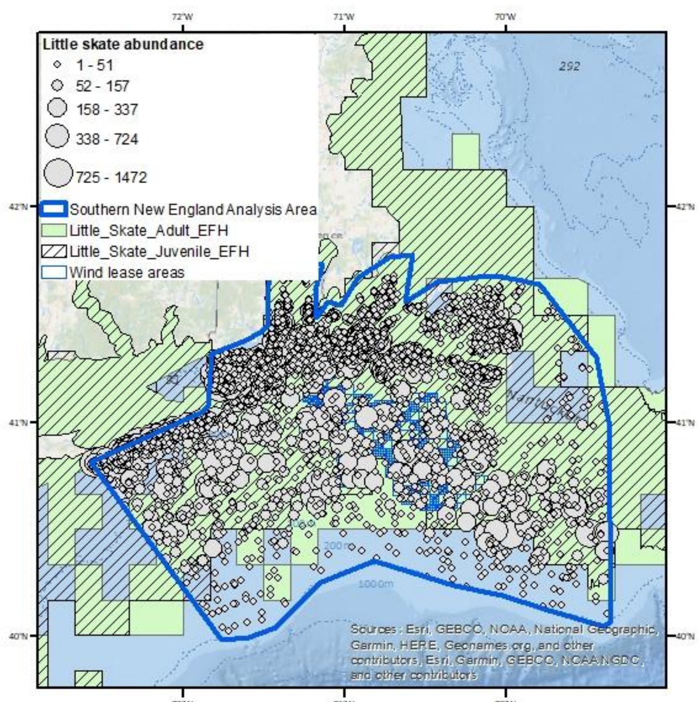


Figure 12. Monkfish abundance (MA, NEAMAP, NMFS, and RI trawl survey data, 2000-2019) with juvenile and adult monkfish EFH. Also shown are wind lease areas and SNE analysis area.

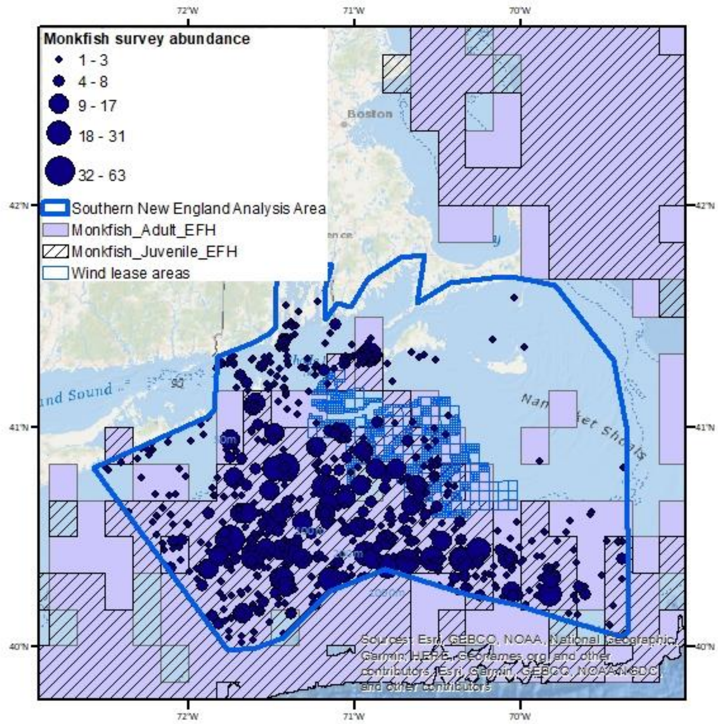


Figure 13. Ocean pout abundance (MA, NEAMAP, NMFS, and RI trawl survey data, 2000-2019) with juvenile and adult ocean pout EFH. Also shown are wind lease areas and SNE analysis area.

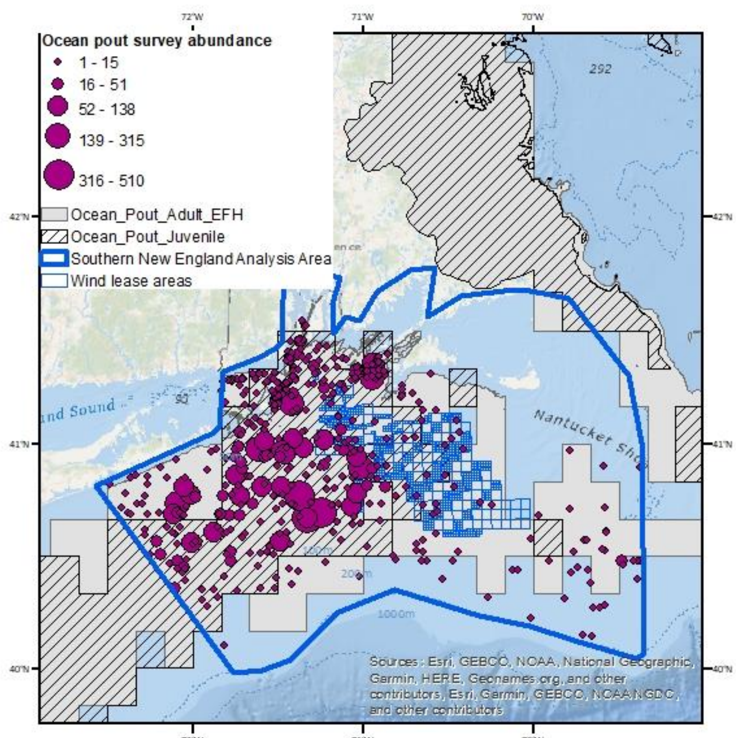


Figure 14. Red hake abundance (MA, NEAMAP, NMFS, and RI trawl survey data, 2000-2019) with egg/larval/juvenile and adult red hake EFH. Also shown are wind lease areas and SNE analysis area.

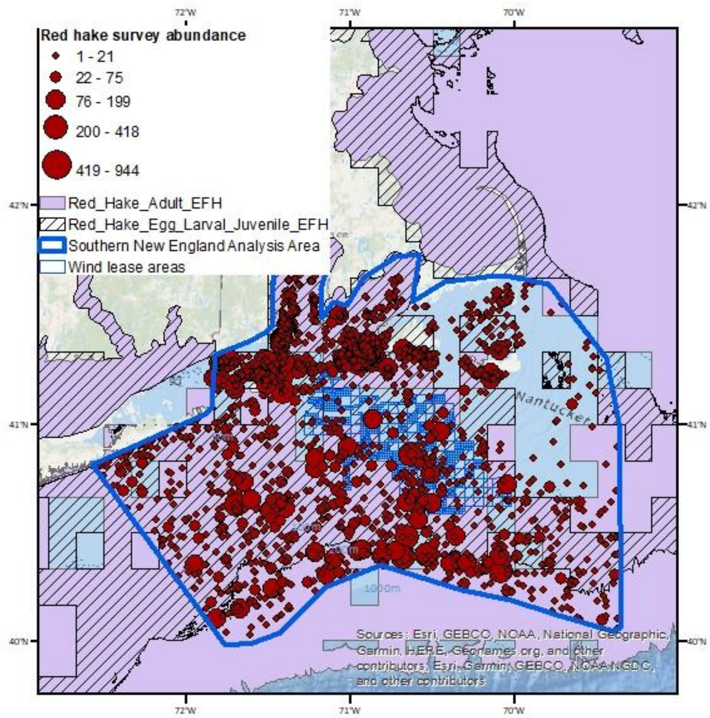


Figure 15. Silver hake abundance (MA, NEAMAP, NMFS, and RI trawl survey data, 2000-2019) with juvenile and adult silver hake EFH. Also shown are wind lease areas and SNE analysis area.

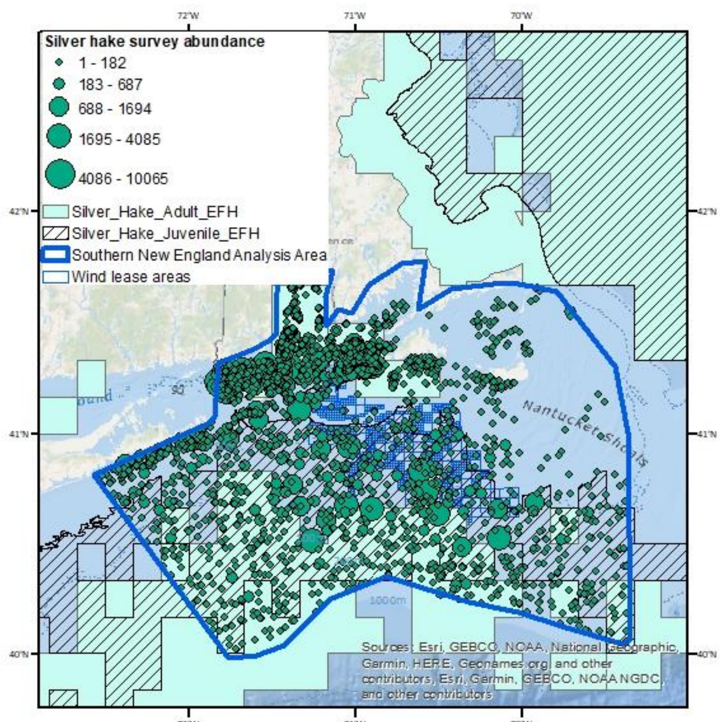


Figure 16. Windowpane flounder abundance (MA, NEAMAP, NMFS, and RI trawl survey data, 2000-2019) with juvenile and adult windowpane flounder EFH. Also shown are wind lease areas and SNE analysis area.

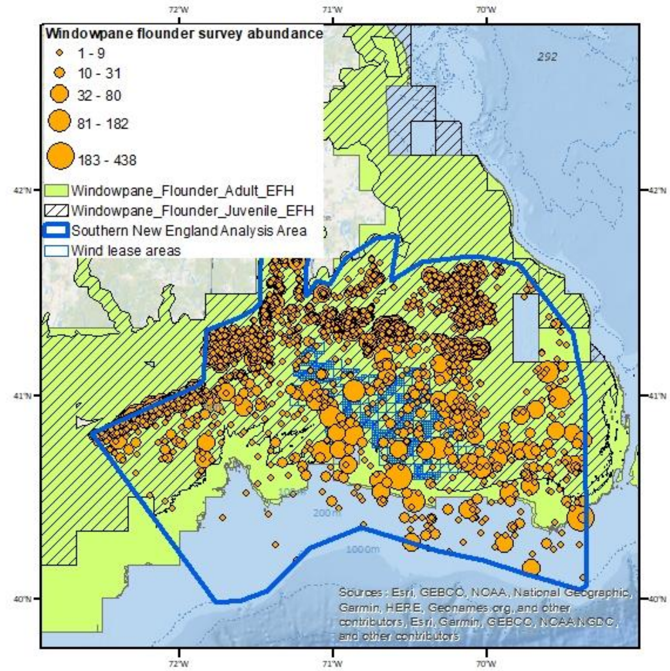


Figure 17. Winter flounder abundance (MA, NEAMAP, NMFS, and RI trawl survey data, 2000-2019) with juvenile and larval/adult winter flounder EFH. Also shown are wind lease areas and SNE analysis area.

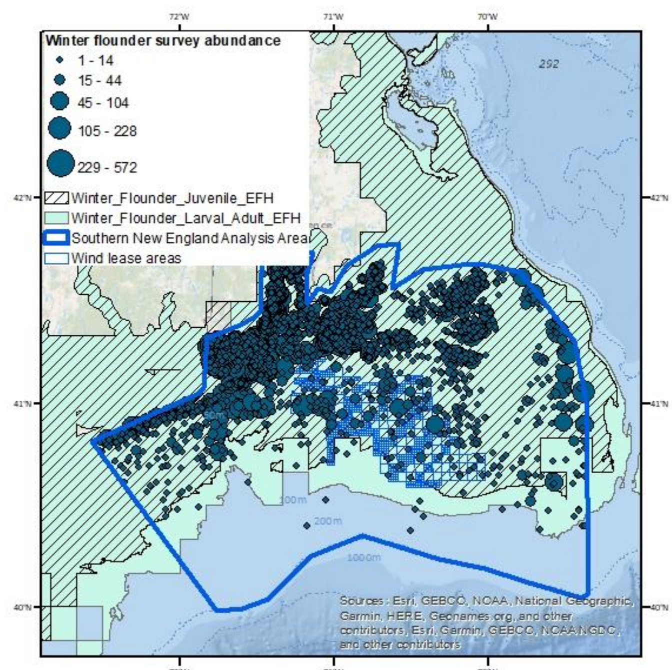


Figure 18. Winter skate abundance (MA, NEAMAP, NMFS, and RI trawl survey data, 2000-2019) with juvenile and adult winter skate EFH. Also shown are wind lease areas and SNE analysis area.

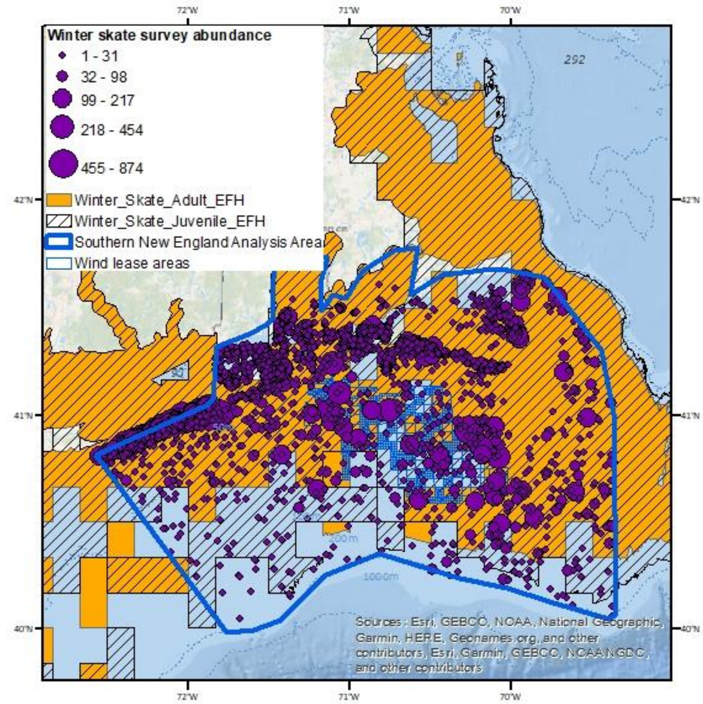
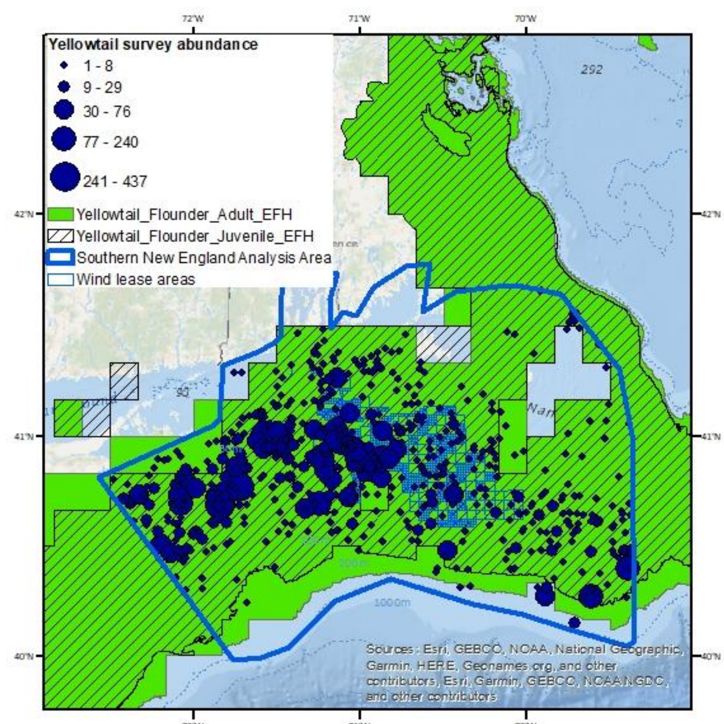


Figure 19. Yellowtail flounder abundance (MA, NEAMAP, NMFS, and RI trawl survey data, 2000-2019) with juvenile and adult yellowtail flounder EFH. Also shown are wind lease areas and SNE analysis area.



5.2 SPECIES DISTRIBUTION, ABUNDANCE, AND HABITAT USE

Note – remove species not associated with complex habitat that are not part of Alternative 4 as refined.

There are patterns to fish habitat use across multiple spatial and temporal scales, and understanding such patterns is important for developing suitable conservation measures. Trawl survey data are often used in combination with environmental data to document mesoscale patterns (1-1,000 km) of species distribution and abundance. At the tow level, trawl data provide an integrated measure of species occurrence and relative abundance across all habitat types encountered within the tow path. At finer spatial scales, for example using hook and line gear or even with short duration tows with trawls or dredges, fish catches can be paired with a habitat map to determine fish distribution by habitat type. At microhabitat scales (centimeters to meters), video or still camera data pair observations of habitat features and the fish using those habitats in a single data source. Such fine scale data can be used to estimate how fish use habitat features, for example a silver hake sheltering in a sand wave to conserve energy while station keeping during feeding (Auster et al. 1991, 1995), or a juvenile cod camouflaging from predators amongst pebbles, cobbles or seagrasses (Grabowski et al. 2018, and references therein). Distributions of microhabitat features can be dynamic over time. This section summarizes both mesoscale and microscale habitat associations in Southern New England.

Auster et al. (1991, 1995) used a remotely operated vehicle to evaluate fish habitat use at a 55 m site in Southern New England known as The Fingers. Among other species observed at the site, multiple species that are the focus of these HAPC alternatives were documented: red hake, silver hake, ocean pout, little skate, monkfish, and sea scallop. Bottom habitat was classified as flat sand, sand wave crests, shell, or biogenic depressions, and the heterogeneity and direction of species distributions by habitat type were evaluated using Chi-square tests and Pearson's product moment correlations (Table). The specific associations documented in this study are not fixed and may vary by area and based on fish abundance, but the point is that these diverse habitat features are occupied selectively by fishes, and maintenance of seabed feature diversity is therefore important to supporting ecological relationships.

Table 5. Microhabitat associations for HAPC focal species at The Fingers (source: Auster et al. 1991).

Species	Flat sand	Sand wave crests	Shell	Biogenic depressions
Ocean pout	-	NS -	+	NS +
Little skate	-	NS -	+	NS +
Red hake	NS -	NS +	NS +	NS +
Silver hake	+	NS +	-	NS -
Sea scallop	-	NS -	+	NS +

Many authors have considered the associations between juvenile cod and their habitats and estimated how these associations may contribute to stock production. Grabowski et al. (2018) conducted a meta-analysis of field and lab studies (also see summaries of cod-habitat literature in NEFMC 2016, Vo1ume 1, Section 4.1.1 and NEFMC 2022), concluding that recently settled cod have a strong association with structured habitats (seagrasses, pebbles, cobbles), and age-0 cod settle in these structured habitats in shallow water, moving into deeper waters over time. As part of the same study, Grabowski et al. also evaluated cod-habitat associations in the field using a combination of video, hook and line, and trawl survey data. Differences were observed between age-0, age-1, and age 2-3 fish. Based on inshore trawl surveys, they found age-0 cod were more common in shallow sand habitats, while age-1 and age-2 fish were more commonly captured in granule-pebble habitats. However, they acknowledged that complex habitats shallower than 20 m where settlement might be occurring were not trawled. In the hook and line survey, somewhat older fish were most commonly caught over cobble/ledge habitats as compared to granule-pebble habitats and were not detected over mud or sand. While their field work was conducted in mid-coast Maine, Southern New England has similar coastal habitats including nearshore pebble-cobble and seagrasses.

Langan et al. (2020) studied the distribution and abundance of larval, juvenile, and adult cod in the waters off Rhode Island. These cod represent the southernmost population in their geographic range, and decreased abundance might be expected due to warming temperatures. Despite this, numbers of cod in Southern New England have increased since the early 2000s. Larval data for Narragansett Bay showed occurrence of larvae and post larvae between January and May, suggesting spawning in late December through mid-February, with more specific date estimates dependent on assumptions about growth rates, which are uncertain as they are based on Georges Bank growth curves. Age-0 fish were observed throughout Rhode Island state waters across a range of depths, primarily caught between March and June, with most catches in April and May, also consistent with winter spawning. These age-0 cod were consistently abundant in the trawl survey and their abundance increased markedly beginning in 2002. They suggested that vertical relief, specifically macroalgae and boulders, might be used by these age-0 fish for shelter and feeding, acknowledging that Narragansett Bay is generally dominated by fine sediments. Age 1+ (combining larger juveniles and adults) were caught in Rhode Island and Block Island Sounds. These older fish are caught in smaller numbers in the RI trawl survey. More juveniles that adults were observed in this coastal survey, suggesting that adults, which appear to be increasing in abundance in Southern New England based on vessel trip report and Marine Recreational Information Program data also evaluated in the study, more typically occupy offshore banks.

Malek et al. (2014) considered an overlapping and somewhat more offshore study area as compared to Langan et al., examining Northeast Area Monitoring and Assessment Program (NEAMAP) trawl survey data combined with dedicated otter and beam trawl tows made south of Block Island and on and around Cox Ledge. They considered the broader fish and invertebrate community assemblage, not only Atlantic cod, focusing on benthic taxa (i.e., Atlantic herring were excluded from the analysis). They classified zones by depth into inshore (20-30 m), nearshore (30-40 m), and offshore (40+ m). Little skate and silver hake were amongst the most abundant species in the otter trawl catches, and sea scallops were among the most abundant species in beam trawl catches. There were east-west and inshore-offshore patterns in community composition, with abundance highest near Block Island and the greatest biomass offshore. North of Cox Ledge and south of Block Island were the areas of highest diversity. Various locations within the study area were dominated by particular species, and there were major differences in catches between spring and fall surveys, indicating spatial and temporal heterogeneity in the fish communities in the study area.

Friedland et al. (2021) examined species occurrence and production within wind energy areas along the Northeast U.S. coast. All the Massachusetts/Rhode Island and Massachusetts lease areas were examined as a single site, E1 (existing wind area 1). Among the goals of their study were to "identify the species with habitats overlapping the wind energy lease areas; characterize the relative importance of lease areas to species modeled in the study; and determine which aspects of the ecosystem were critical in shaping habitat in the lease areas." Habitat use indices were calculated to document the occurrence of the species in a wind area relative to the species' occurrence shelf-wide, and species were grouped into high, moderate, low, or no reliance. Next, occupancy (presence/absence) and biomass were compared across leases and with respect to lease area location and size and 0-1 indices were generated, with 0.7 used to indicate higher importance of the wind areas to the species. Of the species evaluated in this action, little skate and windowpane had occurrence indices above this threshold, but a number of other species (Atlantic herring, silver hake, winter flounder, yellowtail flounder) had values exceeding 0.6 in one or more seasons (Table 6). Physical and biological predictor variables were included in the species distribution models, and depth, temperature, phytoplankton, and zooplankton tended to be important predictors across multiple species (not necessarily those considered here, as the results were pooled). The authors noted that the potential for changes to hydrodynamics and thus plankton dynamics following turbine installation could influence to species occurrence and relative importance of wind areas in the future.

Table 6. Occupancy indices for HAPC focal species. Bolded text indicate >0.6 level of importance of the wind areas to the species. Source: Friedland et al. 2021.

Species	Spring Occurrence Index	Fall Occurrence Index
Atlantic cod	0.2672	0.0280
Atlantic herring	**0.6476**	0.1094
Atlantic sea scallop	0.1708	0.2328
Little skate	**0.7346**	**0.7781**
Monkfish	0.2509	0.2955
Ocean pout	0.5484	0.1234
Red hake	0.4009	0.4351
Silver hake	0.5855	**0.6628**
Windowpane flounder	**0.7403**	0.5448
Winter flounder	**0.6433**	**0.6620**
Winter skate	0.5957	0.4327
Yellowtail flounder	**0.6476**	0.4982

Fishery independent survey data were used to understand distribution and abundance of species in the Southern New England area. Data from four surveys were examined:

- Northeast Fisheries Science Center bottom trawl
- Northeast Area Monitoring and Assessment Program (NEAMAP) bottom trawl
- Massachusetts Division of Marine Fisheries bottom trawl
- Rhode Island Coastal Trawl Survey

Figure 20 shows the distribution of effort in these surveys. The analysis area (blue outline in the figure) includes both inshore and offshore areas and was drawn to roughly align with NEFSC survey strata. The purpose of this area was to serve as a bounding box for pulling fishery independent data; others may spatially define Southern New England somewhat differently.

The two figures below the map show abundance and biomass over time, combining data for all surveys and considering just the 12 species that are part of Alternative 4. Biomass is the total kg summed across all tows by year, and abundance is the total weight across all tows by year. The figures that follow break out abundance and biomass by survey.

Cluster dendrograms were developed to show which species, of the 12 included in Alternative 4, that tend to co-occur in the catch. Species that are closer on the diagram tend to be caught on the same tows. The dataset is total (sum) abundance for each species in each year and zeros for any absences. The first plot (shown below) is a combination of all surveys and each subsequent plot is for individual surveys.

Figure 20. Fishery independent survey tows in SNE analysis area from 2000– 2019. Four surveys are color coded.

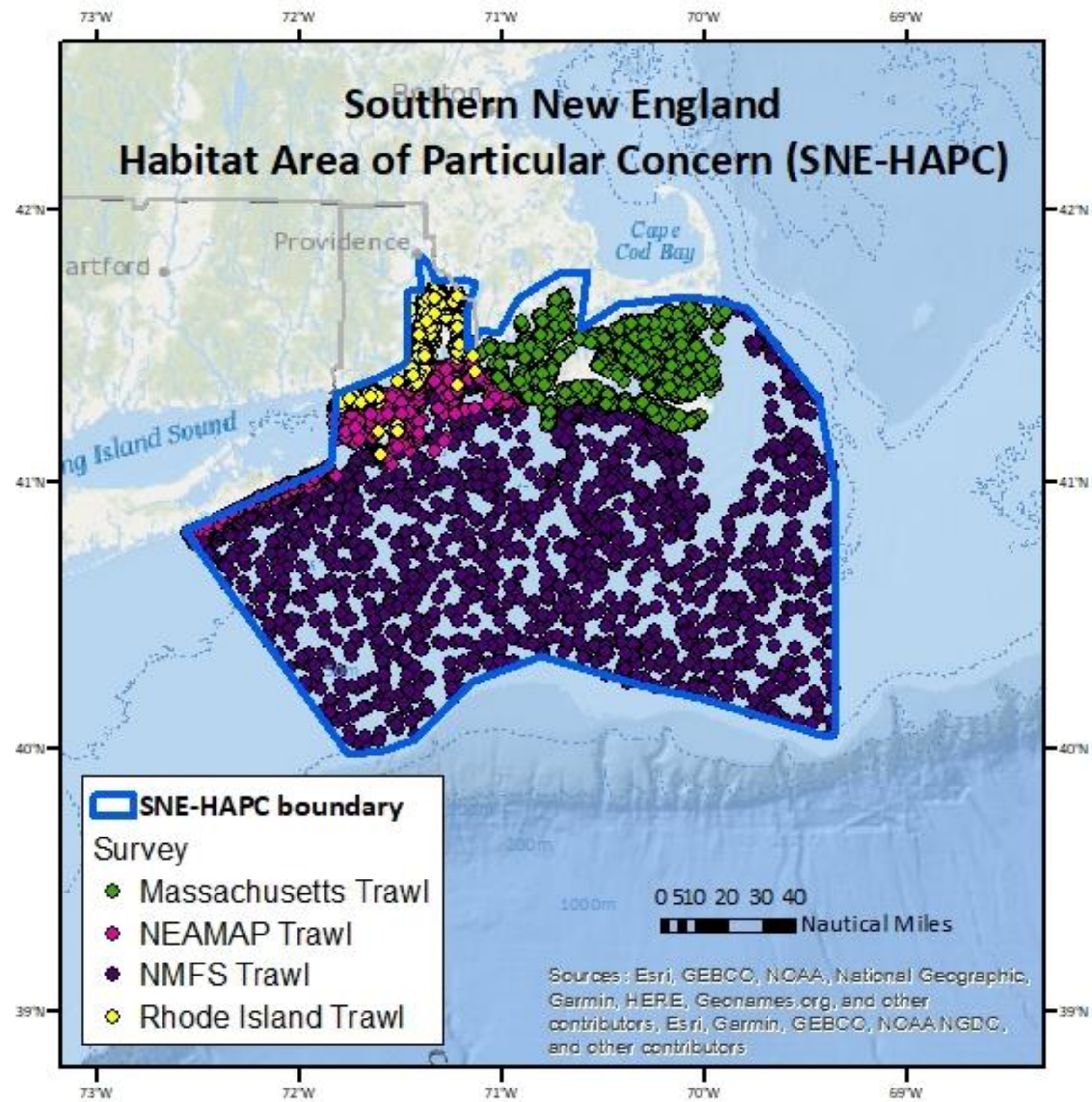


Figure 21. Abundance over time of 12 focus species caught in all four trawl surveys. Scale on y-axis varies by plot.

