UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
GREATER ATLANTIC REGIONAL FISHERIES OFFICE
55 Great Republic Drive
Gloucester, MA 01930-2276

June 7, 2021

Ms. Michelle Morin
Chief, Environmental Branch for Renewable Energy
Bureau of Ocean Energy Management
45600 Woodland Road, VAM-OREP
Sterling, Virginia 20166-4281

Re: South Fork Offshore Wind Energy Project, Lease Area OCS-A-517, offshore Rhode Island

Dear Ms. Morin:

We have reviewed the final Essential Fish Habitat (EFH) assessment provided on April 7, 2020, for the proposed South Fork offshore wind energy project. The revised EFH Assessment was provided in response to our request for additional information provided on December 14, 2020. This project includes the construction, operation, maintenance, and decommissioning of a commercial scale offshore wind energy facility by South Fork Wind Farm (SFWF), within Lease Area OCS-A 0517, located approximately 19 miles southeast of Block Island, Rhode Island, and 35 miles east of Montauk Point, New York. The SFWF also includes an Operations and Maintenance (O&M) facility that will be located onshore at a commercial port facility at Montauk in East Hampton, New York. The SFWF includes up to 15 wind turbine generators (WTGs or turbines) with a nameplate capacity of 6 to 12 MW per turbine, an offshore substation (OSS), and a submarine transmission cable network connecting the WTGs (inter-array cables) to the OSS. The South Fork Export Cable (SFEC) would transmit energy from the SFWF to either Beach Lane, Town of Easthampton, New York or Hither Hills, Montauk, New York. The Beach Lane alternative would require approximately 61.8 linear miles of cable to a sea-to-shore connection located approximately 1,750 feet offshore of Easthampton, NY or 50.0 linear miles of cable to a sea-to-shore connection located approximately 1,750 feet offshore of Montauk, NY. Both cable corridor alternatives would connect to land by horizontal directional drilling (HDD) of the cable to a depth of 65.6 feet below the seabed.

As you are aware, the Magnuson-Stevens Fishery Conservation and Management Act (MSA) and the Fish and Wildlife Coordination Act (FWCA) require Federal agencies to consult with one another on projects such as this. Insofar as the project involves EFH, the consultation process is guided by the EFH regulatory requirements under 50 CFR 600.920, which mandates the preparation of EFH assessments and generally outlines your obligations. We offer the following comments and recommendations on this project pursuant to the above referenced regulatory process.

Comments on the EFH Assessment

The EFH assessment provided to us on April 7, 2021, has substantial deficiencies and fails to address the majority of the general comments we submitted and the detailed information we requested in our December 14, 2020, letter. These major deficiencies include: (1) failure to address all potential impacts that are expected to occur as a result of the project; (2) inadequate information to determine how stated impacts were determined and evaluated; and (3) conflicting impact assessment calculations and information. Of note is the absence of a meaningful evaluation of the potential project impacts for Atlantic cod. We have significant concerns that the project may result in substantial impacts to Atlantic cod EFH by adversely affecting benthic habitats and causing acoustic impacts that may interfere with cod spawning. These concerns were discussed at length in our December letter and in our follow-up coordination with your staff and the third-party contractor. However, your EFH assessment provides minimal analysis of such impacts and does not respond to our specific information requests or our discussions with you related to the level of detail necessary for the assessment.

Further, the assessment of impacts to EFH is inconsistent with the EFH regulations. This issue was also stated in our December letter and discussed with your staff and the third-party contractor. Your assessment is more consistent with a NEPA analysis. The effects analysis is structured around identified impact producing factors and generally characterizes impacts related to their perceived significance level, rather than evaluating impacts to habitats by activity type or fully analyzing the effects of identified adverse impacts. This approach to the EFH assessment appears to have resulted in both incomplete assessments of the project impact effects to EFH and inconsistent information of project impacts throughout the document. For example, although specifically addressed in both our general comments and detailed information request, your document does not discuss the potential for habitat conversion of small-grained rocky habitats to soft-bottom habitats resulting from cable installation. Further, there are multiple instances of inconsistent project impact calculations presented throughout the document. The inconsistencies in project impact calculations range from very minor differences (e.g. 821 versus 820 acres of vessel anchoring impacts) to moderate differences (e.g. 0.034 to 0.86 acres of dredging for the O&M facility) to major differences (e.g. 0.2 acres of impact per monopile versus 482 to 490 acres of boulder relocation impacts for all monopile installations). Pursuant to the MSA regulations, EFH conservation recommendations are provided to avoid, minimize, or offset adverse impacts to designated EFH for managed species that would occur as a result of the proposed action. While minor deviations in the assessment of a particular impact would unlikely change the basis for our recommendations, moderate to major discrepancies in the calculated impacts of a project element may substantially affect our evaluation of the project and the conservation recommendations necessary to conserve and protect EFH for managed fish species. While we requested detailed information on the specifications and basis for each project component used in the calculations of project impacts in our December 2020 letter and in follow-up meetings, these details for the presented impact calculations are largely missing or unclear.

Also of great concern, on May 20, 2021, we received notice of an updated version of the COP, dated May 7, 2021, that includes new information that was not incorporated or assessed in the EFH assessment. Of particular concern is the additional information provided related to unexploded ordinances (UXO) in the project area. Mitigative actions related to the removal or remediation of UXOs would likely result in impacts to EFH and should be described and evaluated in the EFH assessment. To date we have not received adequate information to determine, if or how the new information presented in the updated COP may affect the basis of our recommendations.

The EFH assessment should be revised to clarify and address the apparent inconsistencies in the project impact calculations and to address the new information included in the May 2021 updated COP. We request that you provide a revised assessment for our review so we may determine whether the new information you provided affects the basis of our EFH conservation recommendations contained herein, or whether supplemental EFH conservation recommendations may be necessary to address the new project information included in the updated COP.

We also recommend that you work with us to develop an EFH template that can be used for future EFH assessments of wind projects in the region. Despite the high level of engagement between our respective staff on habitat concerns and issues related to EFH, that engagement and cooperation between our agencies was not well reflected in your EFH assessment. While we recognize that the tight timelines limit your ability to review and address identified deficiencies in the documents, we cannot continue to consult on these projects with inadequate assessments. An EFH assessment template would provide third-party contractors with a consistent format and basis for the development of project specific EFH assessments moving forward. We welcome the opportunity to work with your staff on the development of such a template in the near term.

Given the expected upcoming workload associated with wind project reviews, there are proactive steps that can be taken to help ensure a more efficient consultation process. As discussed above, the development of an EFH assessment template could help to ensure adequate EFH assessments are provided. However, we also believe it is crucial that you ensure that the COP is complete, and all project information is included and addressed in the EFH assessment prior to initiating consultation with us. This will help to ensure that the full and final project scope is included in the EFH assessment and will minimize the potential for additional workload associated with duplicative project reviews resulting from last minute project changes or new information.

Resources in the Project Area

EFH Designations in the Project Area

The project area is designated as Essential Fish Habitat (EFH) by the New England Fishery Management Council (NEFMC), the Mid-Atlantic Fishery Management Council (MAFMC) and NOAA Fisheries, for multiple federally managed species. These species include Atlantic cod (*Gadus morhua*), summer flounder (*Paralichthys dentatus*), winter flounder (*Pseudopleuronectes americanus*), inshore longfin squid (*Doryteuthis pealeii*), yellowtail flounder (*Limanda ferruginea*), windowpane flounder (*Scophthalmus aquosus*), ocean pout (*Zoarces americanus*), red hake (*Urophycis chuss*), black sea bass (*Centropristis striata*), little skate (*Leucoraja erinacea*), winter skate (*Leucoraja ocellata),* witch flounder (*Glyptocephalus cynoglossus*), Atlantic sea scallop (*Placopecten magellanicus*), Atlantic mackerel (*Scomber scombrus*), Atlantic surfclams (*Spisula solidissima*), albacore (*Thunnus alalunga*), bluefin tuna (*Thunnus thynnus*), skipjack tuna (*Katsuwonus pelamis*), yellowfin tuna (*Thunnus albacares*). In addition, the coastal tiger shark species (*Galeocerdo cuvier*) and sandbar shark (*Carcharhinus plumbeus*) have EFH designated in within the export cable route and the lease area, as do five pelagic shark species (dusky shark (*Carcharhinus obscurus*), blue shark (*Prionace glauca*), porbeagle (*Lamna nasus*), shortfin mako (*Isurus oxyrinchus*), and common thresher shark (*Alopias vulpinus*)).

Some species and life stages may be more vulnerable to effects of the project. Species with benthic life stages as designated EFH may be more vulnerable, particularly those such as Atlantic cod (*Gadus morhua*), Atlantic sea scallop (*Placopecten magellanicus*), Atlantic surfclam (*Spisula solidissima*), little skate (*Leucoraja erinacea*), longfin inshore squid (*Doryteuthis pealeii*), ocean quahog (*Arctica islandica*), scup (*Stenotomus chrysops*), white hake (*Urophycis tenuis*), red hake (*Urophycis chuss*), and winter skate (*Leucoraja ocellata*). Species that are habitat limited, aggregate to spawn, or have benthic eggs and larvae may be more vulnerable to the effects from the project. Project effects are of particular concern for Atlantic cod, a species with benthic life history stages dependent upon complex structured habitats that are vulnerable to project related impacts. Atlantic sea scallop, Atlantic surfclam, and ocean quahog are also particularly vulnerable due to their benthic existence and limited mobility. Winter flounder, ocean pout, Atlantic wolffish and longfin squid are benthic spawners with demersal eggs, making reproduction for these species particularly vulnerable. Atlantic cod and longfin squid aggregate to spawn and may be more vulnerable to longer term impacts if spawning behavior is disrupted.

Habitat Areas of Particular Concern

The project area includes areas designated as Habitat Areas of Particular Concern (HAPC) for summer flounder. HAPCs are designated as high priorities for conservation due to the major ecological functions they provide, and their vulnerability to anthropogenic degradation and development stressors, and/or their rarity. Under Amendment 13 of the Summer Flounder, Scup, and Black Sea Bass Fishery Management Plan, the MAFMC has designated areas of macroalgae and submerged aquatic vegetation (SAV) as a HAPC, when associated with EFH for juvenile and adult summer flounder. This HAPC is present in and adjacent to the project area, particularly along the export cable route that runs from the wind lease area to both landing locations on Long Island, NY.

Cox Ledge

The proposed project is located on Cox Ledge, an area with particularly complex and unique habitat conditions that support a wide range of marine resources. This area provides habitat for feeding, spawning, and development of federally managed species, and supports commercial and recreational fisheries and associated communities. Impacts to complex habitats, such as those found in the project area, are known to result in long recovery times and may take years to decades to recover from certain impacts. Such impacts may result in cascading long term to permanent effects to species that rely on this area for spawning and nursery grounds and the fisheries and communities that target such species. This area is also known to support spawning aggregations of Atlantic cod.

