Baseline Value of Commercial Fisheries Landings from the Revolution Wind Export Cable Corridor in Rhode Island State Waters

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List of Abbreviations

CDC – Construction Disturbance Corridor

COP – Construction and Operations Plan

ECC – Export Cable Corridor

ECRA – Export Cable Route Area

GDP – Gross Domestic Product

NEMFIS – Northeast Marine Fisheries Information System

NMFS – National Marine Fisheries Service

NOAA – National Oceanographic and Atmospheric Administration

PPI – Producer Price Index

RIDEM – Rhode Island Department of Environmental Management

RW – Revolution Wind

RWEC – Revolution Wind Export Cable

VMS – Vessel Monitoring System

VTR – Vessel Trip Report

WLA – Wind Lease Area

Summary

Based on Rhode Island Department of Environmental Management (RIDEM) data from 2008 to 2019, we estimate the average annual value of commercial landings from Rhode Island State waters in the vicinity of the Revolution Wind Export Cable route to be $42,600 to $61,300 (2020$) per km^2. Including indirect and induced effects, these landings generate average annual economic impacts of $92,100 and $132,800 per km^2 in Rhode Island. The Revolution Wind Export Cable Corridor (defined here as two 180 m wide lanes surround each of the two export cables) has a footprint of about 11.92 km^2 in Rhode Island waters. We estimate the average annual value of landings from the ECC in Rhode Island waters to be between $508,000 and $732,000 (2020$), or between $1,099,000 and $1,584,000 including indirect and induced effects.

Introduction

This report estimates the level of pre-development commercial fishing operations and associated landings and landed value originating in Rhode Island State waters in the vicinity of the Revolution Wind Export Cable (RWEC) route. Revolution Wind LLC is a joint venture between Ørsted and Eversource. In Rhode Island State waters, the cable route extends from the landing site near Davisville for about 20 km south through parts of Narragansett Bay, and then in an east-south-easterly direction to federal waters (Fig. 1). The hatched area in Fig. 1 is the surveyed corridor, varying in width between 400 and 3,200 m, within which the cables will ultimately be located.

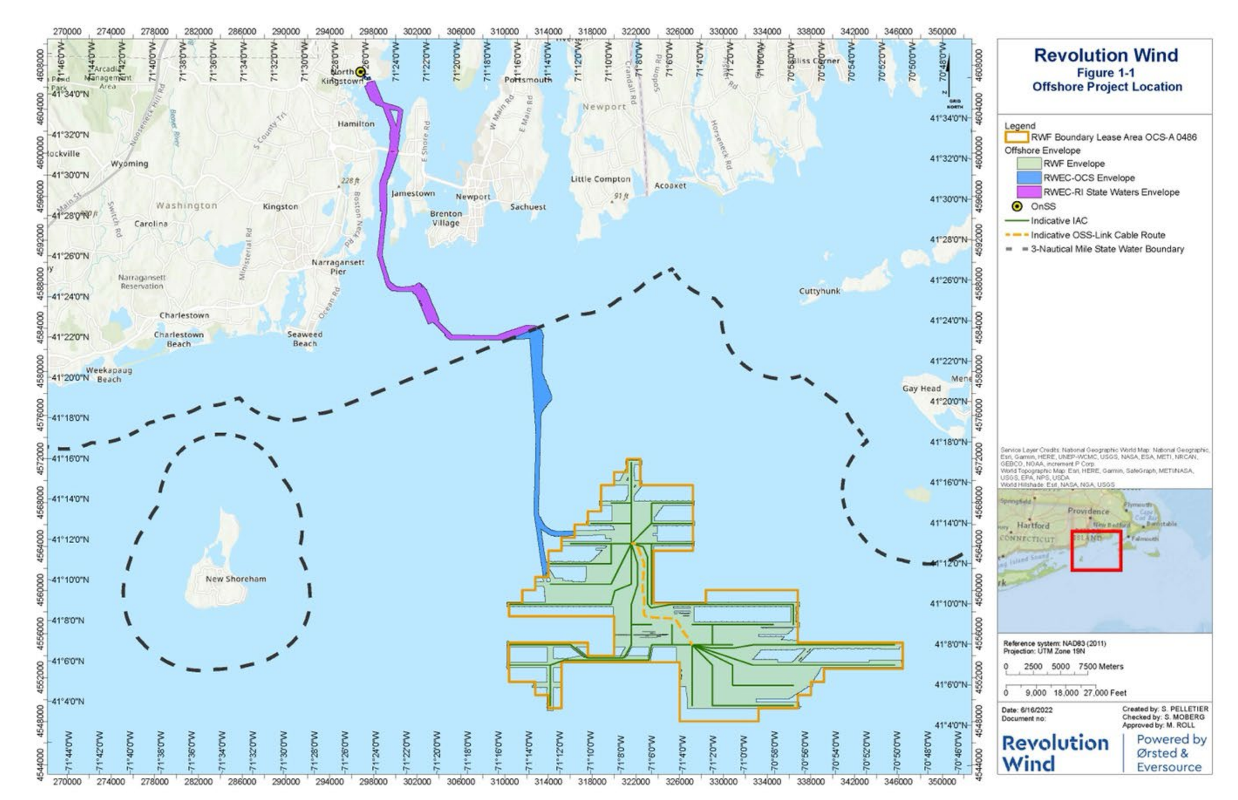

Figure 1. Revolution Wind project area and export cable route. Source: Revolution Wind.