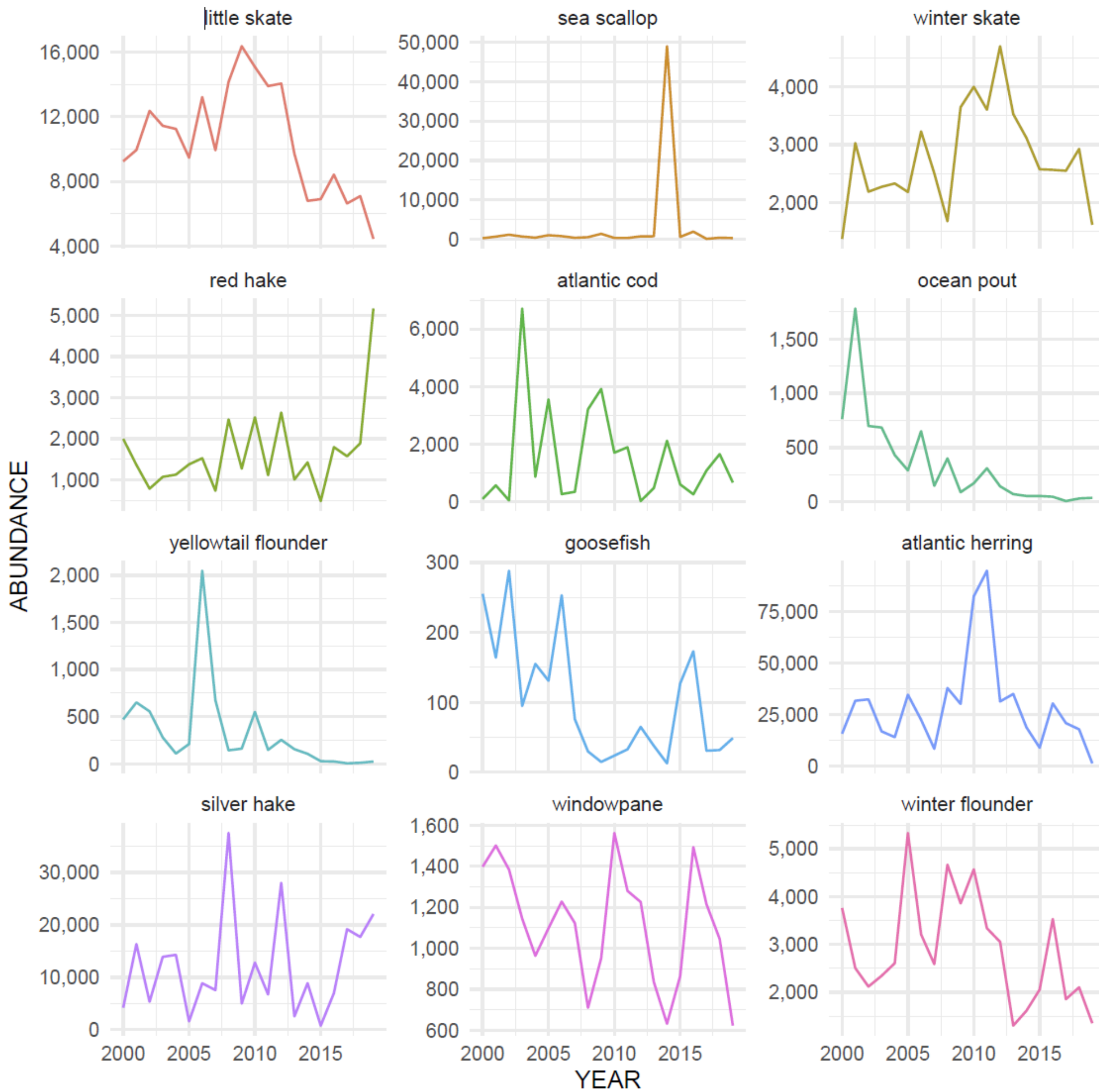


Figure 22. Biomass over time 12 focus species caught in all four trawl surveys. Scale on y-axis varies by plot.

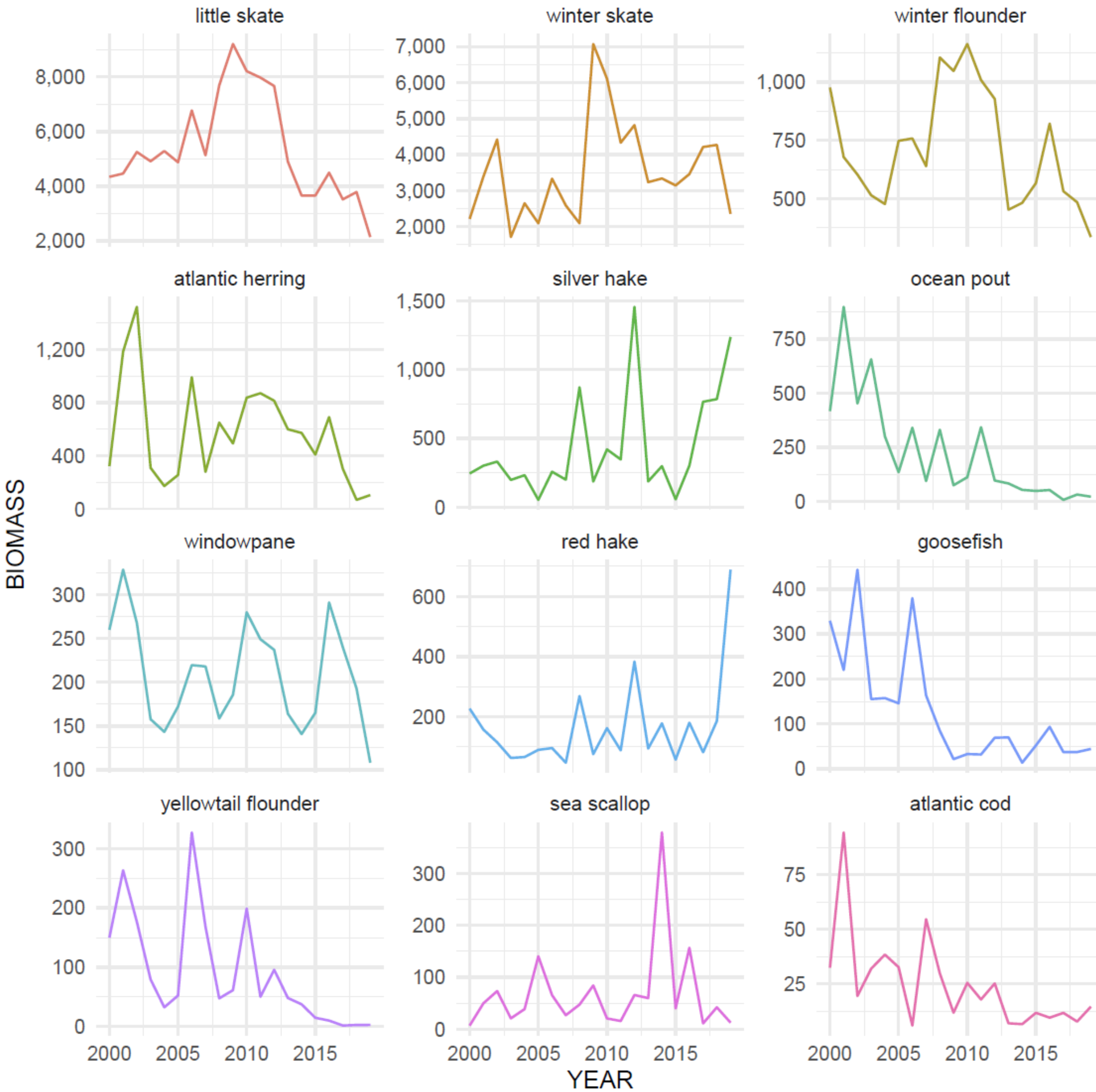


Figure 23. Abundance of focal species from 2000-2019, by survey.

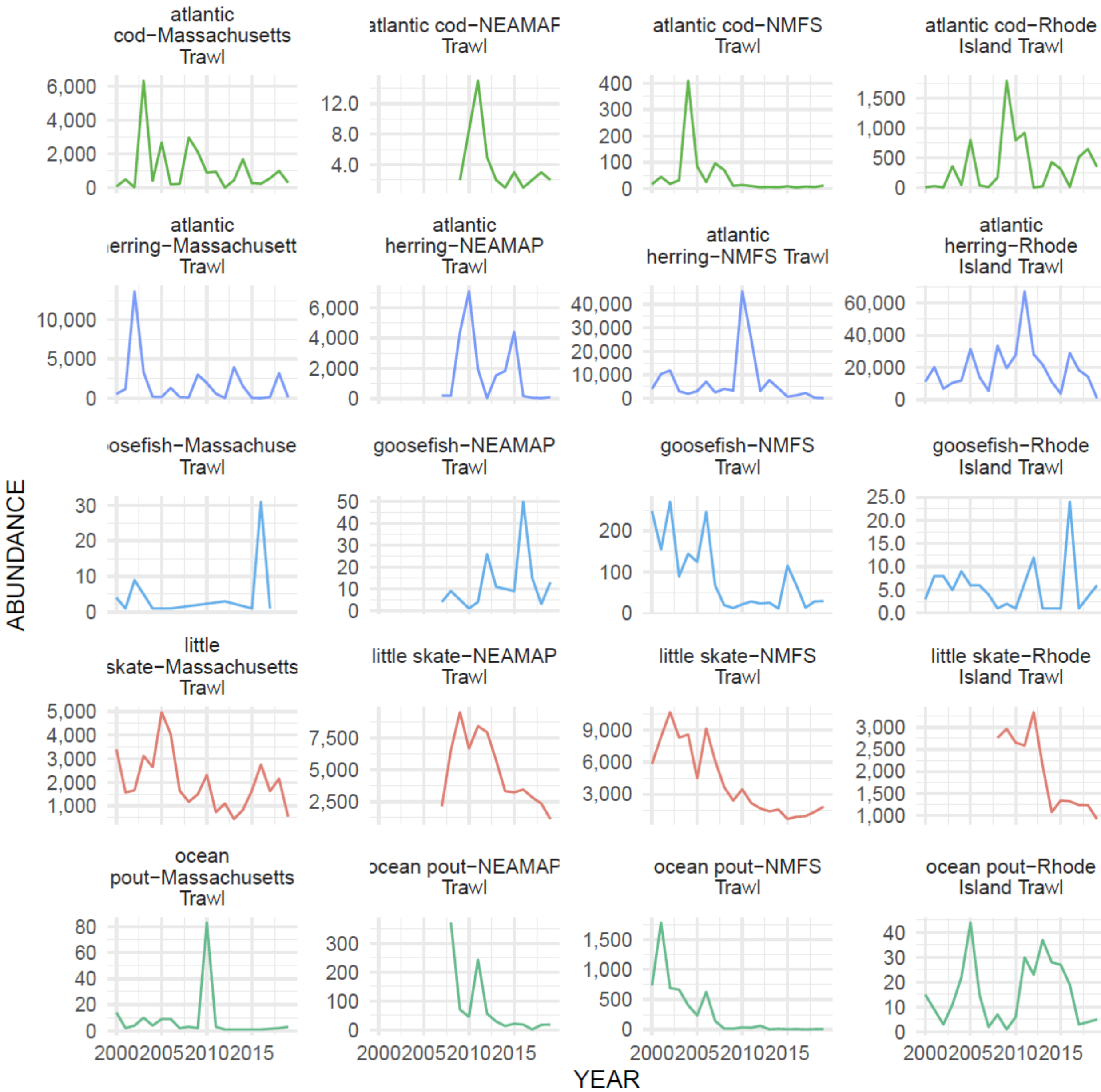


Figure 22, continued.

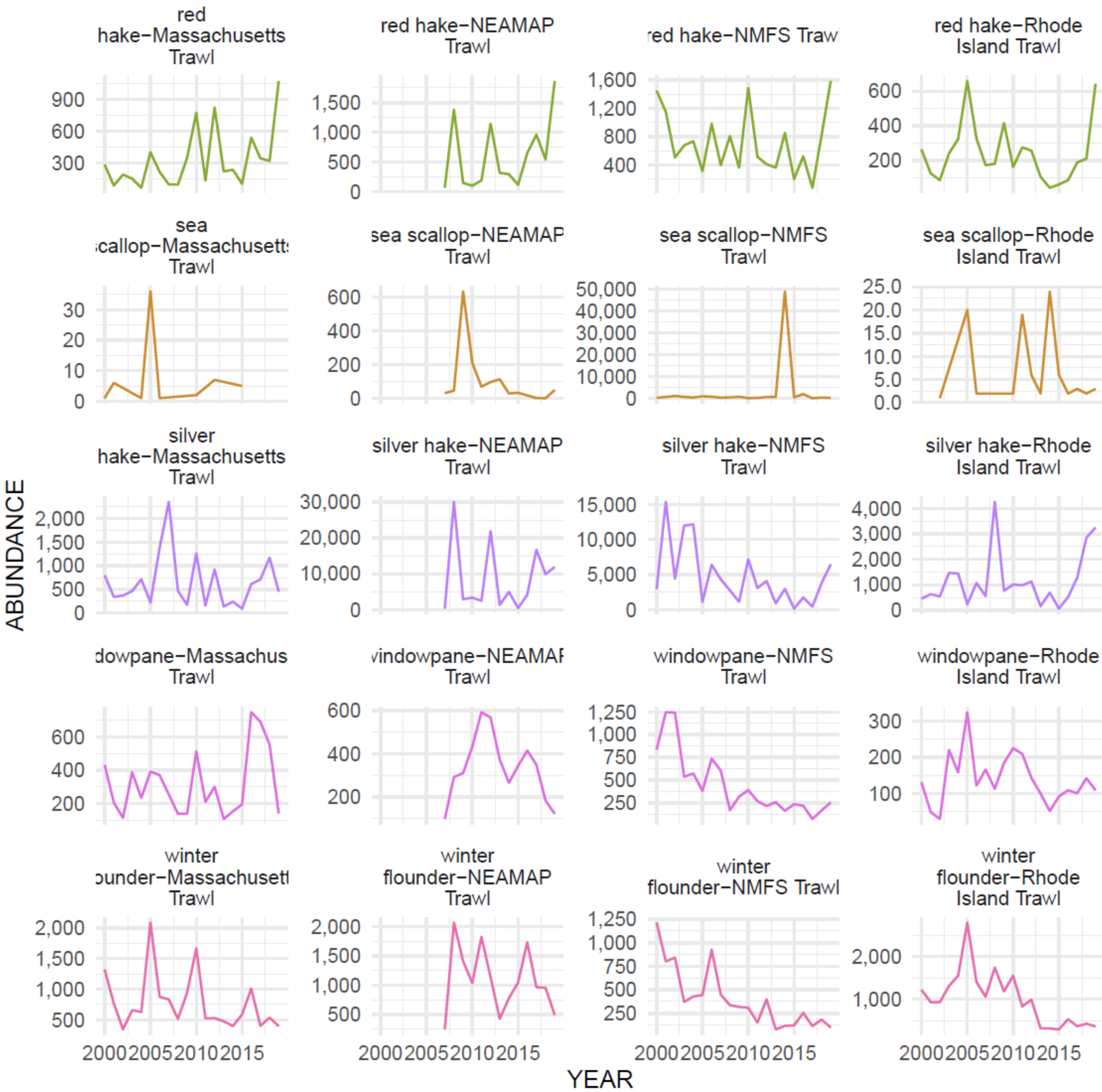


Figure 22, continued.

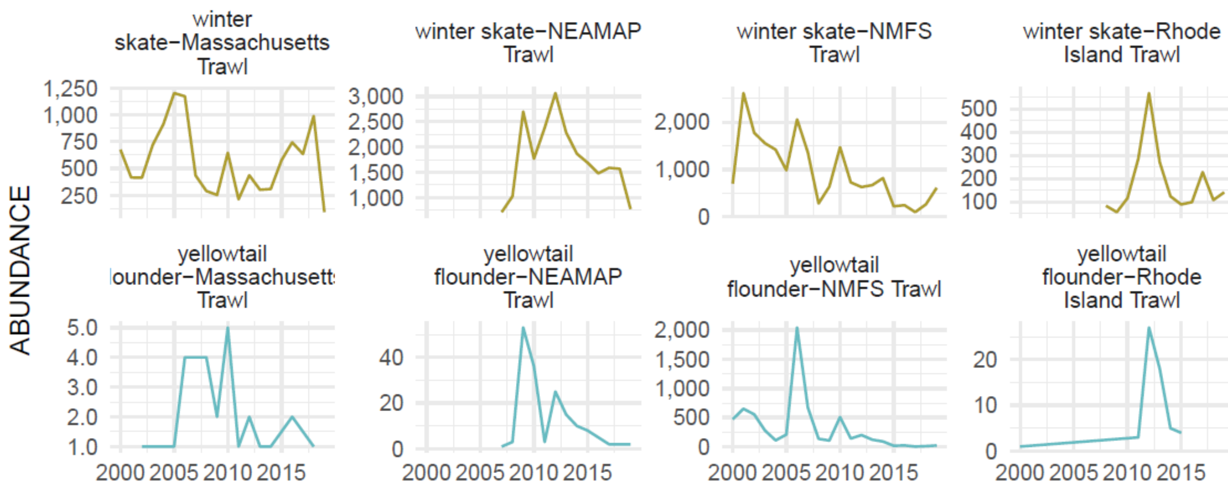


Figure 24. Biomass of focal species from 2000-2019, by survey.

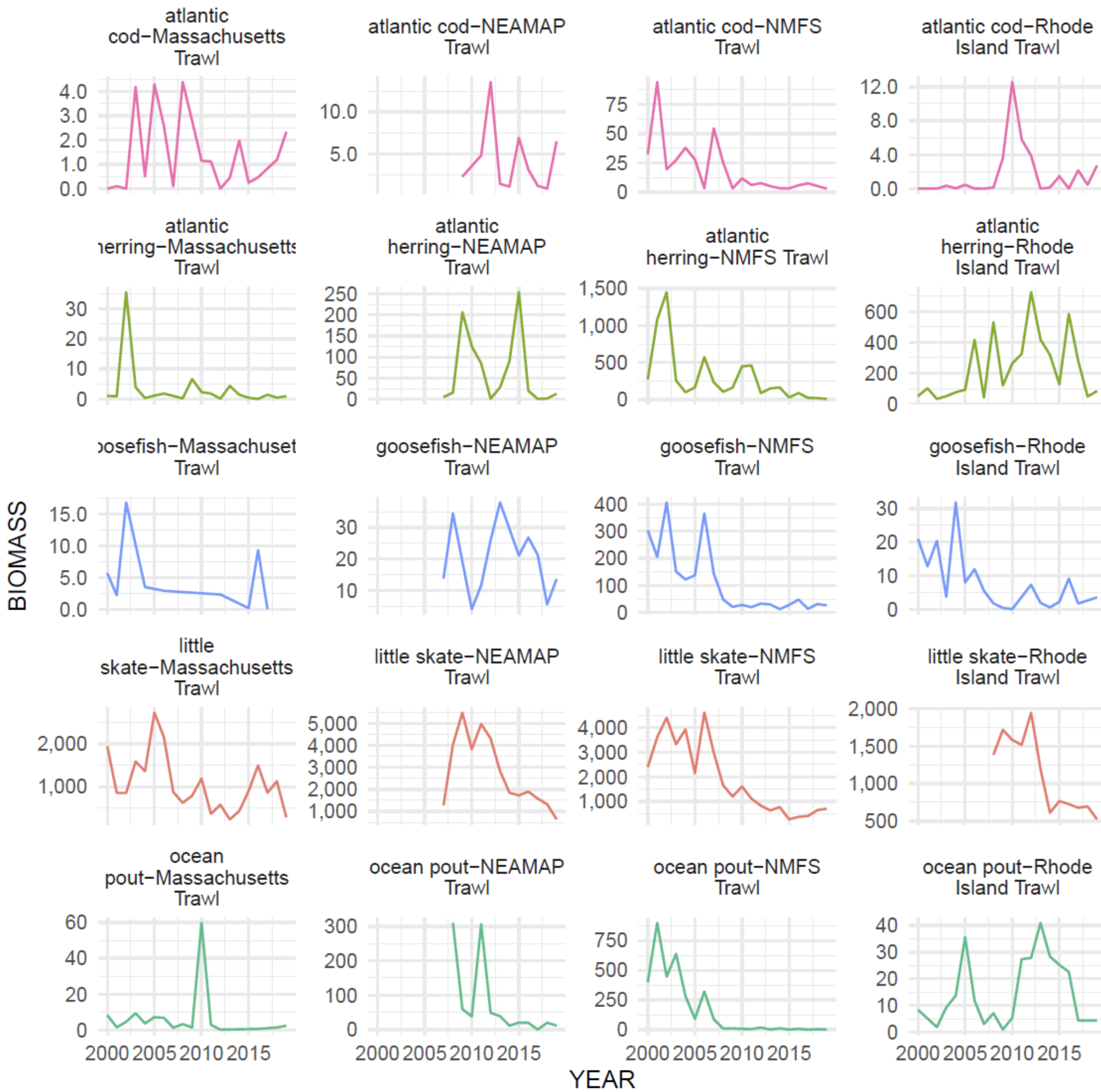


Figure 23, continued.

Figure 23, continued.

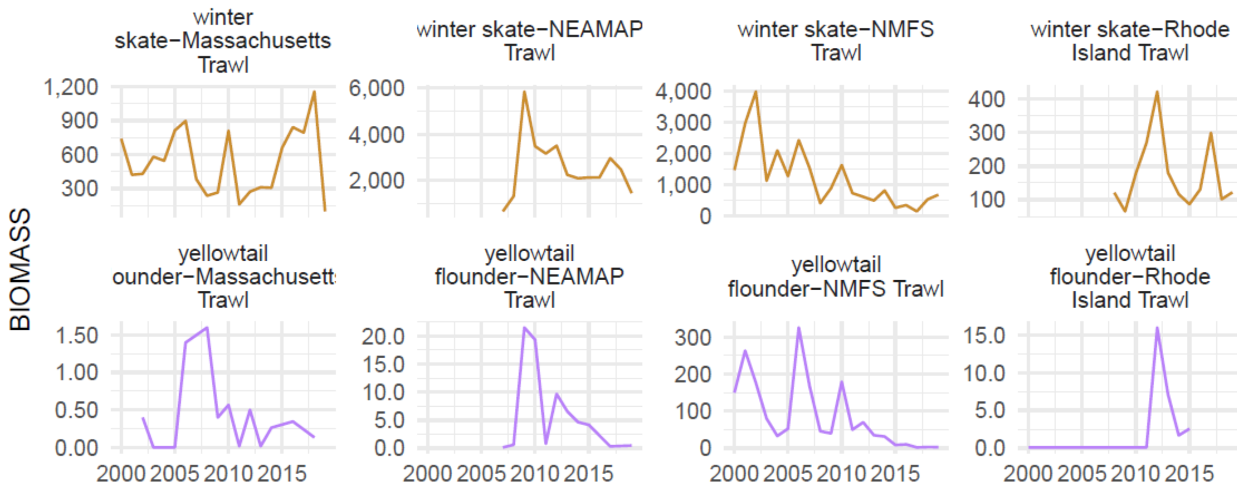


Figure 25. Co-occurrence patterns of 12 focus species in all four trawl surveys in the Southern New England region.

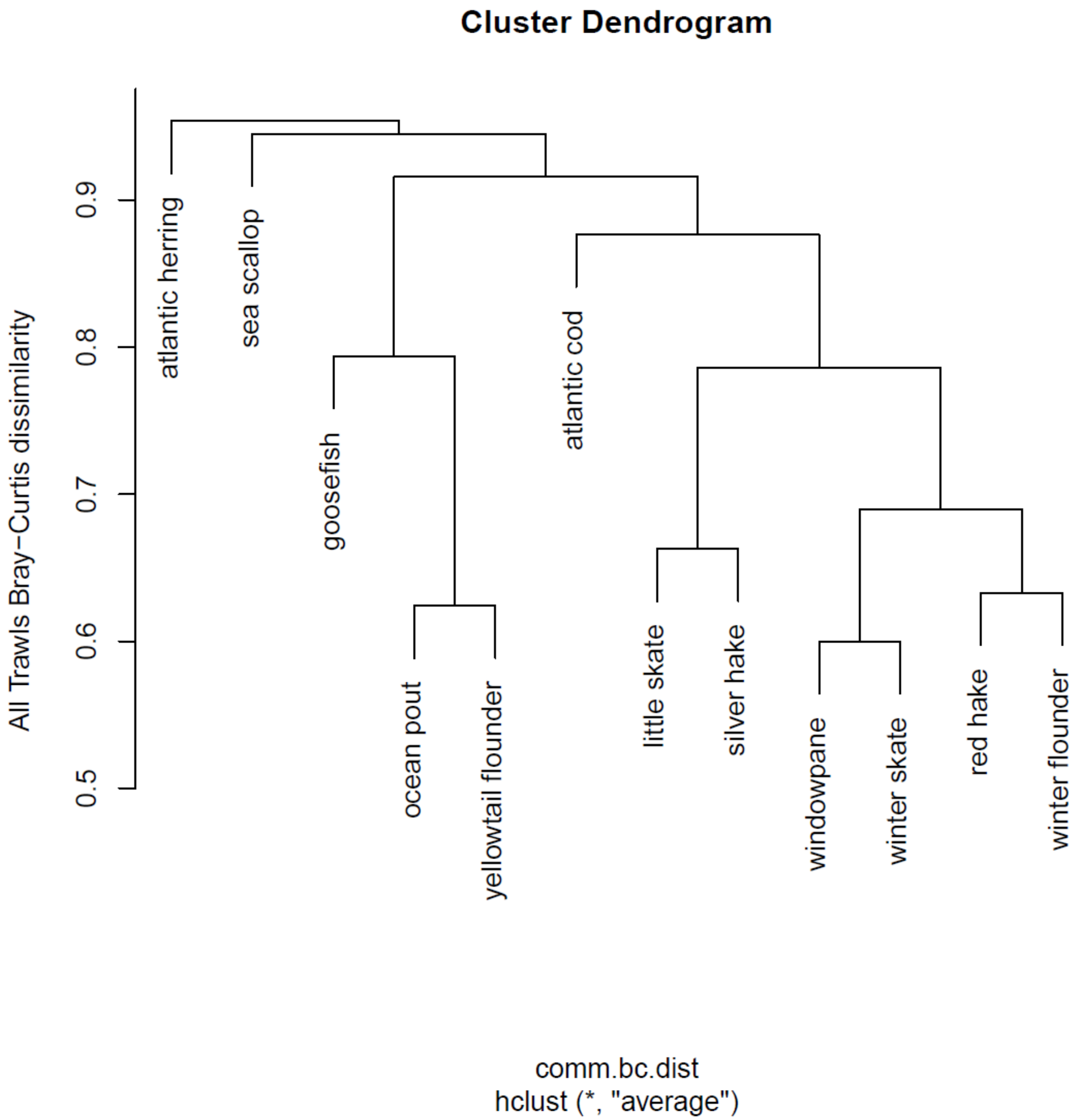


Figure 26. Co-occurrence patterns of 12 focus species in all four trawl surveys in the Southern New England region. MA trawl survey data only.