Atlantic cod

Atlantic cod are an iconic species in New England waters and a highly sought-after catch for recreational fishermen. In 2013, the recreational marine bait and tackle industry in New England was estimated to contribute $200 million in total sales, $78.9 million in income, and 1,256 jobs to the local economy (Hutt et al. 2015). Atlantic cod was reported to be the fifth greatest generator of sales. In the most recent Economies of the Fisheries (2016), commercial and recreational fisheries are estimated to contribute 97,000 jobs and generate $8.7 billion in sales annually in the New England region with Atlantic cod remaining one of the key recreational species in the region (NOAA 2018).

Atlantic cod are divided into two stocks for assessment and management purposes, a Georges Bank (GB) and a Gulf of Maine (GOM) stock. The Atlantic cod stock most affected by the project area is the Georges Bank stock, which includes cod found in Southern New England waters and those around Cox Ledge. According to a preliminary 2019 operational assessment, the Georges Bank cod stock is overfished and near record low biomass observed in 2014. Despite recent emergency management actions and severe reductions in fishery resource allocations, cod stocks in the region remain at less than 10% of the target sustainable spawning stock biomass, with the latest stock status report for Atlantic cod GOM and GB stocks estimate at 6-9 percent and 7 percent, respectively, of the target for maximum sustainable yield (National Marine Fisheries Service - 1st Quarter 2021 Update Table A. Summary of Stock Status for FSSI Stocks).

Although the cod resource in southern New England has traditionally been assessed as part of the Georges Bank stock, new information on the stock structure of Atlantic cod in U.S. waters of the northwest Atlantic has identified five separate, but interrelated, spawning sub-populations in the region (Zemeckis et al. 2014a, 2017, NEFSC 2020). The southernmost sub-population is in the area that includes Cox Ledge. These sub-populations have not yet been designated as separate stocks for management purposes, so there are no population size assessments available for them. There is, however, information indicating that, unlike other spawning components, cod in southern New England have increased in abundance during the last 20 years (Langan et al. 2020). Depletion of individual spawning groups of cod is being driven by overfishing and climate change (Mieszkowska et al. 2009), so further reductions in spawning habitat from wind energy construction and operation activities pose an additional, cumulative, threat to local cod resources. Given the state of Atlantic cod stocks and the economic importance of the species to recreational and commercial fisheries, it is essential to minimize adverse impacts to habitats that can support and increase survivorship of critical life stages for cod in southern New England.

Habitat Types within the Project Area

Rocky Habitats

The project area overlaps with structurally complex habitats, including natural rocky habitats that have been identified as occurring throughout most of the project area. Rocky habitats provide three-dimensional structure that plays an important ecological role for fish as shelter and refuge from predators (Auster 1998; Auster and Langton 1999; NRC 2002; Stevenson *et al.* 2004). The relationship between benthic habitat complexity and demersal fish community diversity has also been positively correlated (Malek et al. 2010). Rocky habitats are inherently complex, where their physical complexity provides crevices for species to seek shelter from predation and flow, these habitats also provide a substrate for macroalgal and epibenthic growth that can increase the functional value of these habitats as refuge for juvenile fish. Multiple managed fish species have life history stages that are dependent on, or mediated by, rocky habitats and their associated attributes (Gotceitas et al.1995, Lindholm et al. 1999, Auster 2001, Auster 2005, Methratta and Link 2006). Rocky habitats are particularly sensitive to disturbances that reduce their fundamental complexity, with impacts ranging from long-term to permanent where extended recovery times of biological components are on the order of years to decades (Auster and Langton 1999; Bradshaw et al. 2000, Collie *et al*. 2005; NRC 2002; Tamsett *et al.* 2010). Due to their important role for multiple marine organisms and vulnerability to disturbances, impacts to rocky habitats should be avoided wherever feasible.

Submerged aquatic vegetation

Eelgrass, a submerged aquatic vegetation (SAV), is another complex habitat found in the project area. Eelgrass is known to play a critical ecosystem role. Highly valued as a refuge, nursery ground, and food resource for a number of commercially important finfish and shellfish (Kenworthy *et al.* 1988; Thayer *et al.* 1984), eelgrass also stabilize sediments by buffering the erosive force of waves and currents (Fonseca and Cahalan 1992) and plays an important role in carbon sequestration (Fourqurean *et al*. 2012, Duarte and Krause-Jenson 2017). In many locations along the east coast, eelgrass coverage has declined by fifty percent or more since the 1970's (Thayer et al. 1975, Short et al. 1993, Short and Burdick 1996). Loss of eelgrass is attributed to reduced water quality and clarity resulting from elevated inputs of nutrients or other pollutants such as suspended solids and disturbances such as dredging (Kemp et al. 1983, Short et al. 1993, Short and Burdick 1996, Orth et al. 2006). Eelgrass may also be adversely affected through shading and burial or smothering resulting from turbidity and subsequent sedimentation (Deegan and Buchsbaum 2005, Duarte et al. 2005, Johnson et al. 2008). Given the widespread decline in eelgrass beds along the East Coast, any additional loss to this habitat may significantly affect the resources that depend on these meadows. Successful compensatory mitigation for impacts to SAV can be costly and difficult to implement, making this habitat especially vulnerable to permanent loss. While no eelgrass was found within the cable corridor, eelgrass beds were mapped in the vicinity of the proposed O&M facility, with one bed located approximately 114 m away. We expect direct project impacts can be avoided; however, it will be important to ensure vessel operators have access to updated and accurate eelgrass delineations to ensure vessels associated with project construction or maintenance avoid anchoring within the adjacent beds.

Sand waves

In addition to complex habitats, sand waves provide structural complexity and are specified as components of EFH for multiple managed fish species. Sand ripples and sand waves are found in both the lease area and along the export cable route. Sand waves (ripples and megaripples) found in sandy, high flow environments provide fish with shelter and opportunities for feeding and migration (Gerstner 1998). In addition to providing flow refugia, sand waves may also play an important role in mediating fish-prey interactions and providing shelter from predation (Auster *et al.* 2003). Disruptions of these features during sensitive life history stages may result in disproportionate impacts to the species that rely upon their mediating effects.

Pelagic habitat

The presence of resources within the project area is also driven by pelagic habitat. Water temperatures in this region are warmer at the surface and cooler at the bottom with strong stratified conditions occurring in the spring and summer. Vertical mixing occurs in the fall, maximizing bottom temperatures, followed by a drop in temperatures and nearly isothermal conditions in the winter (Guida *et al.* 2017). Coast wide distributions of fish and macroinvertebrates have recently been shown to align with distributional trends in lower trophic levels, in addition to more generally known physical factors such as temperature and depth (Friedland *et al.* 2019). Species distribution models (Friedland *et al*. 2021) suggest that these primary and secondary production factors are important features of suitable habitat for managed species that are likely to occur in the project area. Specifically, individual taxa are often associated with environmental variables that affect the pelagic habitat including depth, bottom temperature, chlorophyll and thermal fronts, and the presence of several zooplankton species. Large scale changes in hydrodynamics or vertical mixing could potentially affect the habitat suitability for managed species.

Soft Bottom Habitats
Sand and mud habitats serve important functions for the fish and invertebrate species that rely on them for refuge, feeding, and reproduction. These habitat types support distinct benthic communities that serve as EFH for managed fish species by directly providing prey and foraging habitat, or through emergent fauna providing increased structural complexity and shelter from predation. Habitat attributes within fine grained substrates also provide important functions for managed fish species including shelter, foraging, and prey. For example, biogenic depressions, shells, moonsnail egg cases, anemone, and polychaete tubes within mud and sand habitats serve as shelter for red hake (Able and Fahay 1998; Wicklund 1966; Ogren *et al.* 1968; Stanley 1971; Shepard *et al.* 1986). While impacts to soft bottom habitats would affect EFH for multiple managed fish species, soft bottom habitats are expected to recover more quickly than other more complex habitats.

Project Effects to Essential Fish Habitat

Benthic Habitat Impacts

Habitat Conversion and Community Structure
According to the EFH assessment, the South Fork project is expected to result in permanent habitat conversion of 871.6 acres within the SFWF and up to 441.3 acres in the SFEC due to the installation of monopiles, including the foundations and associated scour protection, and inter-array cable protection within the lease area, and for cable protection in portions of the export cable. Permanent impacts of the project will largely result from the addition of artificial hard substrate for foundation and cable protection, boulder clearing, and anchoring within complex habitats. The addition of artificial hard substrate to protect turbine foundations and cables in structurally complex rocky habitats will result in a loss of both physical and biological structural complexity provided previously by natural rocky habitats. The introduction of hard substrate into soft bottom habitats will provide more habitat within the project area for species such as black sea bass and red hake, but will result in habitat loss for other species, particularly bivalves such as ocean quahog and surf clams.

Turbines have been shown to serve as artificial reefs and fish aggregation devices for demersal and semi-pelagic species (Petersen and Malm 2006; Reubens *et al.* 2013; Wilhelmsson *et al.* 2006). Results from Horn Rev I showed that during the first three years after construction, fish species increased in number, while other post-construction studies have shown high spatial and temporal dynamics in fish communities and only minor effects on fish assemblages near the turbines (Leonhard *et al.* 2011; Lindeboom, *et al.* 2011). A meta-analysis examining fish abundance at offshore wind farms in Europe found several factors were associated with higher finfish abundance inside wind farms, including characteristics of the wind farm, sampling methodology used, and location of the farms. Specifically, abundance was higher for soft bottom species and complex-bottom species, but no difference was seen with pelagic species (Methratta and Dardick 2019). Turbine foundations at the Block Island Wind Farm attract large numbers of black sea bass, a common resource species that aggregates around structured benthic habitats to feed and reproduce (HDR 2020). This species is expected to benefit from the addition of WTGs and scour protection. Black sea bass are known to be voracious predators and it is not clear if or how an increase in this species around the WTG would impact sensitive life stages of other fish species including juveniles, eggs, and larvae.

In addition to a change in fish abundance, the introduction of hard artificial substrate in soft bottom areas may result in the presence of species that had not previously used the area. At offshore wind farms in Belgian waters, the introduction of hard substrate in otherwise sandy areas resulted in the presence of fish species that had rarely been observed previously. These effects were more pronounced for turbines that required scour protection (Kerckhof *et al.* 2018). Small scale changes in fish communities observed around wind turbine structures may, in part, be a result of diversification of feeding opportunities and higher food availability (Leonhard *et al.* 2011, Degraer *et al.* 2012).

