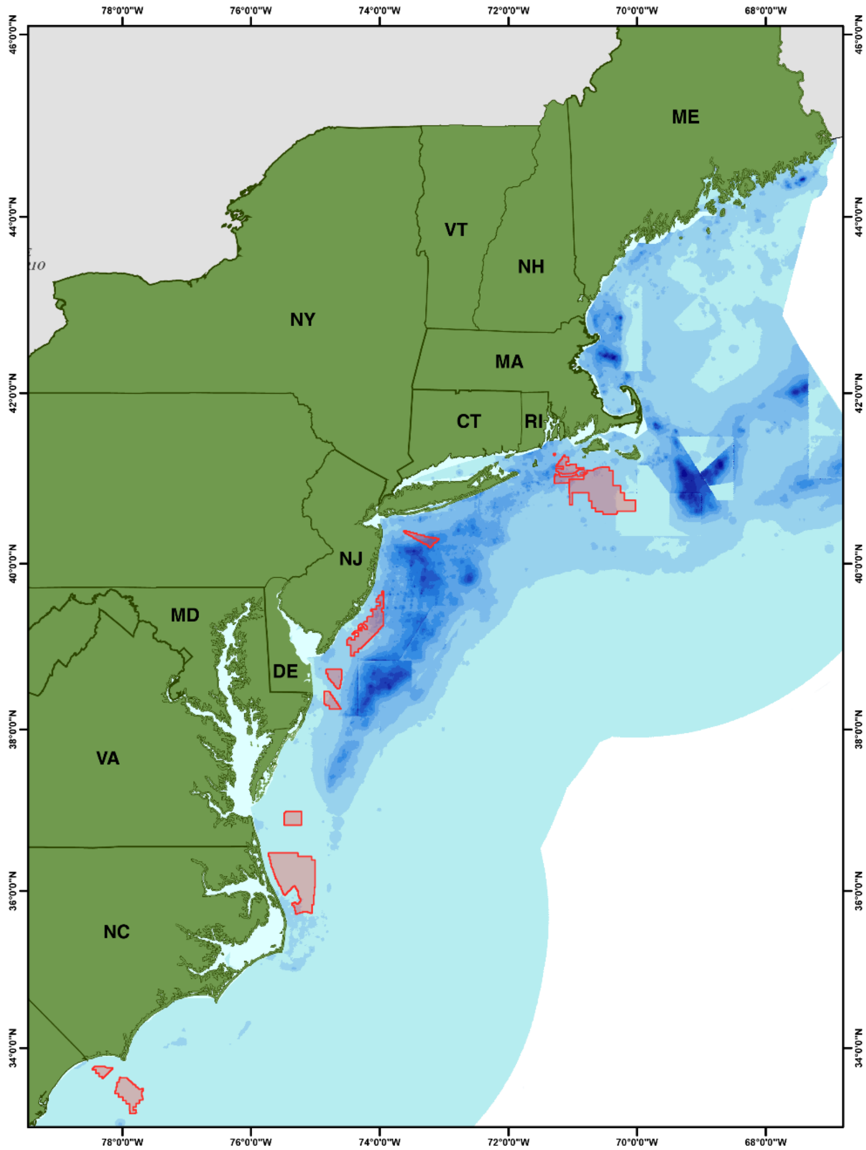
OCS Study
BOEM 2017-012

Socio-Economic Impact of Outer Continental Shelf Wind Energy Development on Fisheries in the U.S. Atlantic

Volume II—Appendices



U.S. Department of the Interior
Bureau of Ocean Energy Management
Office of Renewable Energy Programs

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Socio-Economic Impact of Outer Continental Shelf Wind Energy Development on Fisheries in the U.S. Atlantic

Volume II—Appendices

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Appendix I. Research Design and Methodology

This study makes use of data that contain personally identifiable information (PII), which is confidential by law and is suppressed within this analysis, when appropriate. When aggregated landings are examined, the magnitude of the Atlantic fishery is such that PII is rarely a concern. However, as smaller subgroups are identified, disclosure of PII becomes of greater concern. The "rule of three" is used here—if any subgroup aggregation consists of three or fewer individuals, landings data and exposure are not disclosed in detail, and this information is marked as not disclosable. Whenever possible, if suppressed data exceed a threshold for inclusion in this analysis, the subgroup is noted as such, but specific details including the extent of exposure are suppressed.

Geospatial mapping and analysis was performed in ESRI ArcGIS 10.1 and 10.2.

I.i Data Sources

In this report, "exposure" refers to a port group of fishermen whose fishing activity occurs in or near a Wind Energy Area (WEA). Depending on the type of fishing and the data available, exposure may be measured in different ways. This chapter describes the type of data available and how the authors analyzed the information.

I.i.i Commercial Fisheries

No single dataset contains all fishing activity in the U.S. Atlantic coast. Instead, multiple databases hold information on most, but not all, harvesting occurring between Maine and South Carolina. Appropriate linkages allow for these datasets to work together to characterize fishing activity in federal waters.

In the Northeast, spatial data on fishery catch are derived from three sources: Vessel Monitoring System (VMS), spatial data from the Northeast Fisheries Observer Program database (NEFOP), and vessel logbook data. The Southeast reports data in a logbook very similar to the Vessel Trip Reports in the Northeast, so we use "VTR" as shorthand for both in this report.

Because VTR coverage is the most encompassing in terms of identifying the spatial location of fishing activities, these data were used to assess fisheries' exposure to WEA development. A method of statistically accounting for the spatial distribution around the self-reported VTR location was developed. Using data from NMFS Northeast Region Observer database, which include the exact latitude and longitude of all hauls on an observed trip, the authors estimated confidence intervals for any given gear, area, and trip length. For example, observer data showed that 25 percent of all hauls occurred within 2.82 nautical miles of the reported VTR fishing point for bottom trawlers on four- to six-day trips in the Gulf of Maine. By estimating different intervals for different gears, trip lengths, and areas, the authors accounted for a significant amount of variation (see DePiper 2014).

None of these datasets provide information on the value associated with the fishing activities. Therefore, price data are drawn from a third database: Commercial Fisheries Dealer Reports. Although the VMS data are useful for validating VTR-derived spatial information, they were not used directly in the revenue exposure analysis.

I.i.i.i Surfclam Vessel Logbook Data for Commercial Fishing Activity

VTR data include species-level detail on catch weight, discard weight, and dealer purchasing catch; trip-level detail including date and time sailed, date and time landed, landing port, crew size, a single set of latitude and longitude where most fishing effort occurred, average tow or soak time per haul, and NMFS statistical area fished; and gear level detail on gears used. The Mid-Atlantic managed surfclam and ocean quahog fishery reports only sporadically into the VTR database. For this reason, entries for this fishery were deleted from the VTR dataset, and the official Individual Fishing Quota logbooks were used instead.

I.i.i.ii Commercial Fisheries Dealer Reports for Commercial Fishing Activity

The NMFS Northeast Region Dealer Database was used to construct a monthly-species-price time series. This price was then applied to VTR-reported landing weight to generate landing revenue for each VTR record. Prices were deflated to 2012 real $US using the Producer Price Index for fresh and frozen seafood (Bureau of Labor Statistics, Series ID PCU3117103117102).

I.i.i.iii Caveats for Commercial Fishing Data Sources

The authors of this study acknowledge that data used in this analysis only provide a partial picture of the fishing activity along the Atlantic coast. Known concerns about the data (Battista et al. 2013) include:

- Several fisheries are not required to report in the VMS/VTR programs. Absence of data does not indicate an absence of fishing activity in the area. Fisheries with known gaps for this project include:
    - Lobster
    - Shrimp
    - Menhaden
    - Harvest of non-federally-permitted species

The underreporting of lobster was addressed by acquiring landings data from the State of Maine Department of Marine Resources. The Department randomly chooses 10 percent of all lobster fishermen to submit landings reports each year. Through the reweighting of lobster landings to match total annual lobster landings, the authors were able correct the underreporting of lobster revenue in the exposure and impact analyses. Using only the landings reported by federally permitted vessels from the state reports, the authors generated a multiplier for each year, zone, and distance from shore category. With all Maine-sourced and Maine-landed lobster VTR points rescaled, another 231.2 million pounds of lobster ($872 million in revenue) from 2007 to 2012 are accounted for (see Table I-i).

When vessels never land species that require a federal permit, or when the only species landed are federally managed but do not require VTR reporting, VTR coverage may be incomplete. Shrimp landings in the Southeast region do not carry a VTR reporting requirement and rarely involve other VTR-required species. Therefore, shrimp harvesting vessels in the Southeast have no spatial data in the VTR dataset. Similarly, menhaden is not federally managed but may be harvested from federal waters. In general, species not federally permitted are not commonly harvested; therefore, VTR coverage is nearly complete notwithstanding the lobster, shrimp, and menhaden exceptions.

Table I-i. VTR lobster landings.

Year	Zone	Scaled Maine Department of Marine Resources Federal Permit Landings (lbs.)	VTR Landings (lbs.)	Multiplier
2008	A_1	3,564,020	347,278	10.3
2008	A_2	3,008,730	585,142	5.1
2008	A_3	1,173,653	26,285	44.7
2008	B_1	2,426,550	205,066	11.8
2008	B_2	1,758,870	222,645	7.9
2008	B_3	917,900	7,569	121.3
2008	C_1	4,600,320	521,787	8.8
2008	C_2	2,067,650	187,535	11.0
2008	C_3	761,190	19,884	38.3
2008	D_1	3,654,040	405,820	9.0
2008	D_2	451,270	65,935	6.8
2008	D_3	297,580	27,323	10.9
2008	E_1	1,090,720	197,094	5.5
2008	E_2	220,780	116,027	1.9
2008	E_3	160,670	22,122	7.3
2008	F_1	2,874,380	460,002	6.2
2008	F_2	356,870	106,566	3.3
2008	F_3	618,740	31,221	19.8
2008	G_1	1,770,190	192,129	9.2
2008	G_2	568,630	331,426	1.7
2008	G_3	396,757	26,040	15.2
2009	A_1	3,933,210	401,212	9.8
2009	A_2	4,404,740	551,516	8.0
2009	A_3	620,540	24,235	25.6
2009	B_1	2,593,550	205,503	12.6
2009	B_2	4,776,130	329,136	14.5
2009	B_3	745,370	14,802	50.4
2009	C_1	4,468,480	678,210	6.6
2009	C_2	2,294,540	381,527	6.0
2009	C_3	1,249,890	23,587	53.0
2009	D_1	2,843,580	408,217	7.0
2009	D_2	1,398,900	137,631	10.2
2009	D_3	483,210	22,669	21.3
2009	E_1	1,513,900	206,298	7.3
2009	E_2	872,510	115,176	7.6
2009	E_3	137,160	62,034	2.2
2009	F_1	2,748,610	543,911	5.1
2009	F_2	1,236,100	184,424	6.7
2009	F_3	666,260	43,973	15.2
2009	G_1	1,289,160	164,842	7.8
2009	G_2	894,790	436,835	2.0
2009	G_3	108,410	35,090	3.1
2010	A_1	7,125,050	477,999	14.9
2010	A_2	6,994,640	712,296	9.8
2010	A_3	227,770	33,899	6.7
2010	B_1	5,922,580	200,683	29.5
2010	B_2	1,760,220	327,781	5.4

Year	Zone	Scaled Maine Department of Marine Resources Federal Permit Landings (lbs.)	VTR Landings (lbs.)	Multiplier
2010	B_3	743,420	11,039	67.3
2010	C_1	8,447,860	1,022,216	8.3
2010	C_2	2,790,760	487,067	5.7
2010	C_3	617,280	20,888	29.6
2010	D_1	4,801,680	474,024	10.1
2010	D_2	2,809,770	167,372	16.8
2010	D_3	447,060	41,338	10.8
2010	E_1	2,325,750	300,172	7.7
2010	E_2	748,370	104,096	7.2
2010	E_3	98,770	81,712	1.2
2010	F_1	3,371,730	563,914	6.0
2010	F_2	566,660	228,495	2.5
2010	F_3	618,740	37,156	16.7
2010	G_1	719,150	198,886	3.6
2010	G_2	1,351,310	383,512	3.5
2010	G_3	518,340	50,200	10.3
2011	A_1	4,176,320	360,693	11.6
2011	A_2	4,894,260	685,296	7.1
2011	A_3	1,963,000	95,986	20.5
2011	B_1	6,447,490	193,553	33.3
2011	B_2	2,002,720	228,464	8.8
2011	B_3	2,134,940	2,745	777.8
2011	C_1	6,368,790	711,710	8.9
2011	C_2	3,719,470	523,033	7.1
2011	C_3	1,432,670	73,591	19.5
2011	D_1	3,605,110	397,771	9.1
2011	D_2	2,258,190	135,612	16.7
2011	D_3	1,585,300	48,654	32.6
2011	E_1	1,707,070	213,795	8.0
2011	E_2	1,174,750	157,034	7.5
2011	E_3	72,854	22,956	3.2
2011	F_1	2,205,610	583,715	3.8
2011	F_2	796,360	184,463	4.3
2011	F_3	189,670	45,865	4.1
2011	G_1	1,753,840	253,802	6.9
2011	G_2	1,097,540	247,557	4.4
2011	G_3	396,757	83,737	4.7
2012	A_1	4,461,820	412,925	10.8
2012	A_2	5,063,400	756,737	6.7
2012	A_3	1,883,300	69,987	26.9
2012	B_1	5,034,760	296,561	17.0
2012	B_2	4,819,840	422,874	11.4
2012	B_3	210,570	26,191	8.0
2012	C_1	6,582,770	664,068	9.9
2012	C_2	4,354,140	502,572	8.7
2012	C_3	505,490	128,742	3.9
2012	D_1	3,722,170	363,978	10.2
2012	D_2	3,411,370	278,680	12.2

Year	Zone	Scaled Maine Department of Marine Resources Federal Permit Landings (lbs.)	VTR Landings (lbs.)	Multiplier
2012	D_3	2,591,730	68,569	37.8
2012	E_1	2,422,690	195,379	12.4
2012	E_2	1,679,060	186,814	9.0
2012	E_3	289,200	50,224	5.8
2012	F_1	2,139,180	533,049	4.0
2012	F_2	2,242,040	189,253	11.8
2012	F_3	1,000,290	61,997	16.1
2012	G_1	1,418,140	211,490	6.7
2012	G_2	3,333,880	340,605	9.8
2012	G_3	563,520	71,557	7.9

Notes:

- The Maine Department of Marine Resources did not provide 2007 data; data for that year are calculated from the mean of 2008–2012 data.
- In the "Zone" column, letters indicate Maine Lobster Management Zones (A–G). Numbers indicate distances in nautical miles: "1" = 0–3, "2" = 3–12, "3" = 12+.
- Zone E_3 contains the Maine offshore wind planning area that was not included in this analysis.

I.i.ii Recreational Fisheries

Marine recreational fishing takes place from shore, aboard private or rented boats, and on boats that take passengers for hire. For-hire boats include charter boats, which generally carry six or fewer passengers and charge a boat rental fee, as well as head boats (also known as party boats), which generally carry 10 or more passengers and charge by the person (Holland et al. 2012). U.S. Coast Guard (USCG) licensing of for-hire vessels designates any vessel carrying more than six anglers at a time as a head boat. Shore-based recreational fishing will most likely experience no impacts, as all proposed WEAs are in federal waters, at least 3 nautical miles offshore.

I.i.ii.i Vessel Trip Reports for Recreational Fishing Activity

For-hire vessels, including charter and head boats fishing north of Cape Hatteras for federally permitted species, are required to submit VTRs to NMFS. Most vessels fishing south of Cape Hatteras are unlikely to be included in the Northeast VTR data, unless they have Northeast VTR permits and only occasionally fish south of Cape Hatteras—thus the Northeast VTR does not reflect recreational fishing effort in the Southeast region. Northeast VTR data provide the best spatial information on for-hire fishing activity north of Cape Hatteras. For-hire vessels fishing in federal waters out of the Southeast region report their activity to the SRHS, which is described in greater detail in the next section.

Northeast VTRs include the latitude and longitude "where most of [the] fishing effort occurred" (NMFS Northeast Regional Office 2012). The for-hire reports also include the number of anglers, the number of crew (including the captain), and the number and types of species caught on each trip. Logbook data are subject to human error; the information is initially recorded by hand and later electronically recorded into a database. In addition to potential errors in correctly filling out a logbook, there may be inaccuracies in the information provided (accidental or otherwise). There is no method to independently cross-check the validity of recreational for-hire fishing logbook data (as there is for the commercial fishing logbook data), and there has been no thorough review of for-hire charter and head boat logbooks conducted to identify errors in missing or inaccurate information, or electronic coding errors. Despite these concerns, recreational logbooks in aggregate provide a reasonable approximation of for-hire charter and head boat activity (NEFMC and NMFS 2003).

I.i.ii.ii The Southeast Region Headboat Survey for Recreational Fishing

The SRHS has operated since 1972 on the East Coast. The survey is divided into geographic areas assigned to port agents (Figure I-i); the areas relevant to the data provided for this assessment are:

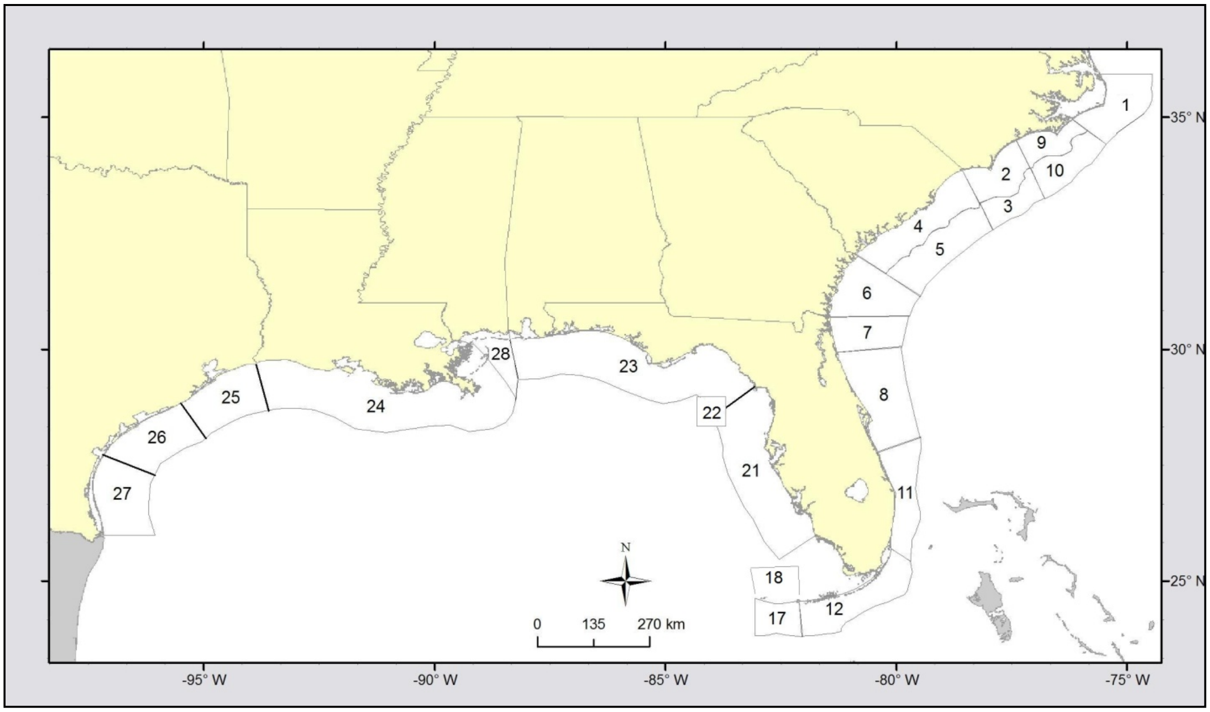
- Offshore Cape Hatteras (#1).
- Cape Fear to Cape Lookout (offshore North Carolina), further divided into inshore (#9) and offshore territories (#10).
- Cape Fear, inshore (#2) and offshore (#3).
- South Carolina, inshore (#4) and offshore (#5).

The SRHS includes a dockside intercept sampling component and a logbook component. This report only uses the logbook data, which are self-reported trip summaries of catch and effort for each vessel trip. The logbooks initially were voluntary, with the SRHS paying head boat owners/captains to participate. Trip reports are now mandatory and linked to permit renewal.

A head boats is chosen to participate in the SRHS if it meets one or more of the following criteria:

- It is licensed to carry more than 15 passengers (or more than six passengers in the South Atlantic).
- It fishes in the exclusive economic zone or state and adjoining waters for coastal migratory pelagic fish, reef fish, snapper-grouper, Atlantic dolphin, or wahoo.
- It charges primarily by the "head."

The SRHS data provide annual landings estimates by species, area, and month for any species landed in the Southeast region head boat fishery (K. Fitzpatrick, pers. comm.).



Source: Brennan 2013

Figure I-i. Geographic areas of the Southeast Region Headboat Survey.

The SRHS logbooks were acquired from the NMFS' Southeast Fisheries Science Center. These data are submitted only for head boat fishing trips out of North Carolina and South Carolina; this differs from the Northeast VTR and MRIP data, which differentiate between charter and head boats by carrying capacity. Each trip record includes information on year, month, day; fishing area, fishing location; trip type (excursions range in duration from half a day to a full seven days); number of anglers; a vessel ID, and the vessel home port. (Fishing locations use cells within 100-square-nautical-mile grid blocks. These blocks are divided into six rows and six columns each, creating 36 grid cells about 9 nautical miles [16 km] to each side. Any trip reported to a grid block without specifying a grid cell was dropped from the dataset.)