The state waters portion of the RWEC route lies almost entirely in NOAA Northeast Marine Fisheries Information System (NEMFIS) Area 539 (Fig. 2).

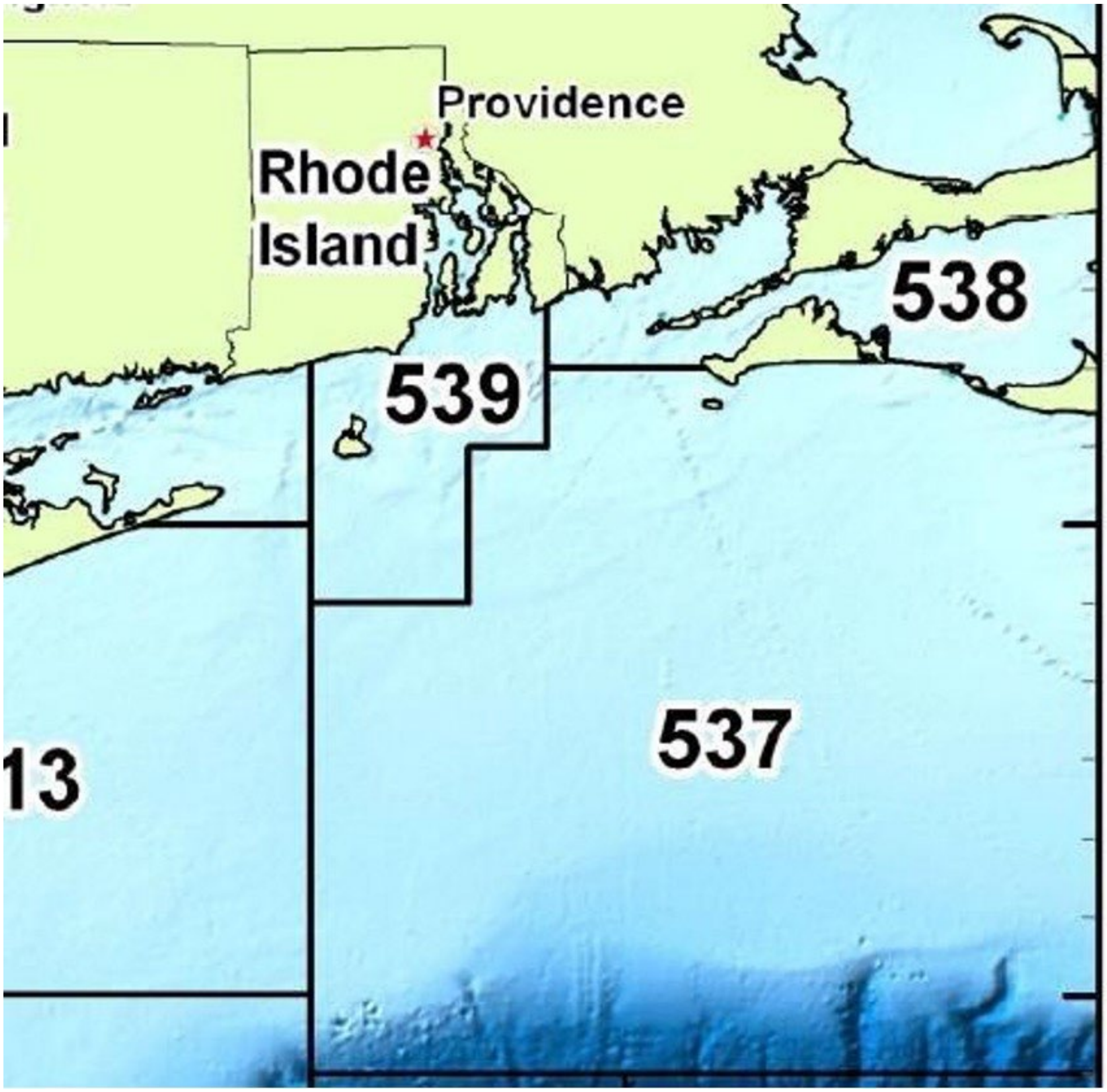

Figure 2. NOAA Fisheries Statistical Reporting Areas. Source: ACCSP (2021).

Methodology

We use two sources of data to develop an estimate of the annual commercial landings and landed value from the RWEC. The first is a dataset provided by NOAA's National Marine Fisheries Service for the entire RWEC route, including the portion that lies in federal waters. This dataset uses modeled representations of federal Vessel Trip Report (VTR) and clam logbook fishing trip data to produce an accurate spatial allocation of landings from each fishing trip (DePiper 2014; Benjamin *et al.* 2018). This dataset does not include landings associated with state permits, and therefore likely underestimates the landings and landed value from the state waters portion of the Export Cable Route.