The addition of artificial hard substrate within natural rocky habitat may also result in shifts in the community composition of fishes, as they often do not mimic natural rocky habitat. The structural complexity of natural rocky habitats such as pebble, cobble, and boulders provide important functional value for fish as shelter and refuge from predators (Auster 1998; Auster and Langton 1999; NRC 2002; Stevenson *et al.* 2004). The type and attributes of artificial hard substrates will be an important factor in how fish species may use these artificial substrates. As previously discussed, natural rocky habitats are inherently complex and multiple managed fish species have life history stages that are dependent on, or mediated by, rocky habitats and their intrinsic fine-scale attributes (Gotceitas et al.1995 , Lindholm et al. 1999, Methratta and Link 2006). The three-dimensional physical structure of rocky habitats creates a diversity of complex crevices within piled cobble and boulder habitats, as well as areas of refuge in the crevices between gravels in pavement habitats and along emergent rock surfaces for species that use the habitats for shelter from predation and flow. These habitats also provide a substrate for macroalgal and epibenthic growth that can increase the functional value of these habitats as refuge for juvenile fish. It also takes time to establish the epifauna and macroalgae that play an important role in mediating the spatial distribution and success of multiple managed fish species, thus the addition of artificial substrates is not expected to mimic natural habitats, particularly for juvenile species. Of particular concern, and addressed in more detail below, are impacts to species such as Atlantic cod that use fine-scale features of natural rocky habitats as shelter from flow and to mediate predation risk.

In addition to fish communities, presence of turbines and artificial hard substrates for scour and cable protection may also affect macrobenthic communities. The addition of turbines and artificial hard substrates within natural rocky habitats would result in losses of established epifaunal communities within the area of placement and are likely to result in impacts to adjacent benthic communities during installation. Similar to fish utilization of artificial habitats, epibenthic colonization of installed artificial hard substrates may vary widely based on the structure and composition of the installed substrate. For example, benthic monitoring at the Block Island Wind Farm found that three years post-construction installed concrete mattress used as cable protection supported no epifaunal growth, indicating that deployment of these devices would have an overall negative effect on organisms that inhabit natural hard bottom substrates (HDR 2019). As discussed in more detail below, artificial substrates provide novel habitats that can provide a platform for the introduction or expansion of invasive invertebrate species. Further, impacts to benthic communities of adjacent natural rocky habitats during installation of artificial substrates are expected to be long-term, with recovery times of the biological components ranging from years to a decade or more (Auster and Langton 1999; Collie *et al.* 2005; NRC 2002; Tamsett *et al.* 2010). The long recovery times of these habitats also provide a pathway for introduced invasive species to expand into adjacent natural hard habitats. Changes to benthic communities within soft-sediment habitats would also be expected, resulting from not only direct conversion of soft to hard substrate within the footprint, but also indirect effects to adjacent soft-sediment habitats. Coates *et al.* (2011) found noticeable differences in the macrobenthic communities with the distance from the turbine, with a lower median grain size and higher macrobenthic densities detected in closer vicinity to the turbine. An increase in local colonizing epifouling communities that develop over time generally results in higher organic matter in sediment closer to turbines; however, the effects on macrobenthic communities appear to be site specific and depend on local-scale factors and the foundation type (Lefaible *et al.* 2018) as well as the age of the turbine (Causon and Gill 2018). Three years after construction at the Block Island Wind Farm, coarse sandy sediments under turbines had been converted to organically enriched soft sediment supporting dense mussel aggregations with increases in mussel growth extending 90 meters out from the turbines (HDR 2020).

Given that the changes in fish distribution and macrobenthic communities may depend on site specific conditions and type of structure, it is important to understand local effects of habitat conversion on fish species, as well as primary productivity and macrobenthic communities. While the addition of artificial hard substrate could aid to offset some of the losses of natural rocky habitats that will result from the construction and operation of the proposed project it will be necessary to evaluate changes at the site to understand impacts to the local ecosystem and habitat use by regional fish species. The success of placed artificial hard substrate in offsetting losses of natural rocky habitats will be highly dependent on the physical attributes and composition of the novel hard substrate and the fine scale features of the natural rocky habitats that will be lost.

Invasive Species

The introduction of new artificial hard substrate into the environment may also provide habitat for non-native species. The number of non-native species on new artificial hard substrate can be 2.5 times higher than on nature substrate, which may provide opportunities for the spread of introduced species (Glasby *et al.* 2007, Taormina *et al.* 2018). Some post-construction studies have observed invasive species colonizing on turbines and scour protection rocks (Degraer *et al.* 2012; De Mesel *et al.* 2015; Guarinello and Carey 2020; HDR 2020; Lindeboom *et al.* 2011), using the introduced substrate to expand their range in the area (De Mesel *et al.* 2015). Fouling assemblages often differ between manmade structures and natural hard bottom habitat, and some evidence suggests these structures can potentially influence biota on adjacent natural hard substrate (Wilhelmsson and Malm 2008). This may be of particular concern for the natural rocky hard bottom habitat to be impacted with the lease area on Cox Ledge.

The invasive tunicate *Didemnum vexillum* (*D. vexillum)* has been expanding its presence in New England waters. Benthic monitoring at the Block Island Wind Farm have shown that this species is part of a diverse faunal community on morainal deposits and is an early colonizer along the edges of anchor scars left in mixed sandy gravel with cobbles and boulders (Guarinello and Carey 2020). Four years after construction at the Block Island Wind Farm, *D. vexillum* was common on WTG structures (HDR 2020). Studies have shown that activities that cause fragmentation of *D. vexillum* colonies can facilitate its distribution (Lengyel *et al.* 2009; Morris and Carman 2012). It is important to minimize or eliminate activities that return fragmented colonies of *D. vexillum* to the water column, to reduce the spread of this invasive species (Morris and Carman 2012). We expect the effects of turbine and cable installation within hard bottom habitat where *D. vexillum* is present could fragment the invasive colonies. The addition of new artificial substrate used for cable and scour protection and the presence of WTG structures may provide habitat for this invasive tunicate. It will be necessary to incorporate an invasive species monitoring component into a benthic monitoring plan.

Juvenile Cod

The project area overlaps with structurally complex habitats on Cox Ledge and along the cable corridor and are particularly important for the survival of newly settled juvenile cod. Multiple studies have demonstrated that despite the potential that juvenile cod may initially settle to the substrate indiscriminately, age-0+ juveniles are more abundant in complex habitats (e.g. rocky or vegetated habitats) (Cote *et al.* 2004; Fraser *et al.* 1996; Gotceitas *et al.* 1997; Gotceitas and Brown 1993; Grant and Brown 1998; Keats *et al.* 1987; Lazzari and Stone 2006; Linehan *et al.* 2001; Lough *et al.*, 1989). Tupper and Boutilier (1995) found settlement of cod did not differ between habitat types, but post settlement survival and juvenile densities were higher in more structurally complex habitats, with cod survival highest on rocky reefs and cobble bottoms. A mark-recapture study found a level of site fidelity exhibited by the age-0+ juvenile cod sampled indicating that once settled into complex habitat juvenile cod maintain a level of residency within that habitat (Grant and Brown 1998). Further, rocky habitats provide a substrate for epibenthic growth that provides additional complexity and serves as refuge for juvenile fish that has been shown to significantly increase survivorship of juvenile cod (Lindholm *et al.* 1999 and 2001). These complex benthic habitats are vulnerable to disturbance that may range from long-term to permanent, with extended recovery times on the order of years to decades (Auster and Langton 1999; Collie *et al*. 2005; NRC 2002; Tamsett *et al.* 2010). Permanent losses of these complex habitats or disturbances that result in a reduction of structural complexity, either the physical or biological component of the habitat, during and just after settlement occurs, are likely to have substantial impacts on the recruitment of juvenile cod in the project area.

As discussed in more detail below, the best available science indicates that spawning in the project area peaks in the late fall/early winter (November-January) with additional spawning likely occurring in the late winter/early spring (February-April) (Deese 2005, NEFSC 2020). Studies conducted on Georges Bank found cod settlement begins approximately 3-4 months post-spawn (Lough *et al.* 1989). Based on this information, we would expect most settlement to occur in the project area from late winter to late spring. The timing of benthic disturbances including placement of scour protection, boulder clearing, cable installation throughout the SFWF and the SFEC, and anchoring could impact settlement of juvenile cod in this area through direct disturbance of habitat.

Cod Spawning

The EFH Assessment does not fully acknowledge the importance of Cox Ledge as a known spawning location for Atlantic cod, instead stating that it *may* provide important spawning habitat for cod. Information provided in multiple sources has documented that Cox Ledge is an important spawning ground for cod (Deese 2005, Zemeckis 2014c, NEFSC 2021). Spawning on Cox Ledge occurs between November and April, with peak spawning expected between December and March (NEFSC 2020). However, preliminary results from a BOEM-funded acoustic and telemetry study[1] suggest peak spawning times for cod on Cox Ledge and within the project area occur between

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[1] Van Parijs pers.comm. related to ongoing study - Mapping the distribution of habitat use of soniferous fish on Cox's ledge, with a focus on Atlantic cod spawning aggregations (BOEM. Award #M19PG00015)

November and January (Van Parijs pers comm). Adult cod that spawn in southern New England are primarily residential, with high rates of site fidelity (Zemeckis 2014c, NEFSC 2021). Spawning cod also congregate over specific substrate types, gravel during the day when resting and adjacent muddy areas at night (Siceloff and Howell 2013). Atlantic cod spawning on Cox Ledge have recently been identified as genetically distinct from other spawning groups (Clucas et al. 2019). These factors increase the vulnerability of this population to impacts resulting from reduced spawning success. Physical habitat disturbance occurring during spawning may interfere with mating behavior and egg production (Dean et al 2014, Siceloff and Howell 2013). Spawning cod form dense aggregations (known as "haystacks") prior to and during spawning that last for days to weeks. Cod spawning aggregations are easily disrupted and disturbances may result in the dispersion of spawning aggregations for extended periods. In the Gulf of Maine, subsequent to the dispersion of a spawning aggregation by bottom gillnet fishing, the dispersed cod did not return to the spawning site for the duration of the spawning season (Dean 2012).

The construction activities in the South Fork project area are proposed to occur 24 hours a day for the duration of project construction. Pile driving is expected to occur from May through December. Due to the vulnerability of spawning aggregations to physical disturbance during spawning and their affinity to specific bottom types and spawning sites, we strongly recommend that measures to avoid and minimize impacts resulting from the construction and operation activities within the South Fork lease area and along the offshore cable corridor are implemented. At a minimum, benthic and demersal construction activities, including pile driving and bottom disturbing activities, should be restricted during the peak spawning season. Based upon the preliminary results of the ongoing BOEM funded study, this would require a time of year restriction from November through January. However, since there is limited data available from the ongoing study, we recommend BOEM extend the time of year restriction through March, consistent with the prior determinations of the peak spawning period for this spawning aggregation. Reduced recruitment, even during a single year, could have a substantial impact on this population. There are also indications that this stock is increasing in size, unlike other stock components that have been severely depleted by overfishing (Langan et al. 2020). Given the current stock status for the species in the region, there is the potential for substantial negative effects for the population should spawning activities be adversely impacted in this segment of the stock.