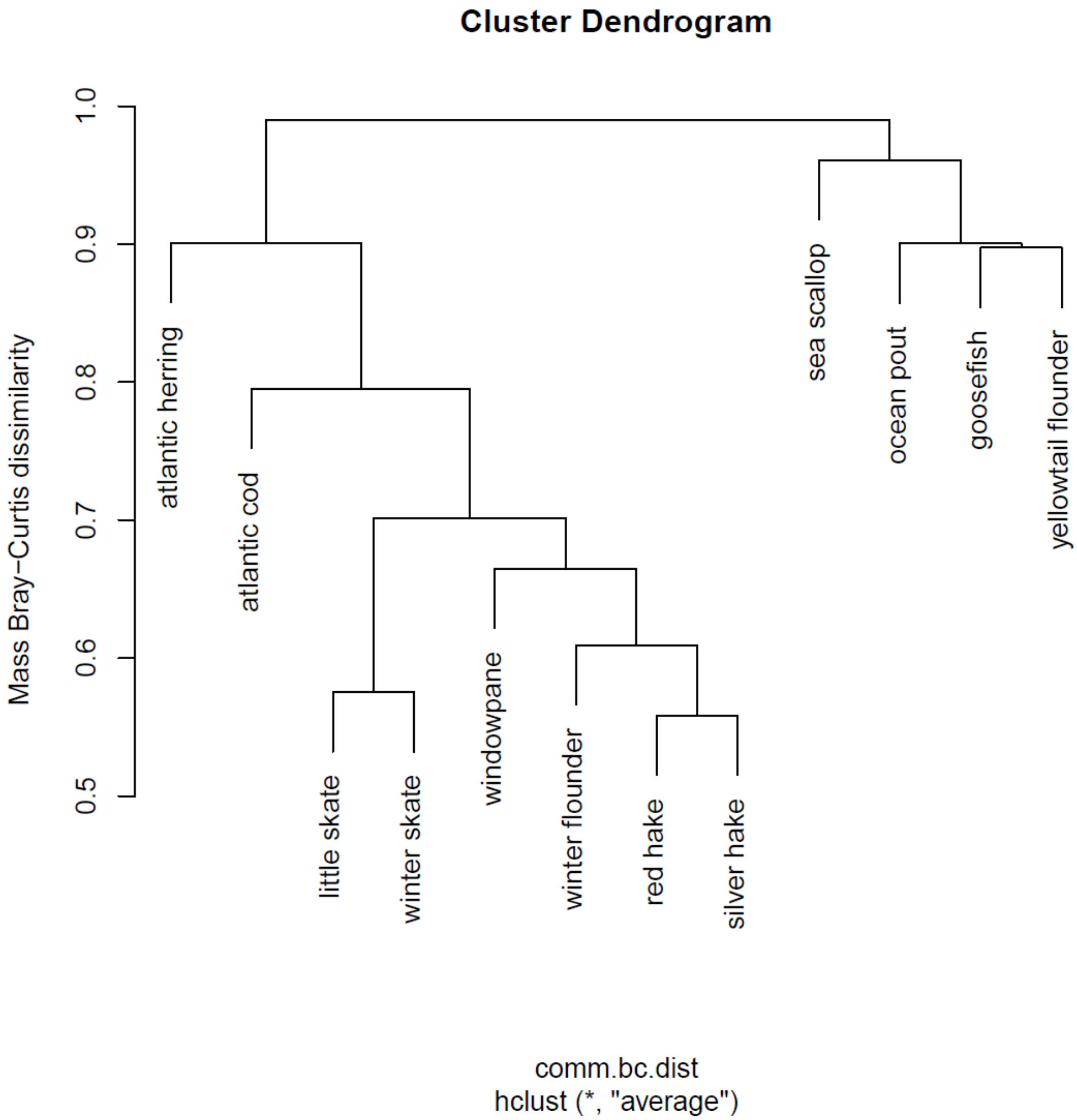


Figure 27. Co-occurrence patterns of 12 focus species in all four trawl surveys in the Southern New England region. NEAMAP survey only.

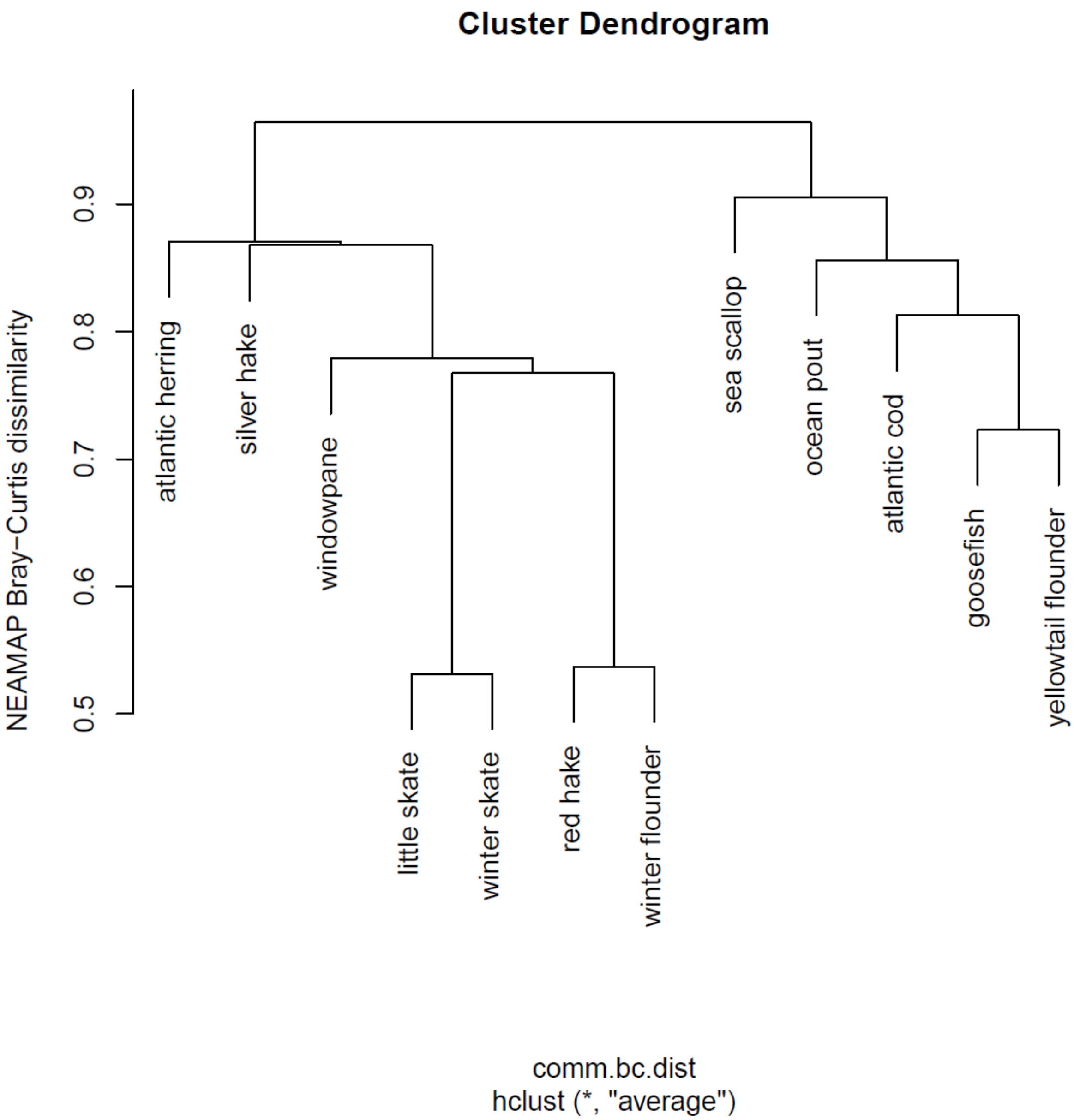


Figure 28. Co-occurrence patterns of 12 focus species in all four trawl surveys in the Southern New England region. NMFS survey only.

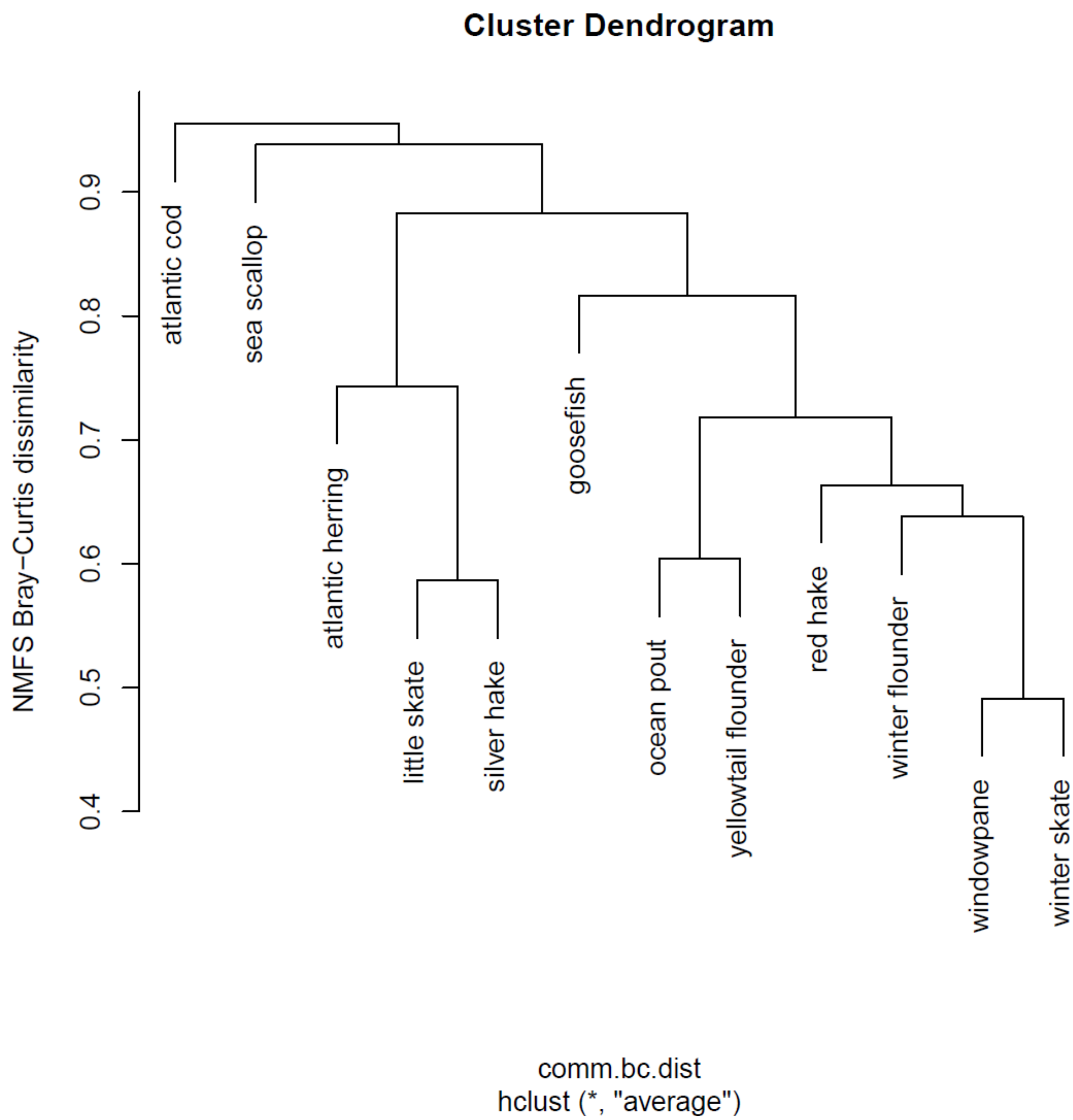
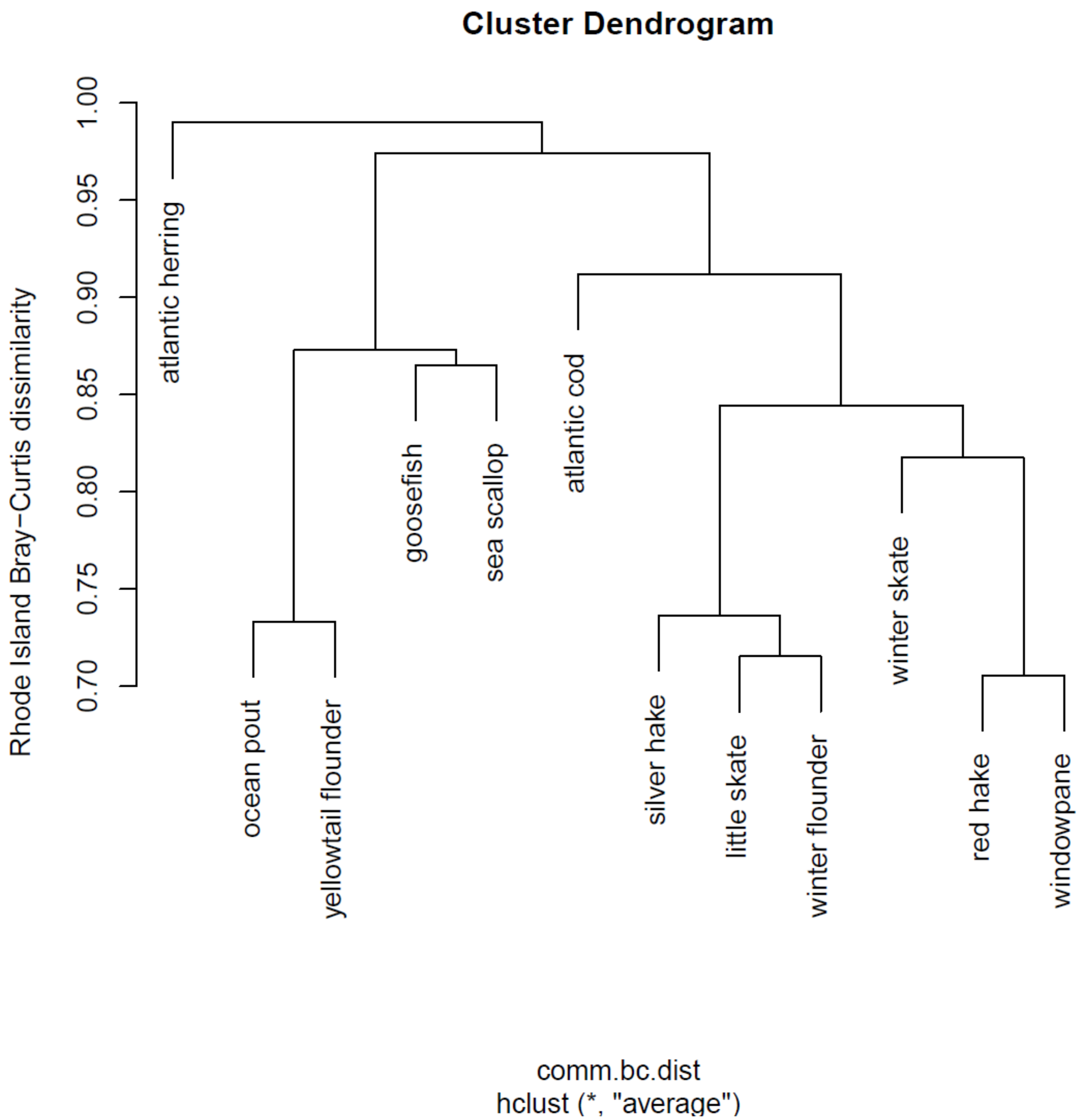


Figure 29. Co-occurrence patterns of 12 focus species in all four trawl surveys in the Southern New England region. RI trawl survey only.



5.3 COD STOCK STRUCTURE AND SPAWNING

The results of the 2020 Atlantic Cod Stock Structure Working Group and the presence of Atlantic cod spawning grounds in the Southern New England region are important factors to consider when developing a HAPC in the region.

5.3.1 Cod spawning

Spawning cod exhibit complex behaviors including male displays, which are accompanied by auditory signals or grunts (Zemeckis, et al. 2019). These behaviors occur in specific locations, and fish exhibit site fidelity, returning to these sites over multiple years (Zemeckis, et al. 2019). Female cod release eggs in batches over a period of one to two months; larger fish are generally more fecund (Kjesbu 1989, Klein MacPhee 2002). The time until hatching is temperature dependent (Pepin, et al. 1997, Geffen, et al. 2006) but is approximately two weeks (Madondo 2013), with a range of 10 to 40 days (MA DMF). In U.S. waters, the time between spawning release and hatch likely varies between one and three weeks (Thompson and Riley 1981). The larval period ranges from several weeks up to five months, and then fish settle to the seabed (Olsen, et al. 2010). Occurrence of adult fish in spawning condition, aggregations of adult fish, and occurrence of male grunts are indicators of spawning, while the presence of eggs and larvae are indicative of recent spawning. Because cod eggs are similar to haddock and witch flounder eggs (Klein MacPhee 2002), and the species often co-occur, larvae are more often used to identify spawning and early life stage habitats (Dean, et al. in review). Cod in Southern New England spawn between late fall and early spring.

Description and criteria of stages of Atlantic cod spawning:

O'Brien, et al. (1993) summarized Atlantic cod maturity stages as shown in Table 7. The Northeast Fisheries Science Center characterizes cod samples from the trawl surveys based on these criteria. Occurrence of ripe, ripe and running, and spent fish in the catch are used as indicators of forthcoming, active, or recently concluded spawning.

Table 7. Description of Atlantic cod maturity stages by sex.

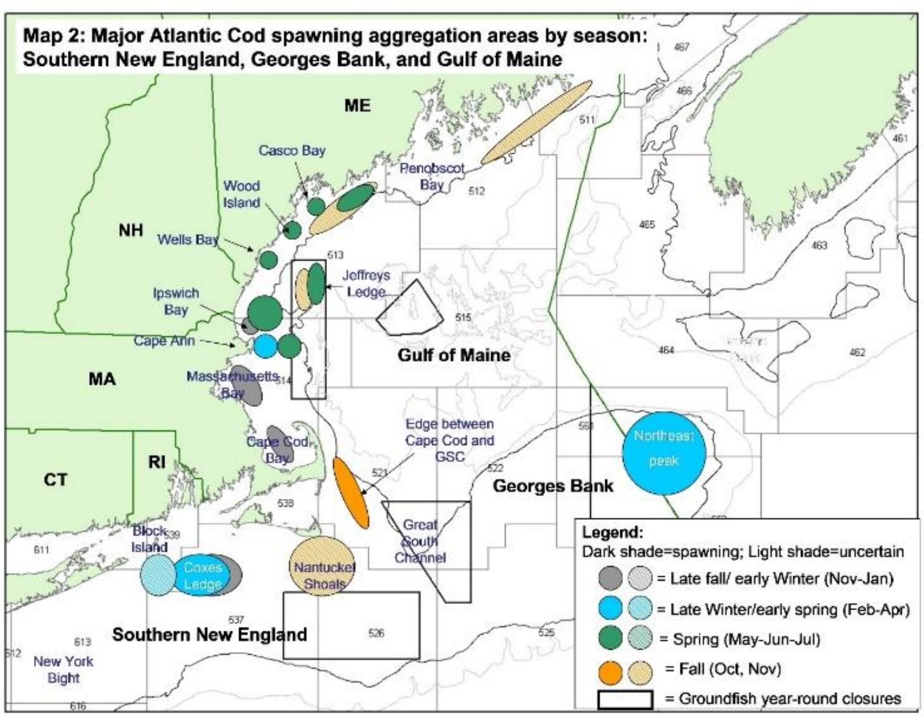
Maturity Stage	**Description of maturity stage by sex**	
	Female	*Male*
Immature	Ovary paired, tube-like, small relative to body cavity; colorless to pink jell-like tissue, no visible eggs; thin transparent outer membrane	Testes small relative to body cavity, colorless to gray and translucent. Testes narrow, lobed and elongated, resembles crimped ribbon.
Developing	Ovaries large, occupying up to 2/3 of the body cavity; blood vessels prominent when present; ovary appears granular as yellow to orange yolked eggs develop. A mix of yolked and hydrated eggs.	Testes large, grey to off-white, firm consistency with very little or no milt present.
Ripe	Ovaries large, may fill entire body cavity; hydrated eggs present. Transparent ovary wall.	Testes larger than 'Developing', chalk white, consistency mostly liquid. Milt flows easily when testes dissected.

Ripe and Running	Eggs flow from vent with little or no pressure to abdomen.	Chalk white milt flows easily from the vent with little or no pressure on abdomen. Once dissected, milt flows easily.
Spent	Ovaries flaccid, sac-like similar in size to ripe ovaries; color red to purple; ovary wall thickened, cloudy and translucent; some hydrated eggs may adhere to ovary wall.	Tested flaccid, may contain residual milt, less robust than 'Ripe'. Edges or other parts of testes starting to turn reddish to brown or grey as milt recedes.
Resting	Ovaries smaller than ripe ovaries, but larger than immature. Interior jell-like, no visible eggs.	Tested shrunken in size relative to 'Ripe'. Color is yellow, brown, or grey with little or no milt.

Southern New England-related literature on Atlantic cod spawning:

Deese (2005) summarized information about cod spawning aggregations to support a broader stock identification study over a study area that included Southern New England, Georges Bank, and the Gulf of Maine. Her report documents fall spawning sites in the Great South Channel and on Nantucket Shoals, as well as late winter and early spring spawning on and west of Cox Ledge. The areas identified are geographically broad (Figure 30). Based on communication with fishermen, spawning activity in Southern New England is highest in late winter into early spring, however, there is some variability within the region. Spawning on Cox Ledge occurs between November and April (with peak levels from November to March), spawning on Nantucket Shoals occurs largely in November, and spawning west of the Great South Channel occurs in the fall, with the area being important for juveniles in the fall and winter.

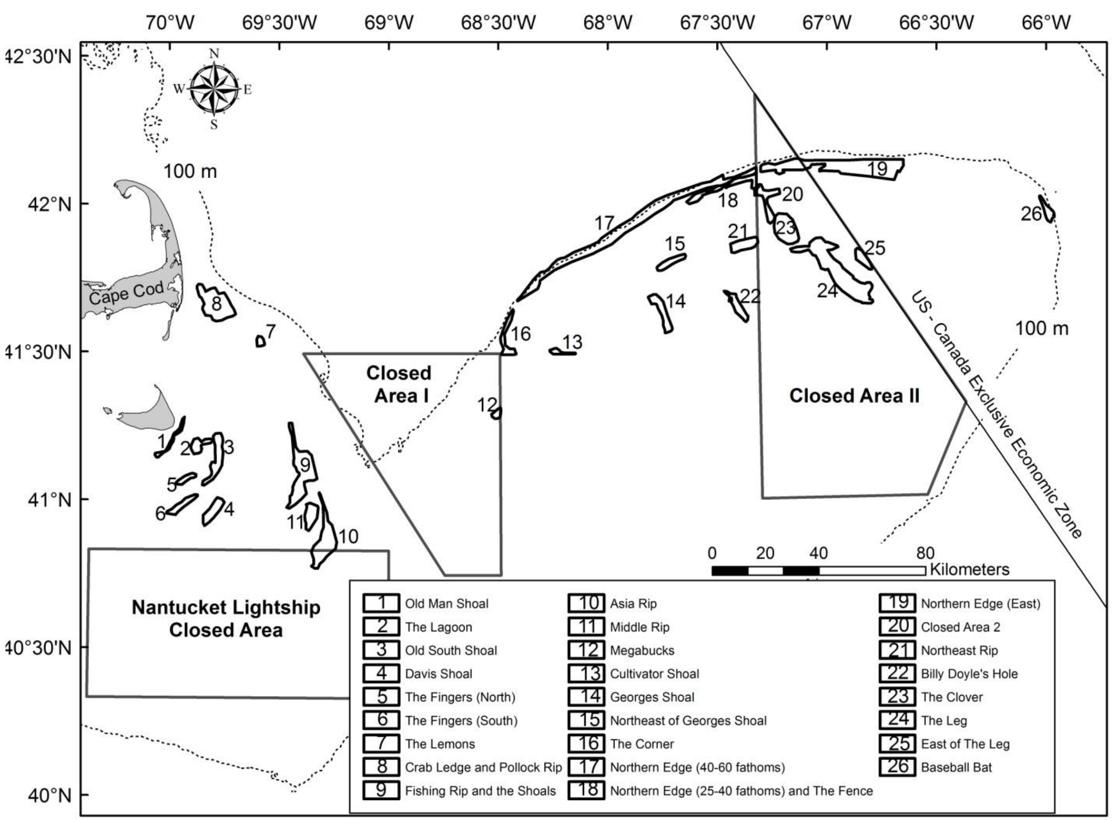
Figure 30. Major Atlantic cod spawning aggregations. Source: Deese 2005.



A subsequent study by DeCelles et. al examined data from historical reports, trawl surveys, fisheries observers, ichthyoplankton surveys, and fishermen's ecological knowledge through surveys to identify cod spawning locations. Their study area encompassed Georges Bank and Nantucket Shoals, the latter of which is at the eastern edge of the Southern New England analysis area defined for this framework. The Cox Ledge spawning areas are outside the scope of the study. The fishermen's ecological knowledge component of the project included 40 interviews with fishermen on where and when cod spawning occurs within the study area. They used a consensus approach combined with fisheries data to discern core spawning grounds. This work is described in a northeast consortium report (DeCelles et al. 2016) and a subsequent publication (DeCelles et al. 2017).

Fishermen identified 84 spawning grounds on Nantucket Shoals and the Great South Channel (some overlapping with each other), the highest number in the study region. There were 9 consensus spawning grounds on Nantucket Shoals independently identified by 3+ fishermen (Figure 31). Spawning activity was associated with specific habitat features in small areas. These sites occurred at depths between 19-38 m. The consensus spawning locations were near shoals, associated with either sandy substrates or complex habitat (rocky hard bottom and gravel substrates) or steep, deep regions. A tenth spawning ground located in the analysis area for this framework action was identified outside of offshore strata 9-25 on Nantucket Shoals. The Nantucket Shoals spawning grounds were used to inform the range of clam and mussel dredge exemption alternatives, including seasonal closures, in the Council's Clam Framework (NEFMC 2019).

Figure 31. Consensus cod spawning grounds that were identified independently by at least three fishermen (DeCelles, et al. 2017).



The timing of spawning activity varied in different regions of Georges Bank. Fishermen identified Nov-Dec as peak spawning on Nantucket Shoals, with notable spawning activity also occurring in October and from January through April. South of Nantucket shoals, cod eggs were abundant in December and January, indicating spawning had occurred in prior weeks. Spawning ended in most regions between March and May. Fishermen noted that some of the differences in spawning location and timing are likely due to separate biological units which do not match the management units. This observation is consistent with the findings of the Atlantic Cod Stock Structure Working Group (see section 5.3.2).

Loerke (2014) examined tagging data to examine population structure of cod in U.S. waters. The Block Island / Cox Ledge spawners were considered to be relatively sedentary, exhibiting limited movement relative to cod in other U.S. regions, and showing no difference in release and recapture locations, on average. Tag release locations from this data set are shown on Figure 32, in relation to the Cox Ledge alternative HAPC boundary (Loehrke 2014, Cadrin, et al. in review; data provided by S. Cadrin, SMAST). Information about fish in spawning condition from each of the number areas is described in Table 8.

Figure 32. Tag release locations from SMAST database. Cod in spawning condition (ripe, ripe and running, or spent) are shown in shades of blue. Other tag releases that were not in spawning condition, or that were not staged, are shown in black.

