Sunrise Wind Farm Project

Appendix N2
Ichthyoplankton Entrainment Assessment

Prepared for:

Sunrise Wind | Powered by Ørsted & Eversource

April 8, 2022

Revision 1 – August 19, 2022

Ichthyoplankton Entrainment Assessment

August 2022

Sunrise Wind
Offshore Converter Station

Prepared For:

Sunrise Wind

Prepared By:

TRC
650 Suffolk St
Lowell, MA 01854

TABLE OF CONTENTS

List of Tables

List of Figures

Abbreviations

AC	Alternating Current
AIF	Average Intake Flow
BOEM	Bureau of Ocean Energy Management
BTA	Best Technology Available
CFR	Code of Federal Regulations
COP	Construction and Operations Plan
CWA	Clean Water Act
CWIS	Cooling Water Intake Structure
DC	Direct Current
DIF	Design Intake Flow
EFH	Essential Fish Habitat Assessment
EPA	United States Environmental Protection Agency
km	kilometer
MGD	million gallons per day
mi	mile
MW	megawatt
NCEI	National Centers for Environmental Information
nm	nautical mile
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination
NY	New York
OCS	Outer Continental Shelf
OCS-DC	Offshore Converter Station
SRWEC	Sunrise Wind Export Cable
SRWF	Sunrise Wind Farm
SWLP	Seawater Lift Pump
TSV	Through Screen Velocity
VFD	Variable Frequency Drive
WTG	Wind Turbine Generator

1. Introduction

Sunrise Wind, a 50/50 joint venture between Orsted North America Inc. (Orsted NA or Orsted) and Eversource Investment LLC (Eversource), proposes to construct, own, and operate the Sunrise Wind Farm (SRWF) and the Sunrise Wind Export Cable (SRWEC) (collectively, the Sunrise Wind Farm Project or Project). The offshore wind farm portion of the Project (i.e., the SRWF) will be located on the Outer Continental Shelf (OCS) in the designated Bureau of Ocean Energy Management (BOEM) Renewable Energy Lease Area OCS-A 0487 (Lease Area). The Lease Area is approximately 18.9 statute miles (mi) (16.4 nautical miles [nm], 30.4 kilometers [km]) south of Martha's Vineyard, Massachusetts, approximately 30.5 mi (26.5 nm, 48.1 km) east of Montauk, New York (NY), and 16.7 mi (14.5 nm, 26.8 km) from Block Island, Rhode Island.

The information and analysis presented in this report was developed in support of a new individual National Pollutant Discharge Elimination System (NPDES) permit under Section 402 of the Clean Water Act (CWA). A NPDES individual permit application for the operation of the Offshore Converter Station (OCS-DC) located in the Lease Area was submitted to the United States Environmental Protection Agency (EPA) on December 1, 2021.

The purpose of the OCS-DC is to collect the medium voltage alternating current (AC) power generated by the wind turbine generators (WTGs), convert it to Direct Current (DC), and transform it to higher voltage for transmission via the SRWEC. The OCS-DC will include a cooling water intake structure (CWIS) as further described below.

The CWA prohibits the discharge of pollutants from point sources to waters of the United States without authorization through an NPDES permit. As described in §125.81, the OCS-DC is a new facility that is considered a point source. Section 316(b) of the CWA requires that NPDES permits for facilities with a CWIS ensure that the location, design, construction, and capacity reflect the best technology available (BTA) to minimize harmful impacts on the environment. The CWIS for the OCS-DC is a new facility and subject to Section 316(b) requirements because it will have a design intake flow (DIF) greater than two million gallons per day (MGD) and will use at least 25 percent of the total water withdrawn for cooling purposes. The information and analysis provided herein was developed to assess the potential effects to marine organisms as a result of CWIS operation at the OCS-DC and is consistent with the Section 316(b) requirements defined at §122.21(r)(4) and presented in Section 3 with the regulatory requirements italicized followed by project-specific response.

2. CWIS Operation

The CWIS for the OCS-DC is withdrawn through three individual vertical pipes in a single parallel cluster attached to the steel foundation jacket. The openings of each of the three intake pipes are located approximately 30 ft (10 m) above the pre-installation seafloor grade and have a total intake surface area of approximately 27 ft^2 (2.54 m^2). Three steel crash bars of 2.4 x 0.8 in (60 x 20 mm) oriented with the narrow aspect facing the current will be fixed across the opening of each intake pipes to exclude large solids.

Each intake pipe has a dedicated seawater lift pump (SWLP) that is equipped with a variable frequency drive (VFD). Each SWLP has a design capacity of 4,245 gallons per minute (gpm) (964 m^3/h), or 6.1 MGD. Depending on cooling water volume requirements, typical operation of the SWLPs will require either one or two SWLPs on duty with the other SWLP(s) on standby (i.e., not in service). The two duty SWLPs will have a combined maximum DIF of 8.1 MGD through the intake openings. In this scenario, seawater will flow into the SWLPs at a maximum through-screen velocity (TSV) of 0.43 ft/s (0.13 m/s) under DIF conditions.

The cooling water volume requirements for the OCS-DC will vary according to ambient water temperature, wind farm power production, and other factors. There is no scenario where all three pumps will be operating simultaneously. The DIF of 8.1 MGD for the OCS-DC involves the simultaneous operation of two SWLPs operating at 66-percent capacity (4.1 MGD each) and represents the maximum daily flow that will occur. The standard operating procedure for the SWLPs are expected to have a daily average intake flow (AIF) ranging from 4.0 MGD to 5.3 MGD. This AIF range is based on seasonal changes in water temperatures and electrical demand. The expected daily AIF and DIF for SWLP operation by month is provided in Table 1, below. Maximum daily AIF and DIF values presented in Table 1 are rounded to the nearest tenth. For accuracy purposes, the analysis presented in Section 3 to assess potential entrainment is calculated using AIF values with three significant figures.

Table 1: OCS-DC Average and Maximum Daily Flow per Month

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily DIF (MGD)	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1
Daily AIF (MGD)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.3	4.6	5.3	4.9	4.1

3. Biological Susceptibility

(i) A list of the data in paragraphs (r)(4)(ii) through (vi) of this section that are not available, and efforts made to identify sources of the data;

Information presented below to support paragraphs (r)(4)(ii) through (vi) is based on project-specific information that has been developed in support of the Construction Operations Plan (COP).

(ii) A list of species (or relevant taxa) for all life stages and their relative abundance in the vicinity of the cooling water intake structure;

Essential Fish Habitat (EFH) has been designated for the 42 individual species of fish and invertebrates in the SRWF presented in Table 2. Refer to INSPIRE 2022 Section 2.2.5 for a detailed description of each managed species.