Sedimentation Effects

Several of the project construction activities will result in the suspension and redeposition of fine-grained sediments, including cable installation, boulder clearing, the placement of scour and cable protection, anchoring, and dredging. Sedimentation impacts will be most impactful for epibenthic invertebrate species and sensitive life stages of fish, such as demersal eggs. Sedimentation impacts vary by habitat type and the depth of deposition. Adverse impacts in soft bottom habitats typically occur as a result of substantial deposition events or burial of demersal eggs, whereas adverse sedimentation impacts in hard habitats may occur even with limited deposition of sediments. The deposition of fine-grained sediments within rocky habitats may result in adverse impacts ranging from the loss of attached epifauna due to smothering, to inhibiting the settlement of larvae resulting from even small depths of deposition on rock surfaces. The proposed construction period of May through December will overlap with peak invertebrate and shellfish spawning and/or settlement periods, which generally occur between April 15 and October 15, with specific spawning timings dependent on the species. Demersal eggs are sensitive to sedimentation impacts (Berry *et al.* 2011; Newcombe and Jensen 1996) and are expected to be impacted by project construction, including cable laying and dredging, as well as direct impacts associated with construction and placement of scour protection within the lease area. Species with designated EFH with demersal eggs include winter flounder, longfin squid, and ocean pout.

Winter flounder, a federally managed species with EFH designated in the project area, may be more vulnerable to project impacts, particularly inshore construction associated with the O&M facility. Winter flounder typically spawn in the winter and early spring, although the exact timing is temperature dependent and thus varies with latitude (Able and Fahay 1998); however, movement into these spawning areas may occur earlier, generally from mid- to late November through December. Winter flounder have demersal eggs that sink and remain on the bottom until they hatch. After hatching, the larvae are initially planktonic, but following metamorphosis they assume an epibenthic existence. Winter flounder larvae are negatively buoyant (Pereira et al. 1999) and are typically more abundant near the bottom (Able and Fahay 1998). Young-of-the-year flounder tend to burrow in the sand rather than swim away from threats. Increased turbidity and the subsequent deposition of the suspended sediments can smother the winter flounder eggs and adversely affect their EFH. Avoiding in-water construction activities such as dredging and pile driving when early life stages are present, particularly in estuarine areas, would avoid and minimize adverse effects to winter flounder EFH for these early life stages. We recommend dredging and silt-producing activities associated with nearshore construction be avoided from January 1 to May 31 to minimize adverse effects to winter flounder eggs and larvae.

Longfin squid also have EFH designated in the project area, including for sensitive early life stages. Squid egg mops are attached to the seabed and may be impacted by project construction through direct loss, dislodging, turbidity and sedimentation. Scientific literature indicates that jarring of egg masses that are near the late stages of embryonic development results in premature hatching and high mortality of the embryos. The egg masses require clear, well-oxygenated overlying water for normal embryonic development so sediment resuspension during cable laying and dredging is expected to impact squid eggs within the cable corridor (Boletzy and Hanlon, 1983; Vidal *et al.* 2002). Impacts to squid eggs will be dependent upon the time of year the project is constructed. Squid mop biomass is highest between May and August. Construction activities during this time, particularly installation of the SFEC and associated dredging offshore Long Island, would likely result in adverse effects to longfin squid eggs.

Electromagnetic Fields

EFH in the project area will also be altered through the emission of electromagnetic fields (EMF) during transmission of the electricity produced during project operation. The project is proposing to construct two 220 kiloVolt (kV) alternating current (AC) offshore export cables with a targeted minimum burial depth of 1.5 m. The two cables will be located approximately 100 m (328 ft) apart, within the proposed export cable corridor. While shielded cables can restrict electric fields, they cannot shield the magnetic component of EMF (Boehlert and Gill 2010) and the movement of water through the magnetic fields induces localized electric fields (Ohman *et al.* 2007).

Burial depth has been suggested to be the most effective means of minimizing magnetic fields (Ohman *et al.* 2007). While the developer will attempt to fully bury the cable for this project, cable protection will be used in areas where minimum burial depth cannot be obtained. We would expect EMF emissions to be greater in those areas. Field measurements of two high voltage DC cables operating in our region found EMF emission deviations based on power transmitted and the burial depth of the cables (Hutchison *et al.* 2018). While deeper burial does not dampen the intensity of EMF, it increases the distance between the cable and seabed or water column, where marine species will detect the EMF emissions. The study did find that even with lower emissions from burial, the EMF emissions were still within levels detectable by marine species (Hutchinson *et al.* 2018).

Many animal groups in the marine environment can sense and respond to EMF, including elasmobranchs, crustacea, teleosts and chondrosteans (Hutchison *et al.* 2018; Thomsen *et al.* 2015; Normandeau *et al.* 2011). Elasmobranch sensitivity to EMF has been documented (Gill *et al.* 2009; Normandeau, 2011) and evidence suggests that sharks may be able to differentiate between EM fields (Kimber *et al.* 2011). A recent field enclosure study showed American lobster (*Homarus americanus*) exhibited a statistically significant but subtle change in behavioral activity when exposed to the EMF emissions from a high voltage DC cable, and little skate (*Leucoraja erinacea*) exhibited a strong behavioral response to the EMF (Hutchison et al. 2020). While behavioral changes were demonstrated, the EMF did not constitute a barrier to movements across the cable for either species (Hutchison *et al.* 2018). However, free-ranging field studies for sensitive species are needed to understand if their natural spatial movements are affected by EMF emissions (Hutchinson *et al.* 2018, Klimley *et al.* 2021). These studies are particularly important, to understand how multiple offshore wind projects affect species migration or habitat use in these areas.

While recent studies have provided more information on this topic, uncertainties still exist around the impacts of EMF emissions on fish and invertebrates, as information on sensitivity thresholds is limited and the biological significance of species detection on a population scale remains unknown (Boehlert and Gill 2010, Taormina *et al.* 2018). EMF emissions are expected to be higher along the export cable than the inter-array cables due to the level of power running through the cables (Thomsen *et al.* 2015). However, the potential impacts on marine fauna from a network of multiple cables in close proximity, across multiple projects, remain uncertain. While BOEM has made the determination that impacts of EMF on fish species in southern New England are negligible (CSA 2019), cumulative effects of multiple wind farms must also be considered (Taormina *et al.* 2018), and therefore, EMF research would be an important component of any monitoring plan, particularly at a cross-project or regional scale. Before and after assessments of EMF emissions associated with cable networks and transport cables are needed (Boehlert and Gill 2010, Hutchinson *et al.* 2018). Observational studies from existing cables and soon to be constructed cables can be used to validate and improve modeling efforts. Such information is necessary to work toward understanding how these projects are modifying habitat and potentially impacting marine resources, particularly at a cumulative scale.

Measures to avoid and minimize impacts to complex benthic habitats

As discussed above, we expect this project to have substantial long-term to permanent impacts to complex habitats as a result of both WTG and inter-array cable installation. While the proposed action considers micrositing of turbine and cable locations to avoid and minimize impacts to sensitive habitats there are limited options for micrositing of turbine and cable locations due to the extensive presence of complex habitats within the identified area. Therefore, the presence of complex habitat in the area substantially limits the effectiveness of micrositing for each turbine location and within the cable corridor in avoiding or adequately minimizing impacts to complex habitats. Other factors, including the need to maintain a 1 x 1 nm turbine layout and engineering restrictions, reduce the feasibility of micrositing to avoid habitat impacts. In some cases, as described below, there are opportunities to microsite to minimize impacts to complex habitats, but we expect the benefits to benthic habitat and fauna to be minimal. As we describe below, micrositing, combined with other measures, may effectively mitigate project impacts to complex habitat.

While not reflected in the EFH assessment, we met with BOEM staff several times to discuss the South Fork habitat data and the feasibility for micrositing to minimize project impacts. Subsequent to the submittal of our December 14, 2020, request for additional information letter, we met with BOEM multiple times between January to March to evaluate the potential for micrositing each of the proposed individual WTG locations, including the two alternate locations, and the inter-array cable routes to avoid and minimize impacts to complex habitats. As you are aware from those discussions, we reviewed multiple layers of data provided by the developer in both an online data viewer portal and as GIS files for our evaluation of the impacts to complex habitat and in our assessment of whether micrositing could avoid or minimize the identified impacts.

We used all the data available to us to evaluate project impacts. For each individual turbine location and inter-array cable route, we first considered the complex, potentially complex, and soft bottom habitat delineations. We further considered the underlying data used to support the delineations at a fine scale for each turbine and inter-array cable route. The additional data we considered included: 1) the multibeam backscatter mosaic provided in the online viewer; 2) the side scan sonar mosaic provided in the online viewer, and at a 0.10-meter resolution as a GIS shapefile; 3) the "boulder pick" data layer provided in both the online viewer and as a GIS shapefile; and 4) the available benthic sample data provided in the online data viewer portal.

Based on the available data, we evaluated the potential for using micrositing to avoid and minimize impacts to complex habitats at each of the proposed WTG locations, including the OSS and two alternate locations, and along the cable routes. In our assessment of project impacts we grouped turbine locations and cable routes based on scenarios identified in BOEM's Draft Environmental Impact Statement for the project.

Scenario A: WTGs are sited within and adjacent to complex habitat and micrositing would not reduce impacts to complex habitats.

We found five (5) turbine locations where micrositing would not avoid or minimize impacts to complex habitats. Specifically, the identified turbine locations include WTGs 1, WTG 7, and WTG 15, as well as the alternate locations 16A and 17A. The inter-array cable routes where micrositing would not avoid impacts include the cables connecting the WTGs 5, 12, and 15 to the array. Construction of WTGs at these locations and the associated inter-array cables would result in substantial unavoidable long-term to permanent impacts to complex habitats. Specifically, WTG locations 1, 15, 16A and 17A are located within or adjacent to larger continuous areas of complex habitats.

Project impacts to complex habitat at WTG 7 would be less than anticipated impacts at the other WTG locations grouped within this scenario. This turbine location was determined to fall within Scenario A, as impacts to complex habitat would be unavoidable, but micrositing the turbine location would not appear to result in the minimization of these impacts. Habitat in and around the

WTG 7 location is heterogenous and we do not expect micrositing at this location would reduce impacts to complex habitat.

Scenario B: WTGs are sited within and/or adjacent to complex habitats and micrositing (if engineering and spacing restrictions allow) would reduce, but not fully avoid, impacts to complex habitats.

Impacts to complex habitats at three (3) turbine locations, including the OSS, and each of the remaining turbine to turbine inter-array cable routes, could be minimized by micrositing, but substantial unavoidable impacts to complex habitats would remain. Specifically, these turbine locations include WTG 5, WTG 12, and the OSS location. Construction at these locations is expected to have substantial direct impacts to complex habitats even with micrositing and mitigation measures imposed on seafloor disturbances during construction. The WTG 5 and WTF 12 areas are located within or immediately adjacent to large areas of continuously complex habitat areas. WTG 5 is proposed within a unique habitat feature that overlaps with cod activity in the area. While micrositing of the turbine location would minimize the direct impacts to complex habitat, the proposed turbine location overlaps with a unique habitat feature of softer sediments surrounded by complex habitats with a high density of large boulders and megaclasts. It would also be infeasible to route the cable connection to this turbine location without resulting in substantial impacts to this complex area. The ongoing Atlantic cod surveys have documented spawning activity in the area surrounding WTG 5.