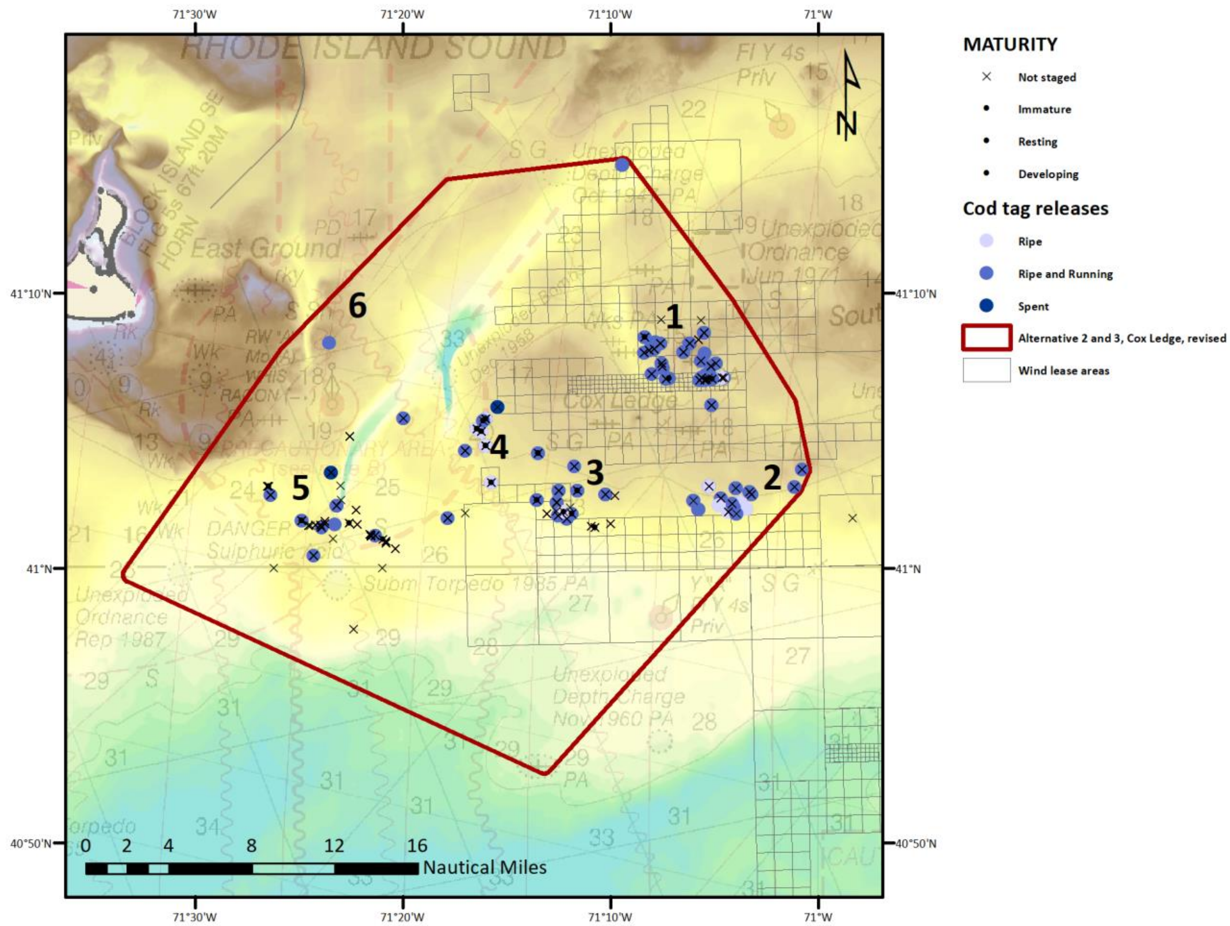


Table 8. Information about tagged cod in spawning condition, including number per site, year tagged, and reproductive stage, and sex. Observations somewhat distant from the numbered sites are not described in the table.

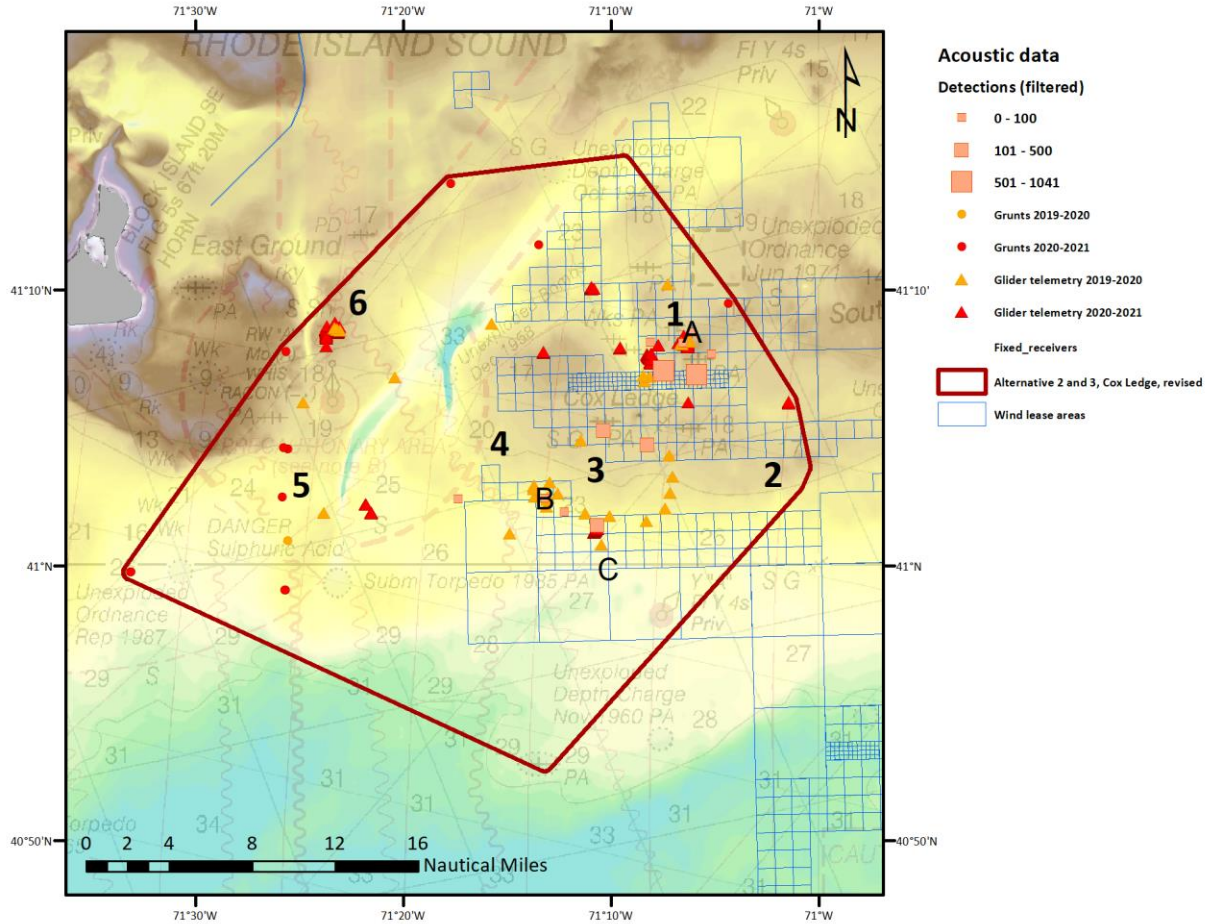
Area 1	12 male, 1 female, all ripe and running, tagged January 2007
Area 2	47 cod, mostly male, mix of ripe and ripe and running, tagged January and February 2007
Area 3	18 cod tagged January and February 2008, 5 cod tagged January and February 2009, 23 cod tagged January 2011; ripe or ripe and running; all male except one
Area 4	175 cod tagged February 2009, February and March 2010, and February 2011; mostly ripe or ripe and running, a few spent; mix of male and female but mostly male.
Area 5	13 cod tagged April 2007, March 2010, March 2011. Mostly ripe or ripe and running males, except two spent females in 2011.
Area 6	Single tagged fish in April 2007, ripe and running male.

Most recently, the Atlantic Cod Stock Structure Working Group considered spawning and early life history information for the species, comparing findings across areas and looking for connections between areas to support stock identification (Dean et al., in review). The study reviewed larval transport studies, bottom trawl data, and ichthyoplankton survey data. A summary of spawning condition data for Southern New England demonstrated that higher proportions of fish are in spawning condition in November, December, and January, but that some fish are still spawning in February and March. Cadrin et al. considered evidence from applied markers, both conventional and data storage tags, to show spatial patterning in cod populations. Using some of the same data as Loerhke (2014) they demonstrated site fidelity and low rates of movement for Southern New England cod. Their analysis of data storage tags indicated that cod in the region occupy a relatively narrow depth range, generally between 40-90 m.

VanHoeck et al. (in review) compared Atlantic cod temporal spawning dynamics within Cox Ledge and Massachusetts Bay using passive acoustic monitoring and acoustic telemetry data. They used both fixed-station and glider-based passive acoustic monitoring to evaluate the occurrence and persistence of cod spawning in space and time at a study site on and around Cox Ledge (Figure) and compared these results to earlier data collected in Massachusetts Bay (see Dean et al., 2014; Zemeckis et al., 2014 a,b, 2017, 2019; and Siceloff and Howell 2013). Grunts were most concentrated between November and December and activity is greatest near the new and full moons. They investigated the relationships between cod sound production (grunting) and environmental cycles (lunar, diel) and found stronger association with lunar and diel cycles in Southern New England vs. in Massachusetts Bay.

VanHoeck et al.'s analysis is part of a recent and still ongoing study that began during the 2019-2020 field season but used earlier acoustic data from 2013-2015 as the basis for the sampling area. One particular site (Site A) had repeated grunts during 2013-15 suggesting an active spawning aggregation, and this location was resampled during 2019-2020 and 2020-2021. During the 2020-2021 field season, the receiver location at Site A differed by 300 m from the earlier sampling, but only one grunt was sampled. Small numbers of grunts occurred at other sites (C and D during 2013; B in 2020). This sampling technique has a small spatial range since cod grunts are somewhat quiet and cod need to be near receiver for grunt detection. Also, cod exhibit diel movements which could affect the likelihood of their sounds being detected by the receiver. Cod that might be spawning on Nantucket Shoals were out of range of the acoustic receivers deployed for this study, however work is ongoing and additional receiver locations to the east of the previous sampling area will be used in future seasons. Detections from 2019-20 and 2020-21 are shown in Figure 33.

Figure 33. Acoustic cod detections. Site D, described in the text, is east of the mapped area and is therefore not shown. Dots and circles represent individuals grunt or tag detections (orange and red for 2019-20 and 2020-21, respectively); squares represent multiple detections at fixed receivers, as shown.



In addition to the Massachusetts Bay and Southern New England studies, similar acoustic techniques have been used to examine spatial and temporal patterns in Atlantic cod habitat use within a wind farm in the Belgian part of the North Sea (Reubens et al. 2013). The 18 km^2 wind farm was located on a sandbank 27 km offshore in 18-24 meters of water, with a mix of gravity based and jacket foundations, although this sampling occurred around the gravity-based foundations. Cod were present near artificial reefs during summer and autumn, and largely absent during the winter months. Fish exhibited strong residency (meaning that they were detected repeatedly at the same sites), and they often aggregated near artificial hard substrates (meaning the telemetry data placed them in close proximity to the center of the wind artificial reef, generally within 50 m). The authors suggested that the patterns of residency and site fidelity at the wind farm, combined with the time of year cod were most prevalent at the site, indicated that they were using the area as a feeding ground, vs. a spawning ground, noting that the spawning sites for these fish are thought to be outside the Belgian portion of the North Se

A survey completed at and near the South Fork Wind Farm site during the winters of 2018 and 2018-2019 captured cod in spawning condition on and around Cox Ledge (Balouskus, et al. 2019, Gervelis and Carey 2020). Cod catch locations from this data set are shown on Figure 34 in relation to the Cox Ledge alternative HAPC boundary (data were taken directly from survey reports). Information about fish in spawning condition from each of the numbered areas is described in Table 9.

Figure 34. Cod catches in the South Fork Wind Farm survey. Cod in spawning condition (ripe, ripe and running, or spent) are shown in shades of green. Other catches that were not in spawning condition, or that were not staged, are shown in black.

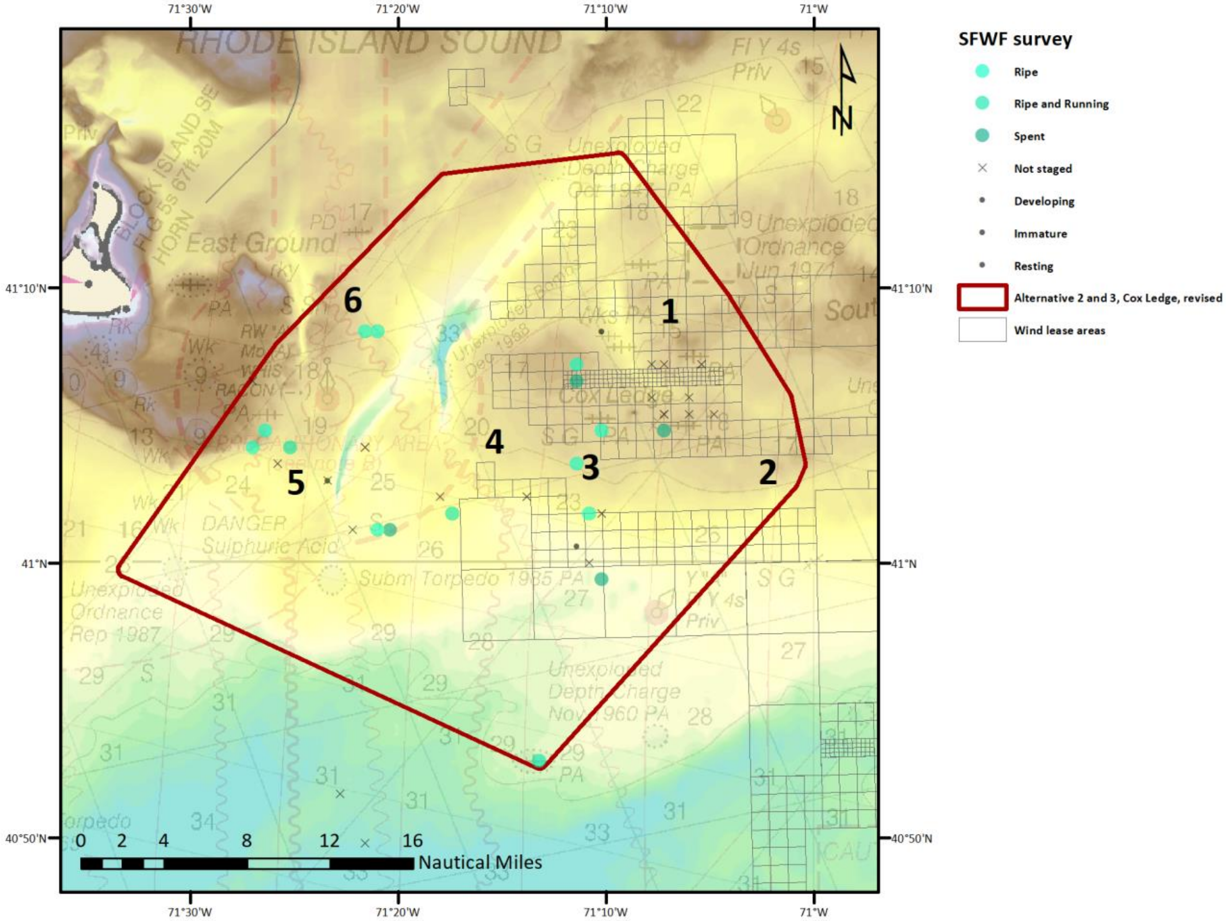


Table 9. Information about cod caught in spawning condition (n=53), including number per site, year tagged, and reproductive stage, and sex. Source: South Fork Wind Farm Survey. Observations somewhat distant from the numbered sites are not described in the table, except for fish caught at the southernmost point of the HAPC boundary.

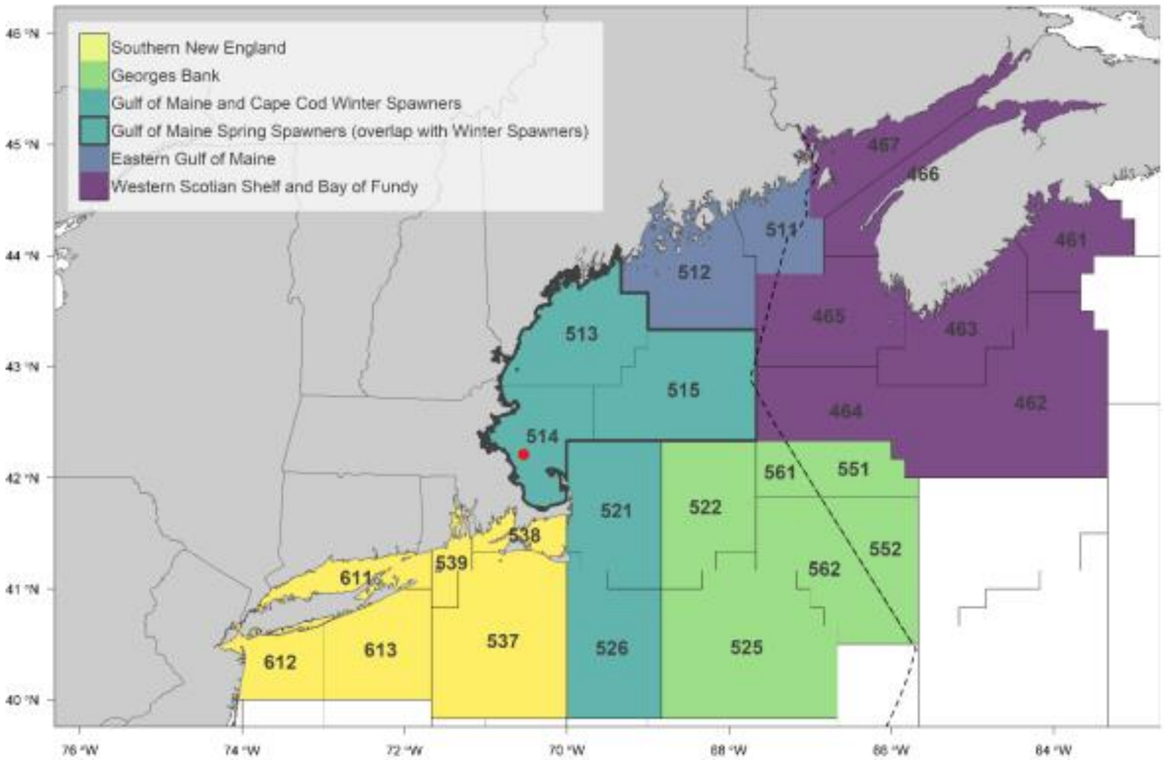
Area 1	No spawning condition fish at site.
Area 2	No spawning condition fish at site.
Area 3	21 fish, December 2018, January and March 2019. Mix of males and females, ripe, ripe and running, and spent.
Area 4	No spawning condition fish at site.
Area 5	6 fish, December 2018 and February 2019. 5 ripe or ripe and running males, 1 ripe female.
Area 6	5 fish, March 2019. Three spent females, 1 ripe female, one ripe male.
Southernmost point	8 fish, February 2019. 7 males mostly ripe and running, one spent female.

5.3.2 Cod stock structure

The 2020 Atlantic Cod Stock Structure Working Group concluded that there are five distinct biological cod stocks in U.S. and adjacent Canadian waters. To reach this conclusion, the working group studied variation in growth rates, morphology, spawning and early life history, genetic markers, and adult cod movement between regions, and considered fishermen's ecological knowledge. The synthesis chapter, Mc Bride et al. (in review) concludes that there are mismatches between current management units, i.e., Gulf of Maine and Georges Bank, and biological stock structure.

The five populations include (1) Southern New England, (2) Georges Bank, (3) GOM and Cape Cod winter spawners combined with GOM spring spawners, (4) Eastern Gulf of Maine, and (5) Western Scotian Shelf and Bay of Fundy (Figure 35). The rationale for a separate Southern New England stock is based on multiple factors. SNE cod exhibit genetic differentiation and have localized movements and settlement. The analysis indicated major connections within Southern New England and between the region and Cape Cod, and minor connections between Southern New England and both Georges Bank and the Gulf of Maine. Southern New England is somewhat data poor compared to other regions, for example there is less information on the sources of cod larvae and juveniles (i.e., no dispersal modeling studies on the spawning and settlement areas, thus, it uncertain if the area has self-recruitment or not). In addition, additional genetic information is needed to determine stock identity.

Figure 35. Proposed biological stock structure of Atlantic cod in NAFO division 5 and adjacent division 4X. Source: Atlantic Cod Stock Structure Working Group 2020.



5.4 OFFSHORE DEVELOPMENT ACTIVITIES AND POTENTIAL IMPACTS TO HABITAT

There are 9 active renewable energy leases in Southern New England, each of which could support multiple projects (Figure 36). Two projects are already permitted (Vineyard Wind I and South Fork), while the remaining are either undergoing environmental review, site assessment, or the development of construction and operations plans. At least two projects seem to overlap the cod spawning areas including South Fork Wind and Sunrise Wind. See Figure 37 and Figure 38 below from the Construction and Operations Plans with project footprints, turbine locations, and cable locations.

Impacts associated with wind development include habitat alterations and conversion associated with installation of turbines, cables, and scour protection materials, anthropogenic acoustic disturbance that hampers fish communication, water entrainment and hydrodynamic changes, and changes to electromagnetic fields along cable corridors (see section 5.4.1). These and other issues are identified as issues of concern in the NEFMC Offshore Wind Energy Policy (December 2021). Fishery species will likely be affected by and need additional protection from these impacts. Approaches to avoiding, minimizing, and mitigating impacts are described in the Council's policy and in comment letters and in EFH consultations on individual projects. These approaches are summarized in section 5.4.2

5.4.1 Impact producing factors from offshore development

This section is a selected literature review summarizing the impacts of offshore development on fishes and habitats, however the literature on this topic is extensive and growing rapidly, and the information included in this section is not exhaustive. Additional impacts of concern are noted within the NEFMC Offshore Wind Energy Policy, in NEFMC/MAFMC and NOAA Fisheries comment letters to BOEM on individual offshore wind projects, and within COPs and NEPA documents prepared for individual offshore development projects, and several other additional resources.

Acoustics

Noise can impact fish physiology or behavior, and effects may be cumulative over time due to multiple intermittent and continuous sound sources. This summary focuses on behavioral effects of noise on fishes. Noise generated from offshore development is thought to disrupt the ability of fish to forage efficiently, evade predators, reproduce, adapt, and shoal cohesively (Herbert-Read, et al. 2017, Mooney, et al. 2020; Siddagangaiah, et al. 2021; Stober and Thomsen 2021). Generally, noise that is viewed as a threat could alter an individual's behavior within a group, especially if the noise masks auditory communication, causes distraction, and induces stress, thereby reducing overall fitness (Herbert-Read, et al. 2017, Mooney, et al. 2020). Installation of foundations through pile-driving and dredging is one of the noisiest construction activities (Mooney, et al. 2020; Siddagangaiah, et al. 2021). One study found that fish recovered more quickly once continuous noise stops while intermittent, irregular, and intense noise is thought to be more disruptive (Neo, et al. 2014), causing physical injury (Mooney, et al. 2020). Based on available data, mid-frequency active sonar (which is typically used to inform likely effects of other seismic source data) is not known to change the behavior of adult herring (Doksæter, et al. 2012). Construction noise frequency range overlaps with the range of several species across multiple habitat types including cod, salmon, black sea bass, flatfish, and squid (Chapman and Sand, 1974; Hawkins and Chapman, 1975; Mooney et al., 2010; Popper et al., 2019). Cod, haddock, and other species' communications are also likely disrupted and masked by ship operation noise (Stanley, et al. 2017). The intensity and duration of noise attenuated through the water vary by the development stage (seismic survey, construction, operation, decommissioning) and the size of the turbines, thus, impacts to fish and invertebrates vary accordingly. Additional research is needed to evaluate the effects of offshore wind noise on fish and invertebrate species. Because few wind farms have been built in the U.S. and none have turbines of the proposed size for recently permitted projects and projects currently under review (12 MW and up), the expected and specific impacts by taxa largely remain conjecture based on data available in other contexts (Popper and Hawkins 2019; Popper et al. 2020; Mooney, et al. 2020; Stöber and Thomsen 2021). For example, van der Knaap (2022) found that resident Atlantic cod in the North Sea did not relocate out of the study area during pile driving associated with construction of a new wind farm (adjacent to an existing wind farm). Cod moved significantly closer to the closest scour-bed of an existing turbine during pile driving, perhaps for a hiding place, and also moved away from the sound source. Pile driving and seismic surveys had different effects on cod within the same wind farm study area, most likely due to the differences in sound exposure between the two disturbances/activities (van der Knaap, et al. 2021). It is unclear if, and to what extent, these impacts are expected during offshore wind development in Southern New England.

Because cod are shown to have high spawning site fidelity, if NEFMC delineates a separate Southern New England stock, there could be population level effects in the reasonably foreseeable future from impact pile driving noise that can result in injury up to 8.4 mi for large fish and 10.1 mi for small fish (South Fork Construction and Operations Plan). This magnitude of sound attenuation impact from wind farm construction noise is consistent with the >40,000-foot impact area stated in the South Fork EFH Assessment and the 8-mile impact radius from each monopile foundation stated in the South Fork DEIS.

Habitat conversion and losses

Construction, operations, and decommissioning of offshore wind development are likely to cause physical habitat conversions from soft-bottom benthic habitat to hard-bottom habitat in the immediate vicinity of the structures (e.g., steel piles, rock scour protection, etc.), directly impacting a variety of fishery species. Disturbance, alteration, and loss of benthic habitat (both value and function) are anticipated impacts from cable and turbine installation. Turbines and substation foundations create substrates for fouling organisms and artificial reefs which replace existing habitat types and could displace other species which prefer soft sediments (e.g., flatfish, bivalves) (Wilhelmsson, et al. 2006; Reubens, et al. 2013). Specific to Southern New England, loss of complex habitat through cable corridor and/or turbine installation would have detrimental effects on cod spawning and survival of juvenile cod, for example (Peer Review of the Atlantic Cod Stock Structure Working Group Report 2020). Other species that rely on complex habitat (e.g., American lobster, juvenile Atlantic cod, longfin squid; Carey, et al. 2020) for shelter especially during their early life history, for refuge from water flow and predation, and for feeding opportunities will also be impacted from loss of complex habitat.

Reef effects

Short and long-term impacts of wind facility operations are likely to cause a "reef effect", creating artificial reefs throughout the project area, attracting certain fishery species (Wilhelmsson, et al. 2006; Reubens, et al. 2013; Love, et al. 2016). The benefits of this effect will vary by target species. The negligible to minor beneficial impact from the increased production is species dependent as it is likely that only certain species will colonize on or aggregate near the reef (Langhamer 2012), and these may or may not be the species of greatest value to anglers. In Southern New England, black sea bass is an example of a species that is likely to colonize on or aggregate near the reef (NOAA 2020).

Hydrodynamic effects

Through modeling work, the physical presence of turbines has been estimated to alter the near-surface and near-bottom temperatures, and thus, habitat conditions for marine species, as well as juvenile transport of commercially important species like sea scallops (Chen, et al. 2021). Vertical mixing is projected to increase within wind farms along with local upwelling because of the interactions of foundations with tidal and wind-driven currents (Floeter, et al. 2017). It is unclear whether the degree of hydrodynamic change is a result of the presence of turbine foundations or natural variability. Further research is also needed to understand the aggregate effects of more than one wind farm (Floeter, et al. 2017). Based on other ongoing research efforts, an individual project has the potential to materially affect oceanographic and hydrodynamic conditions, with an individual project also contributing to cumulative effects from development of several wind farms on a regional scale (Chen, et al. 2021). Potential impacts to the Mid-Atlantic Cold Pool and resulting impacts on fishery species are of concern as well. This is an area of ongoing research (Kohut and Brodie 2020).

Water entrainment

Water entrainment occurs during jet plowing as cables are installed and also occurs on an ongoing basis at the AC/DC (alternating current/direct current) conversion station for the purposes of cooling the DC cable. Entrainment at the conversion station could have substantial and sustained impacts on important forage fish species like sand lance and on ichthyoplankton and zooplankton, including fish eggs and larval stage fish and invertebrates (Wenger, et al. 2017). In Southern New England, cooling systems are being considered for projects that have AC/DC conversion stations, namely Sunrise Wind and Revolution Wind. Direct current cables can carry more power with fewer losses and thus tend to be used over longer transmission distances of roughly 100 km or more (Tetra Tech 2021). Effects included but are not limited to the loss of zooplankton and fish eggs/larvae due to water entrainment and associated temperature differentials from discharge waters, which may impact both the entrained species and their predators (VHB Revolution Wind COP Volume 1 2021; Stantec Sunrise Wind COP 2021).

Electromagnetic field (EMF)

Export and inter-array cables are likely to cause electromagnetic field emissions which may alter fishery species' distributions, migrations, behaviors, and predator-prey relationships for some demersal and pelagic fish and shellfish species (Greenfin Studios 2017). Elasmobranchs, namely skates and spiny dogfish, which are present in Southern New England and managed by NEFMC (and jointly with

MAFMC for spiny dogfish), exhibited a strong behavioral response to EMF in a field study conducted by University of Rhode Island and BOEM (Hutchinson, et al. 2018).

5.4.2 Mitigation approaches for offshore wind development impacts

A select list of approaches to mitigate the impacts of offshore wind development is provided below. Note the mitigation measures included in this section are not exhaustive. Additional approaches are included within the NEFMC Offshore Wind Energy Policy, NEFMC/MAFMC and NOAA Fisheries comment letters to BOEM on individual offshore wind projects, individual offshore development project documents, and several other additional resources.