To address this issue, we use a second dataset on landings from NOAA Fisheries Statistical Reporting Area 539 for the years 2008 to 2019, provided by the Rhode Island State Department of Environmental Conservation. The RIDEM data are compiled as the total yearly pounds landed, by species.

In both data sets, annual landings values vary from year to year; we use the average landings and landed value from 2008 to 2019 as indicative of what the area may yield in the future.

Baseline commercial fishery landings and values

Commercial fisheries data: Export Cable Route Area

We use commercial fisheries landings data for 2008 to 2019 from NOAA for a 10 km wide Export Cable Route Area (ECRA) extending 5km on either side of the entire cable route. The data set includes both landings quantity (in pounds) and value (in dollars) by species, port, and gear type.

The 10 km wide ECRA has no physical significance in the context of the Revolution Wind Lease, and is defined only for the purpose of identifying fisheries landings data that reflect what may be landed from fishing along the export cable route. We use the per unit area (km^2) value of landings from the ECRA to calculate the landed value attributable to the Export Cable Corridor (ECC), defined here as two 180 m wide lanes running along the length of each of the two export cables. About 52.6% of the 63 km long Export Cable Route lies in state waters, giving the ECC a footprint of 11.93 km^2.

The following data description of the NOAA data is based on information provided by the National Marine Fisheries Service (NMFS) on March 20 and April 1, 2020.[1] NOAA has been collecting and improving the vessel trip report (VTR) data for decades. The VTR data have been widely used for fisheries research, management, and economic impact assessments. To gauge landings value and quantity for specific areas off the US coast, NOAA has recently developed a procedure to produce high-resolution spatial information using a combination of VTR and fishery observer data. As described below, we follow the general approach developed by NOAA, which is the best approach at present.

The data presented will summarize estimates of fisheries landings and values for fishing trips that intersected with the export cable. Modeled representations of federal Vessel Trip Report (VTR) and clam logbook fishing trip data are queried for spatial overlap with the cable route area, and linked to dealer data for value and landings information. As detailed in DePiper (2014) and Benjamin et al. (2018), to improve the spatial resolution of VTR, a spatial distribution model was developed by combining vessel trip information from VTR with matching NOAA fishery observer data, including geocoordinates of detailed fishing locations. From this model, landings and value can be summarized for a specified geographic area according to (1) species, (2) gear type, (3) port of landing, and (4) state of landing.

The DePiper approach utilizes a spatial model to distribute the total landings for each commercial fishing trip over a circular area with its center located at the geocoordinate reported in the vessel trip report (VTR), following a distribution decreasing with the radius. The model was estimated using VTR data (for the centroid) and vessel observer data (for haul beginning and endpoints). DePiper (2014) reported that the observer data matched VTR records well (488,251 hauls in the observer data were matched to 27,358 VTR records, representing 87.5% of all hauls with either a beginning or end point of a haul recorded).

[1] Our primary contact at NMFS was Benjamin Galuardi, a statistician at the NOAA Greater Atlantic Regional Fisheries Office. He has worked extensively on fishery data analyses in general and the VTR data in particular, and has authored or coauthored more than 30 publications on fisheries sciences and spatial statistics.

The primary purpose of the observer data collection is to monitor fishery bycatch. NOAA's Standardized Bycatch Reporting Methodology (SBRM) dictates what types of vessels (gear, species, area of operation, etc.), participating in various fisheries, should be sampled and at what rate. The numbers of sea days needed to achieve a 30% coefficient of variation (CV = standard deviation divided by mean) of total discards for each species group were derived for different SBRM fleets covering different gears, access areas, states, and mesh sizes (NEFSC 2013).

Following the DePiper approach, the resulting high spatial resolution data were converted into raster maps. Use of this VTR raster model produces a more accurate estimate of the spatial distribution of landings than other approaches that rely entirely on the self-reported VTR/clam logbook locations, which associate all landings from the trip with a single point location. At 10 nm resolution, the confidence intervals of the DePiper model estimates are around 90% for trips length of one to two days.

The only alternative to the DePiper approach is a model to distribute the total landings from a VTR report over the vessel's track using the vessel monitoring system (VMS) data. The main challenge for this approach is accurate identification of fishing and non-fishing segments of a trip. Muench *et al.* (2018) have shown that using vessel speed alone can lead to a severe misrepresentation of fishing locations. NOAA has adopted the DePiper approach as a standard procedure to generate spatial data; and we agree with NOAA that this is the best approach currently available. The main advantages of the DePiper approach are that (1) it is based on observations of actual fishing locations noted by observers at sea, and (2) it provides a systematic and consistent way to meet the increasing demand for spatial fishing data for relatively small areas in the ocean, which is important for cross project comparison.

Commercial fishery landings from Export Cable Corridor, NOAA data

We define the Revolution Wind Export Cable Corridor (ECC) as the combined footprint of two 180 m wide lanes centered on the two export cables. We base our calculations on the combined area of two distinct 180 m wide lanes. In practice, the lanes will overlap to some extent, as the cables will be placed less than 180 m apart at some locations along their routes.