Table 2: Species with designated EFH in the SRWF

Common Name (*Scientific Name*)	Life Stage			
New England Finfish	**Egg**	**Larvae**	**Juvenile**	**Adult**
Atlantic Cod (*Gadus morhua*)	x	x	x	x
Atlantic Herring (*Clupea harengus*)	x	x	x	x
Atlantic Wolffish (*Anarhichas lupus*)	x	x	x	x
Haddock (*Melanogrammus aeglefinus*)		x	x	
Monkfish (*Lophius americanus*)	x	x	x	x
Ocean Pout (*Zoarces americanus*)	x		x	x

Common Name (*Scientific Name*)	**Life Stage**			
Pollock (*Pollachius virens*)	x	x	x	
Red Hake (*Urophycis chuss*)	x	x	x	x
Silver Hake (*Merluccius bilinearis*)	x	x	x	
White Hake (*Urophycis tenuis*)			x	
Windowpane Flounder (*Scophthalmus aquosus*)	x	x	x	x
Winter Flounder (*Pseudopleuronectes americanus*)		x	x	x
Witch Flounder (*Glyptocephalus cynoglossus*)	x	x		x
Yellowtail Flounder (*Limanda ferruginea*)	x	x	x	x
Mid-Atlantic Finfish	**Egg**	**Larvae**	**Juvenile**	**Adult**
Atlantic Butterfish (*Peprilus triacanthus*)	x	x	x	x
Atlantic Mackerel (*Scomber scombrus*)	x	x	x	x
Black Sea Bass (*Centropristis striata*)			x	x
Bluefish (*Pomatomus saltatrix*)	x	x		x
Scup (*Stenotomus chrysops*)			x	x
Summer Flounder (*Paralichthys dentatus*)	x	x		x
Invertebrates	**Egg**	**Larvae**	**Juvenile**	**Adult**
Atlantic Sea Scallop (*Placopecten magellanicus*)	x	x	x	x
Longfin Inshore Squid (*Doryteuthis pealeii*)			x	x
Ocean Quahog (*Arctica islandica*)			x	x
Highly Migratory Species	**Egg**	**Larvae**	**Juvenile**	**Adult**
Albacore Tuna (*Thunnus alalunga*)			x	x
Bluefin Tuna (*Thunnus thynnus*)			x	x
Skipjack Tuna (*Katsuwonus pelamis*)			x	x
Yellowfin Tuna (*Thunnus albacares*)			x	x
Skates	**Egg**	**Larvae**	**Juvenile**	**Adult**
Barndoor Skate (*Dipturis laevis*)			x	x
Little Skate (*Leucoraja erinacea*)			x	x
Winter Skate (*Leucoraja ocellata*)			x	x

Common Name (*Scientific Name*)	Life Stage			
Sharks	**Neonate**	**Juvenile**	**Sub-Adult Female**	**Adult**
Basking Shark (*Cetorhinus maximus*)	x	x		x
Blue Shark (*Prionace glauca*)	x	x		x
Common Thresher Shark (*Alopias vulpinus*)	x	x		x
Dusky Shark (*Carcharhinus obscurus*)	x	x		x
Porbeagle Shark (*Lamna nasus*)	x	x		x
Sandbar Shark (*Carcharhinus plumbeus*)		x		x
Sand Tiger Shark (*Carcharias taurus*)	x	x		
Shortfin Mako Shark (*Isurus oxyrinchus*)	x	x		x
Smooth-hound Shark Complex (*Mustelus canis*)	x	x		x
Spiny Dogfish (*Squalus acanthias*)			x	x
Tiger Shark (*Galeocerdo cuvier*)		x		x
White Shark (*Carcharodon carcharias*)	x	x		x

(iii) Identification of the species and life stages that would be most susceptible to impingement and entrainment. Species evaluated should include the forage base as well as those most important in terms of significance to commercial and recreational fisheries;

(a) Ichthyoplankton

The CWIS has been designed to maintain a TSV below 0.5 ft/s (0.1525 m/s) under DIF operation. This TSV estimate is below the threshold required for new facilities defined at §125.84(c) and is therefore protective against the impingement of juvenile and adult life stages of finfish. Accordingly, only the species in Table 2 with egg or larval life stages present in the vicinity of the OCS-DC would be susceptible to entrainment. More specifically, Table 2 includes a total of 17 finfish species that meet this criteria and whose early life stages could be proximal to the OCS-DC during water withdrawal activity.

To evaluate the potential entrainment of ichthyoplankton during operational OCS-DC withdrawals, species abundance data was obtained from the NOAA National Centers for

Environmental Information (NCEI) electronic database. This database include data collected by NOAA's Marine Resource Monitoring, Assessment, and Prediction (MARMAP) program from 1977-1987 and by the Ecosystem Monitoring program from 1995 through 2017 throughout the North Atlantic region.

This database includes a total of 31,351 ichthyoplankton tows conducted between North Carolina and Nova Scotia using a 24 in (60 cm) bongo plankton net with either 0.333-mm or 0.505-mm mesh. For this analysis, the full data set was trimmed to include only those ichthyoplankton tows that were conducted within the general geographic region of the OCS-DC and SRWF as indicated in Figure 1. The boundaries of this geographic region were selected to avoid shallow shoreline areas which would be expected to contain species not present at the OCS-DC location, to extend to the edge of the continental shelf, to include various habitat types and waters depths, and to encompass a large number of samples to help offset the natural variability inherent in marine systems. This truncated data set was utilized to assess entrainment susceptibility associated with operation of the OCS-DC and consists of 1,859 total ichthyoplankton tows and contains a total of 90,799 individual ichthyoplankton. The NCEI dataset does not identify eggs to species level; therefore, the species-specific ichthyoplankton entrainment results were calculated only for larval life stages. In the absence of species-specific egg densities that could be susceptible to entrainment, these values were extrapolated from the larval data from the NCEI database as described below.

Larger marine invertebrates, such as the Atlantic sea scallop described in Table 2, are not included in the NCEI database and therefore not included in the analysis presented herein.