Scenario C: WTGs are sited within and/or adjacent to complex habitats and micrositing, (if engineering and spacing restrictions allow) would fully avoid impacts to complex habitats.

During our evaluation, it was determined that eight (8) of the turbine locations could potentially be microsited to avoid impacts to complex habitats, while maintaining the 1 x 1 nm turbine layout. To fully avoid impacts to complex habitats, restrictions within areas of temporary bottom disturbances would be necessary during turbine installation. The turbine locations where micrositing and seafloor disturbance restrictions could avoid impacts to complex habitats include WTGs 6, WTG 8, WTG 9, WTG 10, WTG 13, and WTG 14. Based on the available data reviewed, micrositing of WTG 2 and WTG 4, may be necessary to avoid impacts to complex habitats, but the benefits of micrositing are expected to be minimal.

Scenario D: WTGS are sited in areas outside of complex habitats (i.e., sited wholly in [soft bottom] habitat) and micrositing is not necessary to avoid impacts to complex habitats.

Based on our review of the delineations and underlying data, we identified two (2) turbine locations, WTG 3 and WTG 11, that would not require micrositing to avoid or minimize impacts to complex habitat. The proposed inter-array cable connecting WTG 3 to WTG 4 was also identified as not requiring micrositing to avoid complex habitat impacts.

Based on this turbine by turbine and cable route evaluation to assess the feasibility of using micrositing alone to avoid and minimize impacts to complex habitats, substantial impacts to complex habitats would be unavoidable even without imposing any additional or unforeseen micrositing limitations resulting from engineering restrictions or the presence of unexploded ordinances. While the EFH assessment does not consider the Fisheries Habitat Minimization Alternative currently being evaluated as a project alternative under the NEPA review process, we recommend that BOEM fully consider and adopt this alternative to ensure that the substantial permanent and long-term impacts to EFH are avoided and minimized to the greatest extent possible.

Consistent with this evaluation, we have included specific EFH conservation recommendations for each WTG location and a general cable route recommendation below. Generally, we recommend that you consider removing from the project the turbine locations and cable routes identified as falling within the Scenario A and B bins, as they are expected to have the greatest long-term impacts to complex habitats. In the evaluation of micrositing for each turbine location and cable route identified as consistent with either Scenario B or Scenario C, we recommend that you relocate the turbines and cables to areas, within the micrositing limitations, that exhibit the lowest multibeam backscatter returns.

Should BOEM determine that it is not feasible to eliminate all the turbine locations under Scenarios A and B, we recommend that you consider both the direct impacts of the proposed turbine and cable routes as well as the location of the turbine and cable in the context of the surrounding habitat. Specifically, we consider construction and operation of WTGs 1, 5, 15, 16A and 17A to result in the greatest impact to complex habitats due to the anticipated direct and indirect impacts of these locations and associated cables. While WTG 12 and the OSS would also result in substantial permanent impacts to complex habitats, we understand that the removal of seven turbine locations would not meet the purpose and need of the project. We recommend that you fully evaluate both direct and indirect impacts to complex habitats in the project area as you consider our EFH conservation recommendations related to turbine location and cable route removal.

In addition to turbine removal and micrositing, measures to further minimize impacts to complex habitats can be achieved during construction and maintenance of the project. This can include the development of anchoring plans with identified areas restricted for anchoring to ensure vessels avoid anchoring in sensitive habitat areas. The placement of mid-line buoys along anchor chains can also minimize impacts of anchor sweep on the seafloor. Given the particularly complex nature of Cox Ledge, all feasible measures to avoid and minimize adverse impacts to EFH should be required.

Pelagic Habitat Impacts

Acoustic Effects

The project will also affect EFH through changes in the acoustic environment, which will occur during all phases of the project, construction, operation, and decommissioning. The greatest acoustic effects are expected to come from construction activities (Hoffmann *et al.* 2000). While elevated noise level will occur during construction from increased vessel traffic and cable installation (Taormina *et al.* 2018), noise generated from pile driving during construction of the wind turbine generators is expected to result in the greatest noise levels and affect a more extensive area of EFH.

High levels of acoustic exposure have been shown to cause physical damage and/or mortality in fishes. Pile driving, specifically, is the only other anthropogenic sound source other than explosives that has been known to cause fish kills. The level and duration of sound exposure from pile driving appear to contribute to the degree of damage to fish species (Popper and Hastings 2009). Fish can experience injury from sound exposure both physically, (i.e., tissue damage) as well as physiologically through increased stress levels (Anderson *et al.* 2011; Banner and Hyatt 1973; Popper and Hawkins 2018; Popper and Hawkins 2019). Sound exposure can also result in temporary threshold shifts (TTS) or a temporary decrease in or loss of sensitivity (Amoser and Ladich, 2003).

Effects of acute and chronic sound exposure may also affect necessary life functions for fish and invertebrates, including health and fitness, foraging efficiency, avoidance of predation, swimming energetics, migration, and reproductive behavior (Hawkins and Popper 2017; Popper and Hawkins 2019). Behavioral impacts to fish and invertebrates from anthropogenic noise remains a concern, as noise generated through pile driving may affect a much larger area than mortality and injury (Popper and Hawkins 2016, 2019). A study in Europe has shown that cod and herring can perceive construction noise at distances up to 80 km from the source (Thomsen *et al.* 2008). The behavioral responses from acoustic effects in fish is less understood and may vary by species (Popper and Hawkins 2018; Popper and Hawkins 2019). Behavioral impacts can include startle responses or if capable, fish may leave the area of elevated noise levels (Feist 1992; Nedwell *et al.* 2003; Popper and Hastings 2009; Samson *et al.* 2014, Slotte *et al.* 2004), eliminating the ability of fish species to use the habitat for feeding or reproduction. Migratory routes may also be altered when fish are frightened away from areas. Stanley *et al*. (NMFS/WHOI, unpublished data) shows that the most sensitive hearing frequencies of black sea bass directly overlap with anthropogenic sound such as that produced from the construction of offshore wind farms, e.g., pile driving and vessel sound. Further, within a controlled environmental setting, black sea bass exposed to replayed pile driving signals showed consistent observable reactions to sound onset, exhibiting changes in general behaviors such as time resting on the benthos and swimming (Shelledy *et al*., NMFS-NEFSC, unpublished data). Elevated noise levels may also result in masking or a reduction in an animal's ability to hear necessary natural sounds (Popper and Hawkins 2019; Thomsen *et al.* 2006; Wahlberg and Westerberg 2005). Effects of noise on habitat is of particular concern for reproduction. There is little information on how noise disrupts reproduction in fish (Hawkins *et al.* 2014), but disruption in reproduction, particularly for species that aggregate when they spawn, is of concern.

Noise from pile driving activity may also impact sensitive life stages and habitat (Hastings and Popper 2005; Popper and Hasting 2009), including disruption of larval settlement (Popper and Hawkins 2019). Developing larvae may have different levels of sensitivity to noise at varying stages of development with potential for impacting larval growth in some fishes (Banner and Hyatt 1973). Nedelec (2015) exposed Atlantic cod larvae to random ship noise and regular intervals of noise and found that fish that were exposed had lower body width-length ratios, an indicator of condition. The authors suggest that 45 minutes between noise exposure periods did not allow for sufficient energetic recovery from the disruption of foraging, leading to a cumulative stress response.

There is much less known about acoustic impacts on invertebrates, as there is little information available on how invertebrates detect sound (Popper and Hawkins 2018). However, a study looking at scallop larvae demonstrated that noise exposure may result in malformations in early larval stages, suggesting potential reductions in recruitment from noise exposure (de Soto *et al.* 2013). Sessile species and sensitive life stages, such as demersal eggs, are expected to be vulnerable to noise emitted through project construction, due to their inability to leave the area. The vibrations at the interface between the sediment and water column can extend several kilometers from the source and potentially impact bottom dwelling species in the project area (Thomsen *et al.* 2015, Hawkins and Popper 2017, Popper and Hawkins 2019).

Sound Pressure

Guidelines have been established to provide protection to fish species (Popper *et al.* 2014 and FHWG 2008) and these guidelines are included in the evaluation of acoustic impacts in the EFH Assessment. However, only the behavioral guidelines provided in FHWG (2008) were used in the EFH assessment. The guidelines in the FHWG (2008) for smaller (<0.2 g) and larger (>/+0.2g) individuals that would allow for the assessment of impacts to juveniles were not included in the EFH assessment. The assessment focuses solely on sound pressure and the susceptibility of sound pressure on different fish species. The impacts of sound pressure on fish may vary depending on physiology. Fish with swim bladders may be more sensitive to sound pressure than fish without swim bladders, while fish with swim bladders that use hearing, such as Atlantic cod, may be most vulnerable to impacts from pile driving (Popper *et al.* 2014). No guidelines have been established for invertebrates (Popper and Hawkins 2018; Hawkins and Popper 2017).

Particle Motion

There is a growing body of knowledge demonstrating the importance of particle motion, which accompanies transmitted sound waves, in the sensitivity of fish and invertebrates to noise (Hawkins and Popper 2017; Mooney *et al.* 2010; Mueller-Blenkle *et al.* 2010; Nedelec *et al.* 2016; Popper and Hawkins 2018; Solé *et al.* 2017). While some fish can detect sound pressure, particularly at high frequencies, all fish detect and use particle motion, including elasmobranchs and fish that are sensitive to sound pressure (Popper and Hawkins 2018 and 2019). Particle motion is fundamental to the hearing of fish and invertebrates and may allow fish to detect the direction of the sound source (Nedelec *et al.* 2016; Popper and Hawkins 2019). When considering the potential effects of acoustics on fish, it is important to not just consider sound effect, but also particle motion (Popper and Hawkins 2018).

While the EFH assessment acknowledges the importance of particle motion, the impacts to fish species are not evaluated due to the lack of threshold standards or measurement and modeling standards. The difficulty in measuring and modeling particle motion and the lack of guidelines to indicate the levels of particle motion that may adversely affect fish and invertebrate species has often led to inadequate assessments of acoustic impacts (Popper and Hawkins 2018). More studies are also needed to better understand hearing sensitivities to particle motion to inform standards and guidelines (Popper and Hawkins 2018 and 2019). Given the number of offshore wind projects planned off the east coast, additional studies on this topic are warranted.