Based on NOAA data for the 10 km Export Cable Route Area, the average annual landings (2008 to 2019) from the two 180m wide lanes forming this 22.68 km^2 Export Cable Corridor are about 219,000 lbs (standard deviation 142,000 lbs) with a value of $95,000 (2020$; standard deviation $22,000).

About 52.6% of the 502 km^2 Export Cable Route Area is located in Rhode Island state waters, and 47.4% in federal waters. Assuming that the ECC is distributed similarly across state and federal waters, and that the landed value estimated by NOAA is uniformly distributed across the entire ECRA, this implies that the average annual landed value associated with the Revolution Wind ECC in RI state waters is $49,700, and the average annual value associated with the ECC in federal waters is $44,800.

Table 1 shows the total landings and values, for each year from 2008 to 2019, associated with fishing in the Export Cable Corridor. Table 2 summarizes the average annual landings and value of fisheries production from the Export Cable Corridor by the top five species or species groups.

Table 1. Annual value and quantity of commercial fisheries landings from the ECC.

Year	Value (2020 $)	Landings (lbs)
2008	98,544	117,618
2009	105,082	240,398
2010	86,720	150,650
2011	106,078	196,432
2012	138,310	512,126
2013	110,010	393,782
2014	106,112	373,100
2015	95,854	222,086
2016	91,596	209,436
2017	62,640	75,972
2018	66,692	62,180
2019	66,436	78,780

Table 2. Average annual landings of major species from the ECC, 2008-2019.

	Mean		***Standard Deviation***	
Species	**Value/year** (2020 $)	**Landings/year** (lbs)	**Value/year** (2020 $)	**Landings/year** (lbs)
Revolution ECC				
Herring, Atlantic	17,562	132,076	16,902	137,256
Lobster, American	17,352	3,196	9,126	1,500
Squid/Loligo	9,804	7,186	5,120	3,946
Flounder, Summer/Fluke	9,538	2,408	1,842	658
Scup/Porgy	7,804	11,906	2,748	5,206

Both mobile (e.g., trawl and dredge) and fixed (e.g., pots and gillnet) gears are used in fishing operations. The trawl gear is primarily used for harvesting groundfish, dredge for scallops, and pots for lobster and crabs. The fixed gears are fished using trawls (a series of lobster pots attached to one line) with string lengths of 0.4–0.8 km (up to 1.829 km) or gillnets with typical string lengths of 0.2–3.0 km. Table 3 breaks out annual landings for each area by gear type. Trawl and pot fisheries and gillnets are the most significant in both areas, followed by gillnets and dredges. The “ALL_OTHERS” category includes landings using purse seines, other seines, and weirs/traps, and others that fall under the “rule of three” exclusion.

Table 3. Average annual landings in Revolution ECC by gear type.

Gear	***Mean***		***Standard Deviation***	
	Value/year (2020 $)	**Landings/year** (lbs)	**Value/year** (2020 $)	**Landings/year** (lbs)
Dredge – Clam	-	-	-	-
Dredge – Scallop	2,654	242	1,852	152
Gillnet – Sink	7,726	10,316	2,402	4,790
Gillnet – Other	-	-	-	-
Handline	314	94	116	28
Longline – Bottom	-	-	-	-
Pot – Other	22,008	6,782	7,674	1,842
Trawl – Bottom	45,296	97,640	10,172	34,130
Trawl – Midwater	12,222	98,992	12,556	111,684
Other	-	-	-	-
ALL_OTHERS	4,286	5,316	2,810	4,114

Table 4 summarizes annual landings and landed value for the major ports receiving landings from both areas. Point Judith, Newport, and Little Compton (in Rhode Island) and New Bedford in Massachusetts are among the most significant ports for landings.

Table 5 show average annual landings and landed value from the ECC by state where the catch is landed. Rhode Island and Massachusetts together account for more than 96% of landings from the ECC. The “others” category includes landings in Maine, Connecticut, New York, New Jersey, Maryland, North Carolina, and Virginia, as well as data flagged by the “rule of three” exclusion.

Table 4. Average annual landings at major ports.

Area/Port	***Mean***		***Standard Deviation***	
	Value/year (2020 $)	**Landings/year** (lbs)	**Value/year** (2020 $)	**Landings/year** (lbs)
Revolution ECC				
Point Judith	49,630	84,938	8,184	41,964
Newport	12,996	29,990	6,354	19,748
New Bedford	11,154	70,578	7,936	83,742
Little Compton	8,468	9,534	4,620	6,828
ALL_OTHERS	2,846	8,258	3,696	14,334

Table 5. Average annual landings from Revolution ECC by state.

State	Mean Value/year (2020 $)	Mean Landings/year (lbs)	Standard Deviation Value/year (2020 $)	Standard Deviation Landings/year (lbs)
Rhode Island	75,858	131,252	15,808	52,728
Massachusetts	15,508	82,018	9,096	88,402
Others	3,006	5,666	--	--

The NOAA data for the ECRA suggest that the average annual landed value to Rhode Island from landings in the ECC is less than $5,000/km^2. Because the NOAA data do not include landings from state waters for vessels with Rhode Island state permits, we consider this to understate the actual landings from Rhode Island state waters.