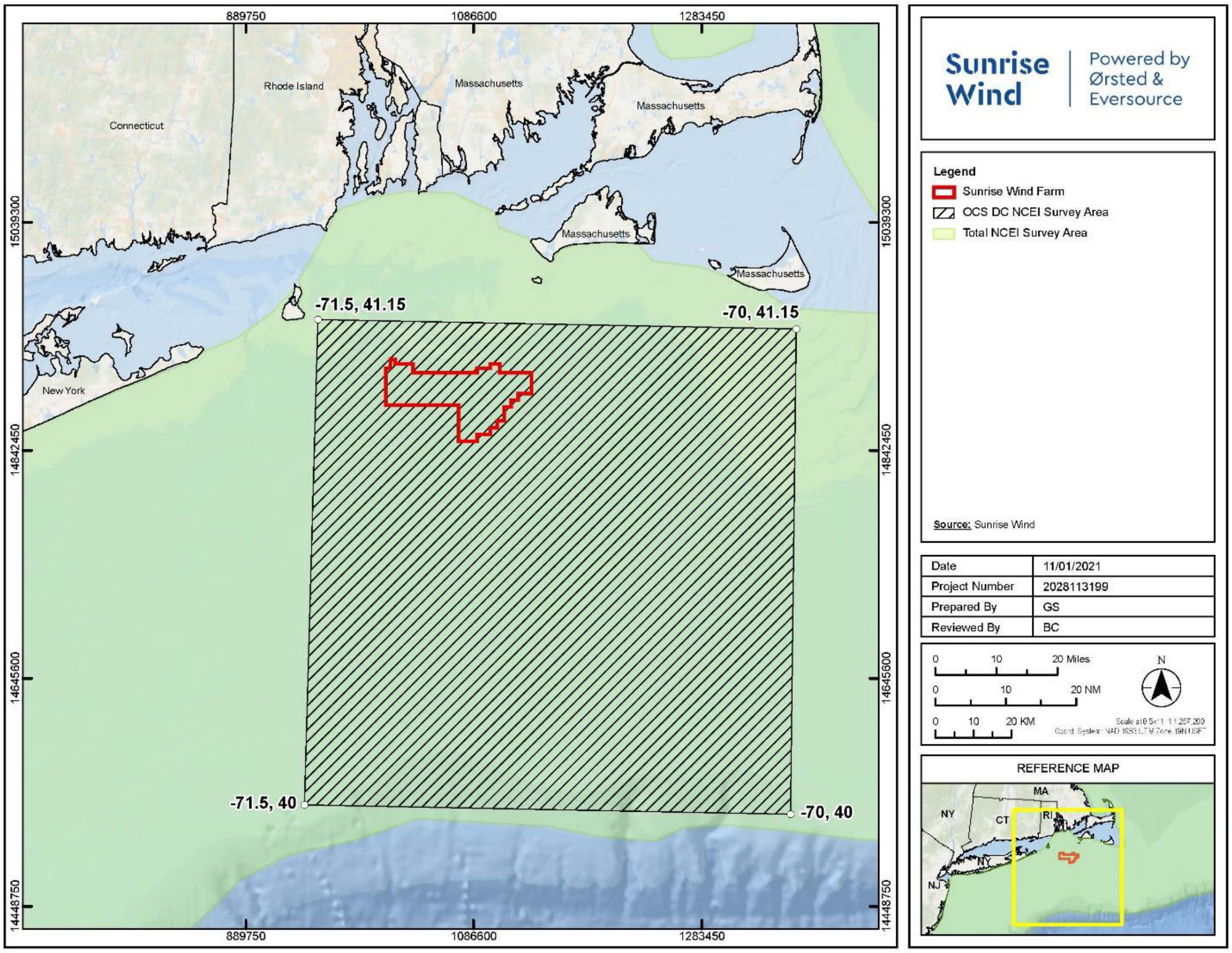

Figure 1. Total and OCS-DC NCEI Survey Area

Using RStudio software, the ichthyoplankton data that fell within the polygon, depicted in Figure 1, were extracted from the NCEI dataset and organized by species and month. RStudio is an open-source software program that executes the programming language "R" for data analysis. Table 3 summarizes the average monthly abundance (#/100m^3) of larvae by species.

With the exception of the ocean pout, the NCEI dataset contained ichthyoplankton density data for all species defined in Table 2 as having egg and larval life stages present in the vicinity of the OCS-DC.

Table 3: Fish Larval Abundance for Each Month From 1977 to 2017 (#/100m^3)

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Atlantic Cod (*Gadus morhua*)	2.174	1.013	0.934	1.085	0.249	0.033	0.000	0.000	0.007	0.000	0.532	1.333
Atlantic Herring (*Clupea harengus*)	8.304	1.638	0.437	0.200	0.000	0.000	0.000	0.000	0.007	7.742	107.347	67.688
Atlantic Wolffish (*Anarhichas lupus*)	0.000	0.092	0.347	0.723	1.438	0.231	0.000	0.007	0.000	0.000	0.000	0.000
Haddock (*Melanogrammus aeglefinus*)	0.006	0.000	0.000	0.000	0.027	0.022	0.159	0.108	0.094	0.005	0.000	0.000
Monkfish (*Lophius americanus*)	0.385	1.132	0.474	0.177	0.049	0.022	0.000	0.000	0.000	0.023	0.032	0.075
Pollock (*Pollachius virens*)	0.000	0.000	0.005	0.023	0.027	0.198	15.317	66.081	54.532	20.203	2.589	0.226
Red Hake (*Urophycis chuss*)	0.062	0.007	0.000	0.015	0.422	2.418	8.207	18.791	10.914	8.203	3.556	1.161
Silver Hake (*Merluccius bilinearis*)	0.019	0.007	0.000	0.000	0.605	3.286	0.183	0.236	2.791	1.733	0.306	0.086
Windowpane Flounder (*Scophthalmus aquosus*)	0.000	0.059	0.315	0.762	2.908	0.923	0.000	0.007	0.000	0.000	0.000	0.000
Winter Flounder (*Pseudopleuronectes americanus*)	0.000	0.000	0.000	0.023	0.795	1.011	0.268	0.074	0.022	0.000	0.000	0.000
Witch Flounder (*Glyptocephalus cynoglossus*)	0.000	0.007	0.033	0.008	9.595	13.231	0.756	0.068	0.000	0.078	0.000	0.000
Yellowtail Flounder (*Limanda ferruginea*)	0.000	0.000	0.000	0.000	0.135	1.440	4.293	8.034	1.971	0.171	0.000	0.000
Atlantic Butterfish (*Peprilus triacanthus*)	0.000	0.000	0.000	0.000	7.941	62.253	0.280	0.054	0.000	0.000	0.000	0.000
Atlantic Mackerel (*Scomber scombrus*)	0.000	0.000	0.000	0.000	0.000	0.033	0.207	0.304	0.000	0.000	0.000	0.000
Bluefish (*Pomatomus saltatrix*)	0.130	0.013	0.009	0.000	0.022	0.000	0.000	0.000	5.072	14.346	8.000	1.677
Summer Flounder (*Paralichthys dentatus*)	0.000	0.000	0.009	0.000	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total	**11.080**	**3.968**	**2.563**	**3.016**	**24.218**	**85.101**	**29.670**	**93.764**	**75.410**	**52.504**	**122.362**	**72.246**

As summarized in Table 3, ichthyoplankton fish larvae are most abundant in the vicinity of the OCS-DC during summer and fall months. The monthly larval densities for each species were multiplied by each respective month's maximum daily AIF and number of days in the month to estimate the potential entrainment that would be expected at the OCS-DC. An example of this calculation for Atlantic cod in the month of March is provided below. This example, and the results presented in Table 4, demonstrate that the calculation was completed using AIF values with three significant figures. The maximum daily AIF and DIF values presented in Table 1 are rounded to the nearest tenth for simplicity.

$$Number\ entrained\ daily = \frac{0.934\ \text{larvae}}{100\ m^3} \times \frac{100\ m^3}{26{,}417\ gal} \times 3{,}960{,}000\ \frac{gal}{day} = \frac{140\ \text{larvae}}{day}$$

$$Number\ entrained\ monthly = \frac{140\ \text{larvae}}{day} \times \frac{31\ days}{1\ month} = 4{,}340\ \text{larvae}$$

The potential larval entrainment that could occur during OCS-DC operation by month and species is presented in Table 4 and Figure 2. Based on this analysis, species that are expected to be most susceptible to entrainment impacts associated with operation of the OCS-DC include Atlantic herring (*Clupea harengus*), red hake (*Urophycis chuss*), Atlantic mackerel *(Scomber scombrus)*, and silver hake (*Merluccius bilinearis*). The commercially important species whose larvae could be most susceptible to operation of the OCS-DC include yellowtail flounder (*Limanda ferruginea*), summer flounder (*Paralichthys dentatus*), and Atlantic butterfish (*Peprilus triacanthus*).

Atlantic cod (*Gadus morhua*) is a species of particular concern in this region but ichthyoplankton from this species are not expected to be as susceptible to OCS-DC operation relative to the other species. This analysis estimates that up to 34,239 individual Atlantic cod larvae could be entrained through the CWIS of the OCS-DC on an annual basis; the peak spawning period for this species occurs in December and January in this region. To put these potential entrainment rates in context, a large female Atlantic cod is capable of producing 3 to 9 million eggs annually (NOAA Fisheries, 2021).