- Avoid construction in spawning areas – existence of a permanent structure in a spawning area would impact that area and could make it unsuitable for spawning.
- Establish a monitoring plan for species of concern with aggregations that are indicative of spawning behavior during planning, construction, and operations. A monitoring plan should also be in place during boulder relocation, pre-cut trenching, cable-crossing installation, cable lay and burial and foundation site prep/scour protection.
    - Include detection thresholds of spawning aggregations with adaptive management measures to restrict development activities if needed.
- Develop and implement a Passive Acoustic Monitoring plan (Van Parijs, et al. 2021) to detect species within wind energy areas.
    - The plan should include proposed equipment, deployment locations, detection review methodology and other procedures. This should be implemented in coordination with other acoustic monitoring efforts within the lease and wind energy area areas and other ocean-user stakeholders.
- Time of year restrictions on construction could be used to limit noise which could mask cod and other soniferous species' communication.
- Use noise dampening technology during construction and operations of offshore wind development.
- Transmission cables, wind turbines, electrical services platforms, or other structures should not be placed in areas with complex habitats.
- Evaluate the difference in impacts between closed and open loop systems to mitigate water entrainment impacts.
- Export and inter-array cables should be buried to an adequate depth to minimize effects of heat and electromagnetic field emissions.

Figure 36. Southern New England wind lease areas, and cable routes for permitted projects (South Fork, brown, Vineyard Wind 1, green). Leases from left to right are Revolution Wind, South Fork Wind, Sunrise Wind, Bay State Wind, Vineyard 2, Vineyard 1, Equinor, Shell, Vineyard Wind.

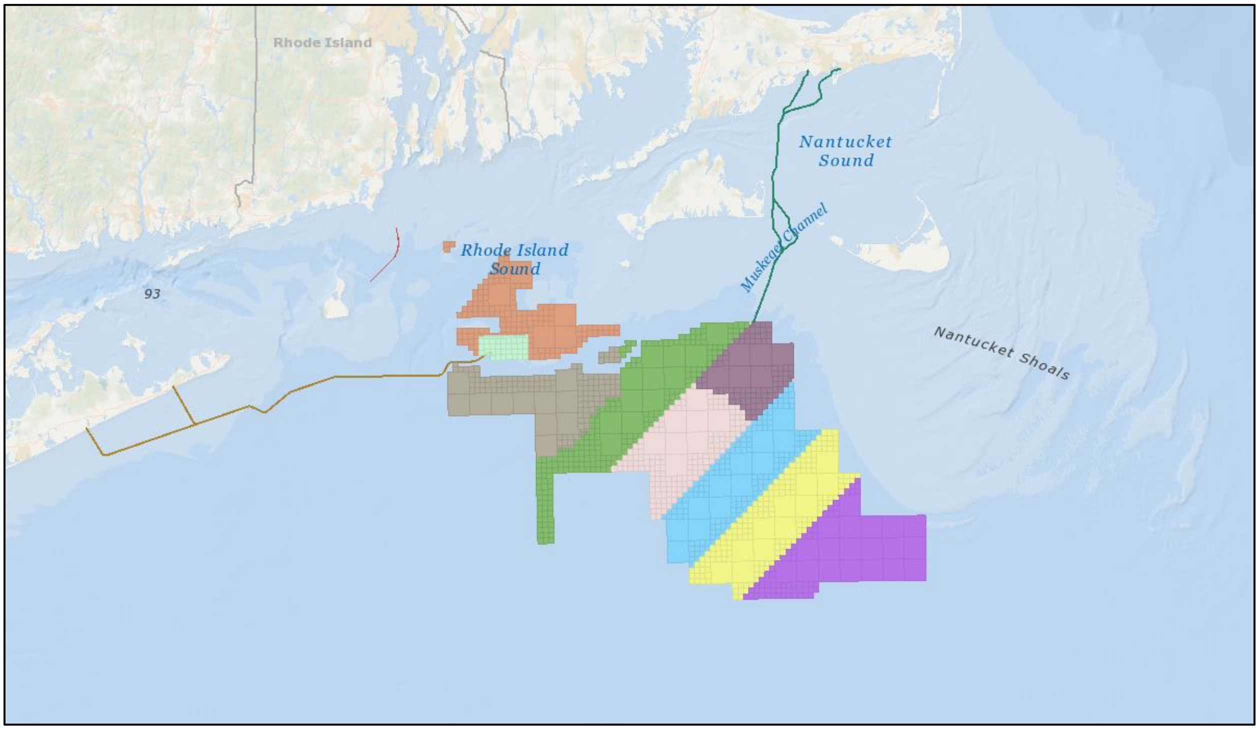


Figure 37. South Fork Wind Farm work area, turbine locations, and inter array cable routes. From Construction and Operations Plan.

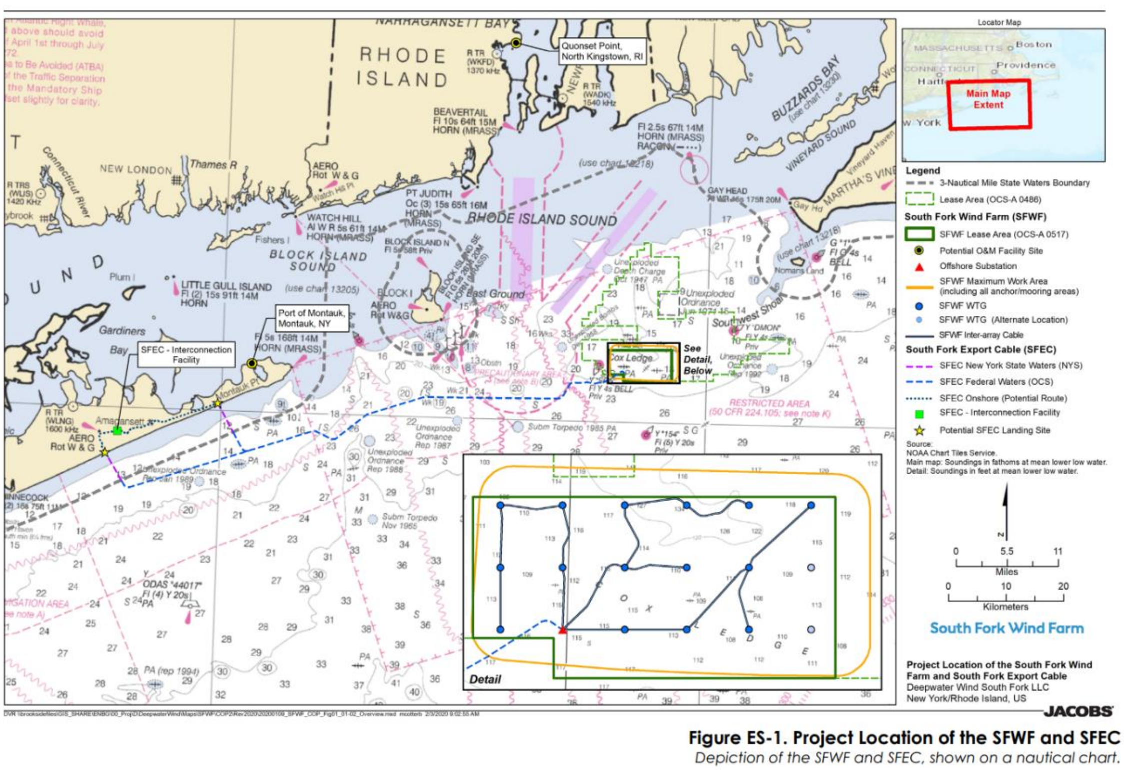
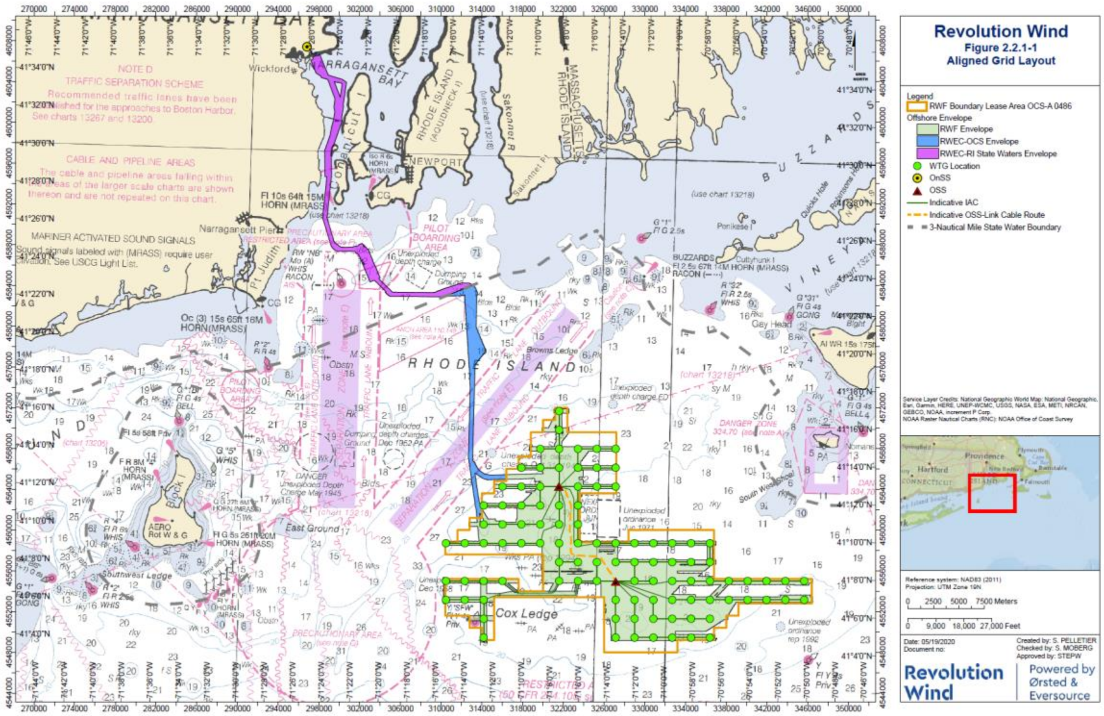


Figure 38. Revolution Wind potential turbine locations and inter array cable routes. From Construction and Operations Plan.



5.5 FISHERY DESCRIPTIONS

5.5.1 Northeast multispecies – large mesh

The Northeast Multispecies (Groundfish) Fishery Management Plan (FMP) specifies the management measures for thirteen groundfish species, both target (cod, haddock, yellowtail flounder, pollock, American plaice, witch flounder, white hake, winter flounder, redfish and Atlantic halibut) and non-target (windowpane flounder, ocean pout, and Atlantic wolffish) species off the New England and Mid-Atlantic coasts. Some of these species (cod, haddock, yellowtail flounder, winter flounder, and windowpane flounder) are further sub-divided into individual stocks that are attributed to different geographic areas. Two stocks, Georges Bank (GB) cod and GB haddock, also have management units. The FMP therefore consists of 20 stocks and 2 management units. Commercial and recreational fisheries catch these species.

The New England Fishery Management Council (NEFMC or Council) makes proposals, through various management actions, to the National Marine Fisheries Service (NMFS) on the management of the fishery. As such, the FMP has been updated through a series of amendments and framework adjustments. Amendment 16 (A16), which became effective in 2010, adopted a broad suite of management measures to achieve the fishing mortality targets necessary to rebuild overfished stocks and meet other requirements of the Magnuson-Stevens Fishery Conservation and Management Act (MSA). Amendment 16 greatly expanded the sector management program and adopted a process for setting annual catch limits (ACLs) that requires catch levels to be set in biennial specifications packages. Amendment 17, effective in 2011, allows for NOAA-sponsored state-operated permit banks to function within the structure of A16. Amendment 18, effective in 2017, addresses fleet diversity and accumulation limits. Seventeen framework adjustments have updated the measures in A16. Amendment 23, which would improve monitoring in the commercial groundfish fishery, is under review by NMFS. NMFS announced a target at-sea monitoring coverage rate of 99% for all sector vessels for fishing year 2022 (May 1, 2022- April 30, 2023). Framework 63, specifications and management measures, is also under review by NMFS.

A16 made major changes to the FMP. The management action adopted a system of ACLs and accountability measures (AMs) that are designed to ensure catches remain below desired targets for each stock in the management complex. AMs are management controls to prevent ACLs from being exceeded and to correct or mitigate overages of the ACL if they occur. AMs should address and minimize both the frequency and magnitude of overages and correct the problems that caused the overages in as short a time as possible. AMs can be either in season AMs or AMs for when the ACL is exceeded.

Sectors are allocated subdivisions of ACLs called Annual Catch Entitlements (ACE) based on each sector's collective catch history. Sectors receive ACE for nine of 13 groundfish species (14 stocks + quotas for Eastern US/Canada cod and haddock; 16 ACEs) in the FMP and are exempt from many of the effort controls previously used to manage the fishery. Each sector establishes its own rules for using its allocations. As of FY2020, 56% of the limited access groundfish permitted vessels are in a sector, and 44% are in the common pool. Common pool vessels act independently of one another, with each vessel constrained by the number of DAS it can fish, by trip limits, and by all the time and area closures. These restrictions help ensure that the groundfish catch of common pool vessels does not exceed the common pool's portion of the commercial groundfish sub- ACL for all stocks (about 1% in recent fishing years) before the end of the fishing year. Relative to the focal species under consideration in this action, there is no directed commercial fishery for ocean pout or windowpane flounder, and possession is currently prohibited.

The recreational fishery includes private anglers, party boat operators, and charter vessel operators. Several groundfish stocks are targeted by the recreational fishery, with some more than others, including GB cod, Gulf of Maine (GOM) cod, GB haddock, GOM haddock, GOM winter flounder, Southern New England/Mid Atlantic (SNE/MA) winter flounder, pollock and redfish. Wolffish was occasionally caught in the past. Relative to the focal species under consideration in this action, like the commercial fishery possession is prohibited for ocean pout or windowpane flounder. Winter flounder and yellowtail flounder have minimum size limits, 12 in and 13 in, respectively. There is a recreational cod fishery whereby private anglers and party/charter anglers are allowed to catch up to 10 fish per day with a minimum size of 21 inches outside of the Gulf of Maine Regulated Mesh Area (NOAA 2021). Based on the NMFS Socioeconomics Impacts of Atlantic Offshore Wind Development data, cod is one of the most frequently kept species kept on recreational party/charter trips in several of the SNE wind energy areas. The Council's proposal in FW63 if approved by NMFS adjusts recreational cod measures to further promote GB cod rebuilding and could be in place as soon as May 1, 2022 to be as follows:

Slot Limit- The minimum size for GB cod would be 22 inches (55.88 cm.) and the maximum size would 28 inches (71.12 cm), total length for the recreational fishery (private, party, and charter)

Possession Limit- Party, charter, and private vessels in the recreational fishery would be permitted to land 5 legal sized GB cod per angler, per day.

Season- Party, charter, and private vessels in the recreational fishery would be prohibited from retaining GB cod from May 1 to July 31. No possession would be in place during this time.

5.5.2 Northeast multispecies – small mesh

The small-mesh multispecies fishery (i.e., whiting fishery) in the Greater Atlantic Region operates from Maine to Cape Hatteras, North Carolina; from inshore to offshore waters on the edge of the continental shelf. The primary target species in the whiting fishery are Northern silver hake and Southern whiting. Recent NEFMC actions including Framework 62 rebuilding program for the southern red hake stock (NEFMC 2020) and draft 2021-2023 Whiting specifications (NEFMC 2021) provide additional details on the fishery. For the most part, the gear requirements for the small-mesh multispecies fishery are determined by the exemption or regulated mesh area being fished, including use of raised footrope trawl. Annual whiting (Northern silver hake and Southern whiting) landings have generally declined over time, especially from 2014 - 2019 (NEFMC 2020). Annual red hake landings have varied over time but have generally declined in both stock areas in the past few years while discards for both have increased since 2013 (NEFMC 2020).

5.5.3 Monkfish

Monkfish are harvested for their livers and the tender meat in their tails. During the early 1990s, fishermen and dealers in the monkfish fishery approached both the New England and Mid-Atlantic Councils with concerns about the increasing amount of small fish being landed, the increasing frequency of gear conflicts between monkfish vessels and those in other fisheries, and the expanding directed trawl fishery. In response, the Councils developed a joint FMP that was implemented in 1999. Since the implementation of the FMP, vessels are more commonly landing large, whole monkfish for export to Asian markets.

According to 2007-2012 vessel trip reports, 47% of monkfish landings were made using gillnets, with most of the remainder (45%) landed by otter trawls (percentages based on data from the Regional Office's Analytical and Program Support Division). Scallop dredges also catch monkfish, but in much smaller amounts. No other gear types account for more than trace landings of monkfish, and there is no recreational component to the fishery. Revenues have generally increased since the mid-1980s, peaking in 1999 and 2000, before declining through 2010. Monkfish revenues in 2012 are about equal to those observed in the early to mid-1990s.

During 2012 in the Gulf of Maine, 87.5% of monkfish landings on trips targeting monkfish used trawls. Most monkfish fishery landings from trips in the NFMA since 1994 also used trawls. Eight percent of landings on trips targeting monkfish in the Gulf of Maine used sink gillnet gear in 2012, a proportion that declined slowly since 1994. Nearly all of the observed monkfish fishing on Georges Bank is conducted with trawls, but there are a few observed gillnet trips on Georges Bank. During 2012, 99.9% of monkfish landings on trips targeting monkfish came from vessels using trawls. Inshore gillnetting for monkfish is conducted more frequently in the southern New England region than in the Gulf of Maine or on Georges Bank. Vessels using trawls typically target monkfish along the continental shelf edge, next to canyons and in deeper water than vessels fish with gillnets. Still, 59.7% of monkfish landings in 2012 were from vessels using trawls and 40.3% were from vessels using gillnets.

5.5.4 Skate complex

The Northeast skate complex fishery in the Greater Atlantic Region includes seven skate species and operates from Maine to Cape Hatteras, North Carolina; from inshore to offshore waters on the edge of the continental shelf. The primary target species in the skate fishery are winter and little skates. Winter and barndoor skates are harvested for their wings for human consumption, often incidental to effort in other fisheries for groundfish, monkfish, and scallops. While thorny skates are large enough to harvest for the wing market, possession has been prohibited since 2003 due to their status. Vessels landing for the wing market either target skates on Georges Bank, the Great South Channel, or west of the Nantucket Lightship area in Southern New England. Vessels landing for the wing market also target skates in the western Gulf of Maine, primarily using trawl gear. Vessels using gillnets often fish east of Cape Cod.

Little skates and juvenile winter skates are harvested as bait for lobster and other fisheries. Bait skate is primarily landed by trawlers, often as a secondary species while targeting monkfish or groundfish. Most of the bait fishery occurs in New England waters. The directed bait fishery by Rhode Island vessels occurs primarily in federal waters from the Rhode Island/Connecticut/New York state waters boundary east to the waters south of Martha's Vineyard and Nantucket out to approximately 69° W. Other ports that participate in the bait fishery to some extent include ports in southern Massachusetts, Long Island, and Connecticut. Recent NEFMC actions including Framework 8 (NEFMC 2020) provide additional details on the fishery.

5.5.5 Atlantic sea scallop

During the fishing years 2009-2018, scallop landings ranged from about 32 to 60 million pounds. In 2018, the total scallop landing from all permit categories increased to about 59.8 million pounds, i.e., a 12.7 percent increase from 2017 landings. Limited access (LA) vessels are responsible for the majority of the scallop landings. In 2017, the LA vessels landed about 50.37 million pounds of scallops, increasing to about 56.76 million pounds in 2018.

Landings by the general category vessels declined after 2009 as a result of Amendment 11 that restricts TAC for the limited access general category (LAGC) fishery to 5.5% of the total ACL. The landings by LAGC fishery (IFQ, NGOM and incidental permits) have also slightly increased in 2018 to about 3.03 million pounds compared to about 2.7 million pounds in 2017.

The bulk of landings come from Georges Bank and the Mid-Atlantic Bight, with additional effort in the Gulf of Maine. Scallops are mostly caught with dredges, although a very small number of vessels in the Mid-Atlantic use trawls.

5.5.6 Atlantic herring

The U.S. Atlantic Herring fishery occurs over the Mid-Atlantic shelf region from Cape Hatteras, North Carolina to Maine, including an active fishery in the inshore Gulf of Maine and seasonally on Georges Bank. Almost all herring are caught for commercial purposes, although some herring are caught incidentally in recreational fisheries for Atlantic mackerel and silver hake. Commercially caught herring are primarily used as bait in the lobster or tuna fisheries, or as a food fish for the export market.

The Atlantic herring winter fishery is generally prosecuted south of New England in Management Area 2 during the winter (January-April), and oftentimes as part of the directed mackerel fishery. There is significant overlap between the herring and mackerel fisheries in Area 2 and in Area 3 during the winter months. The herring summer fishery (May-August) is generally prosecuted throughout the Gulf of Maine in Areas 1A, 1B and in Area 3 (Georges Bank) as fish are available. Restrictions in Area 1A have pushed the fishery in the inshore Gulf of Maine to later months (late summer).

Atlantic herring vessels fish with purse seines, or single or paired midwater trawls, with the midwater pair trawl fleet harvesting most landings from 2008 to 2011 (65% according to July 2013 specifications document). Some herring vessels use multiple gear types during the fishing year. Single and pair trawl vessels generally fish in all areas (October-December in Area 1A). The purse seine fleet fishes in the inshore Gulf of Maine (Area 1A and, to a lesser extent, Area 1B) and in Area 2. The single midwater trawl has been most active in Area 3. Small-mesh bottom trawl vessels represented 4% of herring landings over the time series; other gear types (e.g., pots, traps, shrimp trawls, hand lines) comprise less than 1% of the fishery.

6.0 FISHERY IMPACTS OF ALTERNATIVES

HAPCs are designated subsets of essential fish habitat that receive additional attention from Fishery Management Councils and NOAA Fisheries when commenting on Federal and state projects. Offshore wind development is a specific impact of concern relative to these locations and species, however, this additional conservation focus will also be applied to other offshore development, as well as during development of other federal actions, including fishery management actions. The HAPC designation will support the EFH consultation process which provides non-binding conservation recommendations intended to avoid, minimize, and mitigate the impacts of projects on EFH.

Administratively, HAPC designations are non-regulatory. It is important to note that HAPCs do not need to be designated for the Council to take action to minimize the adverse impacts of fishing on EFH, and that designation of an area as an HAPC does not automatically mean that fishery management measures such as gear restrictions are needed to protect EFH within the HAPC. Also, the NEFMC uses Habitat Management Areas (HMAs) to implement fishing restrictions that are intended to minimize the adverse effects of fishing on EFH. Sometimes HAPCs and HMAs overlap spatially, either fully or partially such that portions of HAPCs are often subject to HMA-based gear restrictions.

Regarding the HAPC designations considered here, direct effects (positive or negative) are not expected for fishery species or the fishing industry. For species that are important to the Council, there are likely to be indirect positive effects in the short and long term based on conservation recommendations adopted for offshore development projects through the EFH consultation process. It is not possible to estimate the magnitude of positive impact the HAPC designation(s) will have on the adoption of these conservation recommendations. Absent additional HAPC designations for SNE, EFH and the existing inshore juvenile cod HAPC will continue to be considered as the foundation for consultation process. The scientific information used to support the HAPC designations considered here can also be used by the Council and NOAA Fisheries when consulting on projects.

Offshore development can affect fishery species in many ways (see section 5.4). Conservation measures are designed to avoid, minimize, and mitigate these effects. For example, offshore development is expected to cause habitat conversion, where natural soft bottom and complex habitats will be converted into artificial hard bottom at the turbine and substation locations. Specific construction locations can be removed or adjusted (microsited) to avoid impacts to habitats of specific concern. Construction and operational noise can alter acoustic habitats and cause behavioral and communication problems for fishes. Noise-dampening installation techniques such as bubble curtains and time of year restrictions may be recommended to reduce noise and/or minimize noise during sensitive time periods. Monitoring activities may also be recommended as a means to better understand the impacts of development. Monitoring could be used to detect presence of sensitive organisms and pause construction, or to better understand impacts to inform future development.

A comparison of alternatives of expected fishery impacts from the HAPC designation is included in Table 10. Additional information is included within each of the alternative sections below.

Note: Impacts will be updated to reflect current alternative language.

Table 10. Expected fishery impacts of alternatives for designating an HAPC in Southern New England.

Alternative Description	Expected Positive Impacts	Expected Negative Impacts
Alternative 1 – No Action	None	None
Alternative 2 – current areas	• Protects current vulnerable spawning habitat in short term if additional conservation recommendations are adopted; could benefit the fishery in the long term if stock status improves, or is at least maintained • Indirectly benefits EFH for other overlapping managed species to the extent that conservation recommendations support these species and habitat features • Focused designation, emphasizes a smaller area that is actively used by fish for a specific purpose • Emphasizes importance of more targeted data collection on cod spawning for fisheries and habitat monitoring plans	• Does not focus protection on historically important spawning sites or those that might be identified in the future
Alternative 3 – historical, current, and future areas	• Proactive approach to protecting cod spawning sites where current usage may be occurring but is not yet clearly documented • Protects current vulnerable spawning habitat in short term if additional conservation recommendations are adopted; could benefit the fishery in the long term if stock status improves, or is at least maintained • Focused designation, emphasizes areas that are used by fish for a specific purpose • Emphasizes importance of more targeted data collection on cod spawning for fisheries and habitat monitoring plans	• Precautionary aspect of designation requires additional data gathering to document use of locations as cod spawning sites in the future as more data and evidence become available.
Alternative 4 – HAPC for multiple NEFMC species	• More comprehensive – accounts for a range of species that will likely be impacted by offshore development via habitat conversion, entrainment, hydrodynamic effects, etc.	• Very broad, not overly different than basing conservation recommendations on EFH of individual focal species, may thus provide limited benefits for EFH consultation • Does not emphasize more targeted data collection efforts for fisheries, habitat monitoring plans

6.1 Alternative 1 No Action

Alternative 1 No Action involves no measures to identify or conserve areas of adult cod spawning or NEFMC-managed species with EFH in Southern New England in relation to offshore wind development. Thus Alternative 1 is not likely to result in any significant effects regarding target and non-target fishery resources.

6.2 Alternative 2 – Cod spawning HAPC on and around Cox Ledge

Alternative 2 provides some degree of protection for vulnerable adult cod spawning habitat by identifying areas of cod spawning sites in Southern New England as an HAPC. The identification of these sites as an HAPC highlights the importance of this essential fish habitat and emphasizes the need for conservation measures to be recommended during EFH consultation on activities such as offshore wind development, drilling, dredging, laying cables, and dumping, as well as fishing activities. The impacts of Alternative 2 on fisheries would be similar in magnitude to Alternative 1 because the Alternative 2 HAPC designation does not restrict fishing activities. However, the impacts of fishing activities on EFH within the HAPC could receive additional consideration following the designation.

It is potentially more likely that NOAA Fisheries EFH conservation recommendations could be adopted given existence of the HAPC versus if an HAPC were not designated. Relevant conservation recommendations that would be emphasized by having an HAPC designation for cod spawning sites include time of year restrictions on construction activities (avoiding times when cod are known to spawn based on acoustic and other survey data), area restrictions on where turbines, substations, and cable corridors can be constructed (avoiding active cod spawning grounds), and monitoring plan requirements to survey for cod aggregations that are indicative of spawning behavior.

It is possible that adult cod spawning habitat outside these known spawning areas identified in Alternative 2 also serves important ecological functions, is rare, and is sensitive to human-induced environmental degradation. However, the current focus is the identification of the HAPC where the known active spawning sites are occurring.

6.3 Alternative 3 – Cod spawning HAPC encompassing current Cox Ledge and Nantucket Shoals sites and sites identified in the future based on new data

Alternative 3 provides additional protection (relative to Alternative 2) for vulnerable adult cod spawning habitat by identifying areas of active cod spawning sites, areas where there is historical evidence of spawning, and any future spawning areas identified in Southern New England as HAPCs. The identification of these sites as HAPCs highlights the importance of this essential fish habitat for conservation and consultation on activities such as offshore wind development, drilling, dredging, laying cables, and dumping, as well as fishing activities. The fishing impacts of Alternative 3 would be similar in magnitude to Alternative 1 because under Alternative 3 fishing activities are not restricted. However, the impacts of fishing activities on EFH within the HAPC could receive additional consideration following the designation.