Landed value and trips by month

Table 6 and Figure 4 show the average monthly landings and values. Table 7 reports the average monthly number of fishing trips that intersect the ECRA.

Table 6. Average monthly value of landings from ECC, 2020$, 2014-2019.

Month	Average landed value, 2020$
Jan	3,126
Feb	1,462
Mar	1,932
Apr	1,858
May	7,818
Jun	11,112
Jul	10,564
Aug	10,550
Sep	8,278
Oct	6,942
Nov	5,944
Dec	13,070

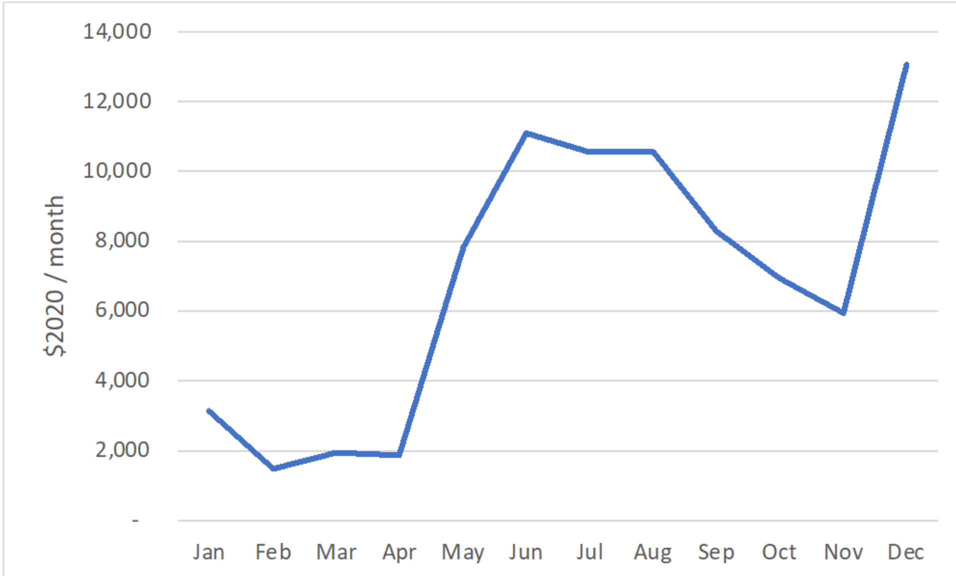

Figure 3. Average monthly value of landings, Revolution ECC, 2014-2019.

Table 7. Average monthly number of fishing trips, 2014-2019.

Month	**Revolution ECRA**
Jan	260
Feb	120
Mar	104
Apr	201
May	876
Jun	1,032
Jul	1,180
Aug	1,053
Sep	872
Oct	660
Nov	511
Dec	398

Commercial fishery landings from state waters around the Export Cable Route, RIDEM data

To capture landings associated with Rhode Island state fishing permits from state waters, we examine landings data from RIDEM for Area 539. The RIDEM data are compiled as the total yearly pounds landed, by species. For the RWEC, the affected area lies within Statistical Area 539, as shown in Figs. 1 and 2 above.

The RIDEM commercial landings quantity statistics come in two separate data sets. The first set includes all species measured in “hail weight” pounds, and the second includes shellfish species measured in other units: quahogs in "number of clams," and softshell clams and oysters in "total pounds." We assume RIDEM "hail weight" and "total pounds" are consistent with NMFS landed weight and live weight designations, respectively. We convert the number of clams into live pounds using a conversion factor of 2.5 clams per pound.

RIDEM does not currently provide revenue or price data associated with these landings, because neither VTRs nor state logbooks include price data. We use the price by species data from the National Oceanic and Atmospheric Administration (NOAA) (described below) to estimate the revenues for landings from Area 539. We assume that in the NOAA data, horseshoe crab landings are in pounds, and the price is in $/pound. For the three shellfish species measured in live weight, we use price in $/live pound from the Maine Department of Marine Resources.[2]

Table 8 shows the average annual commercial fishery landings and landed value for this area from 2008 to 2019, for species/groups with average annual landed value greater than $3 million. Note that RIDEM reports landings for "other commercial shellfish" separately for Area 539 (see Table 10 below); we have combined those with the main Area 530 landings for purposes of this analysis. The average annual landed value for all species combined is $118.2 million (2020$); see Appendix for complete listing of all species.

Based on an Area 539 footprint of 2,550 km^2, the RIDEM data suggest an average annual value of Rhode Island landings from Area 539 of $46,351/km^2 (2020$). This is substantially greater than the value suggested by the NOAA data for the Revolution Export Cable Route (see above).

Table 8. Average annual landings and landed value for Area 539, selected species, 2008-2019. Source: estimated from data provided by RIDEM, NOAA.