Southeast logbooks report landings at the county level rather than the port or port group level. This is particularly troublesome in North Carolina, where some vessels are permitted in the Southeast and report at the county level, while others are permitted in the Northeast and report at the port level. Because the port level reporting contains valuable information, the most detailed level of reporting is maintained.

I.i.ii.iii The Marine Recreational Information Program for Recreational Fishing

Private boat recreational fishing is also an important part of the Atlantic coast economy. The most comprehensive dataset available to estimate private boat recreational fishing activity is the MRIP, an integrated series of surveys coordinated by NMFS to provide estimates of marine recreational catch, effort, and participation across states and fishing modes. Private boat recreational fishing data are collected in two-month "waves," obtained through two primary surveys. The first is a telephone survey of coastal households designed to measure total fishing effort by coastal residents in a given state, mode, and wave. Private boat effort is defined in terms of angler fishing trips, where a "trip" is a day of fishing aboard a private boat. The second survey is an angler intercept survey used to estimate catch-per-unit effort and to estimate correction factors for non-coastal resident angler trips.

The primary limitation of the MRIP data are that they only provide estimates of catch and effort according to three broad areas fished on a given trip (inland, state waters, and the federal exclusive economic zone). All of the WEAs under consideration are located in the federal exclusive economic zone, but the exact locations of fishing trips on boats in the federal exclusive economic zone are not available from the MRIP data. Thus, the MRIP data are limited in their ability to identify recreational fishing activity aboard boats in the WEAs.

I.i.iii Supplementary Data

This section describes the ancillary federal data sources used to augment and corroborate the core landings data used in this report. This analysis relies upon data gathered by social scientists at the NMFS Northeast Fisheries Science Center and the NMFS Southeast Fisheries Science Center to construct social indicators of fishing community vulnerability. In addition to census data, these indicators include data on social vulnerability and gentrification pressure vulnerability on the fishing community. The construction of the social indicators is described in Jepson and Colburn 2013.

Ports are not necessarily well-defined geographically (e.g., different names for the same port; a port covers adjacent cities). The Northeast Fisheries Science Center merged associated ports into port groupings, which generally consist of one to five different named ports. This merge reduced the 405 different ports in the combined dataset to 376 port groups. Port group mapping may be found in Table I-ii. Notably, one of the largest ports in Rhode Island (Point Judith) is mapped to the greater Narragansett area and is listed under “Narragansett, RI.”

Table I-ii. Port group mapping by state.

Port Group	Port Landed	State
Branford, CT	Branford	CT
Bridgeport, CT	Bridgeport	CT
Clinton, CT	Clinton	CT
Groton, CT	Groton	CT
Guilford, CT	Guilford	CT
Mystic, CT	Mystic	CT
New Haven, CT	New Haven	CT
New London County, CT	New London County	CT
New London, CT	New London	CT
Niantic, CT	Niantic	CT
Noank, CT	Noank	CT
Norwalk, CT	Norwalk	CT
Old Saybrook, CT	Old Saybrook	CT
Pawcatuck, CT	Pawcatuck	CT
Stonington, CT	Stonington	CT
Waterford, CT	Waterford	CT
Westport, CT	Westport	CT
Indian River, DE	Indian River	DE
Kent County, DE	Kent County	DE
Lewes, DE	Lewes	DE
Milford, DE	Mispillion	DE

Port Group	Port Landed	State
Other Delaware, DE	Other Delaware	DE
Other Sussex, DE	Other Sussex	DE
Sussex County, DE	Sussex County	DE
Aquinnah, MA	Gay Head/Aquinnah	MA
Barnstable, MA	Barnstable	MA
Barnstable, MA	Cotuit	MA
Barnstable, MA	Hyannis	MA
Beverly, MA	Beverly	MA
Boston, MA	Boston	MA
Bourne, MA	Bourne	MA
Braintree, MA	Braintree	MA
Chatham, MA	Chatham	MA
Chilmark, MA	Chilmark	MA
Cohasset, MA	Cohasset	MA
Danvers, MA	Danvers	MA
Dartmouth, MA	Dartmouth	MA
Dennis, MA	Dennis	MA
Dukes County, MA	Dukes County	MA
Duxbury, MA	Duxbury	MA
Edgartown, MA	Edgartown	MA
Essex County, MA	Essex County	MA
Essex, MA	Essex	MA
Essex, MA	Other Essex	MA
Fairhaven, MA	Fairhaven	MA
Fall River, MA	Fall River	MA
Falmouth, MA	Barnstable County	MA
Falmouth, MA	Falmouth	MA
Gloucester, MA	Gloucester	MA
Harwich Port, MA	Harwichport	MA
Hingham, MA	Hingham	MA
Hull, MA	Hull	MA
Ipswich, MA	Ipswich	MA
Lynn, MA	Lynn	MA
Manchester-by-the-Sea, MA	Manchester	MA
Marblehead, MA	Marblehead	MA
Marshfield, MA	Marshfield	MA
Mattapoisett, MA	Mattapoisett	MA
Nahant, MA	Nahant	MA
Nantucket, MA	Nantucket	MA
New Bedford, MA	New Bedford	MA
Newbury, MA	Newbury	MA
Newburyport, MA	Newburyport	MA
Oak Bluffs, MA	Oak Bluffs	MA
Onset, MA	Onset	MA
Orleans, MA	Nauset	MA
Orleans, MA	Orleans	MA
Other Barnstable, MA	Other Barnstable	MA
Other Dukes, MA	Other Dukes	MA
Other Massachusetts, MA	Other Massachusetts	MA

Port Group	Port Landed	State
Other Suffolk, MA	Other Suffolk	MA
Plymouth County, MA	Plymouth County	MA
Plymouth, MA	Plymouth	MA
Provincetown, MA	Provincetown	MA
Quincy, MA	Quincy	MA
Revere, MA	Revere	MA
Rockport, MA	Rockport	MA
Rowley, MA	Rowley	MA
Salem, MA	Salem	MA
Salisbury, MA	Salisbury	MA
Sandwich, MA	Sandwich	MA
Saugus, MA	Saugus	MA
Scituate, MA	Scituate	MA
South Yarmouth, MA	Bass River	MA
Tisbury, MA	Tisbury	MA
Truro, MA	Truro	MA
Wareham, MA	Wareham	MA
Watertown, MA	Watertown	MA
Wellfleet, MA	Wellfleet	MA
Westport, MA	Westport	MA
Weymouth, MA	Weymouth	MA
Winthrop, MA	Winthrop	MA
Woods Hole, MA	Woods Hole	MA
Yarmouth, MA	Yarmouth	MA
Chesapeake Beach, MD	Chesapeake Beach	MD
Crisfield, MD	Crisfield	MD
Ocean City, MD	Ocean City	MD
Other Anne Arundel(County), MD	Anne Arundel	MD
Other Baltimore(County), MD	Baltimore(County)	MD
Other Calvert, MD	Other Calvert	MD
Other Maryland, MD	Other Maryland	MD
Other Queen Anne's, MD	Other Queen Anne's	MD
Other Somerset, MD	Other Somerset	MD
Pocomoke City, MD	Pocomoke City	MD
Worcester County, MD	Worcester County	MD
Addison, ME	Addison	ME
Addison, ME	Eastern Harbor	ME
Addison, ME	South Addison	ME
Bailey Island, ME	Bailey Island	ME
Bar Harbor, ME	Bar Harbor	ME
Bath, ME	Bath	ME
Beals, ME	Beals Island	ME
Biddeford, ME	Biddeford Pool	ME
Blue Hill, ME	Blue Hill	ME
Boothbay Harbor, ME	Boothbay Harbor	ME
Boothbay, ME	East Boothbay	ME
Bremen, ME	Bremen	ME
Bristol, ME	Bristol	ME
Bristol, ME	Round Pond	ME

Port Group	Port Landed	State
Brunswick, ME	Brunswick	ME
Camden, ME	Camden	ME
Cape Elizabeth, ME	Cape Elizabeth	ME
Chebeague Island, ME	Chebeague Island	ME
Corea, ME	Corea	ME
Cranberry Isles, ME	Islesford	ME
Cushing, ME	Cushing	ME
Cutler, ME	Cutler	ME
Eastport, ME	Eastport	ME
Eliot, ME	Eliot	ME
Freeport, ME	Freeport	ME
Frenchboro, ME	Frenchboro	ME
Friendship, ME	Friendship	ME
Georgetown, ME	Five Islands	ME
Georgetown, ME	Georgetown	ME
Gouldsboro, ME	West Gouldsboro	ME
Hancock, ME	Hancock	ME
Harpswell, ME	Cundys Harbor	ME
Harpswell, ME	Harpswell	ME
Harpswell, ME	South Harpswell	ME
Harrington, ME	Harrington	ME
Jonesport, ME	Jonesport	ME
Kennebunkport, ME	Cape Porpoise	ME
Kennebunkport, ME	Kennebunkport	ME
Kittery Point, ME	Kittery	ME
Lincoln County, ME	Lincoln County	ME
Long Island, ME	Long Island	ME
Lubec, ME	Lubec	ME
Machias, ME	Machias	ME
Machiasport, ME	Bucks Harbor	ME
Machiasport, ME	Machiasport	ME
Matinicus Isle, ME	Matinicus	ME
Milbridge, ME	Milbridge	ME
Monhegan, ME	Monhegan	ME
Mount Desert, ME	Northeast Harbor	ME
New Harbor, ME	New Harbor	ME
Newcastle, ME	Newcastle	ME
Ogunquit, ME	Ogunquit	ME
Ogunquit, ME	Perkins Cove	ME
Other Hancock, ME	Other Hancock	ME
Other Lincoln, ME	Other Lincoln	ME
Other Maine, ME	Other Maine	ME
Other Washington, ME	Other Washington	ME
Owls Head, ME	Owls Head	ME
Pemaquid, ME	Pemaquid	ME
Pembroke, ME	Pembroke	ME
Phippsburg, ME	Phippsburg	ME
Phippsburg, ME	Sebasco Estates	ME
Phippsburg, ME	Small Point	ME

Port Group	Port Landed	State
Phippsburg, ME	West Point	ME
Port Clyde-Tenants Harbor, ME	Port Clyde	ME
Port Clyde-Tenants Harbor, ME	Tenants Harbor	ME
Portland, ME	Portland	ME
Prospect Harbor, ME	Birch Harbor	ME
Prospect Harbor, ME	Bunkers Harbor	ME
Prospect Harbor, ME	Prospect Harbor	ME
Rockland, ME	Rockland	ME
Rockport, ME	Rockport	ME
Saco, ME	Camp Ellis	ME
Saco, ME	Saco	ME
Scarborough, ME	Pine Point	ME
Scarborough, ME	Scarborough	ME
Searsport, ME	Searsport	ME
South Bristol, ME	South Bristol	ME
South Thomaston, ME	South Thomaston	ME
Southport, ME	Southport	ME
Southwest Harbor, ME	Northwest Harbor	ME
Southwest Harbor, ME	Southwest Harbor	ME
Spruce Head, ME	Sprucehead	ME
Steuben, ME	Steuben	ME
Stonington, ME	Stonington	ME
Swans Island, ME	Swans Island	ME
Tremont, ME	Bernard	ME
Tremont, ME	Tremont	ME
Vinalhaven, ME	Vinalhaven	ME
Wells, ME	Wells	ME
Westport Island, ME	Westport	ME
Winter Harbor, ME	Winter Harbor	ME
Yarmouth, ME	Yarmouth	ME
York County, ME	York County	ME
York Harbor, ME	York	ME
York Harbor, ME	York Harbor	ME
Avon, NC	Avon	NC
Bayboro, NC	Bayboro	NC
Beaufort County, NC	Beaufort County	NC
Beaufort, NC	Beaufort	NC
Beaufort, NC	Other North Carolina	NC
Belhaven, NC	Belhaven	NC
Brunswick County, NC	Brunswick County	NC
Carteret County, NC	Carteret County	NC
Craven County, NC	Craven County	NC
Dare County, NC	Dare County	NC
Engelhard, NC	Engelhard	NC
Hatteras, NC	Hatteras	NC
Hobucken, NC	Hobucken	NC
Hyde County, NC	Hyde County	NC
Lowland, NC	Lowland	NC
Manteo, NC	Manteo	NC

Port Group	Port Landed	State
Morehead City, NC	Morehead City	NC
Nags Head, NC	Oregon inlet	NC
New Hanover County, NC	New Hanover County	NC
Ocracoke, NC	Ocracoke	NC
Onslow County, NC	Onslow County	NC
Oriental, NC	Oriental	NC
Other Beaufort(County), NC	Other Beaufort(County)	NC
Other Brunswick, NC	Other Brunswick	NC
Other Carteret, NC	Other Carteret	NC
Other Craven, NC	Other Craven	NC
Other Currituck, NC	Other Currituck	NC
Other Dare, NC	Other Dare	NC
Other Hyde, NC	Other Hyde	NC
Other Washington, NC	Other Washington	NC
Pamlico County, NC	Pamlico County	NC
Pender County, NC	Pender County	NC
Sneads Ferry, NC	Sneads Ferry	NC
Swan Quarter, NC	Swan Quarter	NC
Swansboro, NC	Swansboro	NC
Wanchese, NC	Wanchese	NC
Greenland, NH	Great Bay	NH
Hampton, NH	Hampton	NH
New Castle, NH	New Castle	NH
Newington, NH	Newington	NH
Portsmouth, NH	Portsmouth	NH
Rye, NH	Rye	NH
Seabrook, NH	Seabrook	NH
Absecon, NJ	Absecon	NJ
Atlantic City, NJ	Atlantic City	NJ
Avalon, NJ	Avalon	NJ
Barnegat, NJ	Barnegat	NJ
Bayville, NJ	Bayville	NJ
Belford, NJ	Belford	NJ
Belmar, NJ	Belmar	NJ
Belmar, NJ	Shark River	NJ
Brick, NJ	Brick	NJ
Brielle, NJ	Brielle	NJ
Brigantine, NJ	Brigantine	NJ
Cape May County, NJ	Cape May County	NJ
Cape May, NJ	Cape May	NJ
Eagleswood, NJ	West Creek	NJ
Forked River, NJ	Forked River	NJ
Galloway, NJ	Leeds Point	NJ
Highlands, NJ	Highlands	NJ
Jersey City, NJ	Jersey City	NJ
Keyport, NJ	Keyport	NJ
Little Egg Harbor, NJ	Little Egg Harbor	NJ
Long Beach, NJ	Long Beach	NJ
Manasquan, NJ	Manasquan	NJ

Port Group	Port Landed	State
Margate City, NJ	Margate	NJ
Maurice River, NJ	Heislerville	NJ
Middle, NJ	Reeds Beach	NJ
Middletown, NJ	Middletown	NJ
Monmouth County, NJ	Monmouth County	NJ
Neptune, NJ	Neptune	NJ
Ocean City, NJ	Ocean City	NJ
Ocean County, NJ	Ocean County	NJ
Old Bridge, NJ	Old Bridge	NJ
Other Atlantic, NJ	Other Atlantic	NJ
Other Cape May, NJ	Other Cape May	NJ
Other Cumberland, NJ	Other Cumberland	NJ
Other Gloucester, NJ	Other Gloucester	NJ
Other Hudson (County), NJ	Other Hudson	NJ
Other Monmouth, NJ	Monmouth	NJ
Other Monmouth, NJ	Other Monmouth	NJ
Other Ocean, NJ	Other Ocean	NJ
Point Pleasant, NJ	Point Pleasant	NJ
Port Norris, NJ	Port Norris	NJ
Rumson, NJ	Rumson	NJ
Sayreville, NJ	Morgan	NJ
Sea Bright, NJ	Sea Bright	NJ
Sea Isle City, NJ	Sea Isle City	NJ
Stone Harbor, NJ	Stone Harbor	NJ
Toms River, NJ	Toms River	NJ
Tuckerton, NJ	Tuckerton	NJ
Waretown, NJ	Waretown	NJ
Wildwood, NJ	Wildwood	NJ
Woodbridge, NJ	Woodbridge	NJ
Amagansett, NY	Amagansett	NY
Brooklyn, NY	Brooklyn	NY
Center Moriches, NY	Center Moriches	NY
City Island, NY	City Island	NY
East Hampton, NY	East Hampton	NY
Freeport, NY	Freeport	NY
Greenport, NY	Greenport	NY
Hampton Bays, NY	Hampton Bay	NY
Hampton Bays, NY	Other Washington (County)	NY
Hampton Bays, NY	Shinnecock	NY
Hempstead, NY	Hempstead	NY
Island Park, NY	Island Park	NY
Islip, NY	Islip	NY
Jamaica Bay-Rockaway, NY	Broad Channel	NY
Long Beach, NY	Long Beach	NY
Mastic, NY	Mastic	NY
Mattituck, NY	Mattituck	NY
Montauk, NY	Montauk	NY
Moriches, NY	Moriches	NY
Mount Sinai, NY	Mount Sinai	NY

Port Group	Port Landed	State
Nassau County, NY	Nassau County	NY
New York, NY	Great Kills	NY
New York, NY	New York City	NY
Northport, NY	Northport	NY
Oak Beach-Captree, NY	Babylon (Captree)	NY
Oceanside, NY	Oceanside	NY
Orient, NY	Orient	NY
Other Bronx, NY	Other Bronx	NY
Other Nassau, NY	Other Nassau	NY
Other NY, NY	Other NY	NY
Other Queens, NY	Other Queens	NY
Other Richmond, NY	Other Richmond	NY
Other Suffolk, NY	Other Suffolk	NY
Other Westchester, NY	Other Westchester	NY
Patchogue, NY	Patchogue	NY
Point Lookout, NY	Point Lookout	NY
Port Jefferson, NY	Port Jefferson	NY
Queens, NY	Queens	NY
Seaford, NY	Seaford	NY
Shelter Island, NY	Shelter Island	NY
Southold, NY	Southold	NY
Suffolk County, NY	Suffolk County	NY
Wainscott, NY	Wainscott	NY
Philadelphia, PA	Philadelphia	PA
Barrington, RI	Barrington	RI
Bristol, RI	Bristol	RI
Charlestown, RI	Charlestown	RI
East Greenwich, RI	East Greenwich	RI
Jamestown, RI	Jamestown	RI
Little Compton, RI	Little Compton	RI
Narragansett, RI	Point Judith	RI
New Shoreham, RI	New Shoreham	RI
Newport, RI	Newport	RI
North Kingstown, RI	Davisville	RI
North Kingstown, RI	North Kingstown	RI
Other Newport, RI	Other Newport	RI
Other Washington, RI	Other Washington	RI
Portsmouth, RI	Portsmouth	RI
Providence, RI	Providence	RI
South Kingstown, RI	South Kingstown	RI
Tiverton, RI	Tiverton	RI
Warren, RI	Warren	RI
Warwick, RI	Warwick	RI
Washington County, RI	Washington County	RI
Westerly, RI	Westerly	RI
Charleston County, SC	Charleston County	SC
Georgetown County, SC	Georgetown	SC
Georgetown County, SC	Georgetown County	SC
Horry County, SC	Horry County	SC

Port Group	Port Landed	State
Other Beaufort, SC	Other Beaufort	SC
Accomac, VA	Accomac	VA
Accomack County, VA	Accomack County	VA
Atlantic, VA	Atlantic	VA
Cape Charles, VA	Cape Charles	VA
Chincoteague, VA	Chincoteague	VA
City of Virginia Beach County, VA	City of Virginia Beach County	VA
District 3 Northampton County, VA	Willis Wharf	VA
District 4 Northampton County, VA	Oyster	VA
District 9, VA	Davis Wharf	VA
Greenbackville, VA	Greenbackville	VA
Hampton County, VA	Hampton County	VA
Hampton, VA	Hampton	VA
Newport News, VA	Newport News	VA
Norfolk, VA	Norfolk	VA
Not-Specified County, VA	Not-Specified County	VA
Other Accomack, VA	Other Accomack	VA
Other City of Chesapeake, VA	Other City of Chesapeake	VA
Other Mathews, VA	Other Mathews	VA
Other Northampton, VA	Other Northampton	VA
Other Northumberland, VA	Other Northumberland	VA
Other Virginia, VA	Other Virginia	VA
Other York, VA	Other York	VA
Poquoson, VA	Poquoson	VA
Quinby, VA	Quinby	VA
Sanford, VA	Sanford	VA
Saxis, VA	Saxis	VA
Seaford, VA	City of Seaford	VA
Virginia Beach, VA	Lynnhaven	VA
Virginia Beach, VA	Virginia Beach	VA
Wachapreague, VA	Wachapreague	VA

Permit data were obtained from NMFS Northeast Regional Office *PERMIT* tables. This dataset includes vessel characteristics reported to the USCG when registering the vessel, including vessel length, gross tonnage, horsepower, and home (or "hailing") port.

In total, the dataset represents 4,735 unique vessel hull IDs and 4,816 permits. Of 4,123 vessels reported to the NMFS Northeast Regional Office VTR database (NMFS Northeast Regional Office n.d.-b), 81 reported to the surfclam and ocean quahog database, and 675 reported to the Southeast Regional Office logbook (NMFS Southeast Regional Office n.d.). Further, 96 vessels appeared in both the Northeast and Southeast VTR/logbooks, and 47 surfclam and ocean quahog vessels also reported non-surfclam and non-ocean quahog landings to the Northeast VTR database. No vessels overlapped between the Southeast logbook database and the surfclam and ocean quahog database.

I.ii General Assumptions

The following sections detail the general assumptions employed in assessing the exposure and impacts of WEA development on commercial and recreational fisheries, along with their shoreside dependents.