Table 4: Number of Fish Larvae Entrained Monthly

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Atlantic Cod (*Gadus morhua*)	10,102	4,253	4,342	4,878	1,155	148	-	-	37	-	2,956	6,368	34,239
Atlantic Herring (*Clupea harengus*)	38,590	6,876	2,029	899	-	-	-	-	37	47,787	596,123	323,285	1,015,627
Atlantic Wolffish (*Anarhichas lupus*)	-	387	1,614	3,252	6,682	1,038	-	34	-	-	-	-	13,007
Haddock (*Melanogrammus aeglefinus*)	29	-	-	-	126	99	737	547	486	28	-	-	2,052
Monkfish (*Lophius americanus*)	1,790	4,750	2,204	796	226	99	-	-	-	142	179	359	10,545
Pollock (*Pollachius virens*)	-	-	22	104	126	890	71,179	334,220	283,634	124,702	14,376	1,078	830,331
Red Hake (*Urophycis chuss*)	289	28	-	69	1,959	10,872	38,139	95,037	56,764	50,632	19,750	5,546	279,085
Silver Hake (*Merluccius bilinearis*)	87	28	-	-	2,813	14,776	850	1,196	14,518	10,695	1,702	411	47,076
Windowpane Flounder (*Scophthalmus aquosus*)	-	249	1,462	3,425	13,514	4,151	-	34	-	-	-	-	22,835
Winter Flounder (*Pseudopleuronectes americanus*)	-	-	-	104	3,692	4,547	1,247	376	112	-	-	-	10,078
Witch Flounder (*Glyptocephalus cynoglossus*)	-	28	153	35	44,586	59,500	3,514	342	-	484	-	-	108,642
Yellowtail Flounder (*Limanda ferruginea*)	-	-	-	-	628	6,474	19,948	40,633	10,253	1,052	-	-	78,988
Atlantic Butterfish (*Peprilus triacanthus*)	-	-	-	-	36,900	279,957	1,303	273	-	-	-	-	318,433
Atlantic Mackerel (*Scomber scombrus*)	-	-	-	-	-	148	963	1,538	-	-	-	-	2,649
Bluefish (*Pomatomus saltatrix*)	606	55	44	-	100	-	-	-	26,380	88,549	44,426	8,012	168,172
Summer Flounder (*Paralichthys dentatus*)	-	-	44	-	25	-	-	-	-	-	-	-	69
Total	**51,493**	**16,654**	**11,914**	**13,562**	**112,532**	**382,699**	**137,880**	**474,230**	**392,221**	**324,071**	**679,512**	**345,059**	**2,941,824**

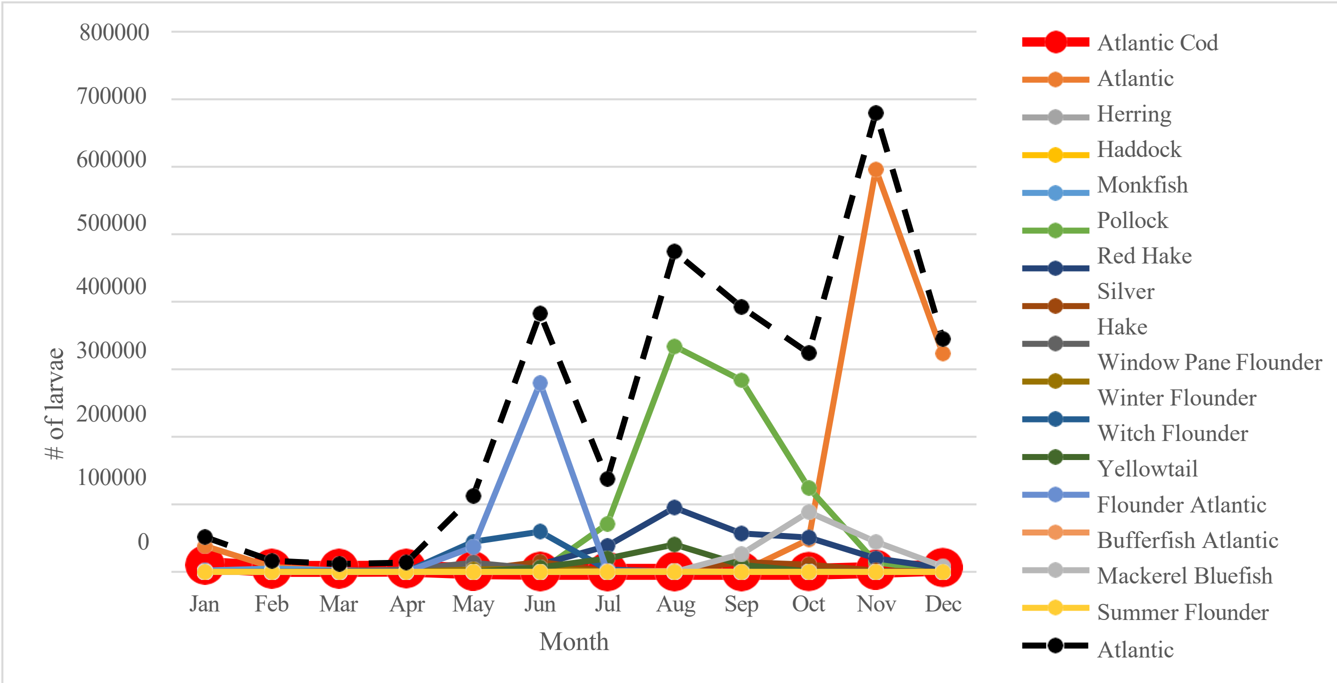

Figure 2. Number of Fish Larvae Entrained per Month

Fish eggs were not included in the NCEI dataset and there is limited data available that quantifies spatially specific fish egg abundance in the region. To estimate potential egg entrainment, the abundance of fish eggs can be back calculated from available larval data using a standard multiplier of 10. This standard multiplier represents a generic mortality rate from the egg to larval stage (Dahlbergm, 1979; Pepin, 1991) and has been applied in a similar manner for other offshore wind projects (South Fork Wind Farm, 2019). Table 5 presents the potential entrainment of fish eggs that could occur during OCS-DC operation by month and species.

Ocean pout is described as having EFH for egg life stages (Table 2) but no larval life stages for this species were detected in the NCEI database. As such, no potential egg entrainment can be calculated for this species. Larval life stages for winter flounder were detected in the NCEI database and therefore potential egg entrainment of this species was calculated and presented in Table 5. These results for potential winter flounder egg entrainment should be interpreted cautiously as there is no species - specific EFH designation for this life stage (Table 2), and they are characterized as benthic and adhesive and therefore are not likely subject to operational OCS-DC impacts.

Table 5: Number of Fish Eggs Entrained Monthly

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Atlantic Cod (*Gadus morhua*)	101,022	42,525	43,416	48,776	11,555	1,483	-	-	374	-	29,558	63,681	342,389
Atlantic Herring (*Clupea harengus*)	385,904	68,758	20,290	8,994	-	-	-	-	374	477,874	5,961,226	3,232,849	10,156,269
Atlantic Wolffish (*Anarhichas lupus*)	-	3,866	16,145	32,518	66,816	10,378	-	342	-	-	-	-	130,064
Haddock (*Melanogrammus aeglefinus*)	289	-	-	-	1,256	988	7,367	5,468	4,864	284	-	-	20,517
Monkfish (*Lophius americanus*)	17,895	47,496	22,035	7,956	2,261	988	-	-	-	1,422	1,791	3,595	105,440
Pollock (*Pollachius virens*)	-	-	218	1,038	1,256	8,895	711,786	3,342,201	2,836,336	1,247,024	143,757	10,785	8,303,296
Red Hake (*Urophycis chuss*)	2,886	276	-	692	19,593	108,721	381,395	950,374	567,641	506,319	197,498	55,464	2,790,860
Silver Hake (*Merluccius bilinearis*)	866	276	-	-	28,133	147,762	8,501	11,961	145,184	106,953	17,018	4,108	470,762
Windowpane Flounder (*Scophthalmus aquosus*)	-	2,485	14,617	34,247	135,140	41,512	-	342	-	-	-	-	228,343
Winter Flounder (*Pseudopleuronectes americanus*)	-	-	-	1,038	36,925	45,465	12,468	3,759	1,123	-	-	-	100,777
Witch Flounder (*Glyptocephalus cynoglossus*)	-	276	1,527	346	445,862	595,001	35,136	3,417	-	4,836	-	-	1,086,401
Yellowtail Flounder (*Limanda ferruginea*)	-	-	-	-	6,280	64,739	199,481	406,327	102,527	10,525	-	-	789,878
Atlantic Butterfish (*Peprilus triacanthus*)	-	-	-	-	368,998	2,799,571	13,034	2,734	-	-	-	-	3,184,337
Atlantic Mackerel (*Scomber scombrus*)	-	-	-	-	-	1,483	9,634	15,378	-	-	-	-	26,495
Bluefish (*Pomatomus saltatrix*)	6,061	552	436	-	1,005	-	-	-	263,802	885,489	444,259	80,115	1,681,720
Summer Flounder (*Paralichthys dentatus*)	-	-	436	-	251	-	-	-	-	-	-	-	688
Total	514,923	166,511	119,120	135,605	1,125,329	3,826,986	1,378,801	4,742,303	3,922,226	3,240,726	6,795,108	3,450,597	29,418,238