Effects On Cod Spawning

Atlantic cod are known to spawn offshore on Cox Ledge and Nantucket Shoals between November and April, with peak spawning expected between December-March (NEFSC 2020). However, preliminary results from a BOEM-funded acoustic and telemetry study[2] suggest peak spawning times for cod on Cox Ledge and within the project area occur between November and January (Van Parijs pers comm). Cod form dense aggregations during spawning (known as "haystacks") that last for days or weeks. Evidence of spawning cod has been reported near and within the project area (Gervelis and Carey 2020; Van Parijs pers. comm.). Spawning aggregations can be easily disturbed by demersal activities and disruptions to spawning aggregations may affect reproductive success, which could result in significant long-term effects to the stock (Dean et al. 2012, Zemeckis et al. 2014c). Research in the Gulf of Maine found that once spawning cod left the area from in-water

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[2] Van Parijs pers.comm. related to ongoing study - Mapping the distribution of habitat use of soniferous fish on Cox's ledge, with a focus on Atlantic cod spawning aggregations (BOEM. Award #M19PG00015)

disturbances such as gillnet fishing, they did not return (Dean et al. 2012). Research in the Gulf of Maine has also shown that cod exhibit strong fidelity to chosen spawning sites, returning to the same site year after year (Zemeckis et al. 2014b). Observations of the movements of spawning cod using acoustic tags has also shown that they congregate over specific substrate types - gravel during the day when resting and adjacent muddy areas at night (Siceloff and Howell 2013). There is also evidence that cod in southern New England are less connected (by larval transport) to other spawning stocks, meaning that they are more susceptible to local depletion by mechanisms such as warming water temperatures, overfishing, and the adverse impacts of wind farm construction (NEFSC 2020). The combined effects of underwater sound and physical disturbance of the water column and the seabed pose serious risks to the maintenance of the southern New England cod stock and recruitment to the fishery.

Measures to minimize acoustic impacts

Effects from pile driving may be minimized with the use of mitigation measures. Specifically, avoiding pile driving and in-water activities that may disrupt spawning activity could avoid impacts to sensitive life stages such as spawning activity. In addition, noise dampening measures may reduce the overall extent of EFH affected by pile driving activity. The EFH assessment indicated the project will be required to use noise dampening methods to reduce noise levels by at least 10 dB, though these methods have not yet been defined. Some noise dampening methods, such as bubble curtains, may be effective in reducing sound pressure emitted from pile driving, but may be less effective in reducing impacts of particle motion (Andrew Gill, pers. comm., Oct 25, 2018, Narragansett, RI). In addition, on-site verification is important; a study in Belgium measuring noise levels from pile driving found that a single bubble curtain proved less effective at mitigating noise effects than predicted (Norro 2018). Some additional measures such as soft start, where noise levels are slowly ramped up to allow animals to evacuate the area, may help reduce the extent of mortality. However, this may not be effective for all species, particularly those that cannot easily move out of the area or for species that either do not exhibit flee response or may have delayed flee responses.

Operational Noise

Operation of offshore wind turbines also results in acoustic emissions, though there is limited information available on the acoustic characteristics of offshore turbines (Popper and Hawkins 2019). Based on the evaluation in the EFH assessment, you do not anticipate detectable impacts on acoustic habitats through project operations. The analysis in the EFH assessment is based on sound pressure measurements taken at the Block Island Wind Farm (BIWF). The BIWF project includes 5 jacket pile turbines which emit an average sound pressure intensity of 119 dB above background levels at a distance of 50 m from turbine foundations during operation. South Fork Wind Farm is using a monopile foundation and noise emissions may vary as studies have found the distances and ability of fish to detect operating wind turbines may depend on conditions at the project site, including the type and number of turbines, water depth, substrate and wind speed (Wahlberg and Westerberg 2005). Existing studies suggest operational noise may be detectable by some fish species, with species such as cod and herring detecting the noise several kilometers away, which may result in masking of communication for some species that use sound; however, behavioral impacts or avoidance is currently expected to be restricted within close range of the turbines (Thomsen *et al.* 2008; Tougaard *et al.* 2008; Wahlberg and Westerberg 2005). However, as noted in the EFH assessment, underwater noise sufficient to alter behavior or cause TTS could have disruptive effects on cod spawning (Dean et al. 2012).

More precise information is needed on turbine emissions, including both sound pressure and particle motion, as well as effects on the seabed (Thomsen *et al.* 2015; Wahlberg and Westerberg 2005; Roberts and Elliot 2017). There is also a lack of scientific knowledge on ambient seabed vibrations, which is necessary to understand any potential effects on the seabed from project operation (Roberts and Elliot 2017). It is important to measure ambient noise prior to construction to obtain background levels and therefore, better understand project effects (Thomsen *et al.* 2015). Given the potential impacts of noise on EFH from both construction and operation, acoustic monitoring will be a critical component of a monitoring plan. The monitoring plan should also address potential effects of the project to cod spawning activities in and around the project area throughout construction and the operation of the project.

Turbidity/Entrainment Effects

Cable installation and dredging will result in both turbidity from the suspension of fine grain sediments and entrainment impacts to pelagic habitats. Boulder relocation as well as scour and cable protection placement will also result in turbidity impacts to pelagic habitats. Elevated suspended sediments in the water column have been documented to result in adverse impacts to various life stages of fish. High turbidity can impact fish by requiring greater utilization of energy, gill tissue damage and mortality (Newcombe and Jensen 1996; Wilber and Clark 2001). Turbidity and entrainment impacts will be most impactful for sensitive life stages of fish, such as demersal eggs and larvae and demersal invertebrate species. The lease area and cable route are designated EFH for sensitive life history stages of multiple managed fish species, including Atlantic cod and several demersal shellfish species including surf clam, ocean quahog and sea scallops. Demersal eggs, larvae, and juveniles are also sensitive to turbidity and sedimentation (Berry *et al.* 2011; (Newcombe and Jensen 1996) and are expected to be impacted by project construction with effects ranging from direct mortality to behavioral impacts. Shellfish are susceptible to elevated levels of suspended sediments which can interfere with spawning success, feeding, and growth (Newcombe and MacDonald 1991; Wilber and Clark 2001). Cable installation will also result in impacts to shellfish and finfish eggs and larvae from water withdrawals. Water withdrawals would result in 100% mortality of any eggs or larvae (benthic and pelagic) that becomes entrained. As discussed above, Atlantic cod eggs and larvae are expected to occur in the project area from late winter through late spring. While the extent of mortality of eggs and larvae will depend on the timing of installation, cable laying activity occurring in the spring, particularly in the area of Cox Ledge, is expected to result in greater entrainment of settling or recently settled cod larvae. The proposed cable construction period will overlap with peak shellfish spawning and/or settlement periods which generally occur between April 15 and October 15, with specific spawning timings dependent on the species.

Hydrodynamic Effects

A limited number of studies have analyzed offshore wind farm effects on pelagic ecosystems. Evaluations have been assessed through modeling and by direct observation (van Berkel et al. 2020). As acknowledged in the EFH Assessment, modeling studies have found that wind farms can alter vertical mixing and seasonal stratification in areas outside the footprint of individual wind farms (Brostrom 2008; Carpenter *et al.* 2016; Cazenave *et al.* 2016). However, direct observation of hydrodynamic effects in two wind farms in the North Sea have indicated that vertical mixing is increased during the summer when the water column is stratified as is the transport of nutrients into the surface layer (Floeter et al. 2017). Given the results of these studies, we question the conclusion in the EFH Assessment that the potential hydrodynamic effects of the South Fork Wind Farm, especially in combination with the other wind energy projects that are planned in southern New England, would be limited to within 200-400 meters of individual WTGs, a conclusion that is inappropriately attributed to a Biological Opinion from another project[3].

In Europe, the presence of wind farms and associated hydrodynamic changes have led to increased suspended sediment observed in the wakes of monopile foundations with direction of wakes changing based on tides and extending up to 1 or more km downstream (Vanhellemont and Ruddick 2014). The impacts of these sediment plumes are unknown but may affect the light field which could have implications for primary productivity and visual predation (Vanhellemont and Ruddick 2014). We would expect the severity of any sediment plumes to depend on local conditions, particularly sediment type and any local scour at the site. Sediment within the lease area is largely heterogeneous and complex, as compared with finer sediment of the North Sea where sediment plumes have been shown to be quite large. We would expect sediment plumes to be less extensive in the project area, but increased turbidity at the site may be possible and may affect adjacent complex habitats. Monitoring at the turbine locations would be necessary to understand changes in local conditions. Further research is also needed to understand the effects from turbine wake sediment plumes, and the impacts of those plumes on local ecosystems (Vanhellemont and Ruddick 2014).

Decommissioning
Habitat will also be altered at the decommissioning phase of the project. BOEM requires all equipment to be removed up to 15 feet (4.6 meters) below the mudline. This will again alter habitat by removing the introduced structures that have colonized epibiota during the 25+ years of operation. While details related to decommissioning are limited at this time, we expect habitat to be further altered and disturbed during this process. As noted in the EFH assessment, additional coordination will be necessary for decommissioning of the project.

Monitoring Project Effects

As discussed in this letter, data gaps remain related to effects from construction and operation of the wind farms, which complicates our ability to fully understand impacts to EFH. Despite the construction and operation of wind farms across Europe, effects on the distribution and abundance of fish species remain poorly understood. The lack of a consistent monitoring framework across wind farms has made it difficult to draw comparisons among studies and to understand how wind farms are affecting fish at a local or regional level (Methratta and Dardick 2019). Wilding *et al.* 2017 cautioned against this “data-rich, information-poor” approach to monitoring effects of Marine Renewable Energy Devices (MRED), as several monitoring programs in Europe have not informed interactions of MRED at relevant ecosystem scales (Wilding *et al.* 2017). Since offshore wind development is at its infancy in the U.S., we have the opportunity to standardize data collection methods across projects to allow for hypothesis-driven monitoring at a regional level. This is particularly important as existing monitoring systems are likely to be insufficient in answering questions related to impacts of offshore wind, and these monitoring systems will also be impacted by

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[3] Please note that NOAA Fisheries biological opinions should not be used as a reference unless referring to specific conclusions for which the particular project that the biological opinion was issued. We do not recommend relying on NOAA Fisheries Biological Opinions to support conclusions reached by BOEM for other projects that were not the subject of that Opinion.

future development.

Given the scale of development proposed on the OCS in a relatively short period of time, it will be important for BOEM to take initiative to ensure regional programs can move forward expeditiously to address these data gaps. Several important questions need to be addressed to understand the cumulative effects of large-scale development on EFH, particularly related to hydrodynamic effects and atmospheric energy extraction and the consequential effects to primary productivity and larval distribution, a major driver in understanding the presence and seasonality of fish species (Friedland *et al*. 2021, Chen *et al*. 2021). Additional studies are also needed related to impacts of particle motion on the benthos and demersal species as well as effects on migration from large-scale habitat alteration and EMF emissions across multiple adjacent projects. Specifically, studies are needed to understand how habitat alteration impacts juvenile fish species in the development areas as the WTGs are expected to attract predatory species, such as black sea bass that also have been found to exhibit site fidelity to particular reefs once established. Studies that evaluate the predator/prey dynamics in these areas are needed to understand potential cumulative effects of large-scale development on juvenile species. Research on existing wind farms suggests the potential for altered food web structures, which may have important ecosystem implications; however, this has not been well studied (Methratta and Dardick 2019). It will be important for BOEM to incorporate requirements for developers to integrate investigation of such issues into regional or project-specific monitoring plans to ensure the regional monitoring programs can move forward.