Species/group	**Landings** (lbs/year)	**Value** (2020$/year)
Squid, shortfin Illex	13,070,423	10,418,157
Squid, longfin Loligo	12,665,456	17,475,079
Commercial shellfish, other	10,195,440	13,292,040
Herring, sea, Atlantic	10,052,757	1,395,015
Skates, Rajidae	7,147,479	16,307,065
Scup	4,784,313	3,096,774
Crab, Jonah	4,113,128	3,009,832
Lobster, American	2,260,895	12,192,734
Goosefish	1,841,364	4,193,760
Skate, little	1,794,937	4,090,470
Flounder, summer	1,684,123	6,633,699
Scallop, sea	1,255,577	13,325,336

[2] https://www.maine.gov/dmr/commercial-fishing/landings/historical-data.html

The difference is likely to due in large part to the inclusion of landings associated with state permits in the RIDEM data. The number of Rhode Island-based vessels fishing with state permits is substantially larger – perhaps by as much as an order of magnitude – than the number fishing with federal permits (RIDEM, pers. comm. Feb. 2022); and landings associated with state permits are not included in the NOAA data for the Export Cable Route Area. That would suggest that the Area 539 landings are concentrated more heavily in state waters rather than federal waters. However, we are not able to estimate with confidence what fraction of Area 539 landings come from state waters, since RIDEM does not have information that permits allocation of the Area 539 data to state vs. federal waters (RIDEM, pers. comm. Feb. 2022).

We consider the RIDEM Area 539 data to be a better reference point for baseline landings from the Rhode Island state waters portion of the Revolution Export Cable Route, and use these values as our baseline landings from the state waters portion of the ECC. State and federal waters each make up about 50% of the total Area 539 footprint. A lower bound estimate of annual baseline landings from the state waters portion of the ECC is based on the assumption that Area 539 landed value is evenly distributed across the state and federal waters portions of Area 539, resulting in the value for state waters of about $46,400/km^2 as shown above. This is likely an underestimate, given that landings from state waters are most likely greater than landings from federal waters in Area 539. An upper bound is based on the assumption that the NOAA data for the Revolution ECRA (estimated in the Revolution

Table 9. Annual value and landings of commercial fisheries from Area 539. Source: RIDEM.

Year	**Value*** (2020 $)	**Landings** (lbs**)	**RI Total***** (lbs)	**Percent** (A539/RI total)
2008	102,383,612	62,678,712	72,044,547	87.00%
2009	86,369,974	73,382,994	84,043,836	87.32%
2010	82,497,897	62,946,960	77,696,394	81.02%
2011	100,444,225	71,085,596	78,749,033	90.27%
2012	122,029,850	80,511,567	85,233,593	94.46%
2013	110,770,999	84,830,946	89,849,566	94.41%
2014	107,770,296	85,277,728	91,779,822	92.92%
2015	103,871,762	69,071,802	75,728,351	91.21%
2016	106,019,540	76,644,942	82,689,439	92.69%
2017	113,476,386	76,592,447	83,797,025	91.40%
2018	113,183,780	74,770,441	81,101,966	92.19%
2019	110,014,713	72,710,862	78,800,921	92.27%
Annual average	104,902,753	74,208,750	81,792,874	90.73%

* Price by species data is from NMFS.
** RIDEM reported hail weight. We assume RIDEM hail weight = NMFS landed weight.
*** NMFS data. https://www.fisheries.noaa.gov/national/sustainable-fisheries/commercial-fisheries-landings

Wind Rhode Island Federal Waters Report between \$5,640 to \$11,900/km^2/year) are representative of landed value from the federal waters portion of Area 539, and that to match the RIDEM value for all of Area 539, average annual landed value from the state waters portion must be between \$82,400 and \$88,700/km^2. This may be an overestimate; the total average annual landings suggested by the RIDEM data for Area 539 from 2008 to 2019 (leaving out "other commercial shellfish") is 74.2 million pounds, or more than 90% of the 81.8 million pounds in average annual total landings attributed to all Rhode Island commercial fishing by NMFS (see Table 9).

Table 10. Annual value and quantify of "other commercial shellfish" from Area 539. Source: RIDEM.

Year	**Value** (2020 \$)	**Landings** (lbs*)
2008	9,301,911	8,283,684
2009	7,291,466	7,117,082
2010	8,106,428	8,537,393
2011	11,493,071	10,269,274
2012	16,532,394	14,306,806
2013	14,406,247	12,577,294
2014	15,428,251	12,794,694
2015	16,847,017	11,415,563
2016	17,171,531	11,175,876
2017	14,000,025	9,167,814
2018	13,997,335	8,482,742
2019	14,928,801	8,217,061
Annual average	13,292,040	10,195,440

* Species include "Clam, Quahog, Northern", "Soft-Shell Clam", and "Oyster" in the RIDEM data.

Some fraction of lobster and Jonah crab landings in Rhode Island are sold directly from boats at dockside, at a price above that reported in the dealer information on which the values above are based. Neither the fraction of landings sold in this way nor the price premium is known exactly. Based on information provided by a group of Rhode Island fishermen (pers. comm., 24 Nov. 2020), we estimate that a 15% premium on the landed value derived from RIDEM data (Table 8) adequately captures this dockside sales effect for Rhode Island landings.