I.ii.i Potential Impacts and Impact Assessment Assumptions

Appendix IV synthesizes the literature on impacts to fish and fisheries due to offshore wind energy development and other similar man-made structures. This synthesis identifies the range of impacts directly investigated in this report, and maps the results to the existing literature. Briefly, the literature indicates a broad range of potential impacts, but also suggests that recreational fishermen are likely to benefit from the placement of hard structure. The impacts on commercial fishermen are less certain, and likely depend on the species targeted, gear employed, and vessel size.

I.ii.i.i Recreational Fishery

Given the overall lack of fine-scale fishing location data for recreational fisheries, the impact analysis for these groups are relegated to qualitative reviews, with no behavioral modeling possible. The discussion of impacts is delineated by the construction and operational phases.

I.ii.i.ii Commercial Fishery

Specific impacts affecting fishery operations around proposed WEAs are not readily available, necessitating a set of assumptions based on best available data. No offshore wind turbines exist in the U.S. Atlantic region as of 2014, but many existing offshore wind farms—especially in Europe, in the UK specifically—provide the basis for scoping the range of potential impacts the U.S. could expect to experience.

Based on European experiences, two primary dimensions of impacts are apparent:

- **Exclusion.** The proposed WEAs may act as a de facto closed area for some commercial fishing operations.
- **Catch impacts.** The construction and operations of offshore wind energy may affect the commercially exploitable biomass in the vicinity.

I.ii.i.iii Dimension of Exclusion

No federal agency has the regulatory authority to restrict access to wind energy facility (i.e., "full closure" of the leased WEAs) for fishing activity. Some localized exclusion or limitations on certain gear types are possible and will depend on local circumstances as well as safety, operating, and other considerations at the discretion of the vessel operator. However, for discussion purposes, a range of potential degrees of exclusion are studied here:

- **Fully open (status quo).** Fishing within the wind energy facility continues with no restrictions.
- **Weather-based closure.** Experiences in the UK have indicated that vessels are reluctant to enter developed WEAs when winds exceed Force 5 level on the Beaufort scale. Force 5 is equivalent to approximately 9.35 meters per second wind speed and is listed as a "fresh breeze" with many whitecaps and small amounts of spray. It is generally associated with waves 2–3 meters high. Changes in expected revenue net of variable costs (RNVC) are estimated based on the alteration of trips to planned WEAs during times in which the wind speed in that area exceeded 9.35 m/s.

- **Gear-based closure.** Experiences in the UK and Northern Europe with smaller turbine sizes (and therefore smaller spacing between turbines), and conversations with U.S. vessel operators, have revealed concerns about de facto exclusion zones based on gear characteristics (Industrial Economics, Inc. 2012; Watson 2014). When fisheries modeled include both mobile (dredge, trawl) and fixed (gillnet, pot, etc.) gear, then the gear-based closure scenario considers the impact of a de facto exclusion for all mobile gear.

- **Fully closed.** In investigating the full range of potential impacts, it is appropriate to evaluate a full closure as a potential outcome for discussion purposes only. Modeling the economic impact of a full closure estimates the upper boundary for costs to the fishery. Note that inclusion of the "fully closed" scenario does not imply that it is desired or even legally feasible.

I.ii.i.iv Dimension of Catch Impacts

While fishery exclusion has emerged as the primary concern for the fishery, the impacts of construction and operation of a WEA on commercially exploitable biomass must also be assessed. Although an exact impact on biomass (and thus catch per unit effort) cannot be estimated, research from North Sea wind farms provides a reasonable range of potential impacts.

Appendix IV reviews literature on the impacts of offshore wind development (and artificial reefs, oil rigs, and Marine Protected Areas) on fish abundance and catch. The estimates range from "no change" to +17 percent abundance. Simplifying a range of changes in abundance into a single estimate of average change in catch requires assumptions, but is necessary for estimation. A rough average of positive changes in abundance can be gleaned from literature: an increase of about 7 percent, which matches the abundance change found in Leonhard and Pedersen (2006). Because detrimental ecological impacts are possible as well, a negative range must be established. Though no studies found a decrease in abundance within a developed WEA, sedimentation studies and anecdotal evidence indicate that a negative effect is possible. In the face of uncertainty and the lack of quantitative studies on ecological impacts, a wide range should be considered. Therefore, a decrease of 25 percent is assumed to represent the worst-case scenario in terms of catch impacts. For sensitivity, a decrease of 7 percent is assumed as well, resulting in the following proposed catch impact scenarios:

- Minus 25 percent catch
- Minus 7 percent catch
- Constant catch (no impact on catch)
- Plus 7 percent catch

In each case, impact on biomass is modeled as a percent change in catch revenue across all species. No biological enhancements in surrounding zones (i.e., spillover effects) are investigated due to the expansive size of zones modeled when compared to the WEAs. Assuming that catch changes in the WEA without changing in surrounding areas implicitly accepts the concept of population enhancement/depletion over aggregation.

Changes in expected catch could alter choices about trip characteristics beyond zone choice. Although all fishing trips involve decisions on what to catch and how long to fish, the dynamics of this choice are too complex to include in this report's modeling. Instead, the modeling assumes that a change in catch results in a direct change in revenue, holding fishing time and effort constant. Changes in effort resulting from lower (or higher) catch per unit time are not discussed further in this report.

I.ii.i.v Scenarios

For each possible scenario in both dimensions (exclusion, catch), model results are used to estimate a total change in expected RNVC. With four exclusion scenarios and four catch impact scenarios, there are 16 potential scenario combinations. "Fully open/no impact on catch" is the no-change status quo scenario and is not evaluated here. For some fisheries, all gears are either fixed or mobile, and thus there are no "gear-based closure" scenarios to model. Fully closed scenarios are unchanged over catch impact scenarios, as changes in catch are only felt if fishing occurs. Therefore, for each fishery modeled, either eight or 12 unique scenarios are reported. Table I-iii shows the possible combinations of exclusion and catch impact scenarios.

Table I-iii. Catch impacts for the range of scenarios, relative to the status quo.

Exclusion	Catch Impact			
	-25 Percent Catch	**-7 Percent Catch**	**Constant Catch**	**+7 Percent Catch**
Fully Open	Full Access; 25 Percent Reduction in Catch	Full Access; 7 Percent Reduction in Catch	Status Quo/ Unchanged; Zero Impact	Full Access; 7 Percent Increase in Catch
Weather-Based Closures	Access in < Force 5 Winds; 25 Percent Reduction in Catch	Access in < Force 5 Winds; 7 Percent Reduction in Catch	Access in < Force 5 Winds; No Change in Catch	Access in < Force 5 Winds; 7 Percent Increase in Catch
Gear-Based Closures	Access for Fixed Gear Only; 25 Percent Reduction in Catch	Access for Fixed Gear Only; 7 Percent Reduction in Catch	Access for Fixed Hear Only; No Change in Catch	Access for Fixed Gear Only; 7 Percent Increase in Catch
Fully Closed	No Access (Change in Catch Irrelevant)	No Access (Change in Catch Irrelevant)	No Access (Change in Catch Irrelevant)	No Access (Change in Catch Irrelevant)

This report gives an overview of primarily cumulative impacts, which assumes that all proposed WEAs are developed. For comparative use, results from one set of scenarios ("fully closed") are reported assuming the development of one WEA (chosen to be the most visited WEA in that modeled fishery) as well as all WEAs. For all other scenarios, results are reported only for a full, cumulative development.

I.ii.ii Exposure Assessment

I.ii.ii.i Commercial Fisheries

Absent any specific regulatory guidance or accepted practice, the authors identified an "exposed" fishery as any fishery, group, or subgroup when one of two thresholds is met:

- On average, more than $1 million in annual revenue was sourced from within a WEA.
- More than 2 percent of average annual revenue was sourced from within a WEA *and* that subgroup's total exposed revenue is greater than $1,000 per year.

A threshold of $1 million ensures that ports which make large economic contributions but are not highly exposed as a share of revenue are included in further analysis. A threshold based on percentage ensures that lower-revenue ports that heavily use the WEAs are included. For example, this would include small, rural, low-revenue ports that rely almost exclusively on a WEA and may be a community's primary source of income, but have total revenues less than $1 million per year.

As smaller divisions with lower total revenue are identified (e.g., port-gear subgroups), the percentage threshold becomes more prominent. Care was taken to eliminate outliers that could misrepresent the data. For instance, if a port is entirely used by trawl and pot gear, but a single purse seine landing occurs once (and that single landing was from within a WEA), purse seiners from this port would appear to be highly exposed even though no meaningful purse seine fishery operates from the port. When examining exposure at the permit level, a "highly exposed" threshold was added at 15 percent of a permit's revenue, to focus the analysis on individuals most likely to be impacted by WEA development.

In addition to examining the exposure of a group or sub-group, a permit-level analysis serves to identify the extent of exposure. The authors adopted a 1 percent threshold commonly used in Regulatory Flexibility Act (RFA) analysis to determine which subgroups to analyze. Although exposure to a WEA is not equal to the "compliance cost" that would be calculated in an RFA analysis, this threshold is informative. Note that use of this threshold does not imply or designate WEA establishment as a regulatory action, nor does this analysis serve as an RFA certification in any form.

An absolute threshold of $100,000 in WEA-sourced revenue per year is included at the permit level. This threshold captures vessels that earn very high revenue, but only occasionally harvest in or near a WEA and therefore do not reach the 1 percent threshold. Regardless of the percentage of exposure, $100,000 per year can be reasonably assumed to be a significant amount of exposure.

Assuming that the distance measured forms the radius of a fishing area, concentric circles representing quartiles of fishing effort were created, each one accounting for 25 percent of all hauls from a given trip. This method translates a single point into a revenue surface for VTR-reported points, allowing for the fraction of overlap between a concentric circle and a WEA to be directly related to the share of revenue from a given trip. For instance, if the 4th quartile concentric circle overlaps a WEA over 1/10 of its area, an estimated 1/40 (i.e., ¼ of 1/10) of that trip revenue is likely sourced from the WEA. If 1/20 of the 3rd quartile also overlaps a WEA, then the total fraction of the trip sourced from the WEA would be (1/20 × ¼) + (1/10 x ¼) = 3/80.

In the Southeast region, only a statistical area and depth fished is reported, with no latitude or longitude in the logbook database. For the region's 118,659 records, latitudes and longitudes were assigned based on a stratified random draw. Using ArcGIS, isobaths for every reported statistical area and 10 m depth increment were generated. Then random draws from within these isobaths were performed for each logbook entry. Under the assumption that the single point that best defines the fishing trip within a reported statistical area is randomly distributed over that statistical area's depth, this would yield an unbiased estimate of the latitude and longitude that *would* have been reported. With latitudes and longitudes assigned, Southeast logbook data were treated as equivalent to Northeast VTR data.

While fishing effort is unlikely to be evenly distributed, the estimate is unbiased in aggregate. In some cases, it may attribute fishing to an un-fished part of the circle; however, it is just as likely that the reverse may be true, washing out any individual level misallocation. Additional information on this process can be found in DePiper (2014) and DePiper et al. (2014). The mapping of revenue across the ocean tied to individuals within specific subgroups is referred to as the revenue surface. When implemented, the result is a raster map where each 250 m^2 area of the Atlantic is represented by a single pixel value representing the summed density (dollars-per-250 m^2) of fishing revenue.

Exposure is calculated for the following groups:

- Aggregated study area (all fisheries from Maine to North Carolina plus Southeast region trips occurring north of the North Carolina–South Carolina border)
- Aggregated state-level
- Aggregated species-level
- Aggregated Fishery Management Plan (FMP)–level
- Port/gear
- Port/FMP
- Port/vessel length

At an aggregated level, incidence of a WEA on a state's or a species' revenue surface provide a bird's-eye view of exposure. For a species, high exposure indicates the potential for impacting the species' domestic supply or trade, which would in turn reverberate through dealers, processors, and end consumers. Similarly, awareness of exposure at the state level is necessary to understand the potential impact to a state's seafood harvest and processing industries. For more effective analysis, exposure must be examined at a focused geographic scale to identify exposed subgroups and disproportional impacts across these subgroups.

Moving beyond aggregations over species or FMP is vital—a one percent reduction in harvest revenue from a single species may not be significant in aggregate, but if that one percent is the total harvest from one port group, the potential impact to that port requires further study. Fishing effort is not fungible—highly exposed ports will not easily transfer effort to other ports should development of WEAs impact their fishing grounds. Port-side infrastructure is immobile, and the social and cultural fabric of an established fishing port cannot simply move to a new, more advantageous area. Therefore, the distribution of potential impacts is studied at a finer scale to identify exactly how exposure is distributed both across and within fisheries.

The dataset contains 16 FMPs. The most commonly landed FMPs are the NE multispecies FMP (510,143 species occurrences) and the summer flounder, scup, and black sea bass FMP (307,808 occurrences). Red crab, occurring 414 times, is the least frequently landed FMP. Note that species that tend to be either caught together or targeted with similar gear at exclusive times of the year may be aggregated into an FMP and managed by the appropriate regional council. For instance, the squid, mackerel, and butterfish FMP includes species not taxonomically similar, but caught in a similar manner, often side by side.

An important factor in assessing economic impact is the dynamic process of effort reallocation. While within-FMP species targeting is fairly liquid, *gear* switching is not. A longline vessel cannot easily switch to trawling without incurring a significant cost, and a trawl vessel, outfitted with a powerful engine and heavy trawl gear, cannot efficiently prosecute a pot trap fishery without retiring valuable gear. In the study period, the number of unique vessels reporting the use of each gear type is as follows: 1,442 hand gear (including bandit reel), 932 lobster pot gear, 919 dredge gear, 898 bottom trawl, 649 gillnets, 516 pot gear, 501 midwater trawls, 248 longline gear, 74 seine gear, and 31 other gear. Many vessels report in multiple gear categories.

Smaller vessels fish differently than larger vessels, even when targeting the same species. Sometimes referred to as "day boat" vessels, smaller vessels tend to fish closer to shore with smaller crews, and generally return to port each night. Larger "long trip" vessels may make extended trips, may fish in waters far from shore for multiple days at a time, and may be more likely to be part of a consolidated or larger business-owned fleet. Small vessels may not be as capable of switching to alternative fishing grounds. The VTR logbook/dataset identifies 4,073 unique commercial vessels are identified. Of these, 2,111 are less than or equal to 50 feet in length, 1,032 are greater than 50 feet in length, and 930 are of unknown or unreported length.

I.ii.ii.ii Recreational Fisheries

Recreational for-hire fishing activity cannot be translated from a single point to a revenue surface for a given trip. This is because there are no observer data to model the spatial locations. Therefore, the authors used raw Northeast VTR and SRHS statistical area data to estimate exposure and the potential economic impacts of WEAs on recreational for-hire fisheries. For-hire port groups were determined based on the same protocol used in the exposure and impact assessment of WEA development on commercial fisheries.

The authors estimated expenditures by anglers on recreational fishing trips exposed to WEAs by combining Northeast VTR, Southeast SRHS, and MRIP effort estimates with angler expenditure data derived from Lovell et al. (2013). Average annual expenditures over the six-year study period on angler trips exposed to the WEAs were estimated for private boat and for-hire angler trips by state, port group, and individual WEAs. Excluded from the assessment were expenditures by anglers on durable goods (e.g., rods, reels, boats), since these items could be used for many trips—including trips outside WEAs. Trip expenditures shown in Lovell et al. (2013) and included in the assessment were auto fuel, auto rental, bait, boat rental, charter fees, crew tips, fish processing, food from grocery stores, food from restaurants, gifts and souvenirs, ice, lodging, parking and site access fees, public transportation, and tournament fees.

The authors calculated average annual angler trip expenditures by multiplying the estimated numbers of exposed angler trips aboard for-hire boats and private boats from 2007–2012 by mean trip expenditures shown in Lovell et al. (2013), then dividing by 6. Angler expenditure estimates associated with the WEAs were calculated by state, by port group, and by each WEA to show the relative contribution by state and port group of angler expenditures estimated to occur in or near a WEA.

As noted earlier, charter boats are for-hire vessels that carry six or fewer passengers, charging a rental fee. Head boats are commonly defined as for-hire vessels that carry 10 or more passengers and charge by the person (Holland et al. 2012). USCG licensing of for-hire vessels designates any vessel carrying more than six anglers at a time as a head boat, while charter boats are vessels carrying six or fewer anglers. Data reporting requirements for each region follow the USCG designations. For this study, charter and head boats are grouped together and referred to as "for-hire" whenever possible.

The authors assessed recreational fishing exposure by estimating fishing effort in or near WEAs in recent years (2007–2012). The recreational fishing data available for this estimation vary by fishing mode; the best available data for both private boat and for-hire recreational fishing modes are shown in Table I-iv, an overview of each dataset is presented in the following paragraphs.

Table I-iv. Data used for assessment of recreational fishing exposure to WEAs.

Region	Mode and Designation	Data Source
Maine to North Carolina	Charter (6 or Fewer Anglers)	Northeast VTR
	Head Boats (More than 6)	Northeast VTR
North Carolina (South of Cape Hatteras) and South Carolina	Charter (6 or Fewer Anglers)	None
	Head Boats (More than 6 Anglers)	Southeast Region Headboat Survey (SRHS)
Maine to South Carolina	Private Boats	Marine Recreational Information Program (MRIP)

Northeast VTR Data Analysis

To be conservative in defining exposure in the recreational data, the WEAs were buffered to 1 nautical mile (1.852 km) out from their borders. The VTR location points were then overlaid with the buffered WEA areas, producing a point file for those VTR locations that were “in or near” the study WEAs. All for-hire boat trips within 1 nautical mile of a WEA border during 2007–2012 were assumed to be “exposed” for purposes of this assessment. Each for-hire boat trip record includes the number of anglers on board, which is used to determine the number of angler trips associated with that record. (One for-hire boat trip with five anglers on board constitutes five for-hire angler trips but only one for-hire boat trip.) Data from Lovell et al. (2013) were then used to estimate the expenditures associated with these trips, based on the number of paying customers (anglers). Figure I-ii shows this approach to assessing for-hire recreational exposure, with a magnification of the NJ WEA to present more detail.

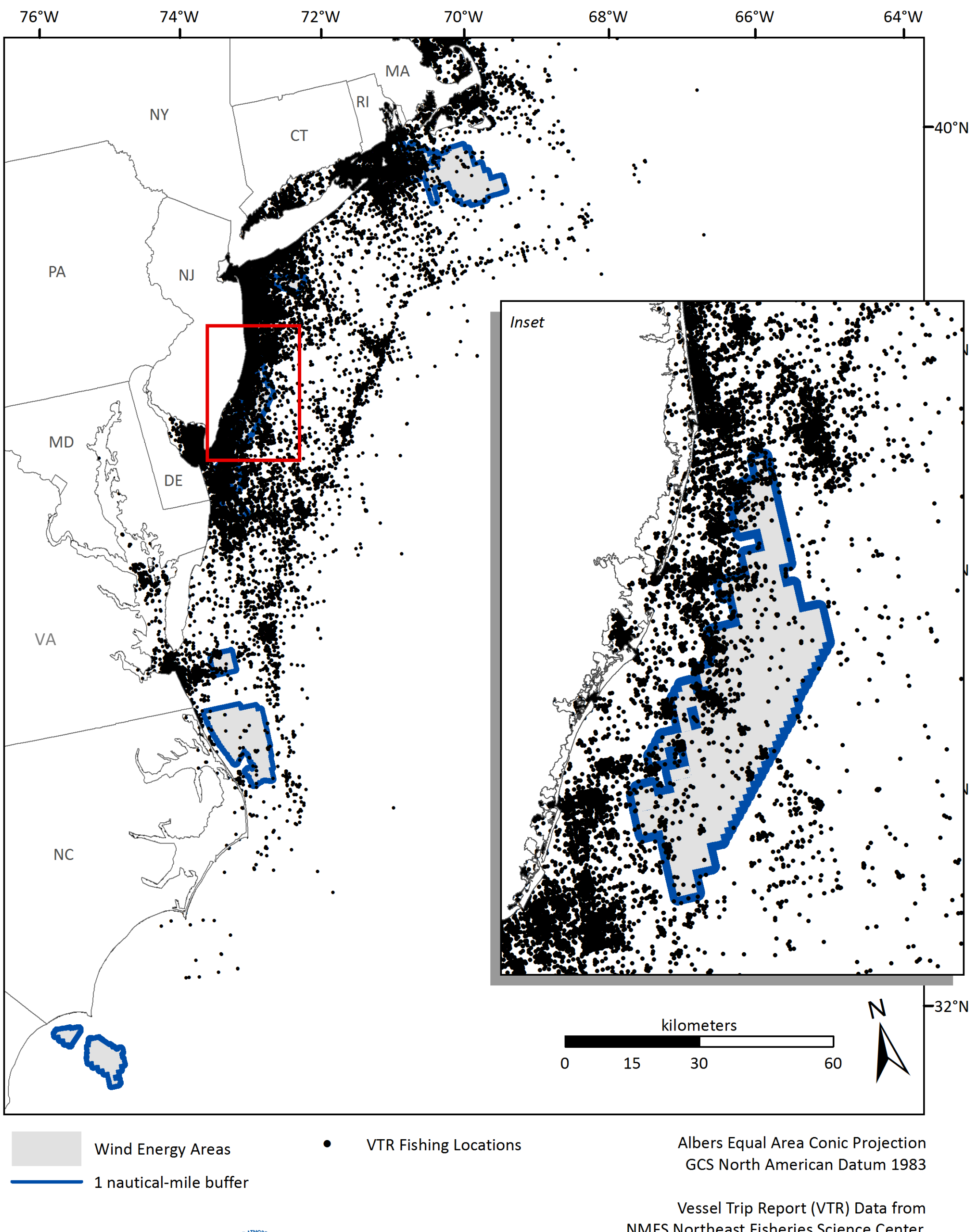


Figure I-ii. Recreational fishing effort.