In addition to regional studies, site specific monitoring and research should be employed by Orsted to understand impacts from the project on EFH and other marine resources. Site specific studies must be designed in a manner capable of identifying project effects. Before-After-Gradient (BAG) studies have advantages for studying impacts of wind farms, as this method can inform the spatial scale of the effects, eliminate the need for control sites, and offer greater statistical power (Methratta and Dardick 2019). Using the distance from the turbine as a survey stratum provides a sampling scheme that can combine the qualities of a BACI study with gradient sampling that allows for better detection and assessment of localized effects, in addition to more diffuse wind-farm wide effects. We recommend this approach be used for site specific monitoring studies, in order to avoid missing the relatively small areas that are likely to be strongly impacted. A BAG approach to monitoring also provides the opportunity to collect more data to help understand changes in community structure, including epibiota, colonization of invasives, macrobenthic communities, and the acoustic environment.

It is our understanding that Orsted is proposing to conduct fisheries and benthic monitoring studies in the project area. Specifically, based on a study plan dated September 2020, Orsted is proposing to collect fisheries information using various gear types including gillnet, beam trawl, fish pot and ventless trap. They are also proposing to conduct benthic monitoring in the project area. An acoustic and telemetry study funded by BOEM and led by the NEFSC is currently ongoing on Cox Ledge. Orsted has incorporated this study as well as an ongoing telemetry study looking at highly migratory species (HMS) into their monitoring plan and described financial contributions to these studies to help increase pre-construction data collection in the area. We would note that Table 6.2 on page 171 of the EFH Assessment incorrectly suggests that NMFS has "approved" these monitoring plans. We did review drafts of the monitoring plans submitted to us by Orsted, and provided comments on June 12, 2020, and additional comments on December 14, 2020 specific to the benthic monitoring plan dated September 2020. While we may have approved experimental fishing permits to conduct some of the proposed surveys, these approvals and previous comments do not constitute approval of the monitoring plan at large, as we have not provided any official concurrence of these plans. Rather, we have raised significant concerns with some of the studies as proposed, which should be addressed prior to commencement.

Given the complex habitat in the project area and the potential impacts of the project on spawning Atlantic cod, we consider a robust benthic monitoring plan and continuation of acoustic and telemetry studies to be the most important components for this project to understand potential impacts of the project on EFH. The latest draft of the proposed monitoring plans was not incorporated into the EFH assessment; however, based on our review of the benthic monitoring plan dated September 30, 2020, we have significant concerns about the ability of the design to detect changes. Specifically, it is not clear that there is adequate sampling or replication to detect meaningful changes (i.e., the statistical power of the study to detect changes). The proposed lack of multi-year pre-construction data collection will also place unnecessary constraints on the study's ability to distinguish between annual variability and changes related to the project construction and operation. The plan does incorporate a Before-After-Gradient (BAG) approach for monitoring changes to benthic habitats at increasing distances from turbines and along transects placed perpendicularly to the onshore cable route; however, there does not appear to be adequate replicates along fixed distances from the turbine and the OEC to support a robust statistical analysis. In addition, it will be critical for the benthic monitoring plan to identify effects of project construction on all different habitat types in the project area, not just boulder habitats. It will be important to ensure that benthic monitoring of the project not only documents pre- and post-construction habitat conditions and benthic communities, including demersal juvenile finfish species that may be more vulnerable to project impacts, but that monitoring is capable of detecting changes at relevant scales as well as across and within different habitat types. It may be necessary to use a variety of sampling techniques to gain proper insight into changes in the community composition and biodiversity in the wind farm (Kerckhof *et al.* 2018; Walsh and Guida 2017). The project should be designed to identify effects of these habitats and changes to macrobenthic communities at various distances from the turbine. Affected hard bottom habitats may be vulnerable to colonization of invasive species, so it will be critical for any benthic monitoring plan to incorporate an evaluation of invasive species growth on the surrounding habitats. We strongly recommend that you coordinate closely with us in the development of the benthic monitoring plan.

The ongoing acoustic and telemetry study mapping the distribution of habitat use of soniferous fish on Cox Ledge, with a focus on Atlantic cod spawning aggregations (Van Parijs *et al.* in progress) is providing important information to help inform cod activity in and around the project area. While this study is only considered to inform "pre-construction" in Orsted's September 2020 monitoring plan, it will be critical for this study to continue through construction and post-construction to help evaluate how cod are using this area over time. The study is funded through 2022, but we would recommend it be expanded as a component of project specific monitoring to help contribute to an understanding of any changes in cod activity from project development in this area.

Additional monitoring and assessments particularly around acoustic effects of construction would provide important information that may help supplement ongoing studies on Atlantic cod in the area. Specifically, the September 2020 monitoring plan does not include any proposed monitoring of the acoustic effects of project construction and operation, which will be important to understand the extent of impacts, particularly on Atlantic cod in this area. We recommend passive acoustic monitoring also be conducted along a range of gradients from near field sites to locations much further from the turbine site, including tens of kilometers. This should be done before, during, and after construction and include both construction and operation measurements. In addition to providing information on project effects on the acoustic environment, acoustic monitoring could detect changes in the presence of species that produce biological sounds and help supplement information found in the ongoing acoustic and telemetry studies. We strongly recommend you work with us in the development of any monitoring study.

EFH Conservation Recommendations

The project area, covering both the WDA and the OECC, is designated as EFH under the MSA for multiple federally managed species, including Atlantic cod, summer flounder, winter flounder, windowpane flounder, scup, black sea bass, longfin inshore squid, Atlantic scallop, surfclam and ocean quahog. As described above, the proposed project would result in significant adverse effects on EFH. Pursuant to Section 305(b)(4)(A) of the MSA, we recommend that you adopt the following EFH conservation recommendations.

1. The inadequacies of the EFH assessment have hindered our ability to provide comprehensive and detailed conservation recommendations. These inadequacies include inconsistencies in your impact calculations and proposed project elements as well as the lack of analysis of new information in the updated May 7, 2021, COP. We recommend that you update and revise the EFH assessment to clarify the type of turbine scour protection to be used and the extent of boulder relocation required for each turbine location. The EFH assessment should also be updated to reflect new information incorporated into the COP, including any identified unexploded ordinances (UXOs) and proposed plans for remediation and movement of any UXOs. We also recommend that your updated EFH assessment describe any anticipated impacts from proposed monitoring plans. If the new information affects the basis of our EFH conservation recommendations, or if upon review of the updated EFH assessment we determine that additional recommendations are necessary to avoid, minimize, or offset adverse impacts to EFH, you will be required to reinitiate the EFH consultation. Additionally, BOEM should coordinate with us to develop an EFH assessment template to help standardize the structure and content of future assessments.

2. Based on the available habitat delineations and data, we have determined that the proposed turbine locations WTG 1, WTG 5, WTG 15, WTG 16A, and WTG 17A would result in substantial adverse impacts to complex habitats. BOEM should remove these turbine locations from the proposed project and prohibit development at these locations.

3. Based on the available habitat delineations and data, we have also determined that micrositing turbine locations will be necessary to avoid and minimize substantial adverse impacts to complex habitats. We recommend that turbine locations WTG 2, WTG 4, WTG 6, WTG 8, WTG 9, WTG 10, WTG 12, WTG 13, TG 14, OSS, and the associated inter-array cables be microsited into low multibeam backscatter return areas and that restrictions on seafloor disturbance (e.g. anchoring) during construction be required to avoid impacts to higher multibeam backscatter return areas. BOEM should require a micrositing plan be developed for each of the identified turbine locations and associated cable routes. The micrositing plan should be submitted for our review and comment prior to BOEM approval.

4. Given the extent of complex habitats in the project areas, BOEM should require the applicant to develop an anchoring plan to ensure anchoring is avoided and minimized in complex habitats during construction and maintenance of the project. This plan should specifically delineate areas of complex habitat around each turbine and cable locations, and identify areas restricted from anchoring. Anchor chains should include mid-line buoys to minimize impacts to benthic habitats from anchor sweep where feasible. The habitat maps and inshore maps delineating eelgrass habitat adjacent to the O&M facility should be provided to all cable construction and support vessels to ensure no anchoring of vessels be done within or immediately adjacent to these complex habitats. The anchoring plan should be provided for our review and comment prior to BOEM approval.

5. BOEM should require scour and cable protection within complex habitats of the lease area use natural, rounded stone of consistent grain size to match existing conditions. Scour and cable protection placed within soft-sediment habitats should incorporate natural, rounded cobble and boulders (2.5-10 inches in diameter for cobble or >10-inch diameter for boulder). Concrete mattresses should not be permitted to be used as scour protection within hard bottom and structurally complex habitats, and any required use of concrete mattresses for cable protection should be mitigated through the addition of natural, rounded stone. Should the use of any engineered stone be necessary, it should be designed and selected to provide three-dimensional structural complexity that creates a diversity of crevice sizes. BOEM should require that the applicant provide descriptions and specifications for any proposed engineered stone for agency comment and review prior to final design selection.

6. BOEM should restrict pile driving and all bottom-disturbing activities within the lease area during periods of Atlantic cod spawning. Pile driving activity and bottom-tending disturbances should be prohibited during peak spawning, from November through March to avoid and minimize substantial adverse impacts to Atlantic cod EFH.

7. BOEM should require the applicant to use noise mitigating measures during construction, such as soft start procedures, to ensure fish have the opportunity to evacuate the area prior to pile driving activity, and the deployment of noise dampening equipment such as bubble curtains. BOEM should require the development of a plan outlining noise mitigation procedures in consultation with the resource agencies prior to any construction activities. This should include a minimum of 30 days for the resource agencies to review and provide comments. The noise mitigation plan should be filed with BOEM for approval before construction commences. The noise mitigation plan should include a process for notifying resource agencies within 24 hours if any evidence of a fish kill during construction activity is observed, and contingency plans to resolve issues.

8. BOEM should require passive acoustic monitoring to be conducted along a range of gradients from the proposed turbine locations before, during, and after pile driving activities. Resource agencies should be provided a draft of the acoustic monitoring plan for review and comment. The plan should also include sound verification monitoring during pile driving activities. Additional noise dampening technology should be applied should real-time monitoring indicate noise levels are not attenuated to the minimum required 10 decibels. Acoustic monitoring reports should be provided to the resource agencies.