(b) Zooplankton

Along with quantifying ichthyoplankton that may be affected by OCS-DC operations, 63 species of zooplankton are also included in the NCEI database, including *Calanus finmarchicus*. *Calanus finmarchicus* is a heavy- bodied, planktonic copepod that is an important prey species for several organisms in the region, including the North Atlantic right whale (*Eubalaena glacialis*). Entrainment of zooplankton from the NCEI density data was calculated using the approach described above. The average monthly abundance and entrainment estimates for zooplankton are provided in Table 6 and 7.

Table 6: Zooplankton Abundance for Each Month From 1977 to 2017 (#/100m^3)

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Centropages Typicus	37,038	27,151	11,665	5,546	14,070	10,956	19,071	26,766	46,075	62,634	62,721	56,244	379,937
Calanus Finmarchicus	1,146	2,796	20,461	44,029	63,187	30,466	40,360	22,356	6,428	2,032	1,275	1,276	235,813
Pseudocalanus spp.	11,886	19,848	32,535	34,025	55,300	46,345	20,130	6,088	1,993	2,027	1,519	6,776	238,472
Penilia spp.	1	-	2	12	11	-	444	6,527	6,240	3,762	1,176	59	18,233
Temora Longicornis	1,427	2,253	3,350	3,786	18,470	43,808	5,950	1,125	2,099	1,090	1,024	1,959	86,339
Centropages Hamatus	2,010	1,792	1,168	1,439	4,188	8,700	6,953	3,355	1,920	3,175	2,909	5,017	42,627
Echinodermata	13	189	1,501	3,683	6,607	1,029	3	406	29,021	9,972	2,801	172	55,397
Appendicularians	1,721	5,477	10,040	12,507	13,312	9,156	1,120	2,459	4,453	3,949	1,703	434	66,331
Paracalanus Parvus	2,294	4,403	1,407	325	854	1,863	527	2,313	6,963	6,391	10,727	4,863	42,931
Gastropoda	1,448	3,770	3,212	1,255	6,259	8,107	1,077	4,883	3,797	1,833	813	982	37,435
Acartia spp.	1,343	921	237	561	930	1,457	2,795	2,303	4,188	5,201	8,445	3,185	31,567
Metridia Lucens	1,439	1,758	3,545	3,948	4,514	4,480	1,616	2,012	1,764	1,134	1,689	3,009	30,907
Evadne spp.	52	273	971	66	19,257	11,413	1,015	2,460	1,181	266	96	3	37,053
Salpa	2	99	1	5	607	50	803	4,276	10,585	8,334	575	33	25,368
Oithona spp.	1,017	3,206	2,612	1,673	3,478	1,887	1,776	3,169	2,697	1,175	1,505	1,012	25,206
Cirripedia	1,660	6,346	10,730	17,853	3,543	337	12	5	41	43	156	16	40,743
Chaetognatha	1,047	1,056	1,076	882	4,008	4,437	4,580	5,263	2,301	1,991	2,765	2,288	31,695
Hyperiidea	265	683	373	201	4,058	2,987	1,823	3,939	1,185	1,597	2,240	904	20,254
Gammaridea	1,096	1,598	402	3,973	5,113	10,306	1,531	587	1,183	6,933	6,135	5,209	44,066
Evadne Nordmanni	-	-	1	37	198	501	871	18	-	38	19	6	1,689
Calanus Minor	137	52	12	30	69	76	305	1,490	2,004	2,503	2,377	566	9,622
Copepoda	83	572	624	138	222	30	8	29	19	27	26	6	1,783
Clausocalanus Arcuicornis	248	658	900	1,021	1,154	731	155	803	696	480	1,331	308	8,488
Decapoda	29	54	109	201	1,761	1,280	1,022	294	333	402	151	79	5,715
Euphausiacea	48	80	429	903	1,143	518	160	391	758	520	948	273	6,171
Protozoa	97	47	119	317	978	373	140	130	1,204	3,655	547	210	7,816
Acartia Longiremis	33	140	201	340	3,928	8,385	2,909	621	90	42	1,210	26	17,925
Eucalanus spp.	8	1	2	6	19	10	23	13	41	52	57	61	294
Pelecypoda	73	107	36	30	112	28	-	99	56	104	317	159	1,121
Polychaeta	59	91	269	288	743	945	13	66	335	160	161	50	3,182
Podon spp.	-	5	7	6	550	508	16	116	863	16	11	4	2,100
Pisces	126	151	115	89	335	582	381	704	503	176	158	99	3,418
Bryozoa	265	143	79	57	332	150	1	57	281	138	288	318	2,108
Clausocalanus Furcatus	-	-	10	-	51	27	390	579	1,145	926	587	9	3,723
Calanus spp.	4	1	26	94	181	55	769	7	4	24	3	0	1,168
Oncaea spp.	9	11	12	13	24	69	33	432	1,027	942	273	100	2,945
Corycaeidae	102	21	2	-	10	13	31	131	684	411	75	40	1,520

Ostracoda	27	13	57	332	123	39	16	4	204	181	133	120	1,250
Temora Stylifera	6	-	-	-	13	17	60	418	413	460	61	30	1,478
Oithona Spinirostris	14	4	138	224	6	96	251	273	112	314	82	338	1,853
Mysidacea	121	122	54	235	53	84	215	400	82	108	199	222	1,896
Temora spp.	293	272	53	1	17	78	314	5	274	71	169	255	1,801
Tortanus Discaudatus	33	81	174	163	2,353	956	43	12	2	2	12	32	3,864
Paracalanus spp.	148	1	2	-	100	15	3	51	193	78	54	132	776
Siphonophores	85	19	48	101	349	413	220	881	1,683	481	2,213	90	6,584
Coelenterates	21	90	201	567	3,991	11,512	199	70	312	214	105	9	17,290
Ctenophores	-	-	-	-	8	9	6	9	34	19	2	2	89
Euphausiacea	40	68	419	869	1,120	495	124	316	694	482	914	265	5,806
Thysanoessa Inermis	-	1	-	-	-	-	-	11	-	7	-	1	20
Meganyctiphanes Norvegica	1	0	8	25	11	7	20	6	8	2	12	-	101
Thysanoessa Raschii	-	3	1	-	3	-	-	25	21	1	9	-	62
Thysanoessa Longicaudata	0	1	0	-	6	12	14	2	-	3	0	-	38
Euphausia Krohnii	2	-	0	6	0	-	2	24	27	19	9	7	97
Euphausia spp.	-	-	0	-	-	-	-	-	-	1	-	-	1
Thysanoessa Gregaria	2	6	1	1	2	5	0	6	6	4	3	0	36
Nematoscelis Megalops	-	1	-	3	1	-	-	-	1	0	-	-	6
Thysanoessa spp.	4	-	-	-	-	-	-	-	-	-	-	-	4
Thecosomata	388	2,592	2,473	603	3,522	3,726	138	520	572	710	259	102	15,605
Spiratella Retroversa	-	6	7	10	35	153	545	66	-	6	-	9	838
Spiratella Inflata	-	-	-	-	-	-	-	-	-	-	-	1	1
Spiratella spp.	1,011	1,076	656	341	2,171	3,854	209	924	2,511	511	334	788	14,385
Creseis spp.	-	-	-	-	0	-	1	2	5	106	-	-	114
Gymnosomata	0	-	1	2	-	178	7	2	-	1	-	-	190
Total	70,420	90,103	112,535	142,824	253,461	233,714	121,200	110,299	151,314	137,937	123,385	98,155	1,645,347