As for Alternative 2, it is potentially more likely that NOAA Fisheries EFH conservation recommendations could be adopted given existence of the HAPC versus if an HAPC were not designated. Relevant conservation recommendations that would be emphasized by having an HAPC designation for cod spawning sites include time of year restrictions on construction activities (avoiding times when cod are known to spawn based on acoustic and other survey data), area restrictions on where turbines, substations, and cable corridors can be constructed (avoiding active cod spawning grounds), and monitoring plan requirements to survey for cod aggregations that are indicative of spawning behavior.

The Council is sensitive to the possibility that as additional information is evaluated on the impact from offshore development to adult cod, protection of additional habitats may be warranted.

6.4 Alternative 4 – Complex habitat HAPC in Southern New England for multiple NEFMC species

Note: Expected impacts for Alternative 4 will be further refined based on mapping of complex habitat.

Alternative 4 designates an HAPC for all areas in Southern New England with EFH for Atlantic cod, Atlantic herring, Atlantic sea scallop, little skate, monkfish, ocean pout, red hake, silver hake, windowpane flounder, winter flounder, winter skate, and yellowtail flounder. As better information becomes available and is better understood on the possible effects of offshore development on the species identified in Alternative 4, then the Council may be able to refine its identification and description of the HAPC. The Council can also evaluate the need for fishing gear management measures within the framework process. Note that this alternative could also indirectly benefit other species that are not managed by NEFMC.

More species-specific impacts are included here to provide an overview of the range of impacts of offshore wind development on NEFMC-managed species. Bottom-dwelling species are likely to be most impacted by offshore wind development during construction and operation. For example, sea scallops are bottom-dwelling, sedentary species that will likely be impacted during construction but also during operation where larval transport/dispersion, subsequent recruitment and connectivity between regions will be disrupted (water-column hydrodynamic effects). Monkfish and silver hake are also bottom dwellers likely to be impacted from physical habitat conversions and losses. Skate species will be impacted by the electromagnetic fields (EMF) during operation of wind farms through export cables. Species with egg and larvae EFH in the area will be particularly impacted by water entrainment at conversion stations.

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8.0 APPENDIX A: EFH CONSULTATION PROCESS

NOAA conducts habitat consultations when fish and their habitats interact with human-caused activities in order to minimize any impacts. Activities include fishing operations and also non-fishing activities including, for example, construction and operation of power plants, port expansion, pollutant discharge, and offshore energy development. The Magnuson-Stevens Act requires NOAA Fisheries to identify and conserve EFH for all federally managed fish species. All federal agencies must go through an EFH consultation process with NOAA Fisheries when a determination is made that a publicly funded action might adversely affect EFH. The consultation identifies measures to avoid, reduce, or compensate any adverse impacts to EFH. For state agencies, an EFH consultation is not required for state actions that would adversely affect EFH, however, NOAA Fisheries is still required to provide conservation recommendations to mitigate any impact. Private landowners and federal actions that will not adversely affect EFH are not required to consult with NOAA Fisheries.

More specifically, actions that require consultations with NOAA Fisheries include:

- Proposed activities that are either fully or partially authorized, funded, or undertaken by a federal agency, including the military. If a project requires a federal permit, then the federal agency issuing the permit must consult with NOAA Fisheries.
- Proposed actions that will directly or indirectly adversely affect EFH either physically, chemically, or biologically. This includes adverse changes to waters or substrate, species and their habitat, other ecosystem components, and/or quality / quantity of EFH.

The consultation process entails the following steps for actions that will adversely affect EFH:

1. The action / implementing agency provides notification to NOAA Fisheries in writing (as early as possible).
2. The action agency submits an EFH assessment to NOAA Fisheries.
3. NOAA Fisheries reviews the EFH assessment and provides EFH conservation recommendations, if necessary, to the action agency within 30-60 days (60 days if the action is undergoing an expanded EFH consultation*).
4. The action agency responds to NOAA Fisheries within 30 days for how the agency will proceed with the action (i.e., which, if any, conservation recommendations will be adopted, and a rationale for why certain recommendations are not being adopted)

EFH consultations are typically combined with other review processes including those required under the National Environmental Policy Act and the Endangered Species Act.

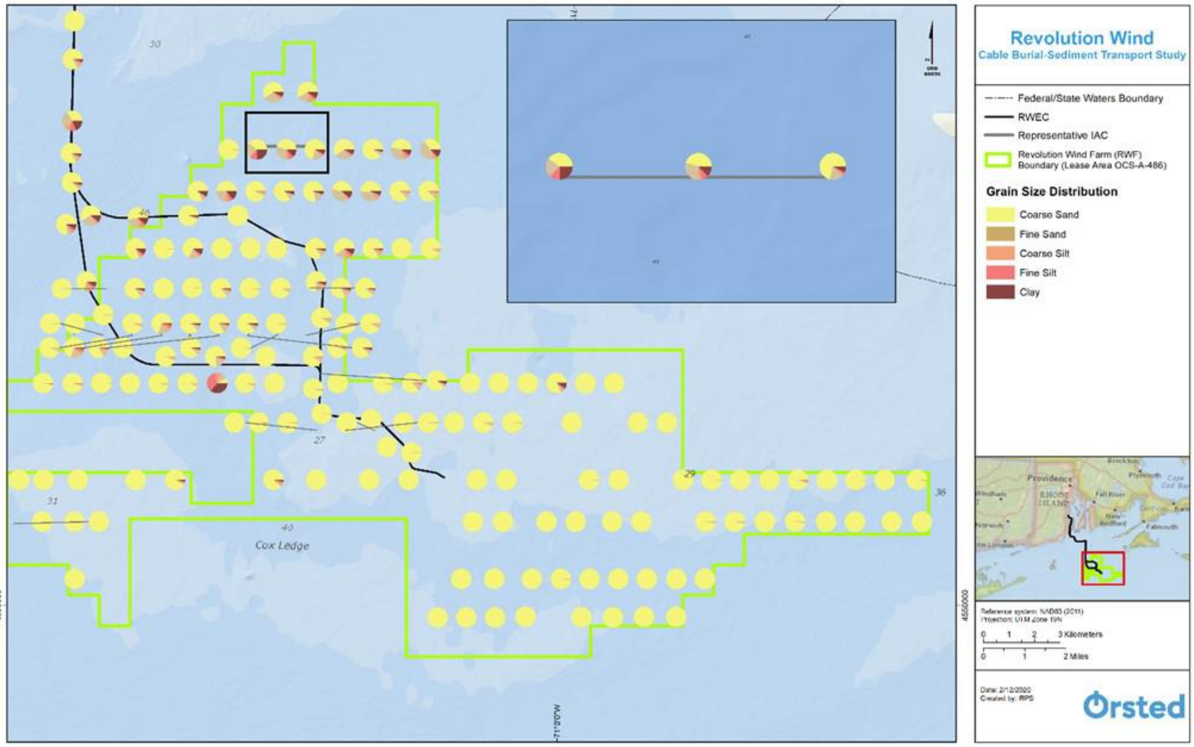
*Actions undergo an expanded EFH consultation process when NMFS determines that either the action may result in substantial adverse effects on EFH or if additional data or analysis would provide better information for development of EFH Conservation Recommendations. NMFS provides an explanation for why an expanded consultation is needed and specify any request for new information. Then NMFS and the Federal agency work together to review the action's impacts on EFH and to develop EFH Conservation Recommendations within 60 days of submittal of a complete EFH Assessment (unless extended in agreement by all parties) (67 FR 2376).

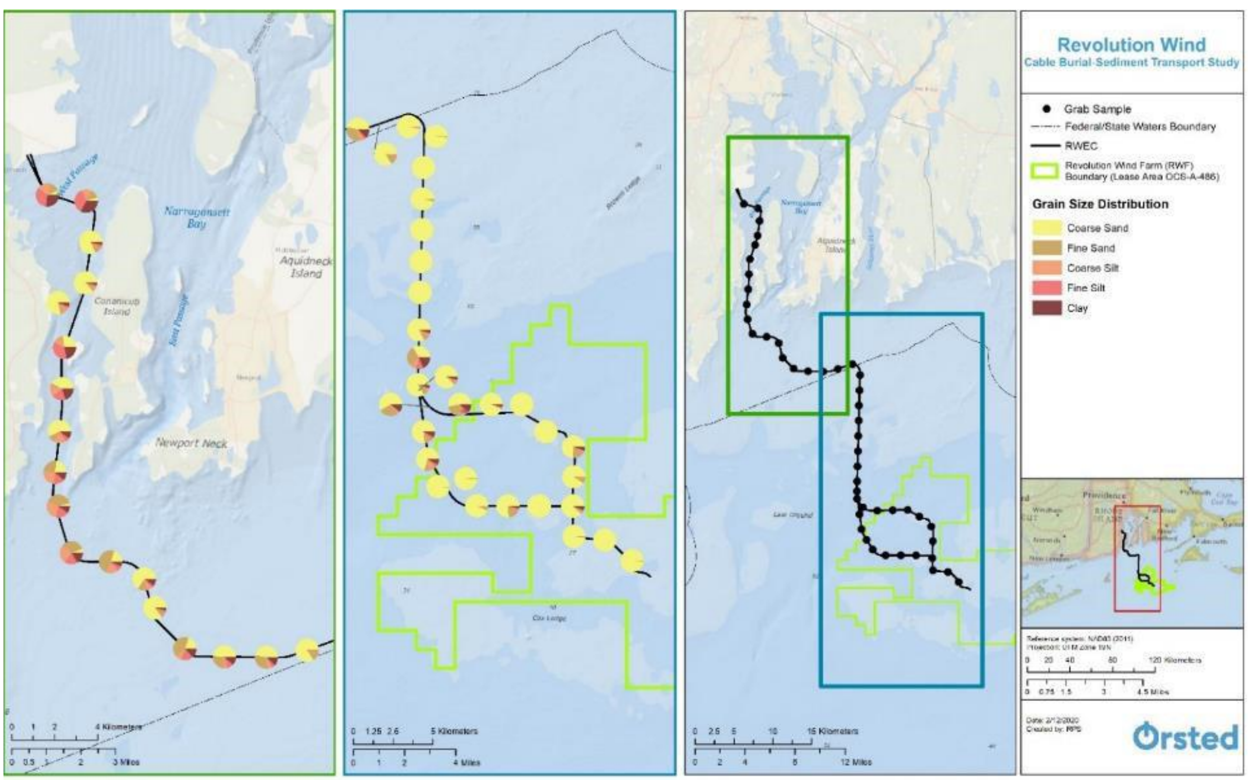
For more information:

- https://media.fisheries.noaa.gov/2022-01/03-201-11_GUIDE%20to%20EFH%20CONSULTATIONS_final%20for%20signature%20%281%29_0.pdf
- https://media.fisheries.noaa.gov/dam-migration/03-101.pdf
- https://www.fisheries.noaa.gov/about/office-protected-resources
- https://www.fisheries.noaa.gov/topic/consultations#habitat-consultations
- https://www.fisheries.noaa.gov/national/habitat-conservation/consultations-essential-fish-habitat

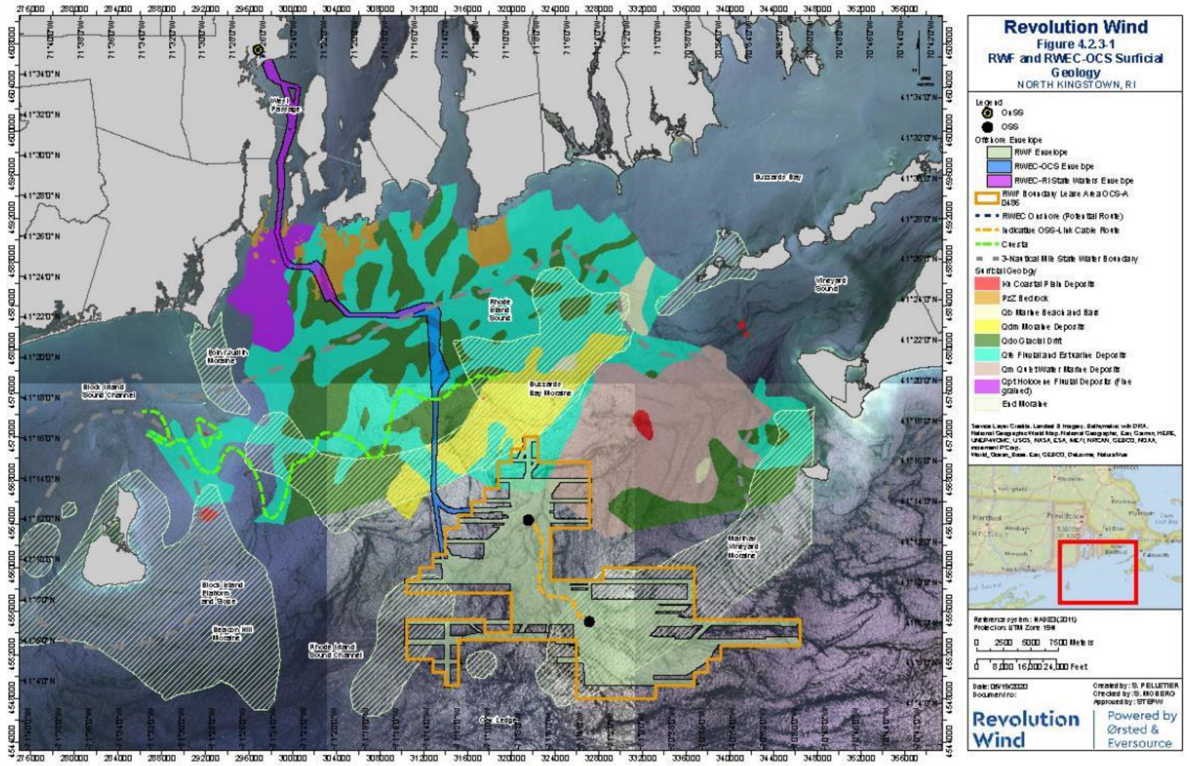
9.0 APPENDIX B: COMPLEX HABITAT DISTRIBUTION IN SOUTHERN NEW ENGLAND

Rev Wind:

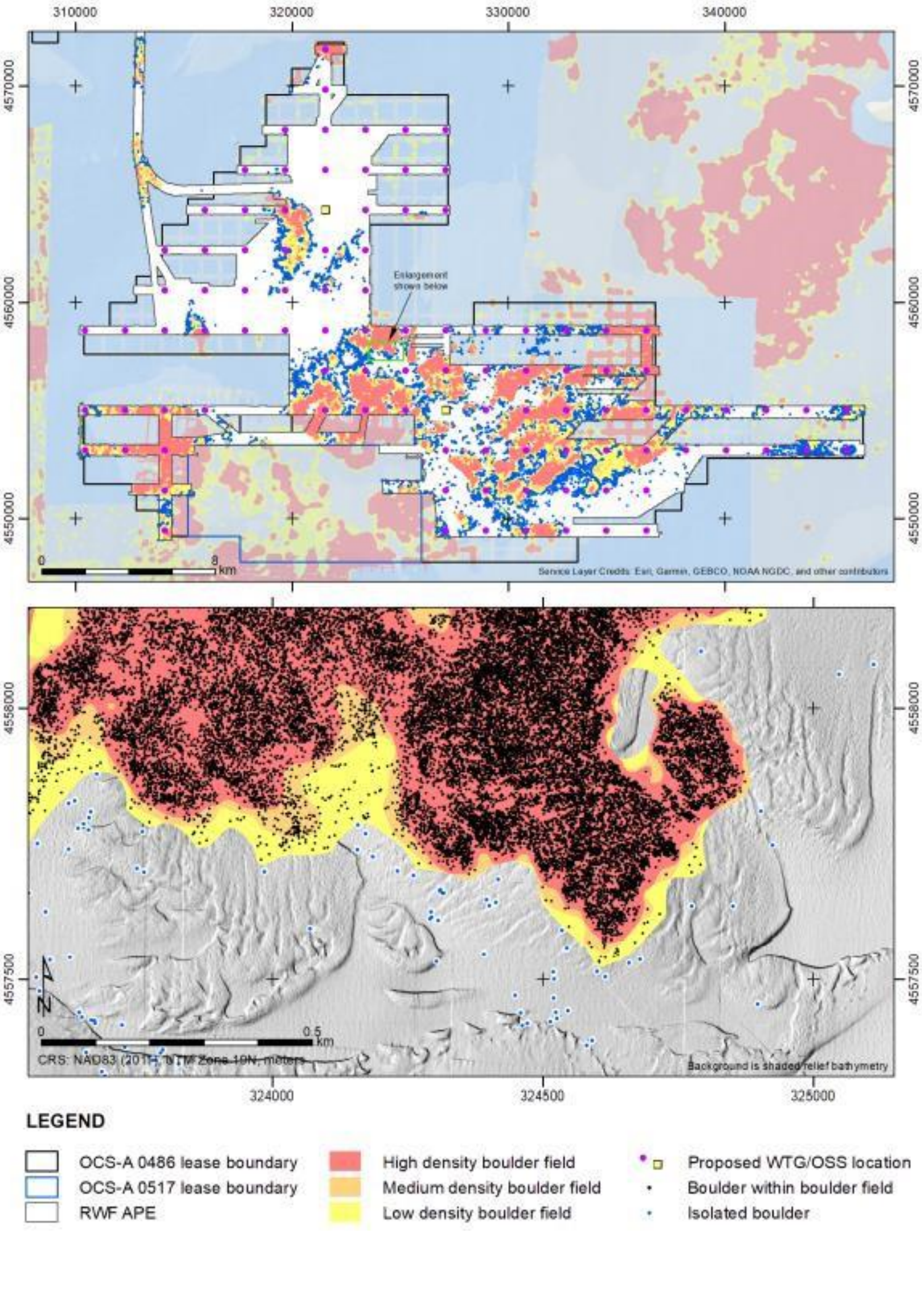




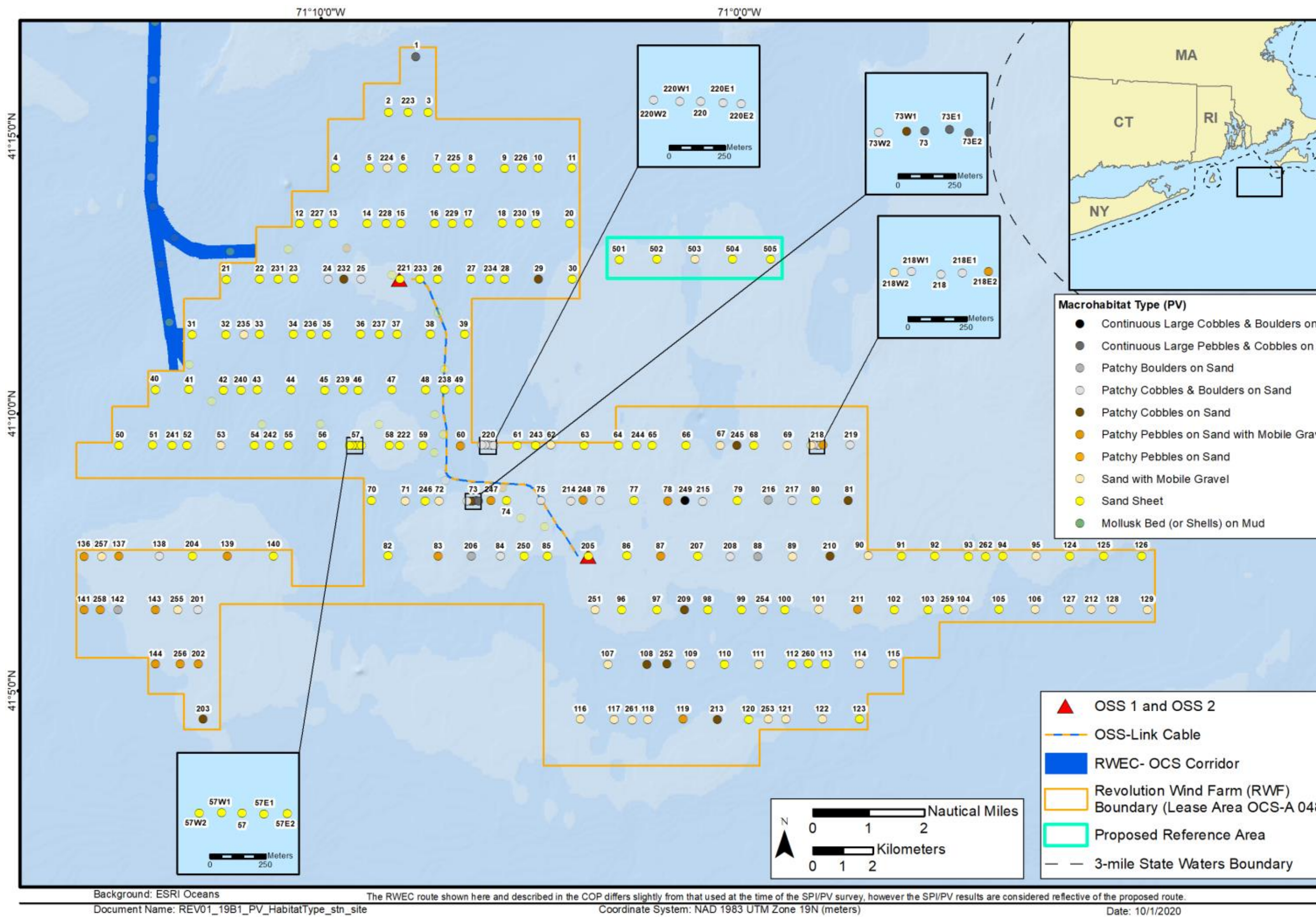
Fig



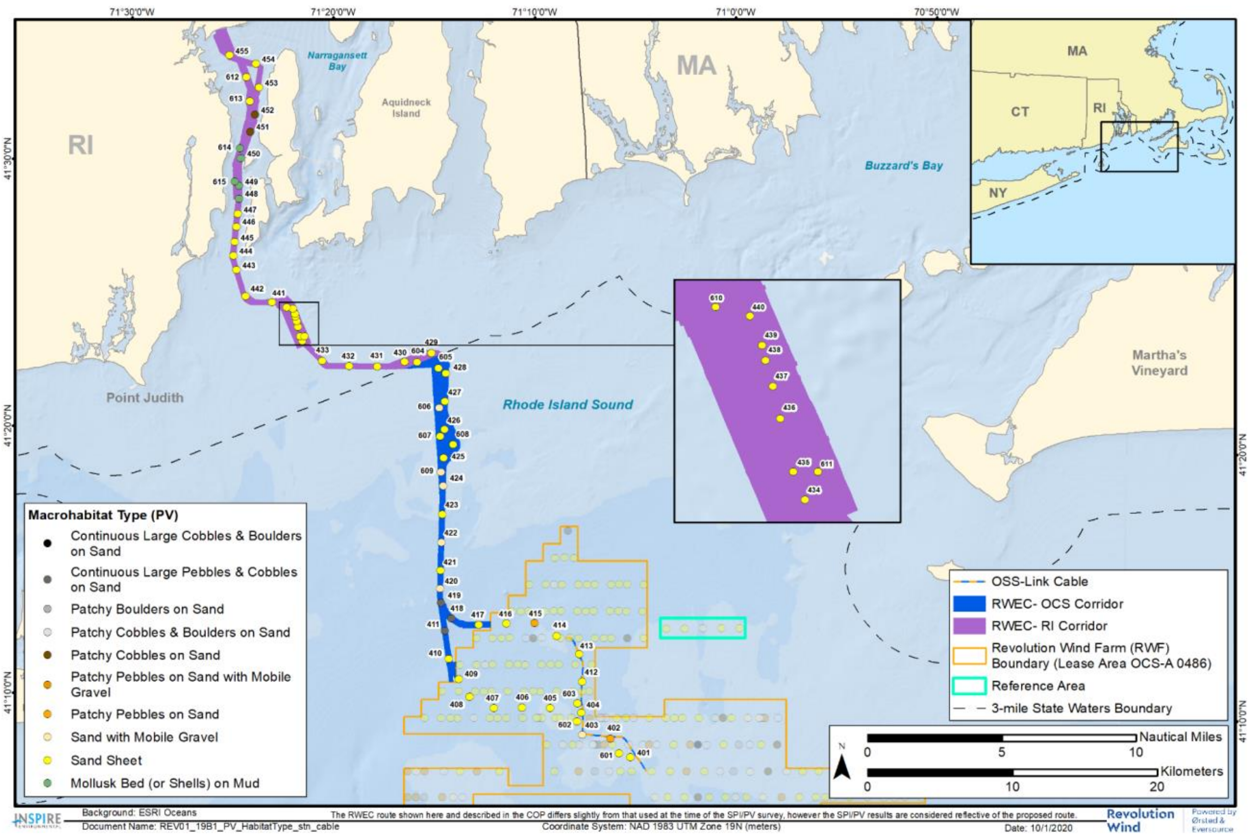
RWF Envelope boulder distribution (top) and classification into boulder fields (bottom)



310000
320000
330000
340000
4570000
4560000
4550000
Enlargement shown below
0
8 km
Service Layer Credits: Esri, Garmin, GEBCO, NOAA NGDC, and other contributors
4558000
4557500
0
0.5 km
CRS: NAD83 (2011), UTM Zone 19N, meters
Background is shaded relief bathymetry
324000
324500
325000
LEGEND
OCS-A 0486 lease boundary
OCS-A 0517 lease boundary
RWF APE
High density boulder field
Medium density boulder field
Low density boulder field
Proposed WTG/OSS location
Boulder within boulder field
Isolated boulder

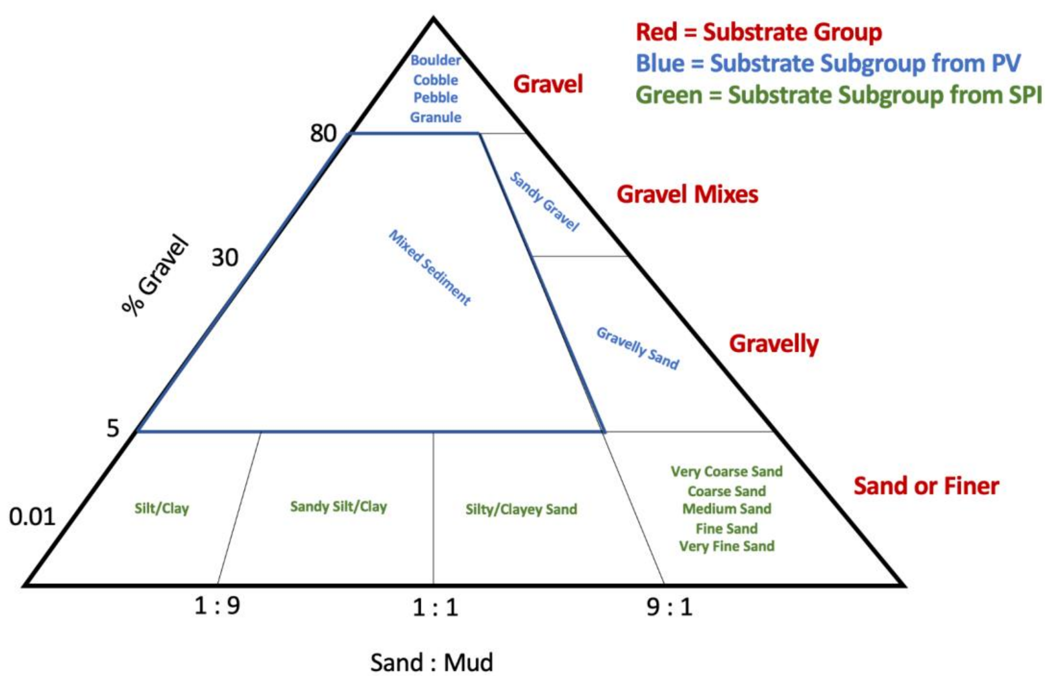


Macrohabitat Type (PV)
Continuous Large Cobbles & Boulders on
Continuous Large Pebbles & Cobbles on
Patchy Boulders on Sand
Patchy Cobbles & Boulders on Sand
Patchy Cobbles on Sand
Patchy Pebbles on Sand with Mobile Grav
Patchy Pebbles on Sand
Sand with Mobile Gravel
Sand Sheet
Mollusk Bed (or Shells) on Mud
OSS 1 and OSS 2
OSS-Link Cable
RWEC- OCS Corridor
Revolution Wind Farm (RWF) Boundary (Lease Area OCS-A 04
Proposed Reference Area
3-mile State Waters Boundary
Nautical Miles
Kilometers
MA
CT
RI
NY
71°10'0"W
71°0'0"W
41°15'0"N
41°10'0"N
41°5'0"N
Background: ESRI Oceans
Document Name: REV01_19B1_PV_HabitatType_stn_site
The RWEC route shown here and described in the COP differs slightly from that used at the time of the SPI/PV survey, however the SPI/PV results are considered reflective of the proposed route.
Coordinate System: NAD 1983 UTM Zone 19N (meters)
Date: 10/1/2020