9. BOEM should require the applicant to revise the proposed Benthic Habitat Monitoring Plan to address agency concerns related to the adequacy of the proposed methods to detect changes, and to require that the plan address potential changes to macrobenthic communities across and within each habitat type in the project area, including the artificial substrates to be constructed. The plan should include monitoring of invasive species growth on constructed habitats, habitats impacted by project construction as well as expansion to the adjacent habitats. The monitoring plan should also include measures to evaluate demersal juvenile fish species response to habitat impacts as a result of the project. The applicant should consult with the resource agencies in the revision and refinement of this plan and give the resource agencies a minimum of 30 days to review and comment on the plan. The applicant should ultimately file the plan with BOEM for approval. BOEM should ensure that the applicant's filing addresses, and includes, all resource agency comments, as well as the applicant's response to those comments.

10. Given the potential for adverse impacts to Atlantic cod spawning activity as a result of the construction and operation of this project, as well as cumulatively as wind expands in southern New England, BOEM should continue and expand the on-going telemetry and passive acoustic survey. The study should be extended to provide continuous monitoring of Atlantic cod spawning aggregations prior to the construction of the project, and post-construction. We also recommend that the survey be expanded throughout the entire MA and RI/MA wind energy areas (WEA) to allow for detection of shifts to spawning activity and any other spawning activity that may overlap with the WEAs that may be affected by this project and future development.

11. Given the uncertainties surrounding potential impacts to hydrodynamics and predator-prey relationships that may result from this project and cumulatively across the southern New England WEAs, BOEM should take measures to address this uncertainty. BOEM should develop and implement a regional scale study to evaluate and monitor shifts and changes in hydrodynamics (e.g., vertical stratification, current velocities, and direction), primary production, and predator-prey relationships that may occur across wind development areas and result in broader scale impacts for the region, managed fisheries, and NOAA-trust species.

12. BOEM should restrict nearshore dredging and silt-producing activities associated with the sea-to-shore cable installation and proposed O&M facility improvements that occur at or adjacent to water depths of 5 meters or less, from January 1 through May 31, of any calendar year, to protect sensitive life history stage winter flounder EFH.

13. The EFH consultation should be reinitiated prior to decommissioning turbines to ensure that the impact to EFH as a result of the decommissioning activities have been evaluated and minimized to the extent practicable.

Please note that Section 305(b)(4)(B) of the MSA requires you to provide us with a detailed written response to these EFH conservation recommendations, including a description of measures you have adopted that avoid, mitigate, or offset the impact of the project on EFH. In the case of a response that is inconsistent with our recommendations, Section 305(b)(4)(B) of the MSA also indicates that you must explain your reasons for not following the recommendations. Included in such reasoning would be the scientific justification for any disagreements with us over the anticipated effects of the proposed action and the measures needed to avoid, minimize, mitigate, or offset such effects pursuant to 50 CFR 600.920(k).

Please also note that a distinct and further EFH consultation must be reinitiated pursuant to 50 CFR 600.920(1) if new information becomes available or the project is revised in such a manner that affects the basis for the above EFH conservation recommendations.

Fish and Wildlife Coordination Act Recommendations
The Fish and Wildlife Coordination Act (FWCA) provides authority for our involvement in evaluating impacts to fish and wildlife from proposed federal actions that may affect waters of the United States. The FWCA requires that wildlife conservation be given equal consideration to other features of water resource development programs through planning, development, maintenance and coordination of wildlife conservation and rehabilitation. Our FWCA recommendations must be given full consideration.

Horseshoe Crabs

Horseshoe crabs are present in the project area and may be impacted by inshore construction activities including export cable installation and construction and dredging activities associated with the proposed O&M facility. Horseshoe crab eggs and larvae are a food source for a number of fish species including striped bass, white perch, weakfish, American eel, silver perch, and federally managed summer flounder and winter flounder (Steimle *et al*. 1999). Dredge disposal/placement may result in the loss of horseshoe crabs and their eggs and larvae, and their habitat, resulting in a reduction in prey species for several federally managed species and adverse effects to their EFH. As noted in the EFH assessment, horseshoe crabs are known to occur within Lake Montauk. Avoiding dredging and placement between April 15 to July 15 minimizes potential impacts to horseshoe crab spawning.

American Lobster and Jonah Crab
The South Fork offshore energy project area is habitat for American lobster (*Homarus americanus*) and Jonah crab (*Cancer borealis*). American lobster is an important commercial and recreational fisheries species. It is important to note that Vessel Trip Report (VTR) data likely under-report total lobster and Jonah crab landings due to permit reporting requirements. Lobster-only permit holders are not required to report VTR data. In 2019 over 125 million pounds of lobster were landed (NMFS 2021).

Shelter providing habitat has been shown to be a critical requirement for recently settled and early juvenile lobsters (Cowan 1999). Adult lobsters also use cobble-boulder habitat but tend to inhabit a broader range of habitats which may include both protected and exposed locations (Aiken and Waddy 1986; Karnofsky *et al.* 1989; Mackenzie and Moring 1985). The project area is known to support lobster, and spans an area used for inshore and offshore migrations (Fogarty *et al.* 1980). Lobster catch in southern New England has declined since the late 1990s, which in part led to the increase in the closely linked Jonah crab (*Cancer borealis*) fishery (ASMFC 2015). Little is known about Jonah crab biology, but the recent expansion in landings has led the Atlantic States Marine Fisheries Commission (ASMFC) to develop a Fishery Management Plan (FMP) for the species in 2015 (ASMFC 2015). As noted earlier, VTR data likely under-report total lobster and Jonah crab landings due to permit reporting requirements. In 2019, nearly 16 million pounds of Jonah crab were landed (NMFS 2021). Jonah crab are most frequently caught in rocky offshore habitats (ASMFC 2015). Observations with submersibles (Wenner *et al.* 1992) found Jonah crab in softer sediments along the continental slope, which was also in agreement with modelling completed by Collie and King (2016). Female crab have been documented to move inshore during the late spring and summer (ASMFC 2015). Taking steps to minimize project effects to EFH, particularly complex habitats more vulnerable to long-term or permanent impacts, will also be important in reducing project impacts to lobster and Jonah crab in the project area. Incorporation of the EFH conservation recommendations outlined above as conditions of COP approval will also be beneficial for reducing project impacts to lobster and Jonah crab.

The South Fork monitoring plan includes trap surveys targeting lobster and black sea bass in the project area to build baseline and identify habitat use, movement, and seasonal distribution of important species. The monitoring plan should emulate existing trap surveys for pre-, during and post-construction sampling, to allow comparison with regional baseline sampling. For example, the monitoring plan for this project uses different numbers, configurations (ventless vs. standard), and soak times for trap gear than similar efforts conducted for the Vineyard Wind 1 Project. Differences in methodology will make it difficult to compare data collected from these studies with data collected from other regional efforts. We recommend that you require the applicant to consult with the resource agencies and possibly even other wind companies in the development of its monitoring plan. The consultation process should involve active, iterative, coordination with the resource agencies to facilitate the exchange of ideas and harmonization between similar studies.

We also recommend you coordinate with us early in the process related to any potential effects of monitoring activities on NOAA trust resources, including protected species. We note that survey or monitoring activities may require permits or authorizations from us and may need to be considered in an ESA section 7 consultation. It is also important with respect to your review of proposed monitoring plans, that you remain updated on the current actions of the Atlantic Large Whale Take Reduction Plan, which includes measures to reduce risk from vertical lines in the waters in and around the project area. More information can be found at https://www.fisheries.noaa.gov/new-england-mid-atlantic/marine-mammal-protection/atlantic-large-whale-take-reduction-plan.

NOAA Scientific Surveys

As noted in the South Fork Draft Environmental Impact Statement, this project and cumulative wind development on the OCS is anticipated to result in major adverse impacts on NOAA Fisheries scientific surveys. This project would have direct impacts on the federal multi-species bottom trawl survey, the surfclam and ocean quahog clam dredge surveys, the integrated benthic/sea scallop habitat survey, ship and aerial-based marine mammal and sea turtle surveys, and the shelf-wide Ecosystem Monitoring Survey. The impacts to our scientific surveys from this project will be driven by four main mechanisms: 1) exclusion of NOAA sampling platforms from the wind development area, 2) impacts on the random-stratified statistical design that is the basis for data analysis and use in scientific assessments, advice, and analyses; 3) the alteration of benthic, pelagic, and airspace habitats in and around the wind energy development; and 4) potential reductions in sampling outside wind areas caused by potential increased transit time by NOAA vessels. These impacts will occur over the lifetime (approximately 2050) of wind energy operations at the project area and in the region.

Adverse effects on NOAA monitoring and assessment activities will directly impact the critical scientific information used for fisheries management and the recovery and conservation programs for protected species. These impacts will result in increased uncertainty in the surveys' measures of abundance, which could potentially affect decisions for fisheries management. Impacts to these surveys will have implications for habitat management and our consultations under MSA, as data collected through our scientific surveys are used to identify EFH and inform conservation and management of sensitive habitat areas.

The implementation of a NMFS scientific survey mitigation plan for the project will be necessary to mitigate losses in accuracy and precision due to the impacts of wind development on NEFSC surveys and scientific advice. This plan would address both project level and regional impacts and include the following elements for all NEFSC surveys impacted by the project: 1) Evaluate survey designs, 2) Identify and develop new survey approaches, 3) Calibrate new survey approaches, 4) Develop interim provisional survey indices, 5) Monitoring by wind energy industry to fill regional scientific survey data needs over the life of offshore wind operations, and 6) Develop and communicate new regional data streams. The goal of this is to ensure the continuity of the important marine scientific investments in long-term data collection and to maintain scientific support for sustainable fisheries.

Conclusion

We appreciate the opportunity to coordinate with BOEM on the South Fork offshore wind development project. The conservation recommendations we provide in this letter will ensure that the adverse effects to EFH and managed species from this project are adequately minimized and compensated. In the event we receive a revised EFH assessment, we may determine that the recommendations provided need to be augmented, or that the consultation needs to be reinitiated if new information affects the basis of our EFH conservation recommendations. Should you have any questions regarding these comments or the EFH consultation process, please contact Alison Verkade at (978) 281-9266 or alison.verkade@noaa.gov. The ESA consultation is ongoing and is expected to be complete by August 9, 2019. Should you have questions related to the ESA Section 7 consultation, please contact Julie Crocker at (978) 281-9480 or julie.crocker@noaa.gov

Sincerely,

Louis A. Chiarella
Assistant Regional Administrator
For Habitat Conservation

cc: Brian Hooker, BOEM
Brian Krevor, BOEM
Tim Timmerman, USEPA
Tom Chapman, USFWS
Christine Jacek, USACE
Candace Nachman, NOAA
Lisa Berry Engler, MACZM
Grover Fugate, RI CRMC

Julia Livermore, RIDEM
Tom Nies, NEFMC
Chris Moore, MAFMC
Lisa Havel, ASMFC

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