Table 7: Number of Zooplankton Entrained Monthly

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Centropages Typicus	172,115,554	113,962,692	54,207,779	24,939,510	65,384,997	49,268,154	88,621,407	135,376,002	239,643,591	386,612,499	348,305,401	268,625,631	1,947,063,218
Calanus Finmarchicus	5,326,946	11,736,469	95,083,149	198,005,020	293,632,425	137,009,812	187,554,524	113,071,920	33,433,389	12,540,384	7,078,196	6,092,455	1,100,564,690
Pseudocalanus spp.	55,232,417	83,306,660	151,191,119	153,014,317	256,979,800	208,418,897	93,546,100	30,792,410	10,363,963	12,509,922	8,437,935	32,364,001	1,096,157,540
Penilia spp.	3,203	-	7,261	53,861	48,908	-	2,065,163	33,010,295	32,456,491	23,220,028	6,532,553	280,635	97,678,397
Temora Longicornis	6,632,567	9,455,037	15,565,297	17,024,537	85,828,961	197,007,279	27,651,154	5,691,119	10,918,470	6,725,718	5,685,488	9,355,103	397,540,731
Centropages Hamatus	9,341,427	7,522,249	5,428,058	6,471,612	19,463,522	39,124,720	32,311,833	16,966,255	9,988,881	19,600,541	16,154,031	23,959,602	206,332,730
Echinodermata	60,223	791,414	6,977,026	16,564,996	30,704,811	4,626,915	12,158	2,051,372	150,944,412	61,550,088	15,555,746	821,960	290,661,119
Appendicularians – append	7,998,442	22,987,614	46,658,197	56,244,340	61,862,387	41,177,085	5,205,351	12,435,101	23,159,237	24,377,660	9,454,405	2,072,666	313,632,487
Paracalanus Parvus	10,658,540	18,482,374	6,540,186	1,463,162	3,967,656	8,377,846	2,446,758	11,698,275	36,217,751	39,448,305	59,569,547	23,227,601	222,098,001
Gastropoda	6,726,669	15,822,582	14,924,881	5,643,343	29,084,122	36,459,926	5,006,178	24,696,280	19,749,638	11,315,843	4,514,022	4,688,599	178,632,085
Acartia spp.	6,241,873	3,863,612	1,101,258	2,522,178	4,323,215	6,553,708	12,987,954	11,650,263	21,785,094	32,105,921	46,895,582	15,210,433	165,241,092
Metridia Lucens	6,685,976	7,377,129	16,472,107	17,755,334	20,976,211	20,147,891	7,509,834	10,175,650	9,177,097	6,996,802	9,380,520	14,371,048	147,025,601
Evadne spp.	239,980	1,145,617	4,510,087	298,552	89,485,419	51,325,363	4,717,631	12,442,296	6,142,215	1,644,969	535,238	14,171	172,501,537
Salpa	10,990	414,014	3,651	21,893	2,821,343	224,855	3,729,710	21,625,741	55,053,204	51,440,268	3,190,637	159,028	138,695,334
Oithona spp.	4,724,248	13,456,512	12,138,834	7,522,296	16,161,835	8,487,808	8,252,437	16,026,622	14,025,937	7,252,388	8,358,517	4,832,250	121,239,685
Cirripedia	7,715,571	26,634,016	49,864,508	80,287,846	16,465,567	1,517,600	54,737	25,574	213,183	264,778	867,524	77,467	183,988,370
Chaetognatha	4,865,197	4,432,480	4,998,583	3,967,980	18,626,882	19,952,570	21,283,889	26,617,647	11,969,841	12,292,147	15,356,304	10,926,909	155,290,429
Hyperiidea	1,229,259	2,865,839	1,732,691	902,872	18,857,608	13,433,931	8,470,414	19,921,643	6,163,020	9,859,311	12,439,820	4,316,957	100,193,363
Gammaridea	5,092,273	6,707,281	1,869,238	17,866,611	23,759,871	46,345,080	7,114,407	2,971,344	6,155,367	42,794,036	34,069,224	24,878,554	219,623,284
Evadne Nordmanni	-	-	5,767	168,345	919,143	2,252,401	4,047,760	91,182	-	237,629	105,078	26,767	7,854,071
Calanus Minor	635,133	217,858	55,121	134,878	320,618	342,299	1,419,553	7,538,116	10,424,986	15,450,697	13,202,121	2,701,641	52,443,020
Copepoda	383,692	2,399,403	2,899,671	619,799	1,033,362	134,610	36,203	146,211	98,425	165,376	141,618	30,546	8,088,917
Clausocalanus Arcuicornis	1,152,772	2,762,960	4,184,423	4,591,857	5,364,932	3,287,470	722,340	4,062,460	3,620,231	2,964,342	7,391,799	1,473,030	41,578,616
Decapoda	133,319	225,761	507,769	904,859	8,184,396	5,757,028	4,748,593	1,486,010	1,732,827	2,480,319	840,852	376,734	27,378,467
Euphausiacea	225,066	334,645	1,995,641	4,060,292	5,311,784	2,330,970	744,602	1,976,254	3,940,353	3,207,396	5,262,017	1,303,453	30,692,473
Protozoa	452,769	196,670	555,172	1,423,421	4,544,240	1,677,506	649,122	658,787	6,259,756	22,557,990	3,040,390	1,001,037	43,016,860
Acartia Longiremis	151,091	586,662	936,019	1,529,050	18,253,776	37,708,651	13,518,848	3,139,781	469,996	260,797	6,718,969	122,079	83,395,717
Eucalanus spp.	38,997	2,969	11,286	28,900	90,502	44,625	104,828	66,356	215,104	319,102	314,574	290,659	1,527,902
Pelecypoda	336,908	449,937	167,230	136,168	519,728	125,876	-	498,436	293,652	639,860	1,761,658	761,235	5,690,688
Polychaeta	275,869	382,959	1,250,896	1,294,573	3,452,193	4,250,801	59,925	334,416	1,744,157	988,542	896,013	239,749	15,170,092
Podon spp.	-	19,022	30,932	25,762	2,555,676	2,285,221	74,568	587,088	4,487,274	96,890	58,815	18,317	10,239,566
Pisces	584,518	634,395	533,784	401,497	1,558,297	2,615,758	1,768,781	3,560,854	2,616,135	1,084,844	879,146	470,839	16,708,848
Bryozoa	1,231,363	599,700	365,164	256,509	1,543,441	673,658	4,863	289,181	1,460,675	850,287	1,598,116	1,517,117	10,390,074
Clausocalanus Furcatus	-	-	45,474	-	235,677	120,557	1,812,441	2,927,178	5,957,291	5,713,528	3,260,847	42,040	20,115,034