SRHS Data Analysis

SRHS for-hire boat trips were reported to occur within a total of 20 blocks in the Southeast region; this assessment focuses on the 43 grid cells that directly intersect with the VA and NC WEAs. Fishing was reported in 17 blocks (Figure I-iii and Figure I-iv). The exposure and impact assessment focuses on for-hire fishing effort in these areas.

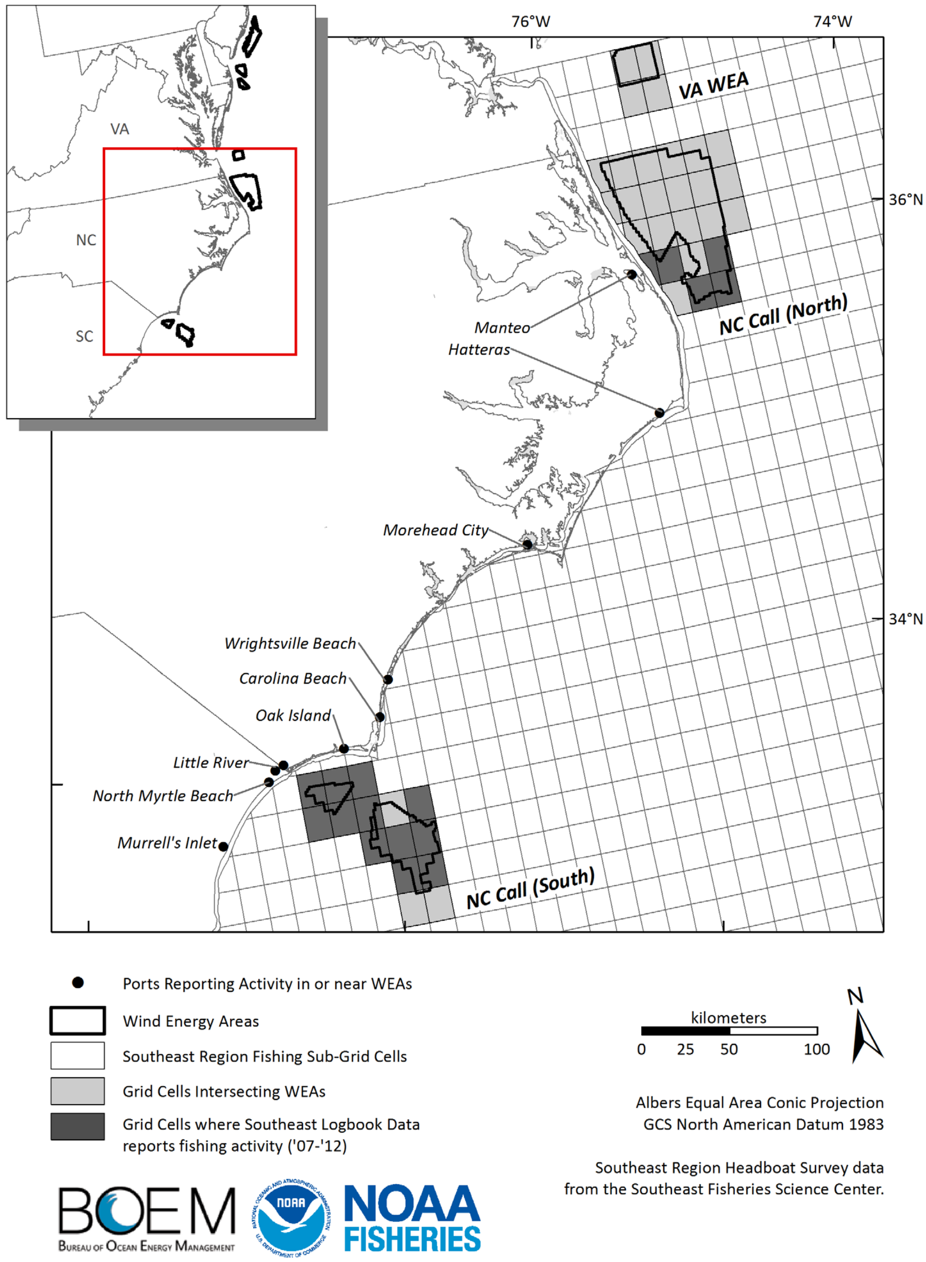


Figure I-iii. The SRHS grid.

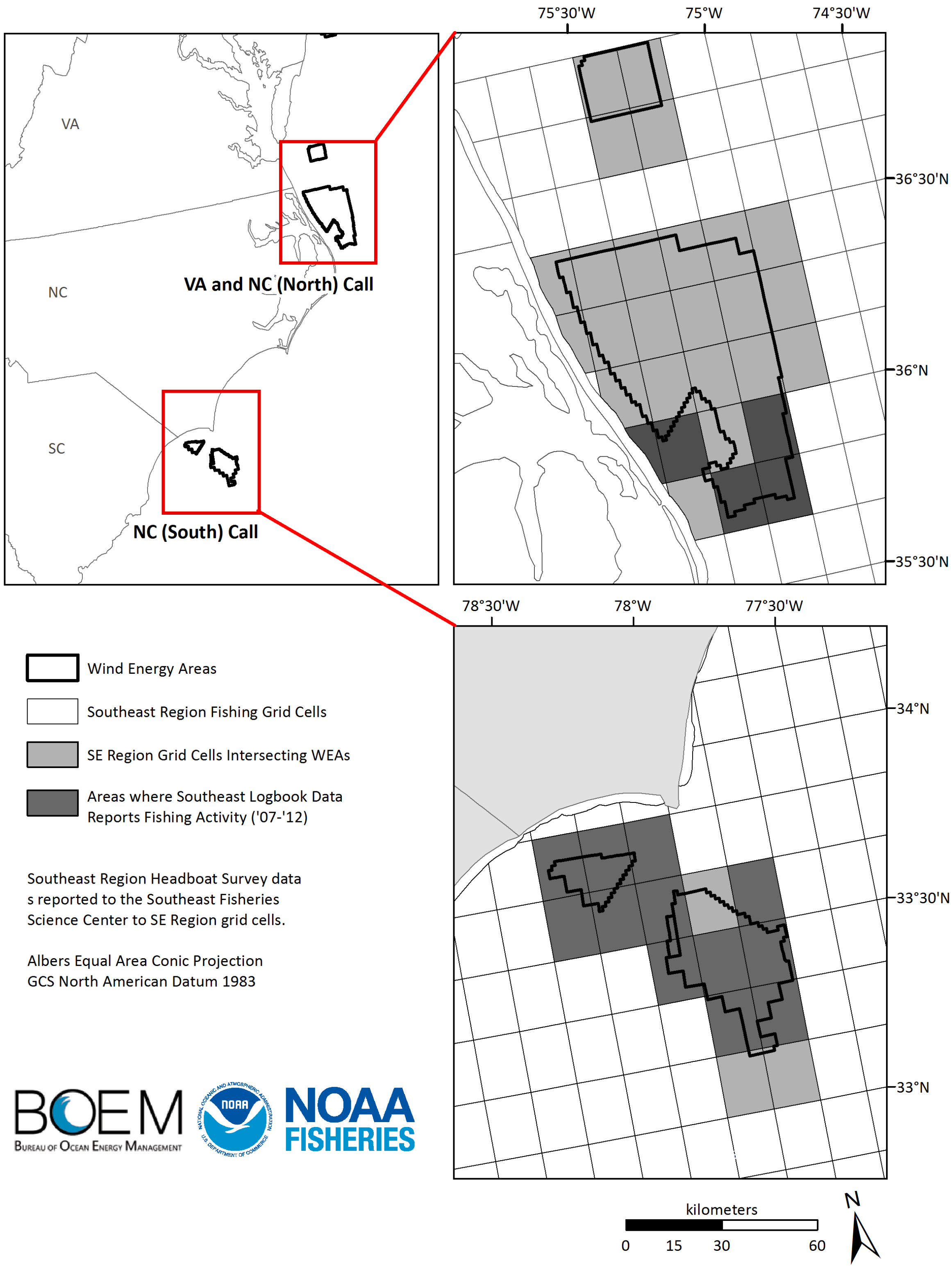


Figure I-iv. SRHS for-hire recreational fishing activity.

Of the reported 18,327 for-hire boat trip records during the study period, 16,011 were reported correctly to the grid cell level. Records were dropped if fishing location information was improperly filled out, reported to the grid block (but not to a smaller grid cell); or left blank. Boat trips hosted anywhere from 1 to over 100 anglers on board. Note that the total number of anglers reported on a single boat trip is not adjusted for the duration of the trip; it is simply the number of anglers reported to be participating on a for-hire boat trip. In other words, a single angler trip may refer to an angler paying to participate in a single, half-day boat trip, or paying to join a two-day excursion.

This analysis designates as "exposed" each SRHS for-hire boat trip that visited any grid cell that intersects a WEA. Grid cells are not well-aligned with the contours of the study WEAs. This may result in an exaggerated estimate of exposed fishing, because for-hire boat trips outside a WEA, but within a grid cell intersecting a WEA, are still designated as "exposed." No further spatial data are available to inform a designation decision rule. Therefore, these values should be interpreted as an estimate of the *maximum* exposure of recreational for-hire fishing to WEAs. Once this designation is made, each for-hire boat trip record is combined with the Northeast VTR dataset to describe for-hire fishing effort and exposure. Charter and head boats south of Cape Hatteras, NC, are not included in these results.

Private Vessel Recreational Fishing

The MRIP database was used to estimate the number of private boat angler trips taken in 2007–2012. To assess the potential exposure of private boat anglers to WEA development, the authors aggregated annual estimates of private boat recreational fishing trips at MRIP angler intercept sites to port-community groups as used in Colburn and Jepson (2012). As previously noted, shore-based fishing is not included because anglers fishing from shore will most likely experience no impact from the offshore development of wind energy facilities.

This assessment includes all port-community groups within a 30-nautical-mile straight line of the WEAs. This threshold distance was used because it represents the maximum one-way distance that a typical charter or head boat vessel might travel for a fishing trip. Port groups within the distance threshold were considered to be exposed. The MRIP port-community groups shown in Colburn and Jepson (2012) are more disaggregated than the port groups in the Northeast VTR and SRHS databases. Thus, to maintain consistency, MRIP private boat angler trip estimates are matched to Northeast VTR and SRHS port groups. The MRIP to VTR and SRHS port group matching is shown in Table I-v.

Table I-v. MRIP to VTR and SRHS port group matching.

State	VTR Port Group	MRIP Port Group
CT	BRANFORD	BRANFORD
		GUILFORD
		WEST HAVEN
	BRIDGEPORT	BRIDGEPORT
		FAIRFIELD
		MILFORD
		STRATFORD
	CLINTON	CLINTON
		MADISON
	GROTON	GROTON
	MYSTIC	OLD LYME
	NEW LONDON	NORWICH
	NIANTIC	EAST LYME
	NOANK	NOANK

State	VTR Port Group	MRIP Port Group
	NORWALK	NORWALK
		STAMFORD
	OLD SAYBROOK	OLD SAYBROOK
	PAWCATUCK	WESTBROOK
	STONINGTON	STONINGTON
	WATERFORD	WATERFORD
DE	INDIAN RIVER	REHOBOTH BEACH-DEWEY BEACH-INDIAN RIVER
	LEWES	LEWES
	MILFORD	BOWERS
		LITTLE CREEK
		MAGNOLIA
		SMYRNA
	OTHER DELAWARE	DELAWARE CITY
		NEWPORT
		ODESSA
		WILMINGTON
	OTHER SUSSEX	FENWICK ISLAND
		MILLSBORO
		MILLVILLE
		SLAUGHTER BEACH
MA	BARNSTABLE	BARNSTABLE
	BEVERLY	BEVERLY
	BOSTON	NAHANT
	BOURNE	BOURNE
	CHATHAM	CHATHAM
	CHILMARK	CHILMARK
	DANVERS	DANVERS
	DENNIS	DENNIS
	EDGARTOWN	EDGARTOWN
	FAIRHAVEN	FAIRHAVEN
	FALL RIVER	FALL RIVER
		SOMERSET
		SWANSEA
	FALMOUTH	FALMOUTH
		WOODS HOLE
	GLOUCESTER	GLOUCESTER
	HARWICH PORT	HARWICHPORT
	HULL	HULL
	LYNN	LYNN
	MARBLEHEAD	SALEM
		SWAMPSCOTT
	MARSHFIELD	DUXBURY
		MARSHFIELD
	NANTUCKET	NANTUCKET
	NEW BEDFORD	DARTMOUTH
		NEW BEDFORD
	NEWBURYPORT	AMESBURY
		IPSWICH
		NEWBURY

State	VTR Port Group	MRIP Port Group
		NEWBURYPORT
	OAK BLUFFS	OAK BLUFFS
	ONSET	MARION
	ORLEANS	EASTHAM
		ORLEANS
	OTHER DUKES	AQUINNAH
		GOSNOLD
	OTHER MA	MATTAPOISETT
	PLYMOUTH	KINGSTON
		PLYMOUTH
	PROVINCETOWN	PROVINCETOWN
	QUINCY	QUINCY
	ROCKPORT	ROCKPORT
	SALISBURY	SALISBURY
	SANDWICH	SANDWICH
	SCITUATE	SCITUATE
	SOUTH YARMOUTH	MASHPEE
	TISBURY	TISBURY
	TRURO	TRURO
	WAREHAM	WAREHAM
	WELLFLEET	WELLFLEET
	WESTPORT	WESTPORT
	WEYMOUTH	HINGHAM
		WEYMOUTH
	WINTHROP	WINTHROP
	YARMOUTH	YARMOUTH
MD	CHESAPEAKE BEACH	CHESAPEAKE BEACH
	OCEAN CITY	BERLIN
		OCEAN CITY
		OCEAN PINES
		WEST OCEAN CITY
	OTHER ANNE ARUNDEL COUNTY	ANNAPOLIS
		DEALE
		MAYO
		SEVERNA PARK
		SKIDMORE
	OTHER CALVERT	SOLOMONS
		BENEDICT
		BROOMES ISLAND
	OTHER MARYLAND	ABINGDON
		BALTIMORE
		BELLEVUE
		BIVALVE
		BUSHWOOD
		CAMBRIDGE
		CHAMP
		CHASE
		CHESTER
		CHESTERTOWN

State	VTR Port Group	MRIP Port Group
		CHOPTANK
		CLAIBORNE
		COBBS ISLAND
		DARLINGTON
		DEAL ISLAND
		DUNDALK
		EARLEVILLE
		EDESVILLE
		EDGEWOOD
		ESSEX
		FREDERICKTOWN
		GEORGETOWN
		HACK'S POINT
		HARMONY
		HAVRE DE GRACE
		JOPPATOWNE
		KENT ISLAND
		LEONARDTOWN
		MADDOX
		MADISON
		MARION
		MILLERS ISLAND
		MOUNT VERNON
		NANJEMOY
		NANTICOKE
		NEAVITT
		NEWBURG
		NEWCOMB
		NORTH EAST
		PERRYVILLE
		PINEY POINT
		PORT DEPOSIT
		QUEENSTOWN
		ROCK HALL
		SCOTLAND
		SECRETARY
		ST. GEORGES
		STEVENSVILLE
		TALL TIMBERS
		TAYLORS ISLAND
		VIENNA
		WENONA
	POCOMOKE CITY	CRISFIELD
		DAMES QUARTER
		FRENCHTOWN-RUMBLY
		SNOW HILL
		WESTOVER
NC	BEAUFORT	BEAUFORT
	HATTERAS	HATTERAS

State	VTR Port Group	MRIP Port Group
	MANTEO	MANTEO
	AURORA	AURORA
	MOREHEAD CITY	BATH
		BAYBORO
		BELHAVEN
		BONNERTON
		MOREHEAD CITY
	NAGS HEAD	KILL DEVIL HILLS
		KITTY HAWK
	OCRACOKE	OCRACOKE
	OTHER CARTERET	ATLANTIC BEACH
		ATLANTIC
		CAPE CARTERET
		CEDAR ISLAND
		CEDAR POINT
		CORE SOUND/SEA LEVEL
		DAVIS
		EMERALD ISLE
		HARKERS ISLAND
		HAVELOCK
		NEW BERN
		NEWPORT
		ORIENTAL
		PINE KNOLL SHORES
		SWANQUARTER
		VANDEMERE
		WASHINGTON
	OTHER DARE	ENGELHARD
		HOBUCKEN
		MANNS HARBOR
		SOUTHERN SHORES
	SWANSBORO	BRIDGETON
		CALABASH
		CAMP LEJEUNE
		CAROLINA BEACH
		CROATAN
		HAMPSTEAD
		HOLDEN BEACH
		JACKSONVILLE
		KURE BEACH
		OAK ISLAND
		OCEAN ISLE BEACH
		SHALLOTTE
		SNEADS FERRY
		SOUTHPORT
		SUNSET BEACH
		SURF CITY
		SWANSBORO
		TOPSAIL BEACH

State	VTR Port Group	MRIP Port Group
		VARNAMTOWN
		WILMINGTON
		WRIGHTSVILLE BEACH
	WANCHESE	WANCHESE
NH	GREENLAND	NEWMARKET
		STRATHAM
	HAMPTON	EXETER
		HAMPTON
	NEW CASTLE	NEW CASTLE
	PORTSMOUTH	DOVER
		NEWINGTON
		PORTSMOUTH
	RYE	RYE
	SEABROOK	HAMPTON FALLS
		SEABROOK
NJ	ABSECON	ABSECON
	ATLANTIC CITY	ATLANTIC CITY
	AVALON	AVALON
	BARNEGAT	BARNEGAT LIGHT
		BARNEGAT
	BELMAR	BELMAR
	BRIELLE	BRIELLE
	BRIGANTINE	BRIGANTINE
	CAPE MAY	CAPE MAY
	EAGLESWOOD	NEW GRETNA
	FORKED RIVER	LACEY
	GALLOWAY	GALLOWAY
	HIGHLANDS	HIGHLANDS
	JERSEY CITY	JERSEY CITY
	KEYPORT	KEYPORT
		LAURENCE HARBOR
	LITTLE EGG HARBOR	LITTLE EGG HARBOR
	LONG BEACH	LONG BEACH
	MANASQUAN	MANASQUAN
	MARGATE CITY	MARGATE
	MIDDLE	MIDDLE
	MIDDLETOWN	ATLANTIC HIGHLANDS
	NEPTUNE	NEPTUNE
	OCEAN CITY	OCEAN CITY
	OLD BRIDGE	SEA BRIGHT
	OTHER ATLANTIC	LINWOOD
		LONGPORT
		NORTHFIELD
		PORT REPUBLIC
		SOMERS POINT
	OTHER CAPE MAY	DENNIS
		LOWER
		UPPER
		WILDWOOD CREST

State	VTR Port Group	MRIP Port Group
	OTHER CUMBERLAND	DOWNE
		GREENWICH
		MAURICE RIVER
	OTHER GLOUCESTER	EGG HARBOR
	OTHER MONMOUTH	LEONARDO
		LONG BRANCH
		OCEANPORT
		PORT MONMOUTH
		RUMSON
	OTHER OCEAN	BEACH HAVEN
		LAVALLETTE
		SEASIDE HEIGHTS
		SEASIDE PARK
	POINT PLEASANT	POINT PLEASANT
	PORT NORRIS	PORT NORRIS
	SAYREVILLE	SAYREVILLE
	SEA ISLE CITY	SEA ISLE CITY
	STONE HARBOR	STONE HARBOR
	TOMS RIVER	TOMS RIVER
	TUCKERTON	TUCKERTON
	WARETOWN	WARETOWN
	WILDWOOD	WILDWOOD
	WOODBRIDGE	FAIRFIELD
		PERTH AMBOY
		SEWAREN
NY	BROOKLYN	BROOKLYN
	CITY ISLAND	NEW ROCHELLE
	EAST HAMPTON	EAST HAMPTON
	FREEPORT	FREEPORT
	GREENPORT	GREENPORT
	HAMPTON BAYS	HAMPTON BAYS
	HEMPSTEAD	BAY PARK
	ISLAND PARK	ISLAND PARK
	JAMAICA BAY-ROCKAWAY	SEAFORD
	LONG BEACH	MERRICK
	MATTITUCK	MATTITUCK
	MONTAUK	MONTAUK
	MORICHES	MORICHES
	NEW YORK	STATEN ISLAND
	NORTHPORT	NORTHPORT
	OAK BEACH-CAPTREE	BAY SHORE
		ISLIP
	OCEANSIDE	OCEANSIDE
	ORIENT	ORIENT
	OTHER BRONX	INWOOD
	OTHER NASSAU	BAYVILLE
		MASSAPEQUA
		OYSTER BAY
		PORT WASHINGTON

State	VTR Port Group	MRIP Port Group
		WANTAGH
	OTHER NY	MAMARONECK
	OTHER SUFFOLK	AMITYVILLE
		BABYLON
		BAYPORT
		BELLPORT
		BLUE POINT
		CENTER MORICHES
		COLD SPRING HARBOR
		COPIAGUE
		CUTCHOGUE
		EAST ISLIP
		EASTPORT
		EATONS NECK
		GREAT RIVER
		HUNTINGTON
		JAMESPORT
		KINGS PARK
		LINDENHURST
		MASTIC BEACH
		MASTIC
		MOUNT SINAI
		NEW SUFFOLK
		OAKDALE
		PATCHOGUE
		SAINT JAMES
		SAYVILLE
		SHIRLEY
		STONY BROOK
		WADING RIVER
		WEST ISLIP
		WEST SAYVILLE
	POINT LOOKOUT	POINT LOOKOUT
	PORT JEFFERSON	PORT JEFFERSON
	QUEENS	QUEENS
	SHELTER ISLAND	WESTHAMPTON
	SOUTHOLD	SOUTHOLD
RI	BARRINGTON	BARRINGTON
	BRISTOL	BRISTOL
	CHARLESTOWN	CHARLESTOWN
	EAST GREENWICH	EAST GREENWICH
		NORTH KINGSTOWN
	LITTLE COMPTON	LITTLE COMPTON
	NARRAGANSETT	NARRAGANSETT
	NEW SHOREHAM	NEW SHOREHAM
	NEWPORT	JAMESTOWN
		MIDDLETOWN
		NEWPORT
	PORTSMOUTH	PORTSMOUTH