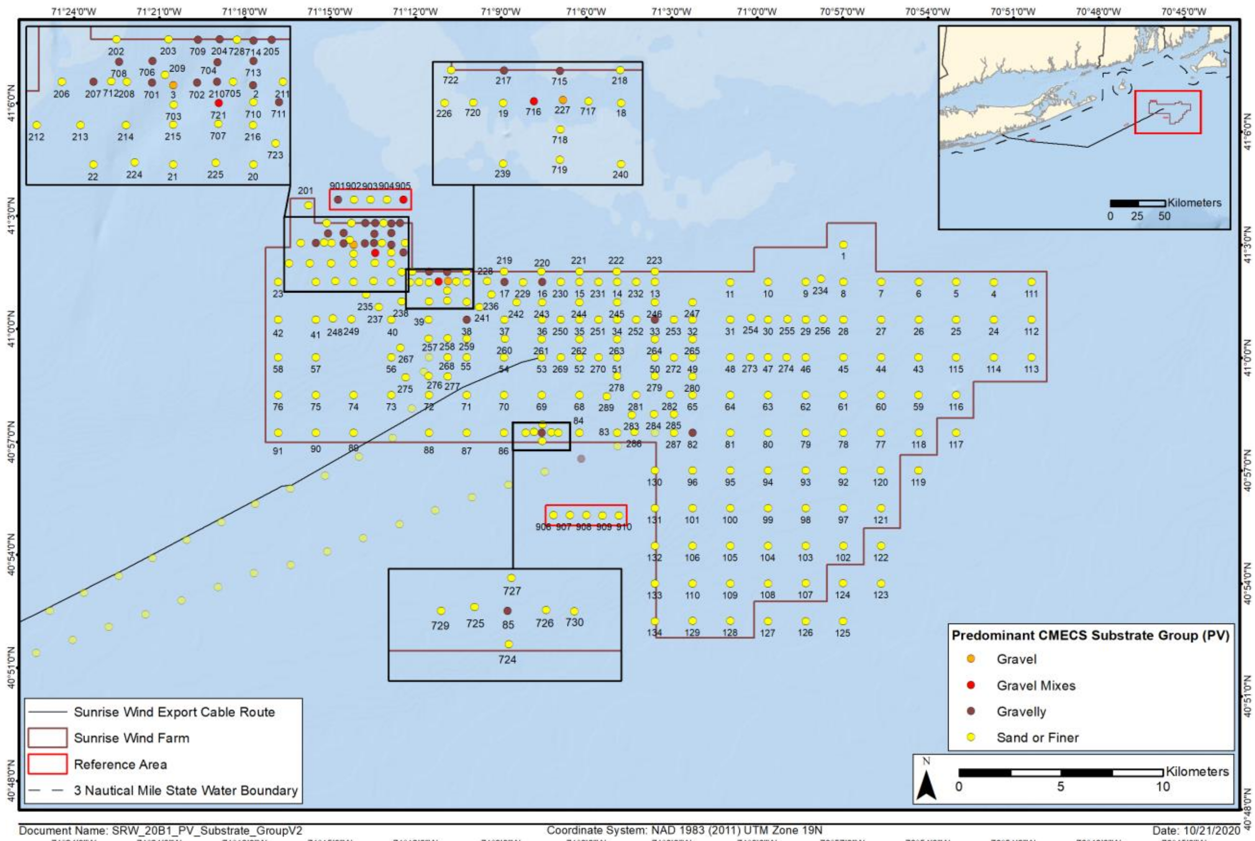


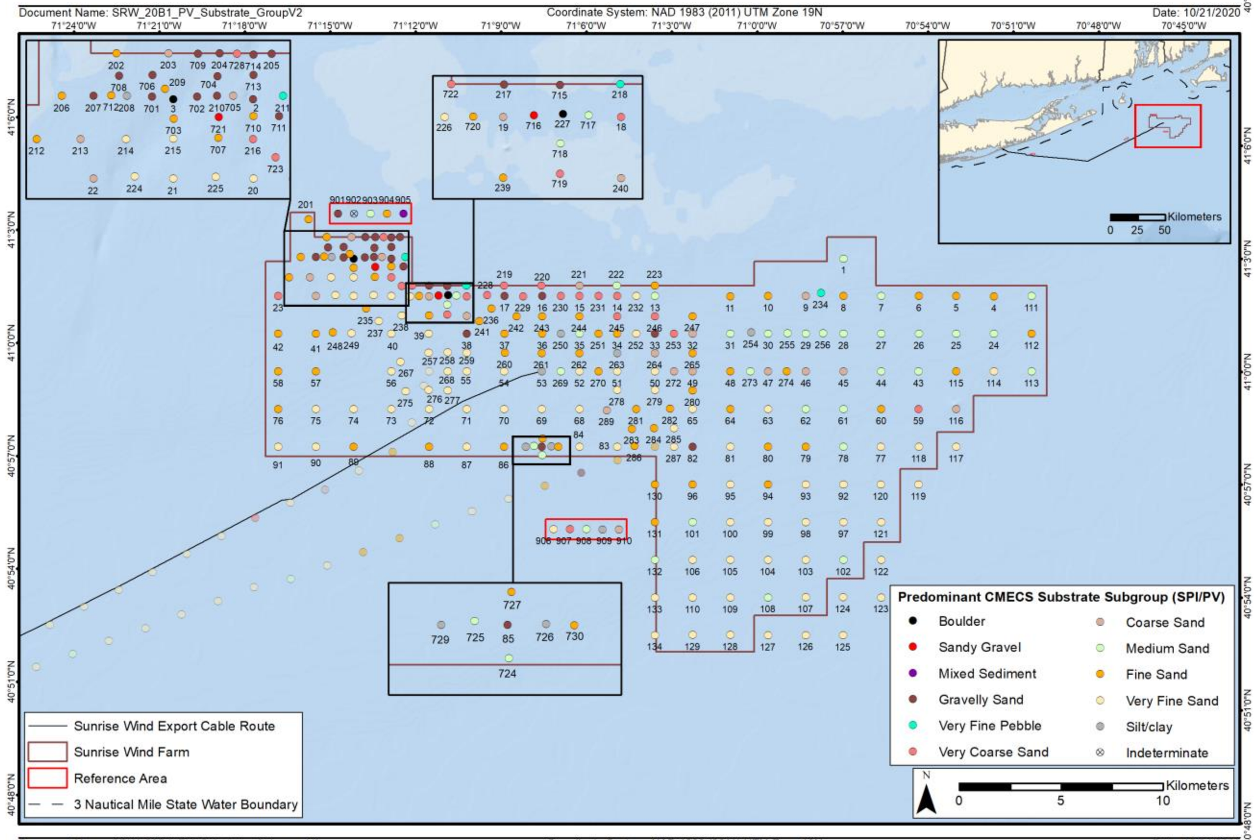
Macrohabitat Type (PV)
Continuous Large Cobbles & Boulders on Sand
Continuous Large Pebbles & Cobbles on Sand
Patchy Boulders on Sand
Patchy Cobbles & Boulders on Sand
Patchy Cobbles on Sand
Patchy Pebbles on Sand with Mobile Gravel
Patchy Pebbles on Sand
Sand with Mobile Gravel
Sand Sheet
Mollusk Bed (or Shells) on Mud
OSS-Link Cable
RWEC- OCS Corridor
RWEC- RI Corridor
Revolution Wind Farm (RWF) Boundary (Lease Area OCS-A 0486)
Reference Area
3-mile State Waters Boundary
RI
MA
Narragansett Bay
Aquidneck Island
Buzzard's Bay
Point Judith
Rhode Island Sound
Martha's Vineyard
CT
NY
Nautical Miles
Kilometers
Background: ESRI Oceans
Document Name: REV01_19B1_PV_HabitatType_stn_cable
The RWEC route shown here and described in the COP differs slightly from that used at the time of the SPI/PV survey, however the SPI/PV results are considered reflective of the proposed route.
Coordinate System: NAD 1983 UTM Zone 19N (meters)
Date: 10/1/2020
Revolution Wind

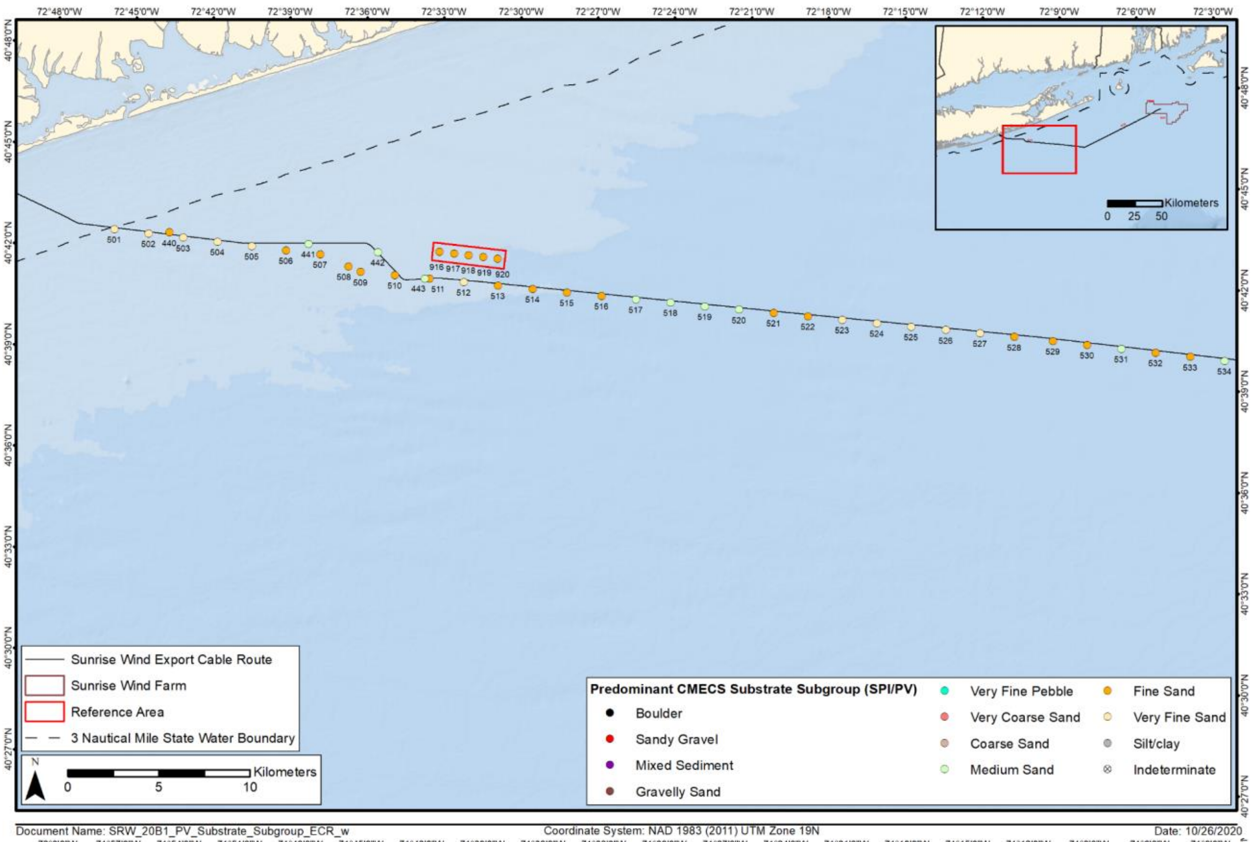
Sunrise

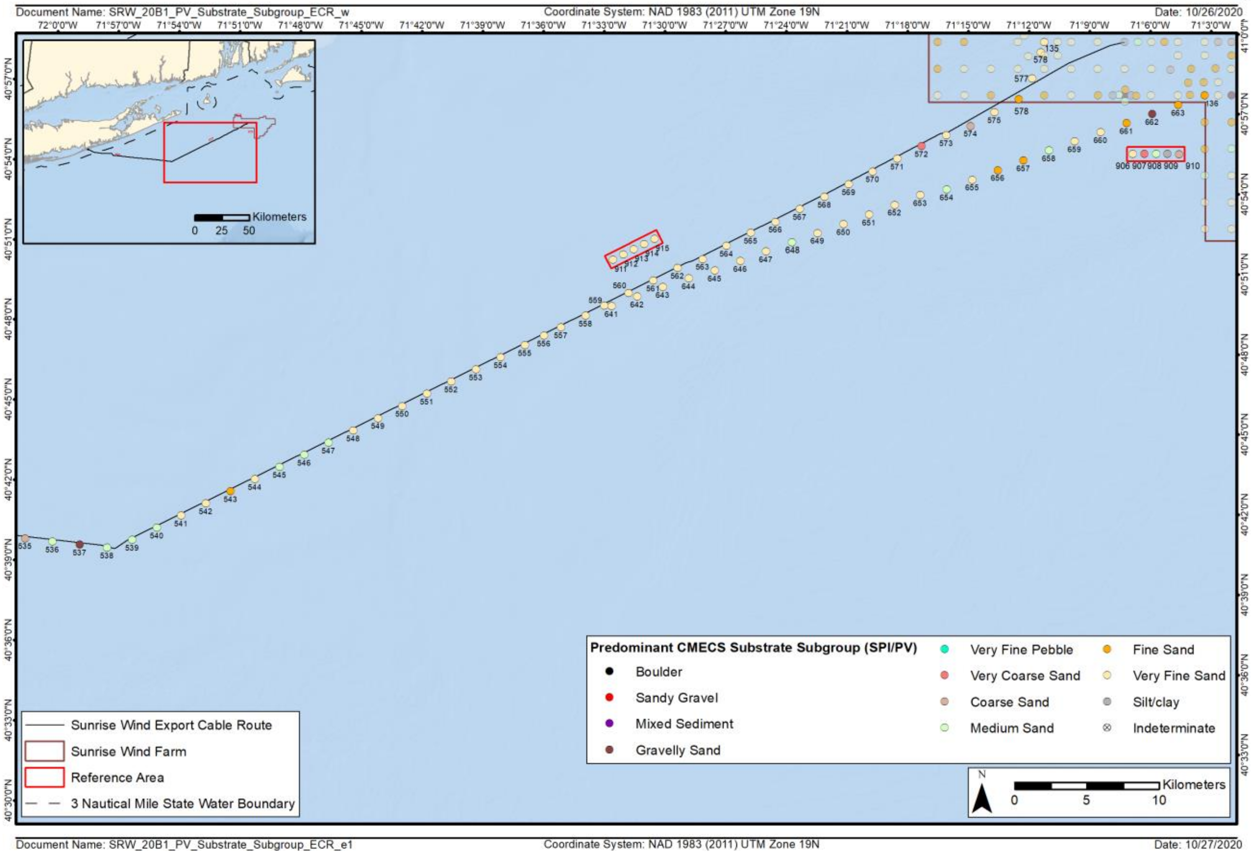


Red = Substrate Group
Blue = Substrate Subgroup from PV
Green = Substrate Subgroup from SPI
Boulder
Cobble
Pebble
Granule
Gravel
Sandy Gravel
Gravel Mixes
Mixed Sediment
Gravelly Sand
Gravelly
% Gravel
80
30
5
0.01
Silt/Clay
Sandy Silt/Clay
Silty/Clayey Sand
Very Coarse Sand
Coarse Sand
Medium Sand
Fine Sand
Very Fine Sand
Sand or Finer
1 : 9
1 : 1
9 : 1
Sand : Mud

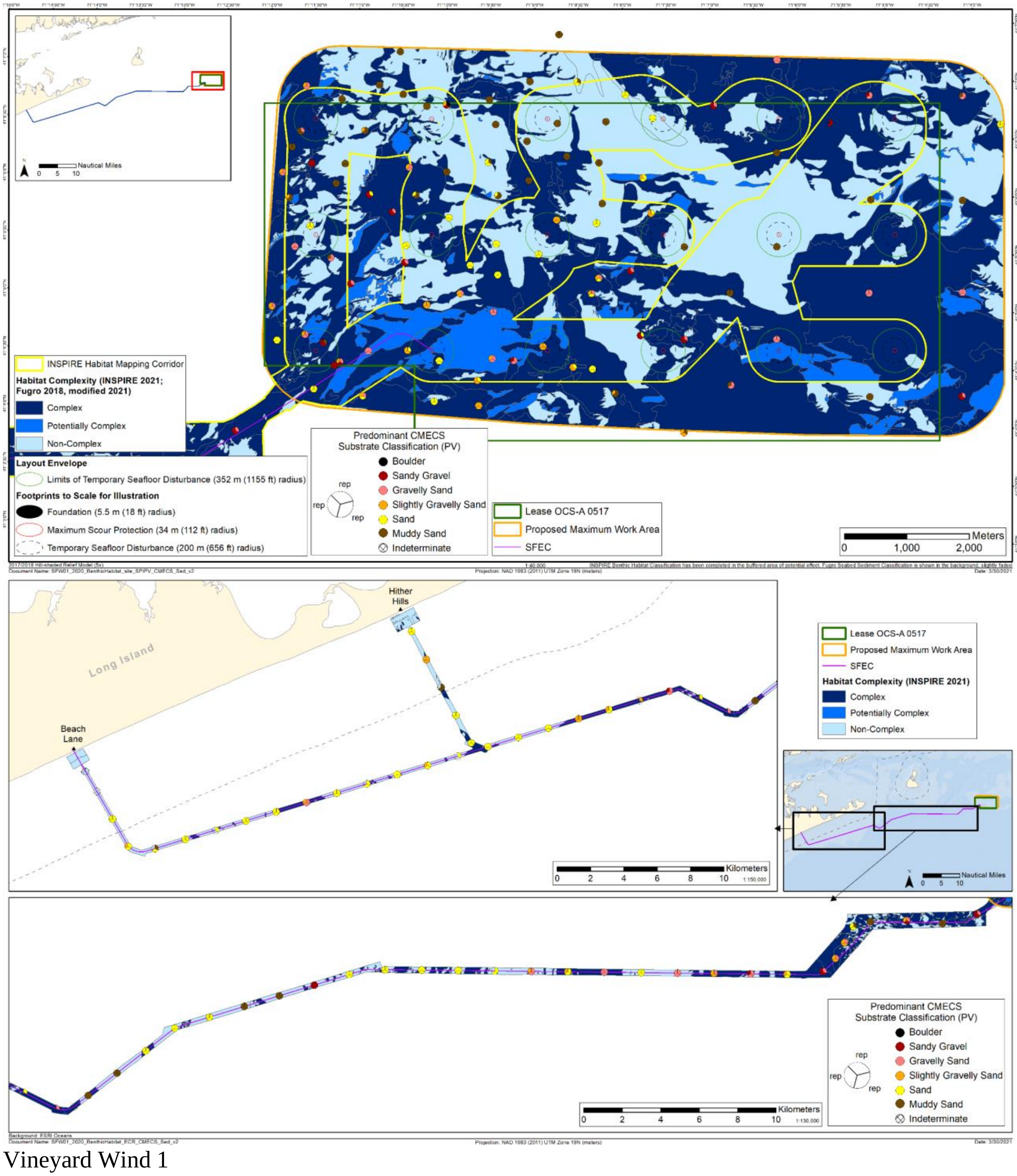

Predominant CMECS Substrate Group (PV)
Gravel
Gravel Mixes
Gravelly
Sand or Finer
Sunrise Wind Export Cable Route
Sunrise Wind Farm
Reference Area
3 Nautical Mile State Water Boundary
Kilometers
Document Name: SRW_20B1_PV_Substrate_GroupV2
Coordinate System: NAD 1983 (2011) UTM Zone 19N
Date: 10/21/2020


Predominant CMECS Substrate Subgroup (SPI/PV)
Boulder
Sandy Gravel
Mixed Sediment
Gravelly Sand
Very Fine Pebble
Very Coarse Sand
Coarse Sand
Medium Sand
Fine Sand
Very Fine Sand
Silt/clay
Indeterminate
Sunrise Wind Export Cable Route
Sunrise Wind Farm
Reference Area
3 Nautical Mile State Water Boundary
Kilometers
Document Name: SRW_20B1_PV_Substrate_SubgroupV2
Coordinate System: NAD 1983 (2011) UTM Zone 19N
Date: 10/21/2020

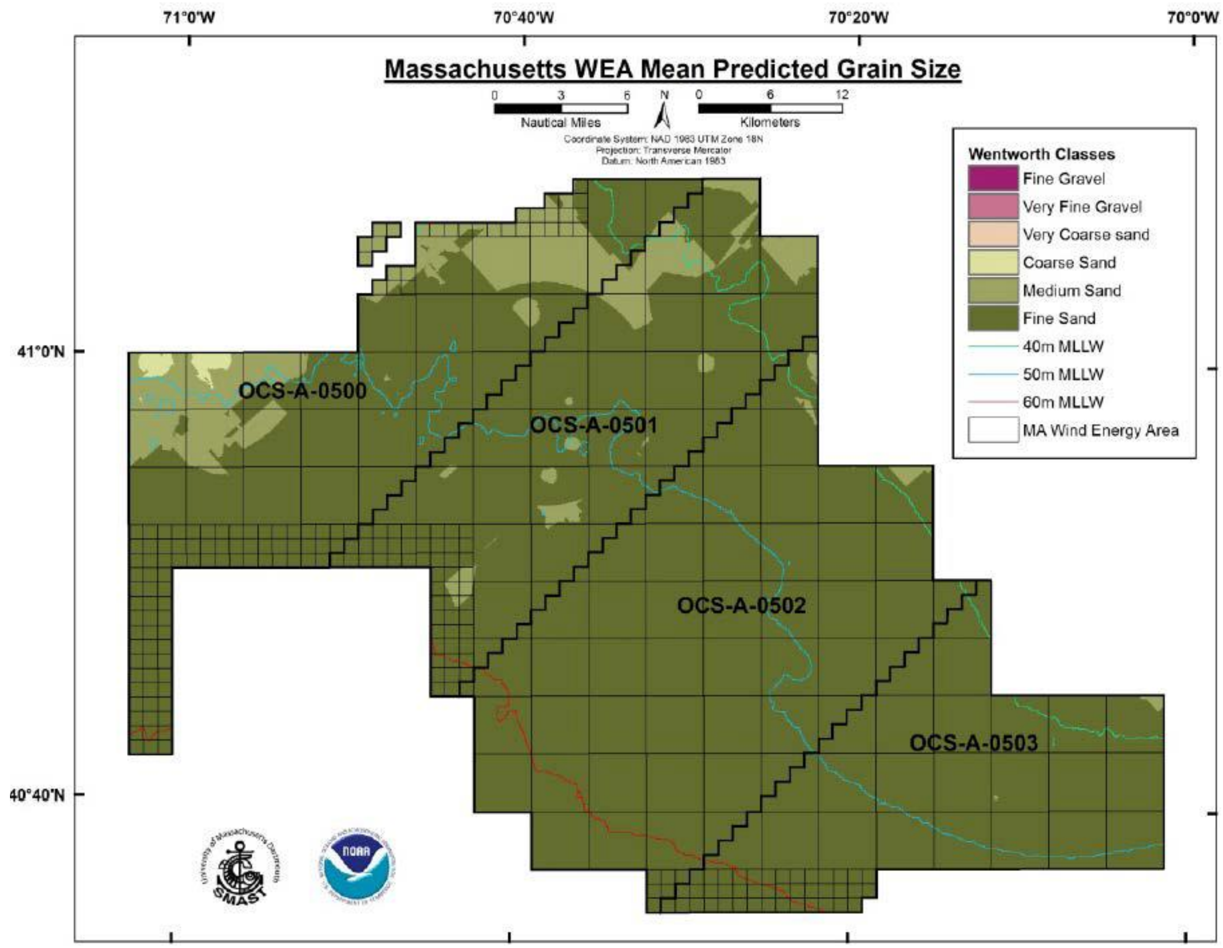

Sunrise Wind Export Cable Route
Sunrise Wind Farm
Reference Area
3 Nautical Mile State Water Boundary
Kilometers
0 5 10
Predominant CMECS Substrate Subgroup (SPI/PV)
Boulder
Sandy Gravel
Mixed Sediment
Gravelly Sand
Very Fine Pebble
Very Coarse Sand
Coarse Sand
Medium Sand
Fine Sand
Very Fine Sand
Silt/clay
Indeterminate
Document Name: SRW_20B1_PV_Substrate_Subgroup_ECR_w
Coordinate System: NAD 1983 (2011) UTM Zone 19N
Date: 10/26/2020

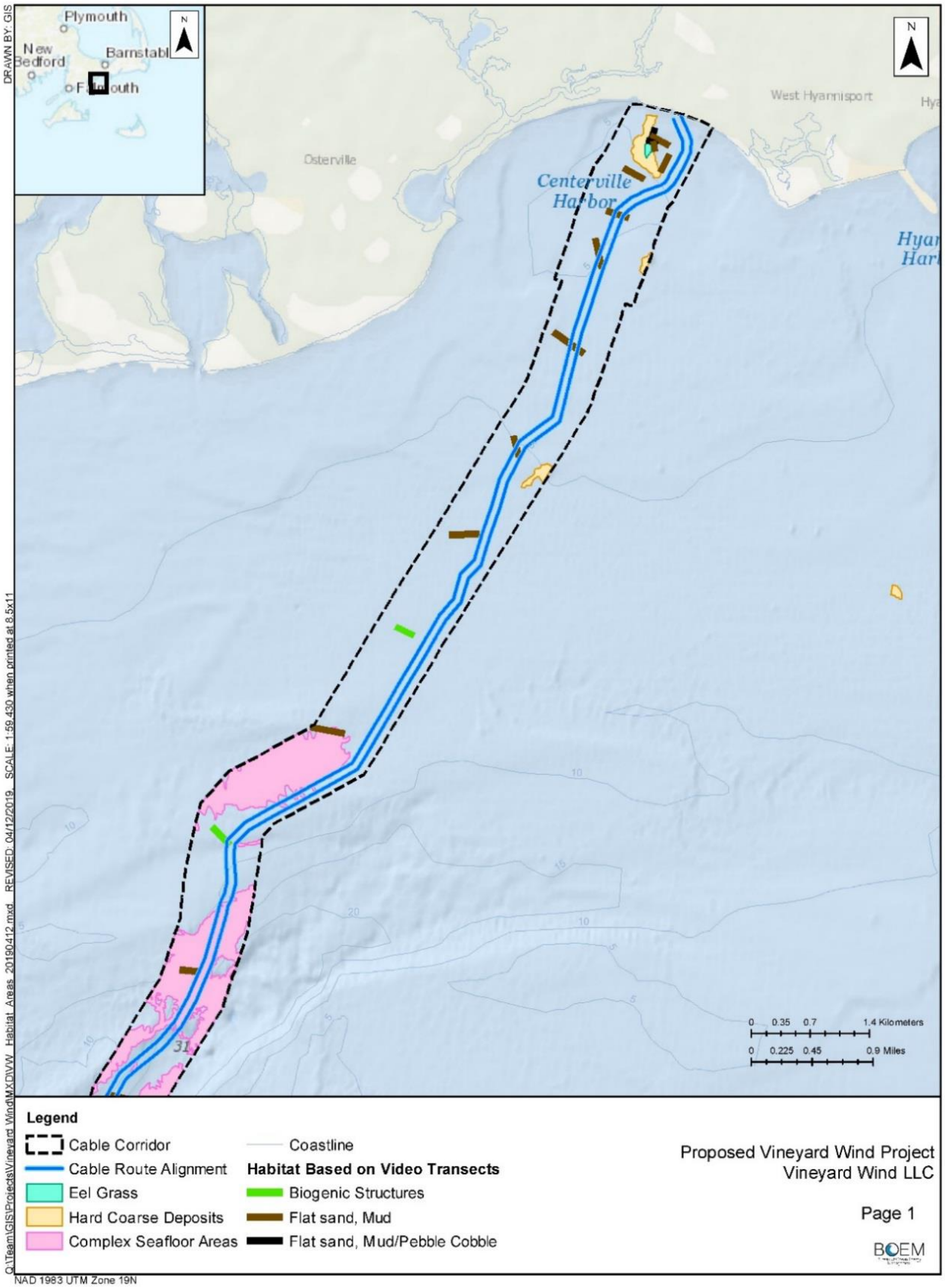

Predominant CMECS Substrate Subgroup (SPI/PV)
Boulder
Sandy Gravel
Mixed Sediment
Gravelly Sand
Very Fine Pebble
Very Coarse Sand
Coarse Sand
Medium Sand
Fine Sand
Very Fine Sand
Silt/clay
Indeterminate
Sunrise Wind Export Cable Route
Sunrise Wind Farm
Reference Area
3 Nautical Mile State Water Boundary
Kilometers
0 5 10
Document Name: SRW_20B1_PV_Substrate_Subgroup_ECR_e1
Coordinate System: NAD 1983 (2011) UTM Zone 19N
Date: 10/27/2020