Calanus spp.	16,296	6,073	119,142	424,331	838,925	248,811	3,573,927	35,262	21,666	148,355	15,958	1,575	5,450,319
Oncaea spp.	42,388	44,161	53,793	59,787	110,970	308,960	155,567	2,185,010	5,342,887	5,815,495	1,513,310	477,819	16,110,147
Corycaeidae	473,744	87,161	11,244	-	47,206	58,635	145,894	664,842	3,555,299	2,535,391	415,894	188,997	8,184,308
Ostracoda	127,259	54,319	264,091	1,493,945	572,471	175,041	74,622	20,124	1,060,746	1,119,341	739,242	573,498	6,274,699
Temora Stylifera	30,174	-	-	-	59,472	76,408	277,848	2,113,703	2,148,127	2,836,456	340,337	143,388	8,025,912
Oithona Spinirostris	66,691	16,209	639,918	1,007,874	28,339	433,798	1,164,832	1,380,831	583,594	1,941,010	456,150	1,612,587	9,331,833
Mysidacea	561,440	511,579	251,602	1,058,667	244,946	376,200	998,836	2,023,875	426,929	669,387	1,107,800	1,060,082	9,291,343
Temora spp.	1,360,945	1,141,151	243,989	6,519	78,847	350,471	1,460,727	24,006	1,423,074	436,620	939,695	1,216,381	8,682,427
Tortanus Discaudatus	154,764	340,874	809,222	734,492	10,932,987	4,299,967	198,957	62,616	8,382	14,857	65,978	152,310	17,775,406
Paracalanus spp.	688,762	2,947	11,286	-	463,888	65,467	14,049	256,306	1,003,466	478,465	300,164	629,604	3,914,405
Siphonophores	395,812	80,173	222,870	455,532	1,621,831	1,858,731	1,024,071	4,455,146	8,753,315	2,966,934	12,291,245	430,793	34,556,453
Coelenterates	96,206	375,703	932,430	2,548,812	18,545,522	51,770,274	923,242	353,756	1,624,297	1,323,248	584,886	42,145	79,120,521
Ctenophores	-	-	-	-	37,912	39,263	29,719	44,629	176,046	117,385	10,198	10,339	465,492
Euphausiacea	184,467	283,831	1,945,997	3,906,589	5,206,477	2,224,380	576,283	1,599,738	3,612,082	2,977,249	5,077,005	1,263,460	28,857,558
Thysanoessa Inermis	-	3,483	-	-	-	-	-	57,630	-	40,456	-	5,826	107,394
Meganyctiphanes Norvegica	4,239	1,518	37,342	111,103	51,777	30,615	94,507	32,377	41,775	11,971	68,208	-	485,432
Thysanoessa Raschii	-	10,493	3,796	-	12,189	-	-	126,764	108,596	9,085	47,502	-	318,425
Thysanoessa Longicaudata	1,821	4,778	747	-	29,431	52,452	63,869	7,587	-	20,762	640	-	182,087
Euphausia Krohnii	9,106	-	1,577	26,146	940	-	8,159	122,561	142,486	119,469	51,115	32,698	514,256
Euphausia spp.	-	-	290	-	-	-	-	-	-	5,157	-	-	5,448
Thysanoessa Gregaria	7,096	25,742	5,892	3,347	7,009	23,567	1,729	29,634	31,141	22,232	17,547	1,575	176,509
Nematoscelis Megalops	-	4,867	-	13,073	3,987	-	-	-	4,174	1,229	-	-	27,330
Thysanoessa spp.	18,400	-	-	-	-	-	-	-	-	-	-	-	18,400
Thecosomata	1,802,851	10,878,077	11,493,129	2,711,684	16,364,501	16,757,550	640,314	2,629,840	2,977,503	4,383,760	1,436,267	488,368	72,563,844
Spiratella Retroversa	-	24,916	32,985	42,984	163,890	688,576	2,532,835	335,662	-	37,009	-	44,192	3,903,049
Spiratella Inflata	-	-	-	-	-	-	-	-	-	-	-	6,508	6,508
Spiratella spp.	4,696,304	4,516,113	3,049,184	1,533,757	10,089,568	17,330,110	970,252	4,672,058	13,059,243	3,156,252	1,855,774	3,763,297	68,691,911
Creseis spp.	-	-	-	-	990	-	2,378	10,436	28,060	654,450	-	-	696,313
Gymnosomata	1,978	-	2,863	8,123	-	798,539	32,259	8,050	-	8,016	-	-	859,827
Total	327,243,595	378,190,699	522,951,644	642,292,937	1,177,837,379	1,051,034,683	563,218,943	557,860,557	787,014,531	851,419,248	685,187,618	468,795,758	8,013,047,593

It is important to note that the potential ichthyoplankton and zooplankton entrainment estimates calculated assume 100 percent mortality of entrained organisms. There is potential that entrained individuals would survive passage through the CWIS due to short residence time in the system and a maximum water temperature exposure of only 90°F (32°C). Entrainment survival studies at existing power plants do not include directly comparable facilities or environments, but *Review of Entrainment Survival Studies: 1970–2000* (EPRI, 2000) identifies 91.4°F (33°C) as an upper threshold discharge temperature for many organisms to survive entrainment in existing power plants located along the Hudson River in NY. These potential mechanisms for entrainment survival have not yet been applied to this analysis but could be considered when evaluating overall biological impacts of the OCS-DC operation.

The SRWF is expected to generate up to 1,034 MW of renewable energy. Compared to traditional fossil fuel power plants with similar MW capacity, the water withdrawal rate of the CWIS at the OCS-DC is relatively low. Table 8 puts the OCS-DC water usage in context with other generating stations in New York with both open and closed-water cooling systems. The values presented in Table 8 are approximate and based on publicly available information and are presented solely for comparative purposes. The average daily water usage at the generating stations with open cooling systems equates to approximately 0.8 MGD per MW of generation. The average daily water usage for the CWIS at the OCS-DC equates to approximately 0.008 MGD per MW, which is consistent with the ratio demonstrated at the Bethlehem facility which utilizes a closed cycle cooling system (Table 8). As a result of reduced daily water usage, entrainment estimates for the CWIS are considerably lower than other power plants. For example, the EPA estimates that 16 billion eggs and larvae are entrained annually at Brayton Point Station (MMS, 2009).

Table 8: Comparison of Water Intake: Power Generation at OCS-DC and New York Stations

Facility name	Facility Type	Cooling System	Water usage (MGD)	Capacity (MW)	MGD:MW	Source
Arthur Kill	Natural Gas	Open	700	800	0.875	Biological Fact Sheet – Cooling Water Intake Structure
Astoria	Natural Gas	Open	1250	1350	0.926	Biological Fact Sheet – Cooling Water Intake Structure
Bethlehem	Natural Gas	Closed	9	750	0.012	NYDEC Ruling
Bowline	Natural Gas	Open	900	1100	0.818	Final Environmental Impact Statement
Indian Point	Nuclear	Open	2500	2150	1.163	Indian Point SPDES Fact Sheet
Northport	Natural Gas	Open	930	1450	0.641	Survey of National Grid Generation
Ravenswood	Natural Gas	Open	1500	2300	0.652	Ravenswood Water Withdrawal Permit
Roseton	Natural Gas	Open	920	1200	0.767	Final Environmental Impact Statement
Sunrise Wind	Wind	Open	8	1034	0.008	

(iv) Identification and evaluation of the primary period of reproduction, larval recruitment, and period of peak abundance for relevant taxa;

Ichthyoplankton for the entrainment-susceptible species with designated EFH near the OCS-DC is detected throughout the year with a period of peak primary production that begins in early summer and extends through the early winter (Figure 2). The overall pattern of reproduction, larval development, and peak abundance is dominated by Atlantic herring, red hake, Atlantic mackerel, and silver hake.