State	VTR Port Group	MRIP Port Group
	PROVIDENCE	EAST PROVIDENCE
		PROVIDENCE
	SOUTH KINGSTOWN	SOUTH KINGSTOWN
	TIVERTON	TIVERTON
	WARREN	CRANSTON
	WARWICK	WARWICK
	WESTERLY	WESTERLY
VA	CAPE CHARLES	OYSTER
	CHINCOTEAGUE	CHINCOTEAGUE
	DISTRICT 3 NORTHAMPTON COUNTY	DISTRICT 1
		DISTRICT 2
		DISTRICT 3
		HORNSBYVILLE
	GREENBACKVILLE	HOG ISLAND
	HAMPTON	HAMPTON
		JAMESTOWN
		NEWPORT NEWS
	NORFOLK	NORFOLK
	OTHER NORTHUMBERLAND	CALLAO
		DAHLGREN
		FLEETON
	OTHER VIRGINIA	ACHILLES
		BACK CREEK
		BOWLER'S WHARF
		CASHVILLE
		CHESAPEAKE
		COLONIAL BEACH
		COPLE
		DARE
		DAUGHERTY
		DELTAVILLE
		FAIRVIEW BEACH
		GARGATHA
		GLOUCESTER COURTHOUSE
		GLOUCESTER POINT
		GWYNN
		HARCUM
		HARTFIELD
		HORSEHEAD
		LERTY
		LITWALTON
		MATTHEWS
		MOLLUSK
		MONTROSS
		NEW POINT
		NORGE
		POQUOSON
		PORT HAYWOOD
		PORTSMOUTH

State	VTR Port Group	MRIP Port Group
		PUNGOTEAGUE
		RESCUE
		RUSHMERE
		SALUDA
		SINGERLY
		SUFFOLK
		SURRY
		TABB
		TAPPAHANNOCK
		TOPPING
		TUCKER HILL
		URBANNA
		WAKE
		WARDTOWN
		WARSAW
		WATERVIEW
		WEST POINT
		WISE POINT
	QUINBY	KIPTOPEKE
	SAXIS	ONANCOCK
	VIRGINIA BEACH	VIRGINIA BEACH
	WACHAPREAGUE	WACHAPREAGUE
SC	HILTON HEAD ISLAND	BEAUFORT
		DALE
		FRIPP
		HILTON HEAD ISLAND
		JASPER
		PORT ROYAL
	LITTLE RIVER	LITTLE RIVER
	MOUNT PLEASANT	AWENDAW
		CHARLESTON
		EDISTO BEACH
		FOLLY BEACH
		HOLLYWOOD
		ISLE OF PALMS
		JAMES ISLAND
		JOHNS ISLAND
		MCCLELLANVILLE
		MOUNT PLEASANT
		NORTH CHARLESTON
		RAVENEL
		ROCKVILLE
	MURRELLS INLET	GEORGETOWN
		MURRELLS INLET
		PAWLEYS ISLAND
	NORTH MYRTLE BEACH	NORTH MYRTLE BEACH
	HILTON HEAD	BLUFFTON

The number of exposed private-boat angler trips that left from these port groups was calculated using the average annual percent of those trips from each state that occurred in federal waters during the study period (Table I-vi).

Table I-vi. Average annual percent of private-boat trips that occurred in federal waters.

State	Percent Private Boat Angler Trips in Federal Waters
CT	0%
DE	5.9%
MA	9.8%
MD	1.6%
NC	13.0%
NH	25.3%
NJ	10.4%
NY	1.9%
RI	4.1%
VA	2.1%

Some ports are "exposed" to multiple WEAs due to the close proximity of the WEAs to neighboring states. Since there is no way to determine which of the multiple WEAs private vessels leaving from these ports might actually visit, exposure is not mutually exclusive. For this analysis, private boat angler trips leaving from ports that are exposed to multiple WEAs are considered equally exposed to each WEA. See Appendix III for more detail on port groups that are exposed to multiple WEAs.

I.ii.iii Shoreside Dependents

I.ii.iii.i Commercial Fishery

Federally reported commercial fishery landings averaged $966 million per year and recreational angler expenditures (including for-hire boat revenue) were over $1 billion per year. These landings and expenditures support a large amount of additional sales, income, and employment. Every pound of fish landed requires inputs such as bait and ice, capital expenditures for vessels and infrastructure, and services such as insurance and maintenance. Landed fish also require employees to process, market, and ship fish for domestic or international consumption. Similarly, both for-hire and private recreational fishing trips purchase bait from supply shops, gasoline and oil from marine service stations, and fishing rods from manufacturers, among other things. These businesses, in turn, purchase additional services and supplies, which expands the linkages between fisheries and regional economies, or shoreside dependents.

To estimate the impact of fisheries on the local economy in terms of jobs, sales, and income, the authors used the Northeast Region Commercial Input-Output Model, developed by the Northeast Fisheries Science Center (Steinback and Thunberg 2007). Input-output models are the most common approach used by economists to estimate the total economic activity attributable to marine recreational fishing. An input-output model is a partial equilibrium model that uses estimates of input use and output production for a large number of sectors. Inputs to this model consist of average annual revenue by sector, where fishing sectors are defined at the gear-region or gear-region-size level (e.g., "Downeast Maine large bottom trawl" or "Downeast private recreational boats"). Outputs from the model consist of estimates for total sales, income, and employment dependent upon the input revenue for each sector considered. Income and employment are the primary data presented here and are delineated by economic sectors, including fishing and processing, as well as other sectors dependent on both commercial and recreational fisheries. Results are calculated for the Mid-Atlantic region and the New England region (Table III-xxv through Table III-xxxii).

Specific definitions of regions and sectors, as well as technical information on the model, are presented in Steinback and Thunberg (2007). Model parameters were updated in 2009–2010 to reflect more recent data. For some sectors (region-gear combinations), insufficient input-output data existed for estimating model parameters. When landings revenue was allocated to a sector without parameter estimates, it was reallocated to the nearest similar sector. The model is limited to the New England and Mid-Atlantic regions, which extend only to the NC–SC border. Consequently, $11.1 million in landings attributed to South Carolina were not included in the analysis.

I.ii.iii.ii Recreational Fishery

Assessing the direct, indirect, and induced impact of angler expenditures exposed to the WEAs provides an indication of the total economic activity supported by recreational fishing in or near the WEAs. In the analysis presented here, economic impact estimates generated from input-output models shown in Lovell et al. (2013) were used to estimate the total average annual economic activity (i.e., sales, income, and jobs) supported by angler trip expenditures in or near the WEAs during 2007–2012. Sales reflect total dollar sales generated from expenditures by anglers in each state. Income represents wages, salaries, benefits, and proprietary income generated from angler expenditures in each state. Jobs include both full-time and part-time workers and are expressed as total jobs. Impact estimates are not shown by state and port group due to confidentiality restrictions.

I.iii Impact Assessment Methodology

The following sections outline the methodology employed in assessing impacts of WEA development on commercial and recreational fisheries, along with their shoreside dependents.

I.iii.i Commercial Location Choice Model

Valuation of a spatially defined patch of ocean has long been an area of study for fisheries economists. Beginning with Bockstael and Opaluch (1983), discrete choice models have been used to analyze fishery behavior, frequently to understand potential impacts of changes in fishery management (Eales and Wilen 1986; Holland and Sutinen 1999; Hicks and Strand 2000; Smith and Wilen 2003; Smith 2005). Estimation of changes in economic welfare followed thereafter (Curtis and Hicks 2000; Hicks et al. 2004; Haynie and Layton 2010).

Location choice fishery models estimate probabilities of fishing in each defined patch of ocean based on observed choices and observable characteristics. The end result does not deterministically define a specific vessel's choice, but rather returns a probability for each location fished. With predicted catch included in the model, it becomes possible to estimate a probability distribution of fishing location under various catch scenarios. Furthermore, a probability distribution of fishing location for trips using specific gears or under certain weather conditions can be calculated for fishing scenarios.

A random utility model framework is used in location choice models for estimating a utility function based on observed choices and covariates defined over a set of discrete choices. In this context, the discrete choice is a specific patch of ocean (a "zone"), the choice-maker is assumed to be the captain of the vessel, and utility is the value or benefit attached to the use of each zone. The covariates are variables, including expected revenue, costs, RNVC, wind speed, ex-vessel prices of important species, season, and vessel characteristics that influence the utility that each choice-maker derives from a trip.

In a location choice model, each zone is assumed to have some utility to each fisherman. That utility is assumed to be influenced by observables such as RNVC. It is also influenced by time-varying conditions such as wind speed. Although it is possible to observe things like expected RNVC and wind speed, we cannot observe the weighting of importance of these factors directly—for example, how much more revenue would a fisherman require from a zone to make up for a 1 m/s increase in wind speed? Furthermore, some factors are not observable to the researcher—such as the fisherman's personal tastes, specific knowledge of fishing conditions gleaned from a network of personal relationships, historical habits, etc. These unobserved factors vary over areas and over time, confounding the estimation of the relative importance of the observed variables.

Assuming a distribution for unobserved factors permits a model that can estimate the weights of importance on observed factors. These weights (or *parameters*), once fit to a large dataset of observed choices, allow for the prediction of zone choices under alternative scenarios. For instance, if there exists an estimate of the influence of wind speed on fishing zone choice, then for a given trip, a probabilistic estimate of the choices made under current wind conditions and under heavy wind conditions is feasible. Because heavy winds alter the utility of each zone choice, a different distribution of probabilities will result. Furthermore, if each trip's costs and revenue to each zone can be estimated, then an expected change in RNVC can be calculated for each trip.

A discrete choice (or location choice) model requires specific assumptions on the scale of the unobserved factors. The use of a random parameters mixed logit random utility model (a type of location choice model) relaxes this assumption by allowing for heterogeneity in tastes at the choice or fisherman level by estimating at least one parameter (here, the parameter on RNVC) over a distribution. Instead of estimating the mean effect of RNVC on choice probabilities, the model estimates a distribution for the mean effect, allowing for differences in tastes or risk aversion. This absorbs and accounts for correlations in the unobserved factors, providing improved estimates. For example, the fisherman's personal tastes or degree of risk aversion can be expected to affect every trip the fisherman makes—i.e., every fishing zone chosen. This means that there is additional information, beyond that contained in the observed variables in the model, that helps explain the fishing locations chosen by a fisherman and can be used to improve overall estimation. Train (2009) provides more background and proofs for the development of a location choice model and the use of random parameter mixed logits.

A drawback to a location choice model is that there are caveats on the economic interpretation of the results. In the most common form of discrete choice models in the literature, recreational choice modeling, the utility function estimated does not include a monetary value for each choice. Instead, a recreation choice (such as camping or freshwater fly fishing) yields a payoff that is not denominated in dollars (e.g., "satisfaction from fishing in a local stream"). In these models, the respondent's income is usually included in the model. A change in the desirability or accessibility to an area results in a change in the utility that may be derived for that area, and a compensating change in income can be calculated from parameters that would leave the person just as well-off (Herriges and Kling 1999; Hanemann 1984). This measure of compensation is only valid over small changes in the choices. This study assessed a range of changes in the choice set, many of which involve simulating the closure of an area.

Each fisherman is treated here as a profit-maximizing producer, and thus measures of producer surplus (or net revenue) may be directly considered rather than calculating a compensating value.

Therefore, we need only calculate RNVC for each area and the probabilities of fishing in each area. Because changes in the choice distribution are not restricted to the "small choice-set changes" restriction, the estimates of choice reallocation—where will a fisherman fish if not in the area that is now closed?—remain valid, even over large changes such as complete closures. A probability-weighted RNVC, similar to producer surplus, can be calculated using the expected revenues and variable costs associated with each zone and the model-estimated probability of fishing in each zone. A second probability-weighted RNVC can then be calculated using the model-estimated probability of fishing in each zone, subject to any constraints on access, increased travel costs or distances, or any other scenario. The resulting difference in RNVC captures the change in net income associated with the scenario in a manner similar to estimates of changes in producer surplus.

Several assumptions underlie this method. "Not fishing" is not an observable choice, since the relevant data are available only for trips that are actually taken. Therefore, the model cannot estimate a change in the *number* of trips. A trip is assumed to always occur, regardless of the choice set, which may result in trips with very large negative changes in RNVC. These would specifically occur when one fisherman has one specific area where revenue is high and costs are low, and all other areas are lower in revenues and higher in costs. Conversely, this method can result in *positive* impacts in some cases, despite assumptions that fishermen are profit-maximizers. This could occur when fishing occurs in an area that has low expected revenue relative to other areas, or when trips are "exploratory" trips into an area where little recent fishing has taken place. Expected revenues are conditional means, and variation from those conditional expectations is expected. *On average*, however, trips will be probabilistically distributed with a skew toward higher-revenue, lower-cost locations and these anomalies will average out. In general, the areas that make up the proposed WEAs are largely marginally productive waters, making it unlikely that a proposed WEA would represent the only option for large numbers of fishermen.

The location choice model employed here also assumes no time shifting of WEA-displaced effort. If a trip occurred on a given day, the model assumes the trip remains on that day. Revenue is calculated at either the monthly or quarterly level for each vessel (see below). Therefore, small temporal shifts would not change the model's outcome. Shifting between seasons, however, is a possible response, but cannot be accounted for in this model. Likewise, port-switching could occur in the medium term. Permanently moving ports may give fishermen the ability to fish second-best areas without incurring costs as high as those estimated based on the observed landing port. This model does not account for this behavior.

By probability-weighting RNVC over each zone for each trip, the expected RNVC reflects both profit-maximization behavior and observed deviations. Deviations from the expected choice are included to the extent that expected RNVC does not fully explain a fisherman's choice (i.e., all significant, non-RNVC covariates in the location choice model, including zone-specific constants), or the estimated costs are not fully accounted for in the conditional mean (e.g., wind speed may make fishing more expensive due to slower possible speeds, which is not accounted for in calculating RNVC). While maximizing RNVC is clearly important (and very significant in all model estimations), non-RNVC factors are important and accounted for as well.

Compiling a single, tractable model covering every fishery that is active within the study area would not be feasible. Furthermore, many fisheries simply do not coincide with proposed WEAs, especially given that WEAs were designed to avoid known high-value fishing areas. To better focus models, and to accommodate fishery-specific constraints, subsets of permits are modeled independently.

Four clusters of commercial fishermen (groupings of permits or trips that share common characteristics and are relatively highly exposed to proposed WEAs) constitute nearly 82.5 percent of all exposed revenue across the study area. These commercial fishermen clusters are described in the following subsections. The modeling methodology used to estimate the potential impact of WEA development on commercial fisheries is then outlined. Specific model results are presented in Appendix II.

I.iii.i.i Cluster 1: Pot and Gillnet Fisheries in Rhode Island and South Coast of Massachusetts

Owing mainly to the size of the MA and RI−MA WEAs, fishing vessels from ports in Rhode Island to the south coast of Massachusetts, including New Bedford, Westport, and other smaller ports in the vicinity, use the WEAs for fishing. This subgroup is defined as Cluster 1 in this report.

Between these ports, a relatively larger share of the exposure falls on gillnetters and pot fishermen. In addition to Westport, MA; Fairhaven, MA; and Little Compton, RI, gillnetters and pot fishermen in Narragansett, RI (4.7 percent/3 percent); Newport, RI (26.7 percent/1.1 percent); Tiverton, RI (8.4 percent/.5 percent); and New Bedford (21.2 percent/3.5 percent) are relatively highly exposed. Perfect geographic boundaries for this grouping do not exist—Cape Cod based gillnetters in Harwich Port, MA (15 percent) and Chatham, MA (2.2 percent) are exposed as well and are included in the cluster.

Even within the cluster, some species are more exposed than others. For instance, despite being the largest single source of revenue, lobster has considerably lower exposure than the second-largest source of revenue, monkfish (also known as angler fish or goosefish). Skates are also affected within this grouping, as shown in Table I-vii, which shows species-level aggregated exposure by total exposure for the top species landed within the proposed WEAs. Appendix III.i contains a complete list of all species caught within WEAs.

Table I-vii. Revenue for top species landed by pot and gillnet fishermen—RI and South Coast of MA.

Species	Total Revenue 2007–2012	Revenue from Within a WEA
Lobster	$81,000,036	$2,428,728
Monkfish	$23,868,202	$4,340,915
Jonah Crab	$22,900,493	$421,510
Skates	$10,643,033	$1,491,038
Red Crab	ND	ND
Cod	$6,298,724	$115,071

Note: Dollar values are in $US 2012. ND = suppressed for confidentiality.

A total of 218 unique permits have landed in one of this group's ports with gillnet, pot, or lobster pot gear more than twice per year from 2007–2012. These 218 permits average 4.6 percent exposure each and account for 11.8 percent of all exposed landing the study area. Of these permits, 148 are considered "day" boats (most trips begin and end on the same day) while 69 are considered "long" boats (most trips span more than one day). Three permits landed less than $2,000 per year and are not included here. For day boats, the median percent of revenue sourced from a WEA was 2.5 percent and the maximum was 60 percent. For long boats, median exposure was 1.4 percent and maximum was 50 percent.

A total of 181 unique dealers have purchased at least $10,000 in landings from these 218 permits. Of these dealers, 42 purchased over $1 million in landings between 2007 and 2012. Three dealers have more than 15 percent of their total purchases sourced from within WEAs, and fished by gillnet, pot, and lobster pot fishermen in affected ports; the greatest proportion was 28 percent of revenue from fishing activity exposed to wind development (Figure I-v).

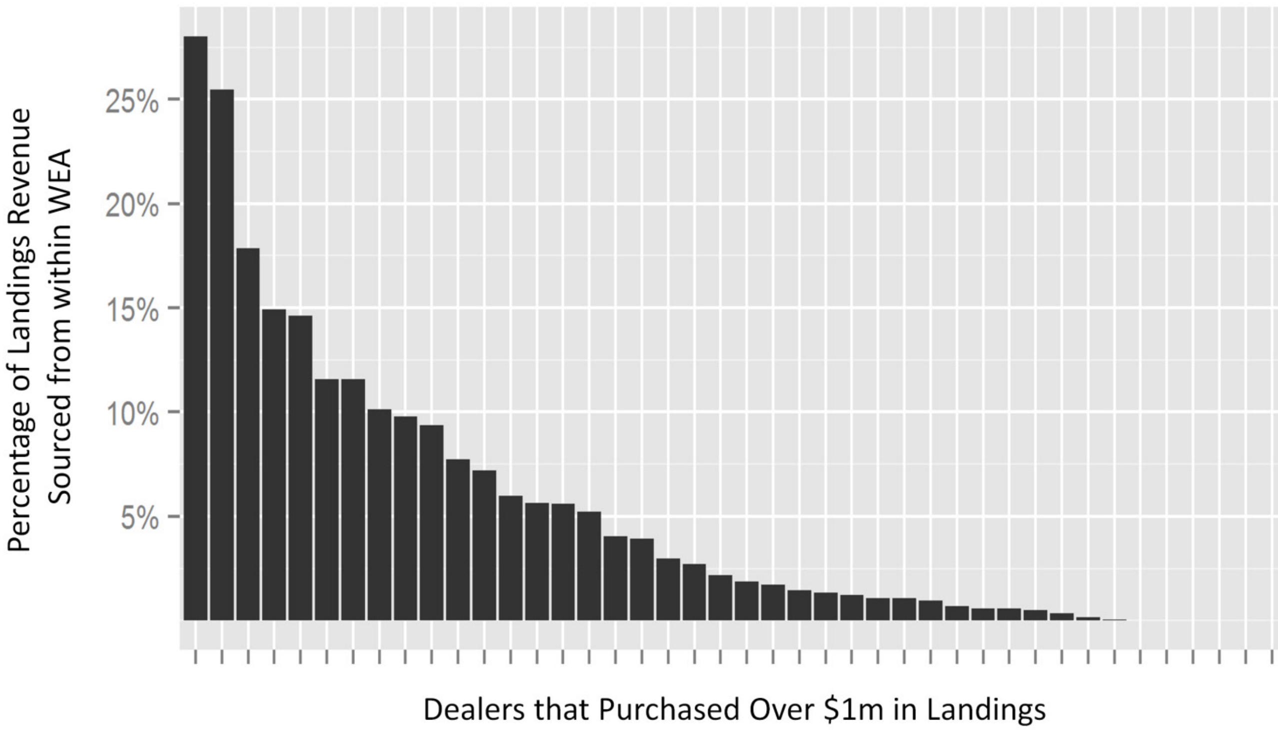


Figure I-v. Exposure for dealers purchasing more than $1 million from Cluster 1.