South Fork



Vineyard Wind 1


71°0'W
70°40'W
70°20'W
70°0'W
41°0'N
40°40'N
Massachusetts WEA Mean Predicted Grain Size
Nautical Miles
Kilometers
Wentworth Classes
Fine Gravel
Very Fine Gravel
Very Coarse sand
Coarse Sand
Medium Sand
Fine Sand
40m MLLW
50m MLLW
60m MLLW
MA Wind Energy Area
OCS-A-0500
OCS-A-0501
OCS-A-0502
OCS-A-0503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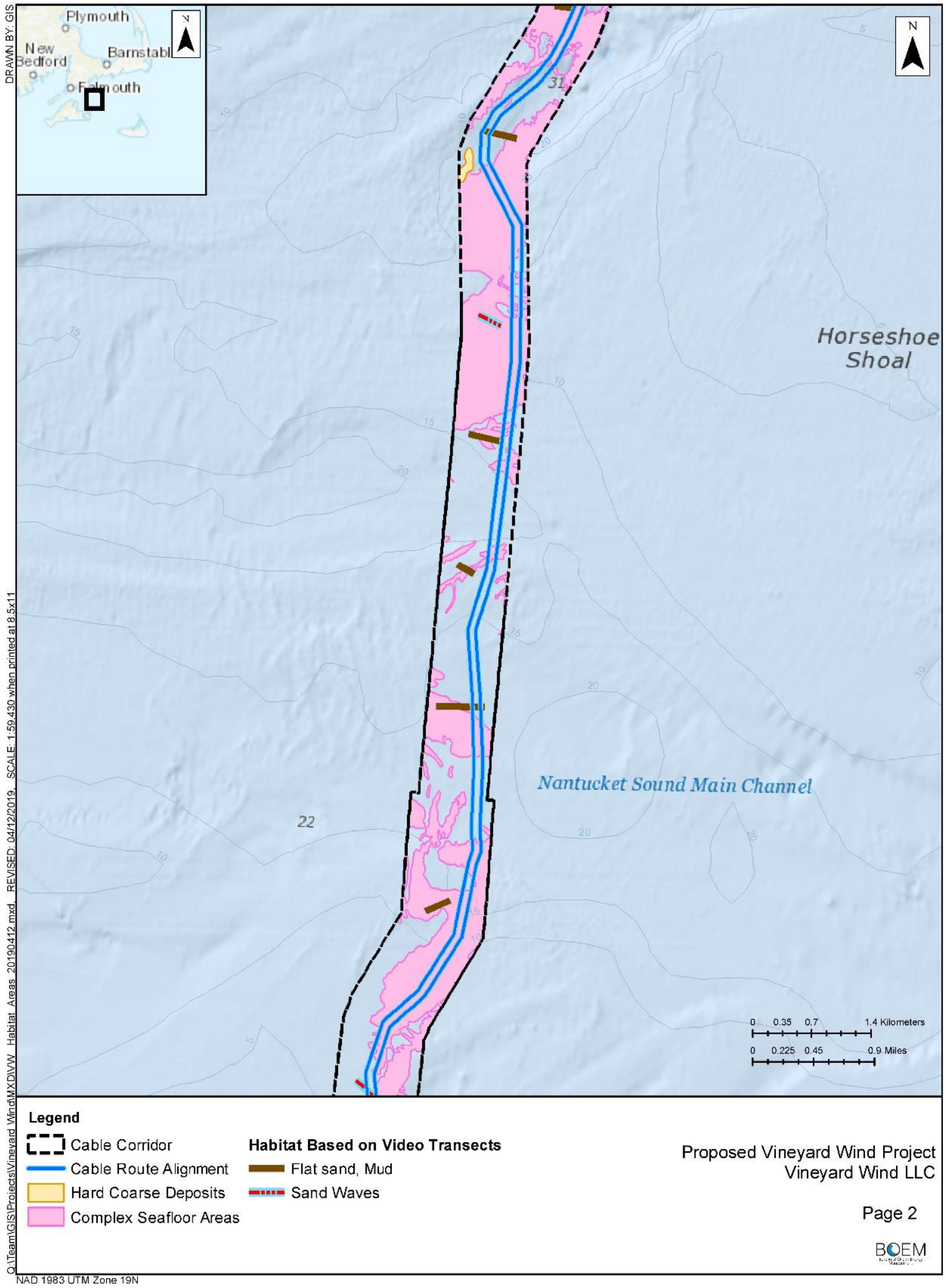
Plymouth
New Bedford
Barnstable
Falmouth
N
West Hyannisport
Osterville
Centerville Harbor
0 0.35 0.7 1.4 Kilometers
0 0.225 0.45 0.9 Miles
Legend
Cable Corridor
Cable Route Alignment
Eel Grass
Hard Coarse Deposits
Complex Seafloor Areas
Coastline
Habitat Based on Video Transects
Biogenic Structures
Flat sand, Mud
Flat sand, Mud/Pebble Cobble
Proposed Vineyard Wind Project
Vineyard Wind LLC
Page 1
BOEM
NAD 1983 UTM Zone 19N



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Plymouth
New Bedford
Barnstable
Falmouth
N
31
Horseshoe Shoal
Nantucket Sound Main Channel
22
0 0.35 0.7 1.4 Kilometers
0 0.225 0.45 0.9 Miles
Legend
Cable Corridor
Cable Route Alignment
Hard Coarse Deposits
Complex Seafloor Areas
Habitat Based on Video Transects
Flat sand, Mud
Sand Waves
Proposed Vineyard Wind Project
Vineyard Wind LLC
Page 2
BOEM
NAD 1983 UTM Zone 19N
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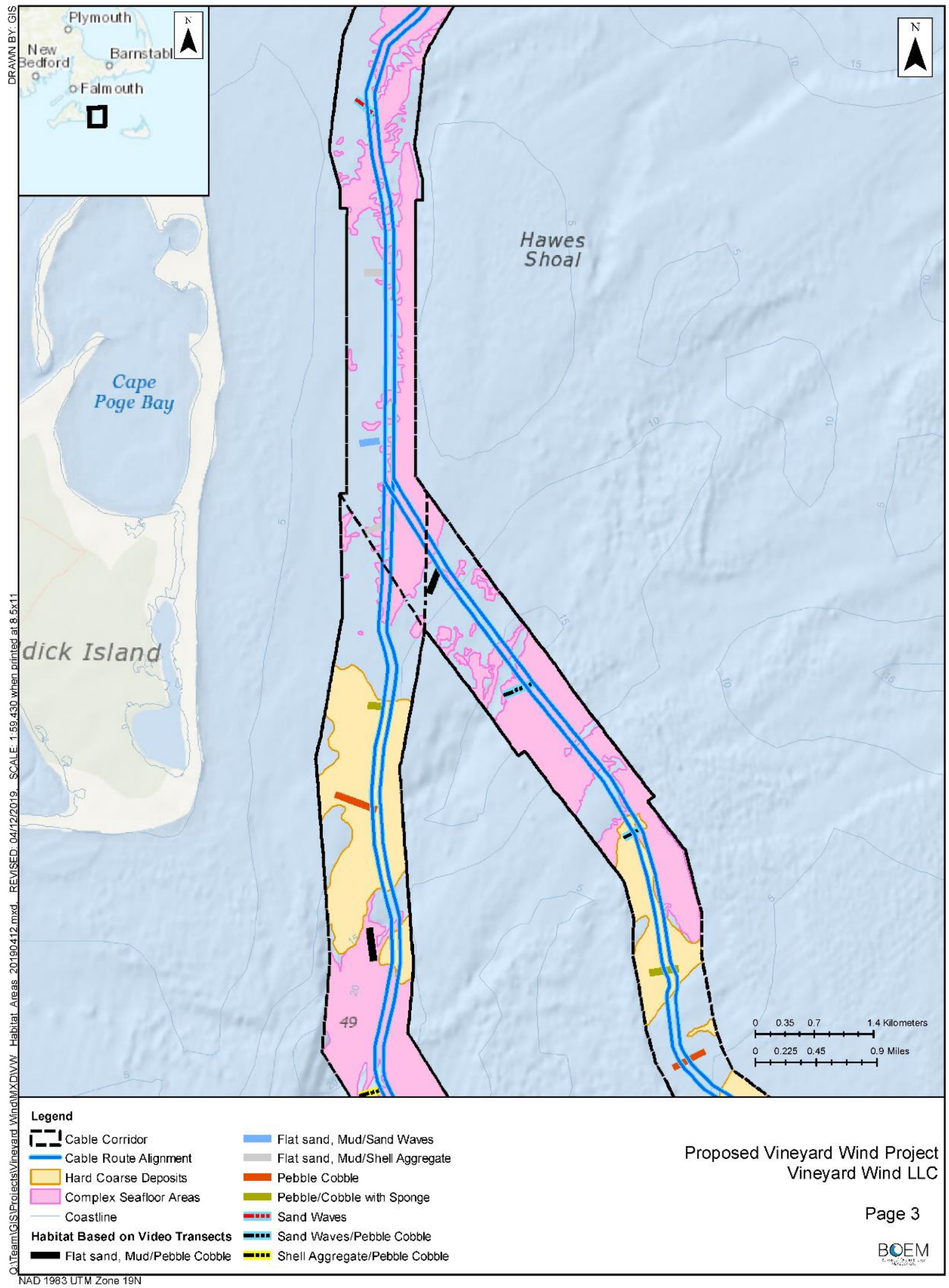
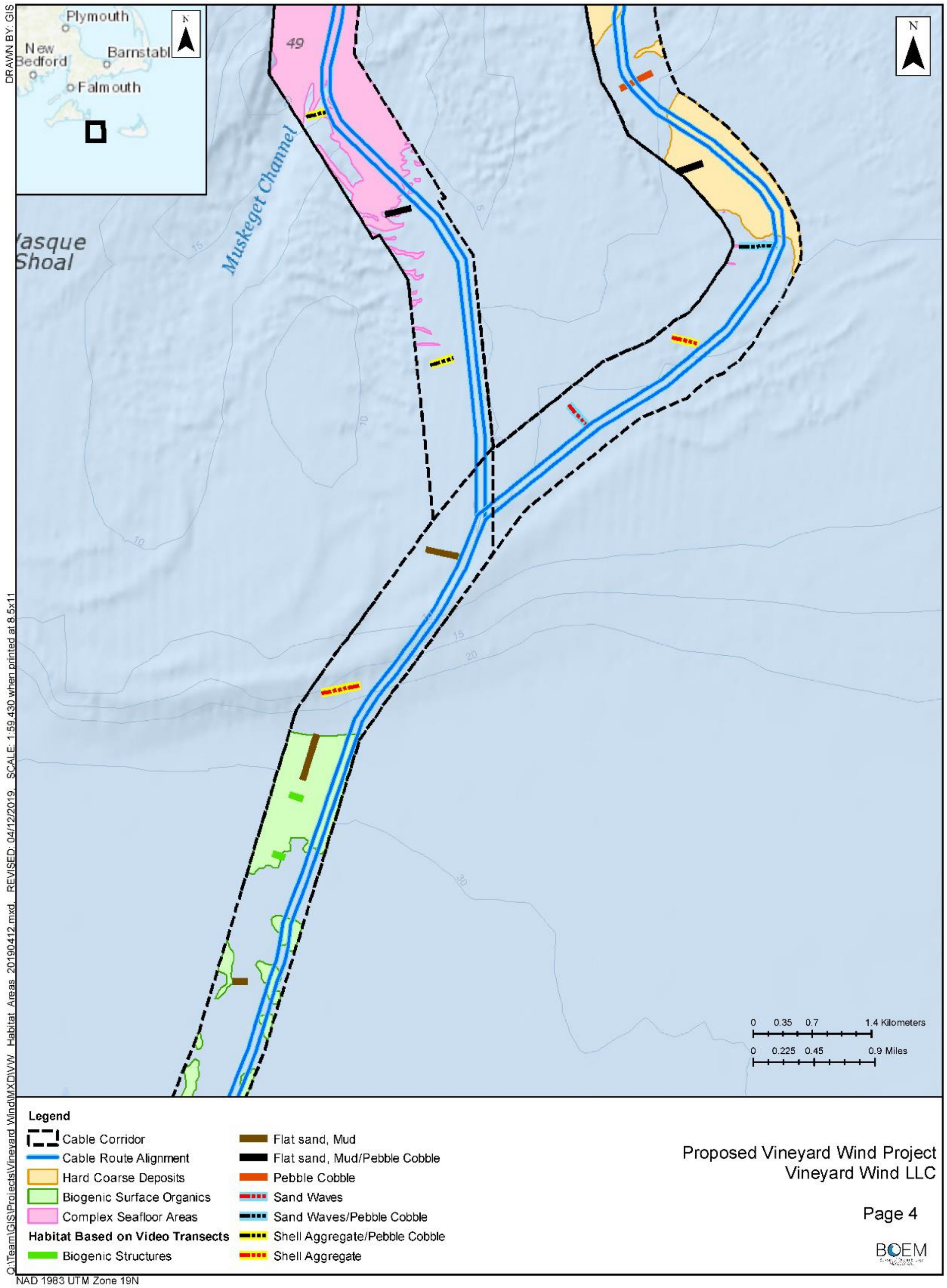


DRAWN BY: GIS
Plymouth
New Bedford
Barnstabl
Falmouth
N
Hawes Shoal
Cape Poge Bay
dick Island
49
0 0.35 0.7 1.4 Kilometers
0 0.225 0.45 0.9 Miles
Q:\Team\GIS\Projects\Vineyard Wind\MXD\VW_Habitat_Areas_20190412.mxd REVISED: 04/12/2019 SCALE: 1:59,430 when printed at 8.5x11
Legend
Cable Corridor
Cable Route Alignment
Hard Coarse Deposits
Complex Seafloor Areas
Coastline
Habitat Based on Video Transects
Flat sand, Mud/Pebble Cobble
Flat sand, Mud/Sand Waves
Flat sand, Mud/Shell Aggregate
Pebble Cobble
Pebble/Cobble with Sponge
Sand Waves
Sand Waves/Pebble Cobble
Shell Aggregate/Pebble Cobble
Proposed Vineyard Wind Project
Vineyard Wind LLC
Page 3
BOEM
NAD 1983 UTM Zone 19N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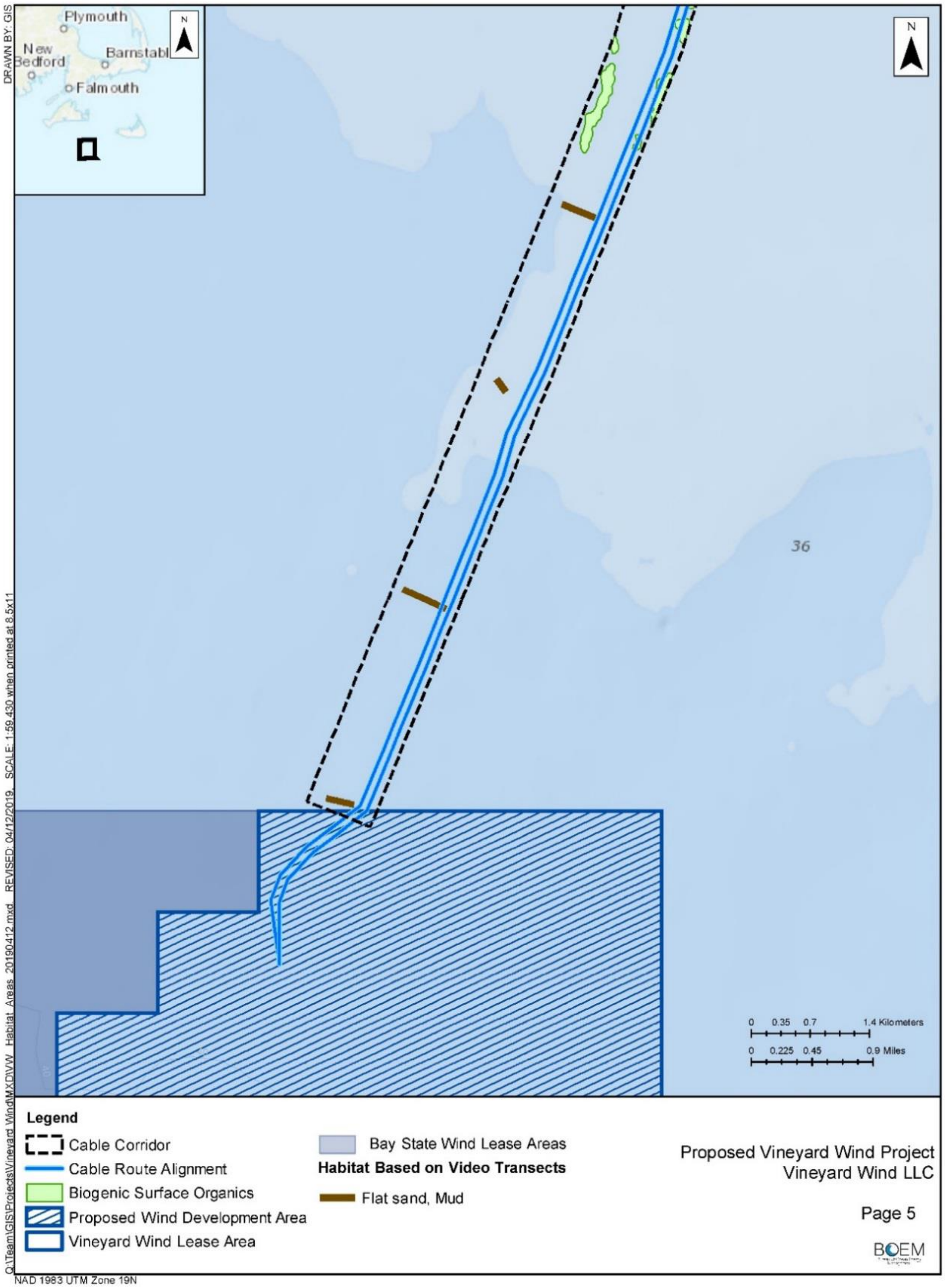
Plymouth
New Bedford
Barnstabl
Falmouth
N
49
Muskeget Channel
Vasque Shoal
Q:\Team\GIS\Projects\Vineyard Wind\MXD\VW_Habitat_Areas_20190412.mxd REVISED: 04/12/2019 SCALE: 1:59,430 when printed at 8.5x11
0 0.35 0.7 1.4 Kilometers
0 0.225 0.45 0.9 Miles
Legend
Cable Corridor
Cable Route Alignment
Hard Coarse Deposits
Biogenic Surface Organics
Complex Seafloor Areas
Habitat Based on Video Transects
Biogenic Structures
Flat sand, Mud
Flat sand, Mud/Pebble Cobble
Pebble Cobble
Sand Waves
Sand Waves/Pebble Cobble
Shell Aggregate/Pebble Cobble
Shell Aggregate
Proposed Vineyard Wind Project
Vineyard Wind LLC
Page 4
BOEM
NAD 1983 UTM Zone 19N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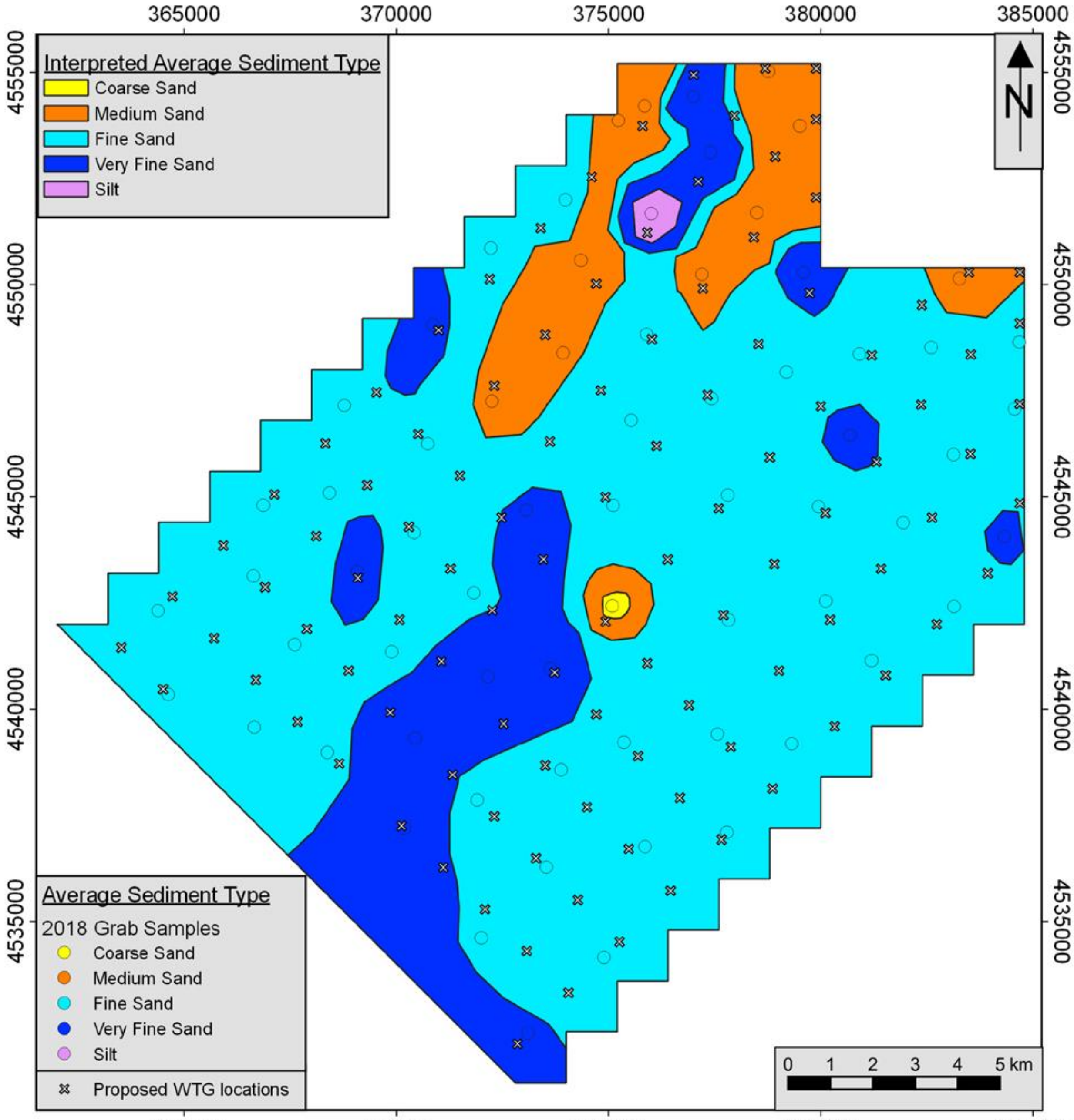
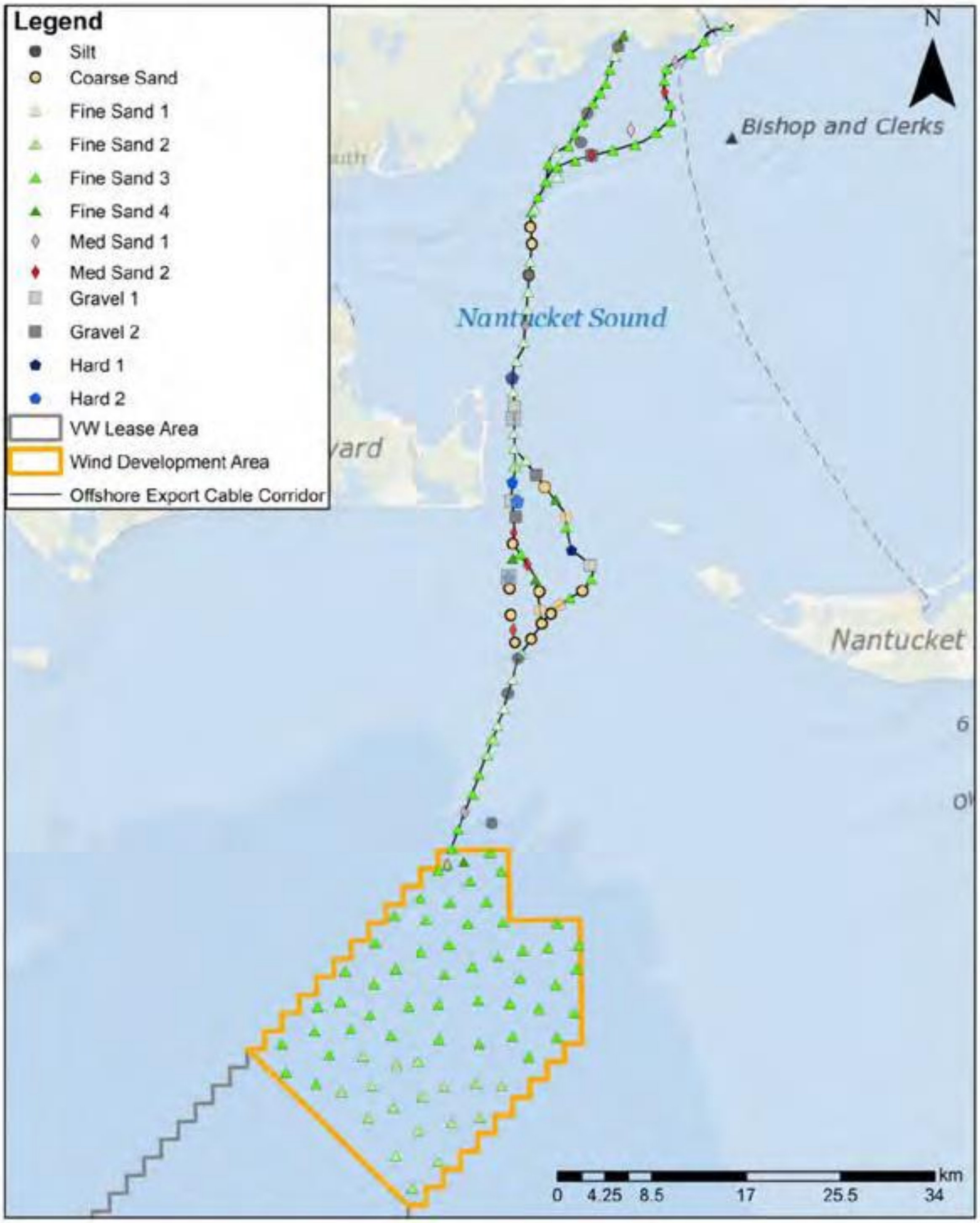
Plymouth
New Bedford
Barnstabl
Falmouth
N
N
36
0 0.35 0.7 1.4 Kilometers
0 0.225 0.45 0.9 Miles
Legend
Cable Corridor
Cable Route Alignment
Biogenic Surface Organics
Proposed Wind Development Area
Vineyard Wind Lease Area
Bay State Wind Lease Areas
Habitat Based on Video Transects
Flat sand, Mud
Proposed Vineyard Wind Project
Vineyard Wind LLC
Page 5
BOEM
NAD 1983 UTM Zone 19N


Interpreted Average Sediment Type
Coarse Sand
Medium Sand
Fine Sand
Very Fine Sand
Silt
Average Sediment Type
2018 Grab Samples
Coarse Sand
Medium Sand
Fine Sand
Very Fine Sand
Silt
Proposed WTG locations
N
0 1 2 3 4 5 km
365000
370000
375000
380000
385000
4555000
4550000
4545000
4540000
4535000


Legend
Silt
Coarse Sand
Fine Sand 1
Fine Sand 2
Fine Sand 3
Fine Sand 4
Med Sand 1
Med Sand 2
Gravel 1
Gravel 2
Hard 1
Hard 2
VW Lease Area
Wind Development Area
Offshore Export Cable Corridor
N
Bishop and Clerks
Nantucket Sound
Nantucket
0
4.25
8.5
17
25.5
34
km