(v) Data representative of the seasonal and daily activities (e.g., feeding and water column migration) of biological organisms in the vicinity of the cooling water intake structure;

Information regarding the seasonal abundance of entrainment susceptible finfish species in the vicinity of the OCS-DC is summarized in Table 3 through Table 5.

(vi) Identification of all threatened, endangered, and other protected species that might be susceptible to impingement and entrainment at your cooling water intake structures;

Four finfish species listed on the Endangered Species Act (ESA) may occur near or in the SRWF:

- Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*);
- Shortnose sturgeon (*Acipenser brevirostrum*);
- Giant manta ray (*Manta birostris*); and
- Oceanic whitetip shark (*Carcharhinus longimanus*).

No critical habitat for these finfish species is present within the SRWF. Although these four federally listed species have ranges that may include the SRWF, the Atlantic sturgeon is the only one of these species whose occurrence is regular or common in the SRWF and thus may be exposed to impacts from the CWIS.

The Atlantic sturgeon spawns in the freshwater of large rivers with juveniles migrating seaward at a length of approximately 2 ft (0.8 m) (Murawski and Pacheco, 1997). Juvenile and adult sturgeon typically inhabit shallow coastal waters comprised of sand and gravel substrates with water depths of 30 to 150 ft (10 to 50 m) (Stein et al., 2004a). Based on these life history characteristics, early life stages are not susceptible to entrainment and larger life stages would not be susceptible to impingement during operation of the OCS-DC.

The fourteen marine mammal species that commonly or regularly occur near the OCS-DC are shown below (Orsted, 2021). Four of these species (as indicated) are also listed on the ESA.

- Suborder Mysticeti (Baleen Whales)
    - Fin whale (*Balaenoptera physalus*) [ESA listed]
    - Humpback whale (*Megaptera novaeangliae*)
    - North Atlantic right whale (*Eubalaena glacialis*) [ESA listed]
    - Sei whale (*Balaenoptera borealis*) [ESA listed]
    - Minke whale (*Balaenoptera acutorostrata*)
- Suborder Odontoceti (Toothed Whales, Dolphins, and Porpoises)

- Sperm whale (*Physeter catodon*) [ESA listed]
- Long-finned pilot whale (*Globicephala melas*)
- Short-beaked common dolphin (*Delphinus delphis*)
- Atlantic white-sided dolphin (*Lagenorhynchus acutus*)
- Atlantic spotted dolphin (*Stenella frontalis*)
- Common bottlenose dolphin (*Tursiops truncatus*)
- Harbor porpoise (*Phocoena phocoena*)

- Suborder Pinnipedia
  - Harbor seal (*Phoca vitulina*)
  - Gray seal (*Halichoerus grypus*)

These large-bodied marine mammals are highly mobile and therefore are not susceptible to impingement or entrainment operational impacts associated with the OCS-DC.

Some species of baleen whales rely on zooplankton as an important component of their diet. Zooplankton that are potentially subject to entrainment are listed in Table 6 and 7. The effect of the OCS-DC on zooplankton entrainment is discussed above and likely represents a small fraction (<0.1 percent) of the stock of these abundant prey organisms in this region.

In the vicinity of the OCS-DC, the Leatherback sea turtle (*Dermochelys coriacea*) and Loggerhead sea turtle (*Caretta caretta*) are considered common (Orsted, 2021) and are federally listed as Endangered and Threatened, respectively, under the ESA. There is no impingement or entrainment susceptibility for early life stages of these species due to their terrestrial egg laying behavior. Juvenile and adult life stages of Loggerhead sea turtles that could be found in the vicinity of the OCS-DC exhibit swimming speeds ranging from 0.52 ft/s (0.16 m/s) to 0.62 ft/s (0.19 m/s) (Abecassis et al., 2013) and therefore should not be susceptible to impingement or entrainment operational impacts.

(vii) Documentation of any public participation or consultation with Federal or State agencies undertaken in development of the plan;

Routine communication with regulatory agencies for various Project components is ongoing. Correspondence with applicable regulatory entities as it pertains to OCS-DC design, operation, and this NPDES permit application is detailed below.

- BOEM and EPA, March 16, 2021, Project Introduction;
- BOEM, EPA, National Marine Fisheries Service (NMFS), August 10, 2021, Project Update and Coordination;
- EPA and BOEM, October 18, 2021, NPDES Permit Pre-Application Meeting;
- EPA, December 1, 2021, NPDES Permit Application submitted for review; and
- EPA, January 3, 2021, NPDES Permit Application deemed complete.

(viii) If you supplement the information requested in paragraph (r)(4)(i) of this section with data collected using field studies, supporting documentation for the Source Water Baseline Biological Characterization must include a description of all methods and quality assurance procedures for sampling, and data analysis including a description of the study area; taxonomic identification of sampled and evaluated biological assemblages (including all life stages of fish and shellfish); and sampling and data analysis methods. The sampling and/or data analysis methods you use must be appropriate for a quantitative survey and based on consideration of methods used in other biological studies performed within the same source water body. The study area should include, at a minimum, the area of influence of the cooling water intake structure.

No project-specific field studies in support of §122.21(r)(4) have been required nor completed in support of the Project. Rather, the robust 40-year ichthyoplankton dataset developed under NOAA was used to provide detailed abundance data for assessing susceptibility of aquatic resources as a result the OCS-DC operation.

4. References

Abecassis, M., I. Senina, P. Lehodey, P. Gaspar, D. Parker, G. Balazs, and J. Polovina. 2013. A model of Loggerhead sea turtle (Caretta caretta) habitat and movement in the Oceanic North Pacific. PLoS One 8(9): e73274. DoI:10:1371

Dahlberg, M.D. 1979. A review of survival rates of fish eggs and larvae in relation to impact assessments. Marine Fisheries Review. 12 pp.

INSPIRE Environmental. 2022. Essential Fish Habitat Assessment, Sunrise Wind Farm Project. Prepared for Stantec, Quincy, MA and Sunrise Wind LLC. Prepared by INSPIRE Environmental. August 2022.

MMS (Minerals Management Service). 2009b. Cape Wind Energy Project, Nantucket Sound, Massachusetts: Final Environmental Impact Statement. U.S. Department of the Inerior. OCS Publication No. 2008-040.

Murawski, S. A. and A. L. Pacheco. 1977. Biological and fisheries data on Atlantic Sturgeon, *Acipenser oxyrhynchus* (Mitchill). National Marine Fisheries Service Technical Series Report 10: 1-69.

National Oceanic and Atmospheric Administration (NOAA Fisheries). 2021. Atlantic cod (*Gadus morhua*) Species Profile. https://www.fisheries.noaa.gov/species/atlantic-cod. Accessed November 11, 2021

Orsted. 2021. Sunrise Wind Construction and Operations Plan. Submitted to the Bureau of Ocean Energy Management on August 23, 2021. https://www.boem.gov/sites/default/files/documents/renewable-energy/state-activities/SRW01-COP-2021-08-23.pdf

Pepin, P. 1991. Effect of temperature and size on development, mortality, and survival rates of the pelagic early life history stages of marine fish. Canadian Journal of Fisheries and Aquatic Sciences. 48:503-518.

South Fork Wind Farm. 2019. Essential Fish Habitat Assessment. Submitted to the Bureau of Ocean Energy Management in May 2019.

Stein, A. B., K. D. Friedland, and M. Sutherland. 2004a. Atlantic sturgeon marine distribution and habitat use along the northeastern coast of the United States. Transactions of the American Fisheries Society 133: 527-537.