I.iii.i.ii Cluster 2: Scallop Harvesters in New Jersey, New York, and Connecticut

Due to the high value of scallop landings, many ports show high revenues sourced from within a WEA, but in many cases, these revenues are less than 1 percent of total species revenue. Cape May, NJ (1.2 percent); Point Pleasant, NJ (3.4 percent); Point Lookout, NY (10.1 percent); Freeport, NY (16.9 percent); New London, CT (3.2 percent); and Stonington, CT (1.4 percent), all located along the Mid-Atlantic bight from New Jersey to the Rhode Island–Connecticut border, exhibit high exposure within their scallop fisheries both from dredge and bottom trawl vessels. Other ports with relatively highly exposed scallop fisheries that were not included here are Narragansett, RI ($393,356, 2.4 percent) and Newport News, VA ($3.1 million, 1.5 percent). This subgroup is referred to as Cluster 2.

A total of 465 unique permits have landed sea scallops in one of this group's ports more than twice per year from 2007 to 2012. Total revenue from these 465 permits is nearly $2.0 billion, of which 1.4 percent ($27.8 million) was sourced from within a WEA. These 465 vessels account for 33 percent of all exposed revenue in the study area. Of these vessels, 52 are considered day boats while 413 are considered long boats. For day boats, the median percent of revenue sourced from a WEA was 0.3 percent with a maximum of 8.7 percent; long boats' median exposure was 0.8 percent with a maximum of 30.1 percent. The majority of these vessels source little of their landings from within a WEA. For exposed long vessels, however, the top percentiles are heavily exposed.

Figure I-vi shows the cumulative exposure for the 465 vessels previously discussed. A difference between day and long vessels is evident in the curve—vessels that predominantly take longer trips tend to be more exposed (the dashed line is to the right of the solid line). No day vessel exceeds 9 percent exposure, but the top 5 percent of long vessels exceed 15 percent exposure. Commensurate with the distance from port to the closest WEAs, longer trip vessels appear to be more exposed.

A total of 294 unique dealers have purchased at least $10,000 in landings from these 465 vessels. Of these 294 dealers, 85 have purchased over $1 million in landings during the study period. Of these 85 dealers, two have more than 15 percent of total scallop purchases in affected ports exposed, and the maximum exposure is 23 percent (Figure I-vii).

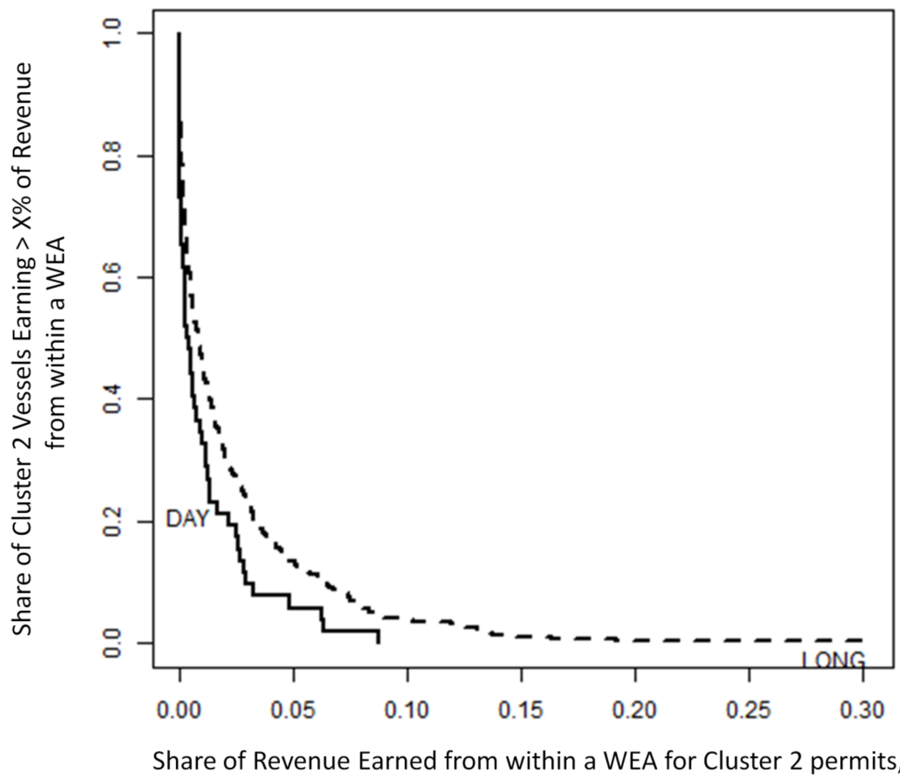


Figure I-vi. Cumulative exposure by trip length for the 465 permits in Cluster 2.

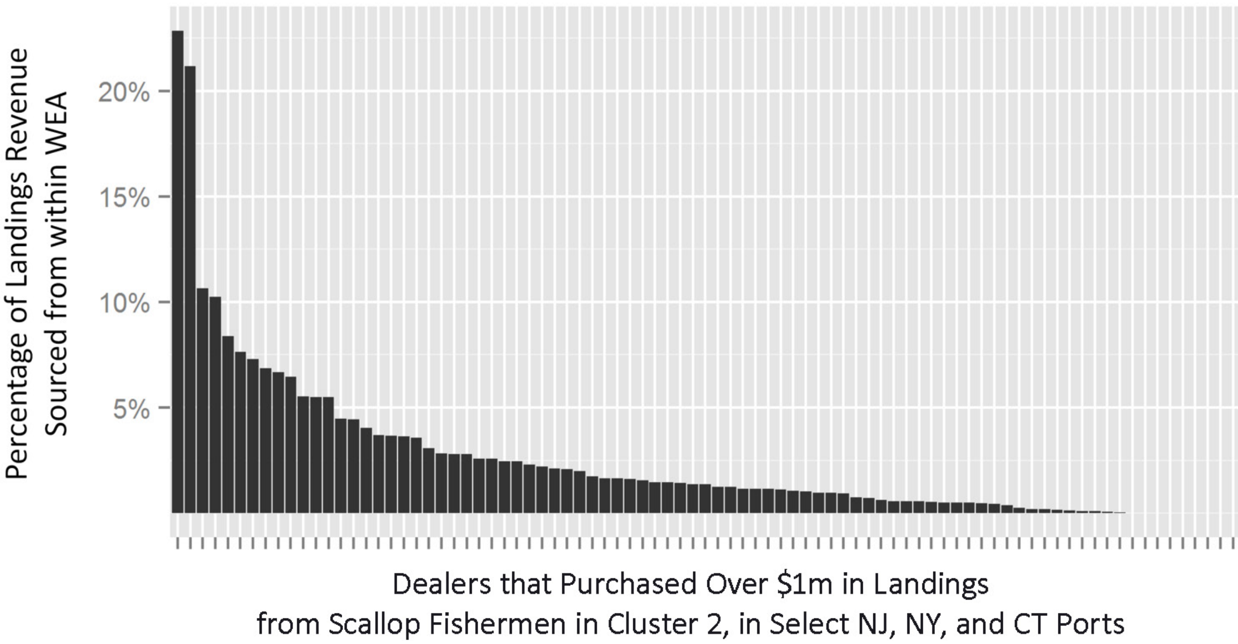


Figure I-vii. Exposure for dealers purchasing greater than $1 million from Cluster 2.

Modeling 465 permits is computationally difficult and the scallop fishery has regulatory limits that highly influence fishing choices. Furthermore, many permits land scallops only occasionally; this sweeps many non-scallop-targeting vessels into the scallop cluster and decreases the exposed share of revenue.

Therefore, permits were narrowed to those (1) greater than 1 percent "exposed" and (2) landing more than 40 percent of total permit revenue as sea scallops. A total of 211 permits remained in the cluster. About $13.3 million in revenue from these 211 permits was reported in the VMS/VTR process. Table I-viii compares the original Cluster 2, which consisted of the entire trip history of any permit landing sea scallops more than twice in select Mid-Atlantic ports, and the group of trips modeled here.

Table I-viii. Refining the scallop cluster (Cluster 2).

Description	Original	Refined
Metric	All Landings from All Permits Landing Sea Scallops More than Twice in NY, NJ or CT	All Landings from All Permits Sourcing > 40 Percent of Landings Revenue in Sea Scallops and Greater than 1 Percent of All Revenue Sourced from a WEA
Unique Permits	465	211
Unique Trips	79,271	25,769
Total Revenue	$1,995 Million	$463.448 Million
Exposed Revenue	$27.821 Million	$13.286 Million
Percent of Revenue Exposed	1.39%	2.87%
Share of Total Exposed Revenue Represented (of $84.2 Million)	33.0%	15.8%

Note: Dollar values are in $US 2012.

Of the 25,769 trips in the refined Cluster 2 dataset, 23,044 were identified as *General Category* trips (GC). These trips contain landings by vessels holding a general category permit and are subject to a possession limit of 600 pounds meat weight of scallops (or 750 pounds under certain observer-based conditions). The remaining 2,725 were designated as *Limited Access DAS* trips (LA). These are trips that either (1) had a matched VMS activity declaration code that indicated a DAS trip or (2) landed over 750 pounds meat weight of scallops. Because there is no possession limit when fishing on a DAS, but DAS allocation is limited, mixing the two datasets would result in highly flawed estimates of "next best" alternatives—DAS trip landings would appear to be highly profitable alternatives to a general category, despite the inability of the fisherman to choose to fish on a DAS. Scallop trips to any of the rotational access areas were omitted from the dataset—there are no proposed WEAs in scallop rotational areas, and a vessel fishing on a DAS or in the general category does not have the option of changing that trip to a rotational access area as the number of trips to a rotational area is limited and strictly controlled. In short, a scallop fisherman's choice set is strongly determined by their permit and DAS allocation, and switching between types of trips is not possible. There were 152 unique permits identified in the LA fishery, 162 unique permits were identified in the GC fishery, and 103 permits appear in both GC and LA datasets, though each trip may only appear in only one dataset.

I.iii.i.iii Cluster 3: Surfclam and Ocean Quahog Fishermen in Select NJ, MA, and RI Ports

Volume I, Section 6.2.2, lists surfclam and ocean quahog harvests as being the second-highest exposed in average annual revenue (behind only sea scallops), and has the highest exposure as a percentage of revenue (6.6 percent). Vessels landing in Atlantic City, NJ have the most exposed surfclam and ocean quahog revenue ($18.1 million, 12.1 percent of all surfclam and ocean quahog revenue). New Bedford, MA ($5.8 million, 5.6 percent of all Cluster 3 exposed revenue) also accounts for a significant amount of exposed surfclam revenue. The southern New England area also has two ports with a total of over $2 million in exposed revenue. Due to confidentiality requirements, neither of these additional two ports may be disclosed, but landings are included in the following analysis. This subgroup is defined as Cluster 3.

A total of 44 permits have landed surfclam or ocean quahogs in one or more of the previously listed ports more than twice per year from 2007 to 2012. These 44 permits have an average exposure of 7.4 percent and account for 29.9 percent of all exposed revenues in the study area. Of these permits, none are considered day boats—the majority of trips on a vessel-by-vessel basis are two to three days in length. Using an adjusted cutoff for day boats at *two days*, 26 permits are considered day boats and 18 are long boats. The median exposure percentage for day boats is 8.0 percent with a maximum of 70.2 percent. For long boats, the median exposure is 1.1 percent, but the maximum is 13.5 percent.

Figure I-viii shows the cumulative plot of exposure by day and long boats. Most day boats are moderately exposed (e.g., 70 percent are exposed at levels of less than 10 percent), with a few having extremely high exposure percentages (e.g., less than 10 percent are exposed at levels between 30 and 70 percent). Similarly, most of the long boats are only minimally exposed (less than 5 percent) few are even moderately exposed, however, the highest exposure level for long boats is only 13.5 percent.

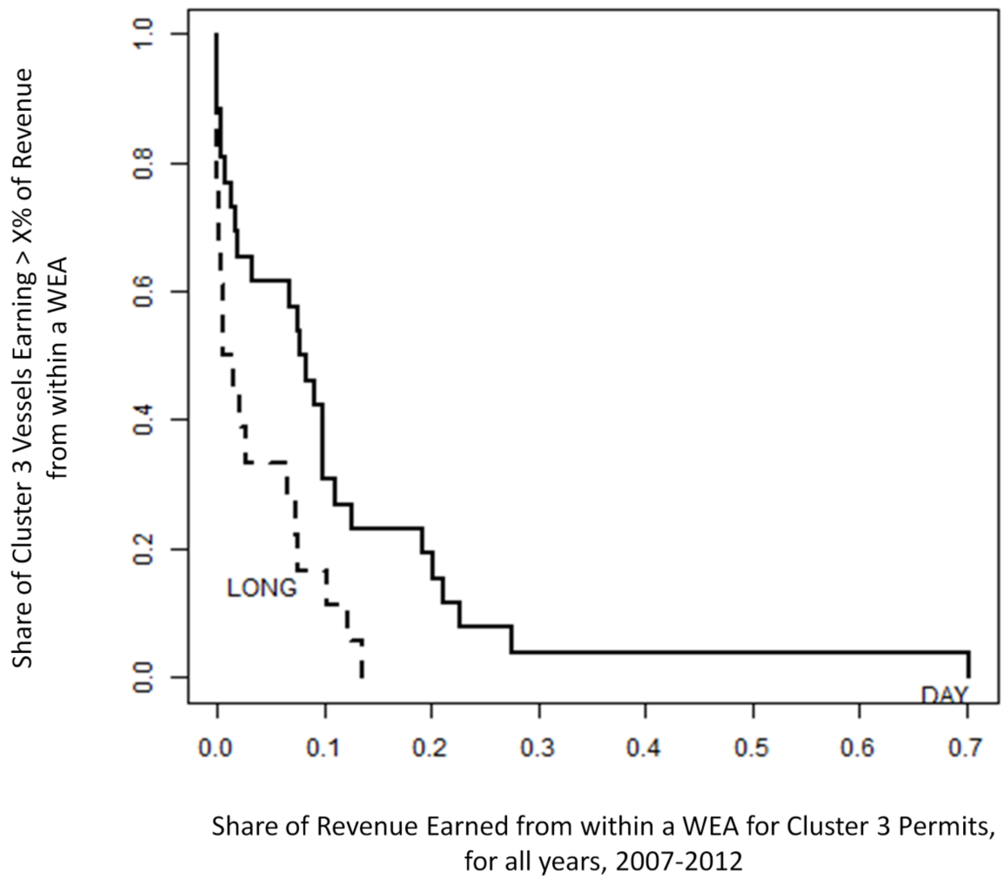


Figure I-viii. Cumulative exposure by trip length for the 44 permits in Cluster 3.

A total of 14 unique dealers have purchased at least $10,000 in landings from these 44 vessels. Six dealers purchased over $1 million in landings during 2007 to 2012. Two dealers had 15 to 18 percent of total clam purchases in the affected ports exposed (Figure I-ix).

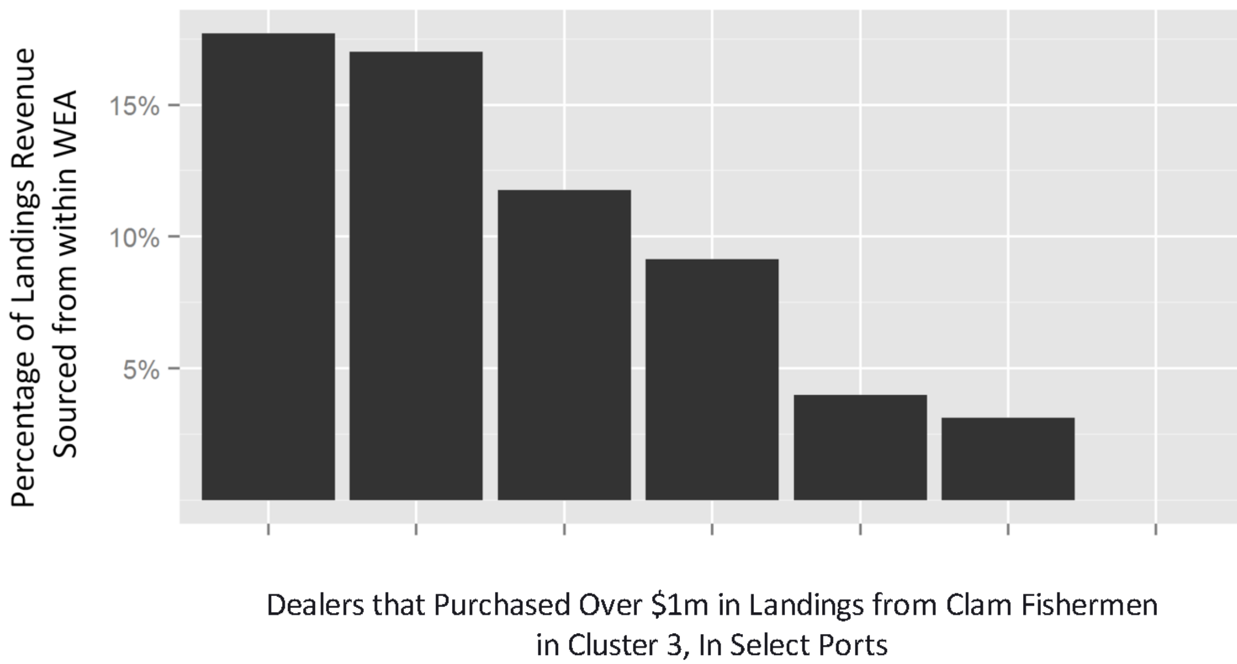


Figure I-ix. Exposure for dealers purchasing greater than $1 million from Cluster 3.

I.iii.i.iv Cluster 4: Oregon Inlet Ports in North Carolina

The southern portion of the sizable North Carolina WEA (circa 2013) is sited due east of the Oregon Inlet. The inlet is a highly dynamic passage through the Outer Banks that is subject to extreme variation in current and sedimentation. In addition to being potentially highly exposed to the southern portion of the NC WEA, multiple ports rely on passage through the Oregon Inlet. Therefore, it is prudent to examine the exposure of the following ports located in Dare or nearby Hyde County: Wanchese, NC; Engel, NC; Nags Head, NC; and "Dare County, NC." The final port on this list is the designation for all Dare County landings data from Southeast logbook data (NMFS Southeast Regional Office n.d.), as this dataset does not designate the individual port names. It is likely that the majority of Southeast Logbook data listing landing as "Dare County" are actually landed in Wanchese or Nags Head. Combining specific ports with the county-level equivalent reconciles the data. Although landings exist in the Southeast logbook dataset for Hyde County, the majority of ports in Hyde County are likely accessed via other, more reliable inlets.

Overall exposure by port (or county) is as follows: Wanchese, NC (4.8 percent, $1.29 million exposed), Engelhard, NC (4.4 percent, $608,000 exposed); Nags Head, NC (34.7 percent, $13,000 exposed); Dare County, NC (5.3 percent, $714,000 exposed). In these ports, the most commonly landed FMPs (from federally reported data) are "None" ($24.8 million, primarily Atlantic croaker, tilefish, king mackerel, shrimp, and Spanish mackerel); summer flounder, scup, and black sea bass species; bluefish; highly migratory species FMP; and mackerel, squid, and butterfish species. This subgroup is referred to as Cluster 4.

Gears used by Oregon Inlet–dependent ports are primarily bottom trawl, gillnet, longline, and midwater trawl (Table I-ix).

Table I-ix. Gears used by Oregon Inlet–dependent ports.

Gear	Total Revenue (2007–2012)	Revenue from Within a WEA
Bottom Trawl	$21,614,160	$1,027,772
Gillnet	$9,138,072	$343,342
Longline	$3,877,424	$76,422
Midwater Trawl	$3,406,973	$469,461
Hand (Includes Bandit Reel)	$1,801,574	$72,479

Note: Dollar values are in $US 2012.

A total of 166 permits have landed in one or more of the previously listed ports more than twice per year from 2007 to 2012. These 166 vessels average 2.53 percent exposure and account for 5.70 percent of all exposed revenue in the study area. Of these vessels, 107 are considered day boats and 59 are considered long boats. The median exposure for day boats is 5.0 percent, with a maximum of 33.4 percent. For long boats, the median is 1.8 percent and the maximum is 28.8 percent.

Figure I-x shows the cumulative exposure by trip length. Day boats are more likely to have higher exposure—for instance, the top 20 percent of them are exposed at around 20 percent or higher while the top 20 percent of long boats are exposed only at around 8 percent or higher. The northern North Carolina WEA, located near the Oregon Inlet, covers much of the range feasible for a day vessel.

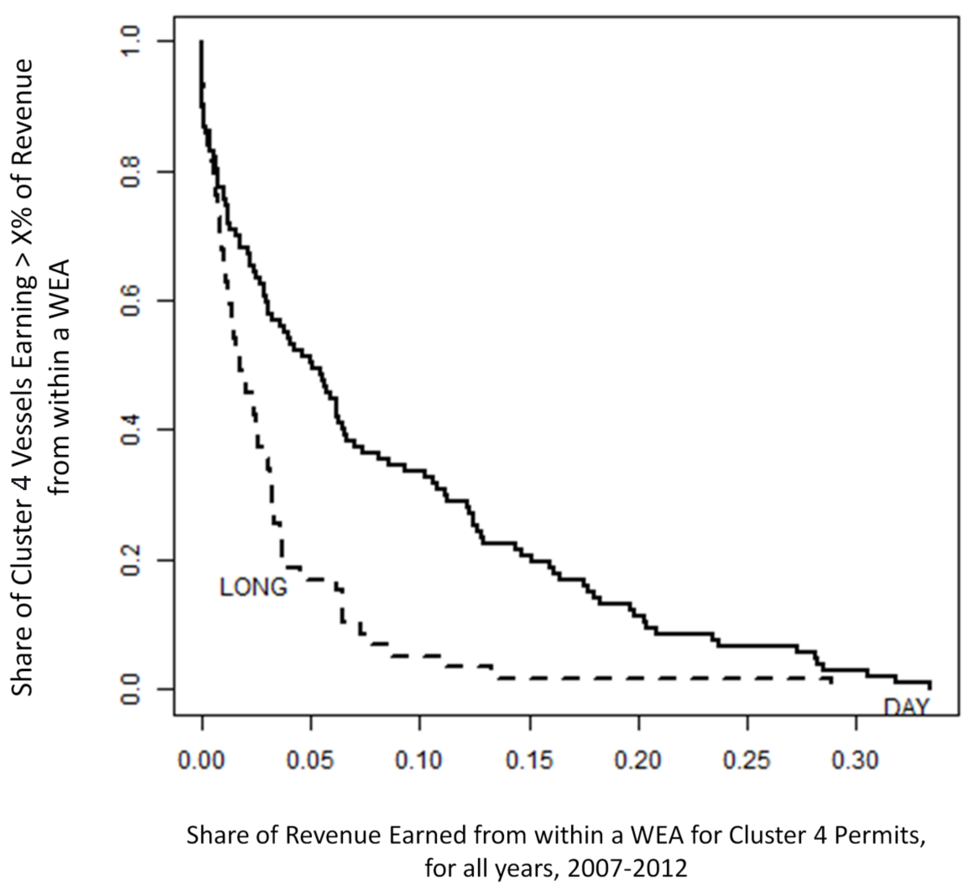


Figure I-x. Cumulative exposure by trip length for the 166 permits in Cluster 4.