Applying this adjustment and the assumptions about the distribution of landings between state and federal waters to the Area 539 landings data, we obtain an estimated average annual value for Rhode Island landings from the Revolution ECC in Rhode Island state waters of \$507,869 to \$731,863 per year, or \$47,571 to \$61,346/km^2/year (2020\$).

Inter-annual price adjustments

We use the Bureau of Labor Statistics' Producer Price Index (PPI) for "unprocessed and prepared seafood"[3] to convert ex-vessel value of fish landings, because this index is specifically for the fishery sector. PPI is a family of indexes that measures the average change over time in selling prices received by domestic producers of goods and services; they measure price change from the perspective of the seller. In contrast, the Bureau of Economic Analysis' general Gross Domestic Product (GDP) deflator[4] measures changes in the prices of goods and services produced in the United States, including those exported to other countries, and captures price changes across all economic sectors. Table 11 shows both indexes from 2000 to 2021.

Table 11. Price indexes.

Year	GDP implicit price deflator	Percent change	PPI fish	Percent change
2000	78.0		198.1	
2001	79.8	2.25%	190.8	-3.69%
2002	81.0	1.56%	191.2	0.21%
2003	82.6	1.97%	195.3	2.14%
2004	84.8	2.68%	206.3	5.63%
2005	87.5	3.14%	222.6	7.90%
2006	90.2	3.09%	237.4	6.65%
2007	92.6	2.70%	242.8	2.27%
2008	94.4	1.92%	255.4	5.19%
2009	95.0	0.64%	250.9	-1.76%
2010	96.2	1.20%	272.4	8.57%
2011	98.2	2.08%	287.6	5.58%
2012	100.0	1.87%	287.6	-0.02%
2013	101.8	1.75%	299.4	4.12%
2014	103.7	1.87%	322.4	7.68%
2015	104.7	1.00%	322.0	-0.13%
2016	105.7	1.00%	327.6	1.74%
2017	107.7	1.90%	337.9	3.15%
2018	110.3	2.39%	344.5	1.96%
2019	112.3	1.79%	349.9	1.55%
2020	113.6	1.21%	350.8	0.27%
2021	118.4	4.15%	413.0	17.74%
Annual average		2.01%		3.66%

Note that the variation in the sector (i.e., fishery) specific price index is considerably larger than that of the GDP deflator. PPI decreases have been observed in several years since 2000. The GDP deflator exhibits a steady trend. We recognize that many seafood prices rose sharply in 2021, as reflected by the

[3] https://www.bls.gov/ppi/#data

[4] https://apps.bea.gov/iTable/iTable.cfm?reqid=19&step=2#reqid=19&step=2&isuri=1&1921=survey

sharp increase in fish PPI for that year. We consider it unlikely that this will significantly alter the long-term trend, and maintain that the historical average is the best predictor of future values.

We report all values in 2020$ for consistency. These values can be easily adjusted to any other-year dollars by applying the appropriate index adjustment. Landed value may be adjusted using the PPI index. For impact values, including upstream and downstream effects (see below), it is more appropriate to use the GDP deflator to adjust, because the multipliers capture economy-wide impacts.

Estimated indirect and induced economic impacts

Economic impact multipliers reflect the linkages between economic activity in different sectors of the economy. For example, when landings increase in the commercial fishing sector, there is an associated increase in the purchases of ice and other supplies in the region, and an increase in onshore transportation and processing of seafood. The resulting increases in economic activity in the commercial fishing supply and transportation and processing sectors are indirect effects of increased landings. In addition, because fishermen and workers in the supply, transportation, and processing industries earn greater income as a result of this increased activity, and spend some of that extra income on local goods and services, there is also an induced effect of greater spending in other sectors. The multipliers capture the combined effect of indirect and induced spending that results from higher commercial landings.

We have developed a regional economic model for Rhode Island State using the IMPLAN model software (IMPLAN 2004) and data for 2019. IMPLAN software and data are commercial products widely used by researchers and management agencies to perform economic impact analyses for a user specified study region (IMPLAN 2004; Steinback and Thunberg 2006; Hoagland *et al.* 2015; UMass Dartmouth 2018; Cape Cod Commission 2020). Based on these models, the upstream output multiplier for the commercial fishing industry in Rhode Island State is 1.84.

We have also taken into account downstream economic activity, such as seafood processing, that may take place at Rhode Island businesses as a result of commercial fisheries landings. This linkage is less direct than the upstream activities, because not all seafood landed in Rhode Island is processed in the state, and Rhode Island seafood processors may import more seafood from elsewhere for processing when Rhode Island landings fall short. Nonetheless, we add a downstream adjustment of 0.379, based on discussion with Rhode Island seafood industry representatives, to the multiplier for Rhode Island landings, bringing the combined multiplier to 2.219, to account for both upstream effects and downstream effects to seafood processors.

While we use a single output multiplier for the entire commercial fishing sector, we recognize that the multiplier may vary across specific fisheries, species, and gear. We also recognize that other types of multipliers, such as those focusing on employment effects, have been used in other analyses. We maintain that the output multipliers we use provide a robust and accurate measure of indirect and inducted effects averaged across the fishing sectors.