Southeast logbook data used in this study do not include a reference to the dealer purchasing the landing. The following data exclude landings listed as "Dare County, NC." A total of 14 unique dealers have purchased at least $10,000 in landings from these 166 vessels. Of these 14 dealers, six have purchased over $1 million in landings during the study period. Of these six dealers, none have more than 15 percent of purchases from Cluster 4 exposed, with a maximum exposure of 6.5 percent (Figure I-xi).

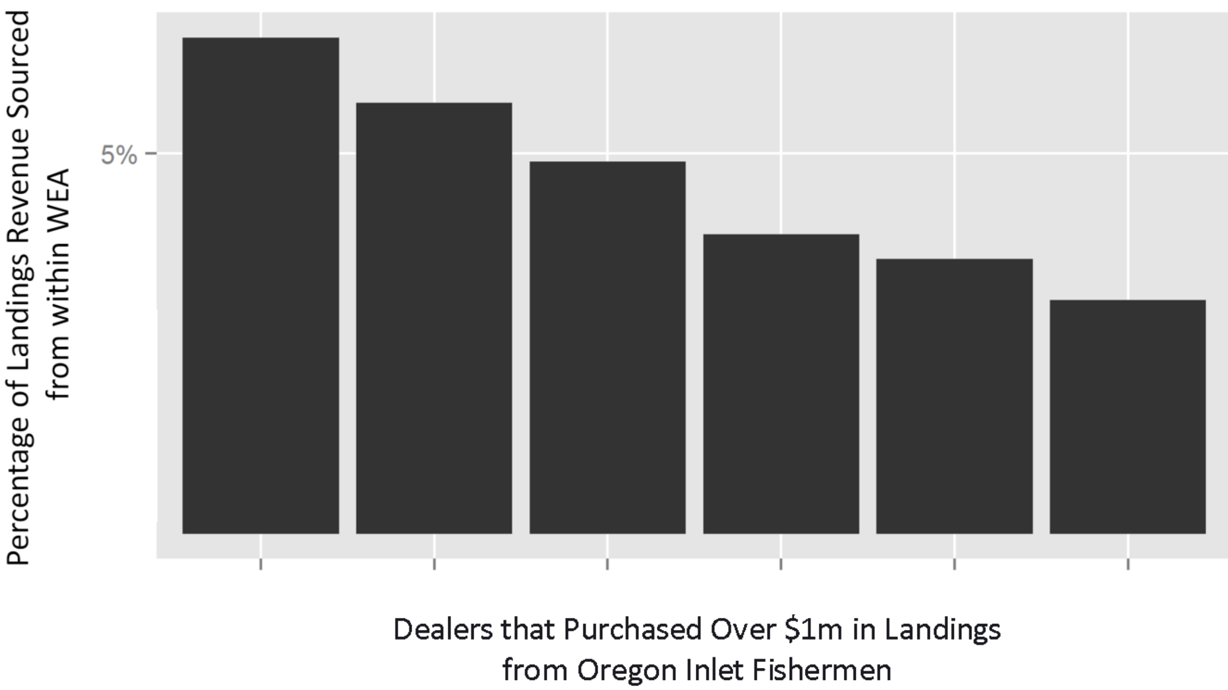


Figure I-xi. Exposure for dealers purchasing greater than $1 million from Cluster 4.

I.iii.ii Defining Locations

A location choice model requires discrete categorization of fishing locations—all trips must be allocated to one and only one location of fishing. Traditionally, a grid of equal-sized cells is overlaid on the extent of fishing and locations are categorized accordingly. However, the rectangular grid does not necessarily represent different fishing choices—in reality, fishing occurs on features, contours, and geomorphologically determined bottom substrates. Furthermore, the WEAs studied here do not neatly fall into a perfect grid.

Following Branch et al. (2005), agglomerative hierarchical clustering is employed to generate an irregular "grid" designed to organize around clusters of fishing effort. The process is performed in the following steps:

All VMS data in the dataset are mapped to the corresponding latitude and longitude. To identify fishing areas, a probabilistic model (Records and Demarest 2013) is applied to identify those VMS pings most likely to be fishing activity. Setting a threshold of probability of fishing at 75 percent eliminates points that are likely to be in-transit pings.

- WEAs will be defined as their own zone, regardless of the clustering process. Therefore, all points that fall within a WEA are removed from the grid creation process.

- A distance matrix is calculated for all points. Due to computational restrictions, if more than 30,000 points are mapped, a random sample of 30,000 is taken.

- Using the distance matrix as a dissimilarity matrix, a "cut" is made equal to the number of desired non-WEA clusters. This "cuts" each point into a group based on proximity. Number of cuts is determined by the number of observations in each zone required to estimate catch. Sparsely populated zones were combined with nearby zones.

- Voronoi polygons are generated around each point, creating an irregular grid of fishing zones.

- The WEAs are then intersected over the grid, generating a spatial map that covers every point in the dataset. This grid map is then used to classify every trip to one and only one zone.

A separate grid is generated for each fishery modeled. Grid regions are identified by zone number, generally starting in the northeast corner and moving southwest in numbering the non-WEA zones, then numbering WEA zones from the southwest back to the northeast.

Fishing occurs over an area, not a point, and thus requires some projection from area to point. For allocating a given trip to a zone, the centroid of fishing is calculated for each trip's VMS pings. These are weighted by the probability that each ping is a fishing ping, and the centroid is the probability-weighted centroid that represents those VMS pings. When VMS data are not available, the logbook-reported latitude and longitude is used under the assumption that this point represents the centroid of fishing on that trip. Trips are given equal weight, regardless of revenue, for calculation of a centroid.

I.iii.iii Estimating Revenue

A fisherman's utility is assumed to be a function of the net revenue that can be generated from an area, which necessitates the estimation of revenue an individual generates from trips within each zone they fish. All of a trip's revenue is assumed to have been generated solely from whatever zone that trip was attributed to. Revenue is estimated for each trip and zone using observed data on landings, vessel characteristics, time, and location. Estimation of choice probabilities requires estimated revenue for *every* zone.

Revenues are estimated using a generalized linear model (GLM). The response variable, revenue, is assumed to follow a gamma distribution with a log link function. This is akin to estimating revenue as a log-transformed response variable, and restricts the model to non-negative results. All zero revenue trips were dropped from the data under the assumption that these trips were breakdowns or lost/damaged gear. GLM addresses the bias associated with anti-log transformation of the response variable which can be common in the face of heteroskedasticity. See Das (2014) for a discussion in the context of fishery economic data.

The exact specification of the revenue model is different for each fishery modeled. In all cases, revenue is modeled as a multi-way fixed effects regression with permit, time, and zone fixed effects. In some cases, zone-gear interactions are used as well. Time away is included in all specifications to control for trip length, which varies widely. Quadratic terms on time are included in some specifications. Month, quarter, year, or season effects are included for some specifications. Time periods (i.e., month versus quarter) were determined on the finest basis supported by the sample. In some fisheries, visits to certain zones were so sparse that a monthly estimate was not feasible and quarterly aggregations were created. The source of the spatial data for the trip (VMS versus VTR/logbook) was also included in three of the four fisheries modeled. The method for reporting the length of the trip varies between the two sources, and vessels with VMS requirements are more likely to participate in higher-valued fisheries. Including a dummy variable for source absorbs the mean effect of these two possible explanations.

For each fishery modeled, the AIC (Akaike information criterion) and log likelihood values were used to identify best fit. Vessel characteristics are constant within permits, and thus were absorbed into permit-level fixed effects. Ex-vessel prices for targeted species were not included; month-year or quarter-year fixed effects are sufficient to capture exogenous shifts in prices that may result from changes in consumer demand or the global market, and are not explained or determined by the actions of the fishery studied.

Revenues for each trip and for each zone, including the zone chosen and observed, are estimated with this process. For zones not visited, trip characteristics are assumed to be held constant including time at sea. Although time at sea may change with different zone choices (i.e., some zones are further away), all increases are allocated to increased steaming time and thus increased cost. It is assumed that time spent fishing, even when unknown, remains constant over zone choices.

I.iii.iv Estimating and Predicting Costs, and Calculating RNVC

Costs are modeled in a manner similar to revenues. Total trip cost is calculated from observer-reported variable costs including fuel, ice, bait, and an average measure of gear damage or loss. Because crew payments are structured in a variety of ways (share of landings, daily rate, or some other arrangement), total trip cost, and thus estimated cost, does not include payments to crew. Furthermore, the cost dataset does not include fixed costs such as vessel purchase (or loan payment), berthing fees, safety equipment, taxes (except those reported with variable purchases such as gasoline excise tax), or opportunity costs. Because these costs are not variable, they are netted out in calculating changes in RNVC.

To identify trips with outlying costs, trip cost per hour at sea is calculated and the top 5 percent (trip cost of over $135 per hour) is excluded from estimation yielding 21,455 records. Summary statistics on these records along with the covariates used in estimation are shown in Table I-x.

Table I-x. Summary statistics for the trip cost model.

Statistic	N	Mean	St. Dev.	Min	Max
Total Variable Trip Cost	21,269	$3,477.33	$6,364.53	$12.35	$49,779.48
Trip Duration (Hours)	21,269	51.02	73.25	0.63	430.50
Mean Fuel Price ($/Gallon)	21,269	$3.11	$0.67	$2.10	$5.31
Length (Feet)	21,269	54.67	17.12	25.00	146.30
Gross Tonnage (Tons)	21,269	61.37	55.66	2.00	476.00
Distance (Port to Centroid of Fishing—km)	21,269	86.92	99.31	0.79	964.98
Tons per Foot (Calculated)	21,269	0.95	0.61	0.06	4.71

Note: Dollar values are in $US 2012.

Trip cost is modeled using a GLM where the response variable, total trip cost, is assumed to follow a gamma distribution with a log link function (see Das 2014). For the purposes of estimating trip cost over a variety of fishing zones, it is necessary to include both distance and time in the model. A number of specifications were estimated and evaluated to minimize AIC. The final specification is shown here, with results following in Table I-xi.

$$\ln(Trip\ Cost) = \beta_0 + \beta_1\ Trip\ Duration + \beta_2\ Trip\ Duration^2 + \beta_3\ Trip\ Duration^3 + \beta_4\ Distance + \beta_5\ Mean\ Fuel\ Price + \beta_6\ Length + \beta_7\ Gross\ Tonnage + \beta_8\ Gear + \beta_9\ Gear \times Tons\ per\ Foot + \beta_{10}\ Distance \times Gross\ Tonnage$$

Table I-xi. Cost estimation parameters (with dredge as the reference gear group).

Variable	Parameter
Trip Duration	0.05**
	(0.0005)
Trip Duration^2	-0.0002**
	(0.0000)
Trip Duration^3	0.0000003**
	(0.00)
Distance (Port to Centroid of Fishing)	0.004**
	(0.0001)
Mean Fuel Price	0.20**
	(0.01)
Gross Tons per Foot	-0.01
	(0.05)
Gillnet	-0.22**
	(0.03)
Hand	-0.60**
	(0.15)
Longline	0.40**
	(0.06)
Other	1.24**
	(0.14)
Pot	0.42**
	(0.14)
Bottom Trawl	0.01
	(0.03)
Midwater Trawl	0.49*
	(0.22)
Length	0.01**
	(0.001)
Gross Tonnage	0.01**
	(0.001)
Tons per Foot x GILLNET	-0.06
	(0.04)
Tons per Foot x HAND	0.22
	(0.30)
Tons per Foot x LONGLINE	-0.08
	(0.11)
Tons per Foot x OTHER	-0.62**
	(0.07)
Tons per Foot x POT	-0.36*
	(0.11)
Tons per Foot x TRAWL BOTTOM	-0.01

Variable	Parameter
	(0.02)
Tons per Foot x TRAWL MID	-0.20**
	(0.07)
Distance x Gross Tonnage	-0.000025**
	(0.0000)
Constant	4.04**
	(0.05)
Observations	21,269
Log Likelihood	-153,840.20
Akaike Inf. Crit.	307,728.50

Note: *p<0.05; **p<0.01.

Although time and distance are correlated ($\rho = 0.78$), they are estimated separately in the model. When modeling for predictions, multi-colinearity does not pose the same issues as modeling for causal inference primarily because multi-colinearity inflates errors but does not bias coefficients (Wooldridge 2013).

Location choice models require both revenue and cost for each possible fishing zone chosen on each choice occasion (trip). Variability in costs between zones chosen occurs through two main conduits: time and distance. A trip that is extended by 100 km will also be extended in time by the amount necessary to transit that distance round trip. Fishing time is not directly reported in the data, so transit time cannot be calculated directly. However, for every trip, the total time at sea is known. From this, a new total time at sea for another zone can be calculated by adding the time necessary to transit the additional distance. For example, if an alternate fishing zone is 100 km further than the observed zone, the distance (measured as the distance from the port to the centroid of that zone's fishing activity) would increase by 100. Separately, time would increase by the duration of steaming necessary to cover 100 km each way. Assuming a mean steam speed of 9 knots (around 16.6 km/h), trip duration would increase by 12.04 hours. Once the quadratic terms for duration are calculated, the new data can be used to predict trip cost for all alternatives available to each fisherman.

Observed vessel trips tend to remain relatively near the port of departure. Therefore, when predicting trip costs for fishing zone choices that leave from one geographic extreme and fish at the other extreme (e.g., a NC-based vessel assessing a zone choice in the Gulf of Maine), the upper range of potential trip costs becomes extreme. Predicted costs may seem unreasonable, sometimes in the hundreds of thousands of dollars or more.

Using an alternative's distance to estimate trip costs gives rise to the question of the hypothetical fishing location to which distance is calculated. Following Mistiaen and Strand (2000), for each fishery modeled and for each zone, a centroid of fishing was calculated from all trips in the data. This provides a single point that represents the expected location of fishing for each zone.

RNVC is the difference between estimated revenues and estimated costs. Calculating a given trip's expected RNVC involves weighting each zone's RNVC by the probabilities of fishing in each zone. While RNVC is a primary driver of zone choice, it is not the only determinant. Weighting each potential location's RNVC by its probability of fishing in that discrete location is akin to integrating over the probability distribution in a continuous case to calculate an expected value. Expected RNVC is used to calculate changes in RNVC over various scenarios. Non-weighted RNVC is used only to estimate the location choice model where RNVC for each possible zone choice is necessary.

Appendix II. Estimation Results

This appendix presents the results of the models underpinning the impact assessment, as described in Appendix I, Section I.iii.

II.i Cluster 1

Cluster 1 is composed of pot and gillnet fishermen in Rhode Island from the South Coast of Massachusetts. See Appendix I.iii for a more thorough overview of Cluster 1. The 218 permits of Cluster 1 source an average of 4.6 percent of their revenue from within a proposed WEA, primarily the MA and RI–MA WEAs. These 218 permits took a total of 62,059 trips. Two permits took the minimum number of trips in the dataset (8) during the study period, while one permit recorded the maximum 1,193 trips total, an average of nearly 200 per year over the 6 study years.

To avoid misreported data, a number of outliers were identified and removed. Revenue per hour was calculated for each trip to identify records with outsized revenue or misreported time at sea. The top one percent of all trip revenue, in which revenue earned exceeded $1,143 per hour, was dropped. This process did not remove a disproportionate number of trips from any single permit, indicating that the top one percent of trips are most likely misreports or recording errors, rather than systematic differences in permit fishing performance. Of the 621 dropped records, 24 (3.8 percent) were trips to a proposed WEA, even though WEA trips represent 6.2 percent of all trips. Zero-revenue trips were also dropped from the dataset.

Three patches of ocean contained less than 100 visits. These trips were removed from the model as well, bringing the total number of trips to 60,856. One vessel was identified as a hagfish-targeting vessel and was removed from the dataset due to the specialized nature of the hagfish fishery. Of the 3,822 trips taken to a proposed WEA, 3,785 trips remain in the dataset, with 37 trips dropped. Summary statistics on the 60,856 trips ultimately modeled are shown in Table II-i and Table II-ii.

Table II-i. Summary statistics for Cluster 1.

Variable	N	Mean	St. Dev.	Min	Max
Revenue	60,856	$3,146.80	$6,216.51	$1.15	$128,966
Time (Hours)	60,856	19.54	31.12	0.17	378
Revenue per Hour	60,856	$177.21	$152.32	$0.09	$1,142
Length (Feet)	60,856	42.14	9.80	22	94
Gross Tons	60,856	25.76	25.22	1	199
Tons per Foot	60,856	0.55	0.32	0.02	2.23
Average Fuel Price	60,856	$3.37	$0.65	$1.83	$5.36

Note: Dollar values are in $US 2012.

Table II-ii. Summary revenue/zone statistics for Cluster 1.

Zone	Trips	Zone Share	Share—Gillnet	Share—Pot	Avg. Revenue per Hour—Gillnet	Avg. Revenue per Hour—Pot	Avg. Revenue per Trip—Gillnet	Avg. Revenue per Trip—Pot
2	242	0.398%	34.7%	65.3%	$87.03	$120.89	$9,679.72	$13,456.47
3	159	0.261%	79.9%	20.1%	$158.66	$162.56	$8,151.20	$29,522.94
4	709	1.17%	0.141%	99.9%	$4.87	$200.51	$308.19	$30,014.58
5	314	0.516%	0.637%	99.4%	$310.47	$182.73	$3,398.75	$21,397.24
6	10793	17.7%	79.2%	20.8%	$314.13	$112.01	$2,410.89	$3,103.24
7	9878	16.2%	96.4%	3.61%	$238.40	$134.32	$1,861.11	$4,283.06
8	34098	56%	33.9%	66.1%	$178.02	$107.82	$2,493.73	$2,794.82
9	748	1.23%	26.5%	73.5%	$190.37	$188.25	$3,346.75	$12,929.49
12	130	0.214%	61.5%	38.5%	$271.90	$277.70	$2,602.82	$57,279.85
17	2792	4.59%	57.8%	42.2%	$212.81	$83.56	$2,672.30	$1,173.47
18	993	1.63%	72.8%	27.2%	$193.87	$118.52	$3,525.04	$3,404.02

Note: Dollar values are in $US 2012.

Figure II-i shows the grids used in modeling Cluster 1 as well as the fishing centroids used to calculate distance. Revenue intensity is also shown for the trips modeled. Grid areas without labeled centroids had less than 100 trips in the set and were dropped. The ports used to define Cluster 1 are labeled. In addition, ports used by permits in Cluster 1, but not used in defining Cluster 1, are indicated but are not labeled.

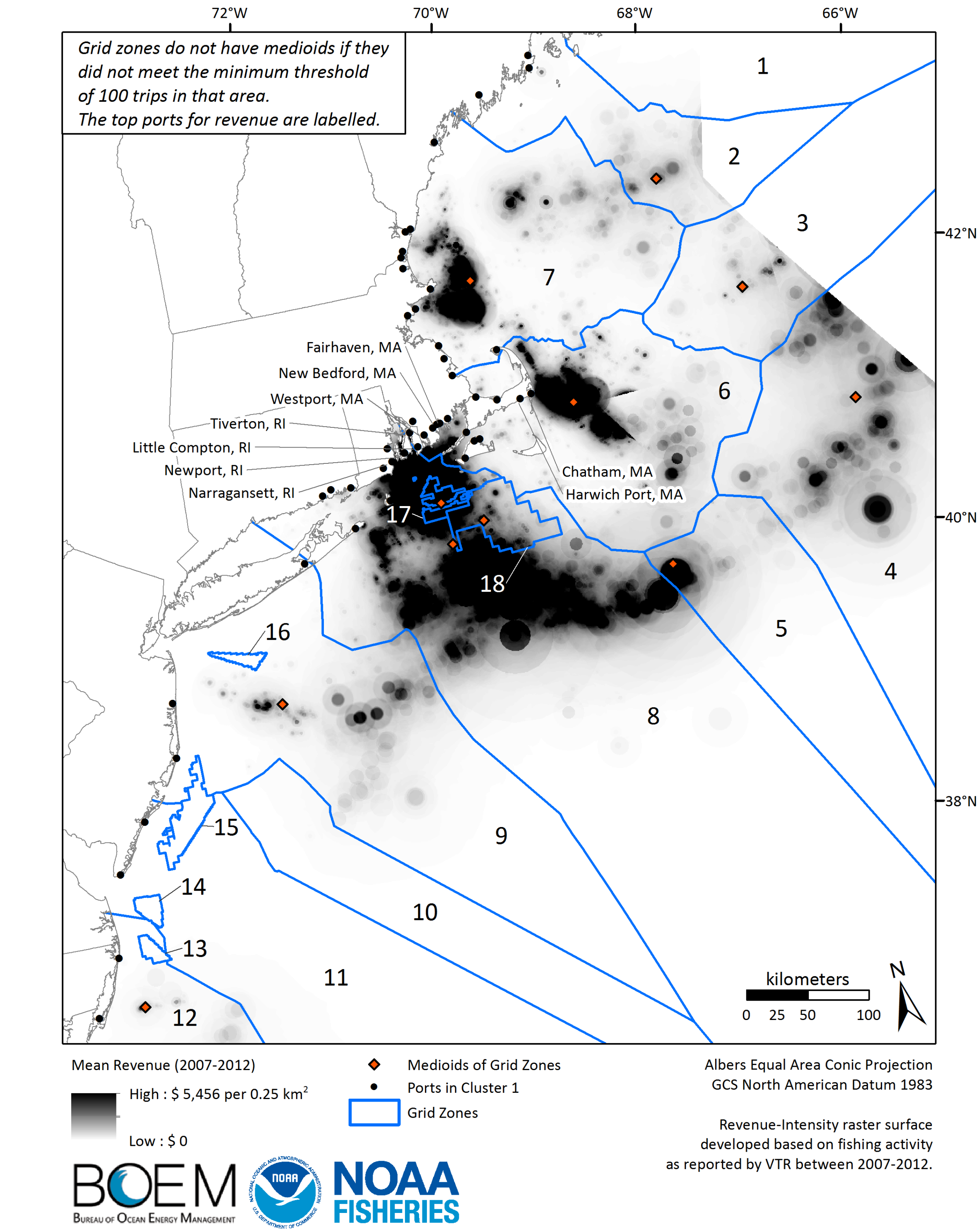


Figure II-i. Cluster 1 grid, centroids, ports and revenue intensity.