We apply the combined upstream and downstream multiplier to all Rhode Island commercial landings except lobster and Jonah crab landings, which are adjusted for dockside sales and receive the upstream multiplier only. This results in an estimated total economic impact in Rhode Island State from commercial fishing in the state waters portion of the Revolution Export Cable Corridor of \$92,123 to \$132,754/km^2/year, or \$1,099,029 to \$1,583,752/year in total.

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Appendix

Table A1. Complete list of species landed in Area 539, total value and pounds 2008-2019.

Species	Value (2020$)	Pounds
SQUID, SHORTFIN ILLEX	125,017,886	156,845,071
SQUID, LONGFIN LOLIGO	209,700,948	151,985,475
HERRING, SEA, ATLANTIC	16,740,180	120,633,080
SKATES, RAJIDAE (FAMILY)	195,684,782	85,769,751
SCUP	37,161,290	57,411,758
CRAB, JONAH	36,117,983	49,357,539
HAKE, SILVER	21,963,592	36,745,274
MACKEREL, ATLANTIC	11,191,775	31,910,064
BUTTERFISH	22,664,971	31,414,426
LOBSTER, AMERICAN	146,312,805	27,130,745
GOOSEFISH	50,325,114	22,096,372
SKATE, LITTLE	49,085,636	21,539,248
FLOUNDER, SUMMER	79,604,388	20,209,476
SCALLOP, SEA	159,904,031	15,066,920
SKATE, WINTER	2,429,305	13,825,271
SHARK, DOGFISH, SPINY	1,994,783	8,438,519
FLOUNDER, YELLOWTAIL	13,832,597	6,451,372
BLUEFISH	3,931,780	5,266,566
HAKE, RED	1,536,410	4,994,115
WHELK, CHANNELED	27,104,352	3,332,160
FLOUNDER, WINTER	8,165,303	3,257,175
BASS, BLACK SEA	12,944,748	2,917,514
COD, ATLANTIC	6,420,302	2,239,471
MACKEREL, ATLANTIC CHUB	1,346,790	2,234,406
BASS, STRIPED	6,739,518	1,439,235
HADDOCK	1,587,989	1,292,830
CRAB, ROCK, ATLANTIC	527,796	931,088
MENHADENS	241,767	818,372
DORY, AMERICAN JOHN	794,113	671,384
HAKE, WHITE	895,245	555,400
FLOUNDER, AMERICAN PLAICE	825,090	498,974
TAUTOG	1,605,096	474,730
SHARK, DOGFISH, SMOOTH	308,296	442,335
SEAROBINS	83,003	279,023
FLOUNDER, WITCH	695,988	253,435
CRAB, HORSESHOE	331,396	220,014
EEL, CONGER	153,410	210,930

BONITO, ATLANTIC	485,220	175,706
TILEFISH, GOLDEN	452,447	172,268
HERRING, BLUEBACK	80,906	133,100
SWORDFISH	573,960	130,425
SKATE, BARNDOOR	270,019	121,405
CRABS, BLUE	176,756	93,732
FLOUNDER, WINDOWPANE	47,766	78,632
CRAB UNKNOWN	133,181	58,717
POLLOCK	48,981	49,841
WHELK, KNOBBED	124,582	43,028
TRIGGERFISHES	63,251	27,834
RAVEN, SEA	43,393	27,053
TUNA, YELLOWFIN	53,692	23,089
TRIGGERFISH, GRAY	34,153	21,609
EEL, AMERICAN	20,546	20,598
REDFISH / OCEAN PERCH	14,011	17,310
TILEFISH, BLUELINE	27,463	16,447
CUNNER	32,210	15,465
SEATROUT, SPECIES NOT SPECIFIED	9,843	15,189
CRAB, GREEN	34,184	14,843
HAKE, UNKNOWN	6,492	9,613
ALEWIFE	22,456	9,501
SEATROUT, WEAKFISH	19,945	9,196
EEL	10,470	8,903
SHAD, HICKORY	4,172	7,121
SEAROBIN, STRIPED	15,674	6,900
DOLPHINFISH	8,697	6,273
SPOT	2,327	4,797
TILEFISH	6,456	4,647
CROAKER, ATLANTIC	2,560	3,863
SKATE, CLEARNOSE	557	3,430
TUNA, BIGEYE	4,723	1,998
HAKE,SPOTTED	1,213	1,926
KINGFISH, NORTHERN	1,760	1,699
SCULPINS	3,392	1,640
HALIBUT, ATLANTIC	14,644	1,574
COBIA	4,429	1,356
SHARK, THRESHER	1,290	1,197
SHARK, SANDBAR	1,122	920
TUNA, ALBACORE	1,095	776
TUNA, LITTLE TUNNY	334	420
FLOUNDER, FOURSPOT	250	409
POUT, OCEAN	433	370

DRUMS	772	344
KINGFISHES	558	116
CUSK	42	87
MACKEREL, SPANISH	118	86
DRUM, BLACK	17	23
OTHER	13	6