II.i.i Revenue Estimates

Revenue for each trip and each zone is generated using the fixed effects model established in Appendix I.iii. For Cluster 1, the specification is as follows (trip subscripts are suppressed for compactness):

$$\begin{aligned}\ln(Revenue)_{qyzgpt} &= \beta_0 + \beta_1\, Quarter + \beta_2\, Year + \beta_3\, Zone + \beta_4\, Zone \times Quarter + \beta_5\, Gear \\ &+ \beta_6\, Zone \times Gear + \beta_7\, Time + \beta_8\, Time^2 + \beta_9\, IsLong + \beta_{10} IsLong \times Time \\ &+ \beta_{11}\, Source + \beta_{12}\, Permit\end{aligned}$$

Where $\ln(Revenue)_{qyzgp}$ is log-transformed revenue for a trip occurring in quarter *q,* year *y,* zone *z,* with gear *g,* permit *p,* and time *t. Zone* is the discrete zone in which the trip occurred, *Gear* is a categorical variable equal to 1 for all pot fishing trips and 0 for all gillnet trips, *Time* is the time at sea in hours, *IsLong* is a dummy variable equal to 1 for all trips over 24 hours, *Source* is a dummy variable equal to 1 for all trips identified only using logbook data (no VMS data), and *Permit* is a categorical variable for vessel permit type.

The result is a multi-way fixed effect model over permit, gear, zone, quarter, year, and source. Interactions between gear-zone and zone-quarter allow for heterogeneous catch over zones (i.e., some areas may provide better landings for pot fishermen, while other zones may be better for gillnetters), consistent with known differences in bottom surfaces. Quarter-zone interactions allow for higher seasonal catches in specific areas. The interaction between *IsLong* and *Time* allows for different slopes for the effect of time on catch for day trips versus longer trips. Outliers were identified using Cook's Distance (Crawley 2013) and were omitted from parameter estimates. Parameter estimates (with estimates for *Permit* fixed effects omitted for confidentiality) are shown in Table II-iii. Parameter signs and significance are consistent with prior expectations.

Table II-iii. Cluster 1 ln(revenue) model parameter estimates.

Variable	Estimate	Std. Error	t Value	Pr(> |t|)
Intercept	7.1083	0.0971	73.20	0.0000
Second Quarter	0.1276	0.1075	1.19	0.2352
Third Quarter	0.0530	0.0996	0.53	0.5947
Fourth Quarter	-0.1440	0.1026	-1.40	0.1605
Zone 3	-0.0128	0.1364	-0.09	0.9254
Zone 4	-3.1465	0.5713	-5.51	0.0000
Zone 5	-0.4745	0.4176	-1.14	0.2558
Zone 6	0.1243	0.0962	1.29	0.1962
Zone 7	-0.0678	0.0949	-0.71	0.4750
Zone 8	-0.0639	0.0953	-0.67	0.5027
Zone 9	-0.0403	0.1107	-0.36	0.7155
Zone 12	0.4167	0.1337	3.12	0.0018
Zone 17	0.2450	0.0979	2.50	0.0123
Zone 18	-0.0478	0.1013	-0.47	0.6371
Pot	0.9795	0.1025	9.55	0.0000
Long	1.4898	0.0214	69.76	0.0000
Time	0.0844	0.0007	113.66	0.0000
Time2	-0.0000	0.0000	-10.21	0.0000
Long x Time	-0.0754	0.0009	-85.51	0.0000
2008	-0.1586	0.0079	-19.98	0.0000

Variable	Estimate	Std. Error	t Value	Pr(> |t|)
2009	-0.3083	0.0080	-38.31	0.0000
2010	-0.2867	0.0081	-35.27	0.0000
2011	-0.2710	0.0083	-32.80	0.0000
2012	-0.3038	0.0085	-35.79	0.0000
VTR	-0.2226	0.0111	-20.02	0.0000
Second Quarter x Zone 3	0.1938	0.1698	1.14	0.2538
Third Quarter x Zone 3	0.3895	0.1710	2.28	0.0228
Fourth Quarter x Zone 3	0.2501	0.1636	1.53	0.1264
Second Quarter x Zone 4	-0.0898	0.1233	-0.73	0.4667
Third Quarter x Zone 4	-0.0863	0.1158	-0.75	0.4560
Fourth Quarter x Zone 4	0.1840	0.1187	1.55	0.1212
Second Quarter x Zone 5	-0.2207	0.1405	-1.57	0.1162
Third Quarter x Zone 5	-0.1427	0.1347	-1.06	0.2894
Fourth Quarter x Zone 5	0.0515	0.1355	0.38	0.7038
Second Quarter x Zone 6	-0.1752	0.1086	-1.61	0.1068
Third Quarter x Zone 6	-0.0380	0.1008	-0.38	0.7063
Fourth Quarter x Zone 6	0.1391	0.1037	1.34	0.1798
Second Quarter x Zone 7	-0.1019	0.1087	-0.94	0.3487
Third Quarter x Zone 7	-0.0321	0.1009	-0.32	0.7504
Fourth Quarter x Zone 7	0.1928	0.1039	1.86	0.0635
Second Quarter x Zone 8	-0.1222	0.1078	-1.13	0.2571
Third Quarter x Zone 8	-0.0872	0.1000	-0.87	0.3829
Fourth Quarter x Zone 8	0.1236	0.1030	1.20	0.2301
Second Quarter x Zone 9	-0.0668	0.1226	-0.55	0.5857
Third Quarter x Zone 9	-0.1104	0.1154	-0.96	0.3388
Fourth Quarter x Zone 9	0.0194	0.1181	0.16	0.8694
Second Quarter x Zone 12	-0.2722	0.1699	-1.60	0.1091
Third Quarter x Zone 12	-0.2840	0.1688	-1.68	0.0925
Fourth Quarter x Zone 12	0.0718	0.1742	0.41	0.6801
Second Quarter x Zone 17	-0.2008	0.1116	-1.80	0.0720
Third Quarter x Zone 17	-0.1430	0.1041	-1.37	0.1694
Fourth Quarter x Zone 17	0.1291	0.1068	1.21	0.2270
Second Quarter x Zone 18	-0.0949	0.1184	-0.80	0.4230
Third Quarter x Zone 18	-0.1490	0.1111	-1.34	0.1798
Fourth Quarter x Zone 18	0.1819	0.1147	1.59	0.1128
Zone 3 x Pot	-0.2117	0.1435	-1.48	0.1401
Zone 4 x Pot	3.1701	0.5724	5.54	0.0000
Zone 5 x Pot	0.4432	0.4125	1.07	0.2826
Zone 6 x Pot	-0.0514	0.0915	-0.56	0.5743
Zone 7 x Pot	0.2157	0.1063	2.03	0.0424
Zone 8 x Pot	0.1480	0.0894	1.65	0.0980
Zone 9 x Pot	0.4527	0.1063	4.26	0.0000
Zone 12 x Pot	0.0488	0.1474	0.33	0.7403
Zone 17 x Pot	-0.1998	0.0924	-2.16	0.0306
Zone 18 x Pot	0.2559	0.0986	2.59	0.0095
Observations	60,818			
Log Likelihood	-495,108.80			
Akaike Inf. Crit.	990,755.70			

Figure II-ii shows the densities of the actual and estimated revenues. Some overprediction occurs in the mid-$2,500 range, but the degree is not severe.

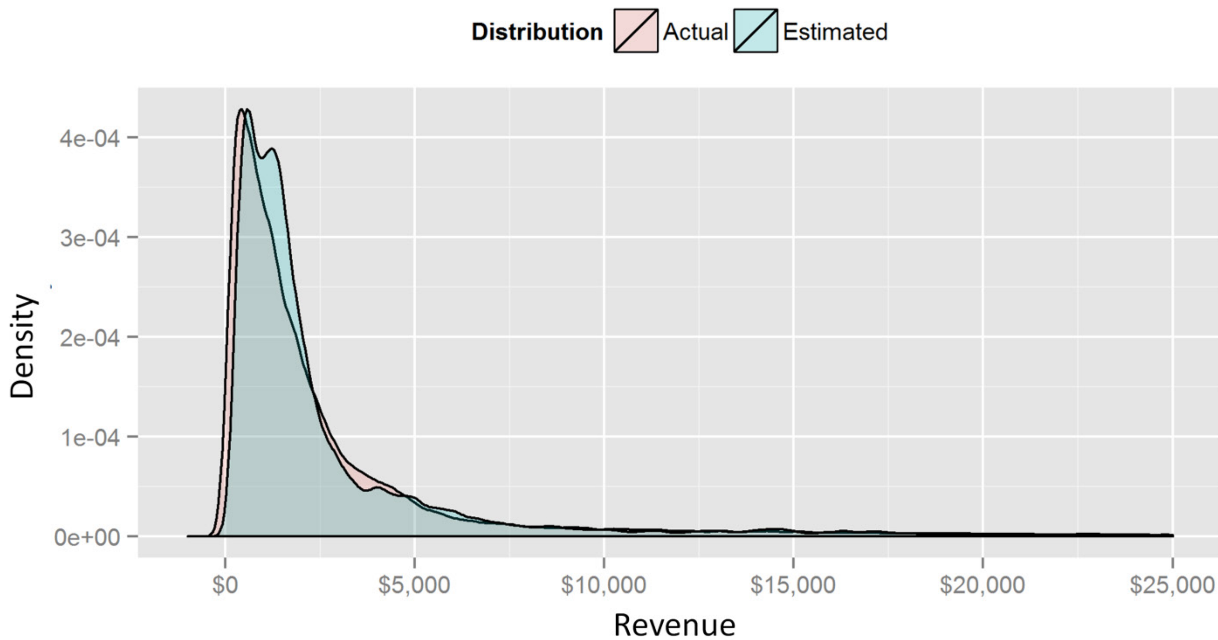


Figure II-ii. Distribution of actual and estimated revenue for Cluster 1.

RNVC are generated using cost estimates described in Section I.iii.i and the predicted revenues, yielding an estimate for RNVC for every trip and across all zones, including the observed (chosen) zone. The distributions of these values *for zones chosen* are shown in Figure II-iii.

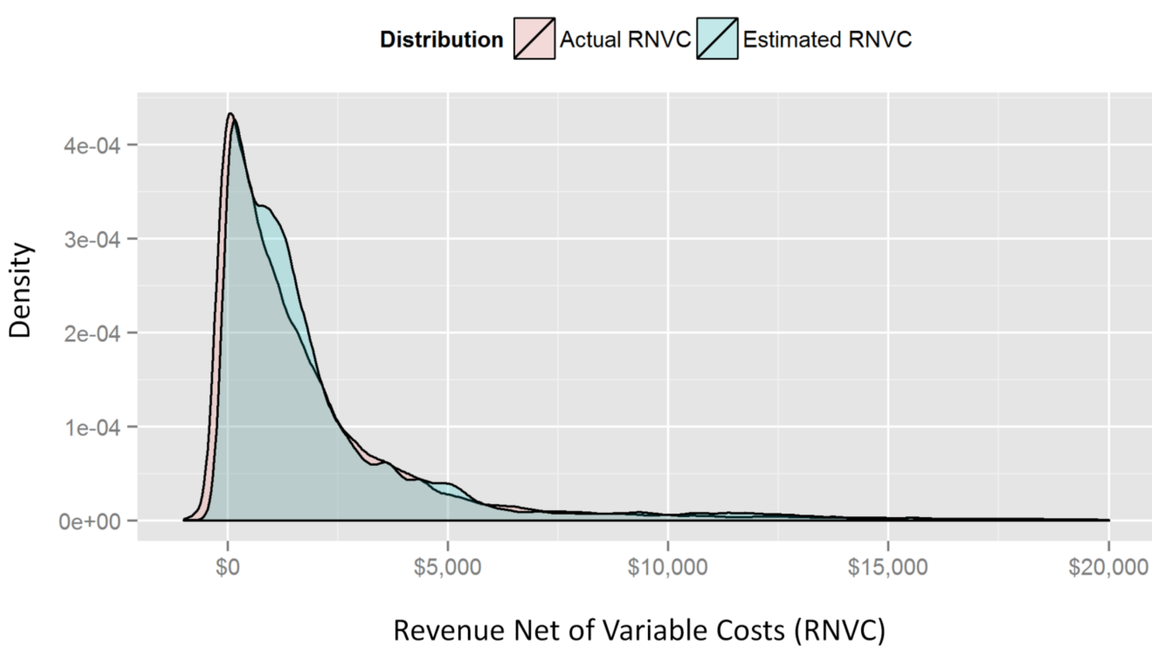


Figure II-iii. Distribution of actual and estimated RNVC for Cluster 1.

II.i.ii Location Choice Model Estimates

Parameters for the location choice model include wind speed, season, and length of vessel. While the estimated revenue and cost models account for length of vessel, and the revenue model accounts for season through its quarter fixed effects, both season and length were included here to account for potential limitations on access to certain areas that could impact smaller vessels, especially under wintertime conditions. Smaller vessels are less likely to travel to areas that are greater distances from shore, even once costs and predicted revenues are accounted for, due to safety concerns. Similarly, winter season (January–April) may also affect location choices independent of costs and revenues. Parameters for the effects of length and season on zone choices *relative* to Zone 2 are included in the parameter estimates in Table II-iv. Revenues Net of Variable Cost (RNVC) was estimated as a random parameter with a log-normal specification. Transforming the coefficient for RNVC to a normal distribution yields a mean estimate of 0.0014. All parameters are consistent with expectations—RNVC is significant and positive (fishermen choose areas with higher net revenues, *ceteris paribus*), and wind speed is negative and significant.

Table II-iv. Cluster 1 location choice model parameter estimates.

Variable	Estimate	Std. Error	t Value	Pr(> |t|)
Zone 3	4.2489	0.3972	10.70	0.0000
Zone 4	-0.0101	0.4720	-0.02	0.9830
Zone 5	1.0365	0.5456	1.90	0.0575
Zone 6	11.6433	0.3050	38.17	0.0000
Zone 7	14.8538	0.3099	47.93	0.0000
Zone 8	14.4773	0.2958	48.94	0.0000
Zone 9	17.2487	0.3653	47.22	0.0000
Zone 12	20.9259	0.6097	34.32	0.0000
Zone 17	11.3515	0.3313	34.26	0.0000
Zone 18	12.5750	0.3560	35.32	0.0000
RNVC	-6.6111	0.0073	-908.65	0.0000
Std. Dev. RNVC	0.2886	0.0044	66.05	0.0000
Wind speed	-0.0697	0.0132	-5.27	0.0000
Zone 3 x Summer	0.2643	0.2471	1.07	0.2847
Zone 4 x Summer	1.5839	0.1725	9.18	0.0000
Zone 5 x Summer	1.2449	0.1998	6.23	0.0000
Zone 6 x Summer	1.2755	0.1568	8.14	0.0000
Zone 7 x Summer	-0.4735	0.1514	-3.13	0.0018
Zone 8 x Summer	-0.2867	0.1515	-1.89	0.0584
Zone 9 x Summer	-1.4290	0.1824	-7.83	0.0000
Zone 12 x Summer	-1.2613	0.3834	-3.29	0.0010
Zone 17 x Summer	1.0866	0.1674	6.49	0.0000
Zone 18 x Summer	0.2163	0.1758	1.23	0.2185
Zone 3 x Length	-0.1231	0.0057	-21.44	0.0000
Zone 4 x Length	0.0327	0.0060	5.44	0.0000
Zone 5 x Length	0.0008	0.0075	0.11	0.9103
Zone 6 x Length	-0.2272	0.0044	-52.22	0.0000
Zone 7 x Length	-0.2691	0.0047	-57.72	0.0000
Zone 8 x Length	-0.2264	0.0041	-55.63	0.0000
Zone 9 x Length	-0.3843	0.0059	-65.13	0.0000
Zone 12 x Length	-0.4775	0.0093	-51.10	0.0000
Zone 17 x Length	-0.2575	0.0053	-48.62	0.0000

Variable	Estimate	Std. Error	t Value	Pr(> |t|)
Zone 18 x Length	-0.2841	0.0057	-50.03	0.0000
Log-Likelihood	-66928.46			
AIC	133923			
McFadden R^2	0.166			

The model was run with a specification that omitted the zone-specific parameters for season and length (equivalent to constraining zone-specific parameters for season and length to zero). AIC is minimized in the unconstrained model, and a score test strongly rejected the constrained model in favor of the unconstrained model.

Model results are then used to calculate a discrete distribution of choice probabilities for each trip. Table II-v reports the predicted and actual choice shares for each zone in the model. Predicted shares are very close to actual shares with a maximum difference of -1.61 percent (Zone 7). Zones 17 and 18, which contain the WEAs, are very slightly overpredicted. The model predicts the chosen zone correctly (returns highest probability estimate on the zone actually chosen) 57.3 percent of the time.

Table II-v. Actual and predicted choice trip shares by zone fished for Cluster 1 trips.

Zone	Predicted	Actual	Difference
2	0.4%	0.4%	-0.05%
3	0.4%	0.3%	0.12%
4	0.7%	1.2%	-0.45%
5	1.0%	0.5%	0.49%
6	17.7%	17.7%	-0.08%
7	14.6%	16.2%	-1.61%
8	56.4%	56.0%	0.36%
9	1.3%	1.2%	0.11%
12	0.3%	0.2%	0.10%
17	5.0%	4.6%	0.44%
18	2.2%	1.6%	0.58%

II.ii Cluster 2

This section presents the modeling results for Cluster 2.

II.ii.i General Category

The GC dataset represents 162 of the 211 Cluster 2 permits, covering 23,044 trips. Summary statistics are presented in Table II-vi and Table II-vii. The primary WEA fished is the NY WEA (Zone 12), which shows a high amount of scallop revenue in the eastern extent, and is accessible to vessels in the Mid-Atlantic bight, especially the fishing communities on Long Island. Zone 7, the Northern NC Call, is not heavily visited but has very high average revenues, although almost none of those revenues are from scallops. To address outliers and misreported data, a visual break in revenue per hour was identified at the top 0.75 percent and bottom 0.75 percent of revenue per; these trips were dropped. Trips with zero revenue and trips of over 500 hours were dropped as well. 10 trips that occurred in zones with less than 50 trips (Zones 8, 9, and 10) were dropped. 343 trips overlapped with trips included in Cluster 4. These trips were similar in characteristics and species targeted to the Cluster 4 trips and were removed from Cluster 2 GC. The final dataset includes 22,458 trips by 161 unique permits. A total of 586 trips were dropped, with 39 trips to WEAs dropped. WEA trips comprised 6.6 percent of all dropped trips, slightly higher than the 4.8 percent composition of WEA trips in the total dataset. The minimum number of trips per permit in the dataset is one, the maximum is 846.

Table II-vi. Cluster 2 GC summary statistics.

Statistic	N	Mean	St. Dev.	Min	Max
Revenue	22,458	$3,646.86	$4,544.86	$25.45	$92,676.93
Time (Hours)	22,458	21.19	21.46	0.50	283.00
Revenue per Hour	22,458	$254.35	$270.96	$4.98	$2,831.15
Pounds Scallops	22,458	292.01	191.30	0.00	858.00
Scallop Price per Pound	22,458	$8.65	$1.28	$3.50	$18.78
Length (Feet)	22,458	61.91	14.07	28	95
Gross Tons	22,458	79.26	42.45	5	199
Average Fuel Price	22,458	$3.40	$0.72	$1.87	$5.36
Source = VMS	22,458	86.8%	—	—	—
Gear = Dredge	22,458	53.4%	—	—	—

Note: Dollar values are in $US 2012.

Table II-vii. Summary revenue/zone statistics for Cluster 2 GC.

Zone	Trips	Zone Share	Avg. Revenue per Trip	Avg. Scallop per Trip	Avg. Revenue per Hour	Avg. Scallop per Hour
1	1,983	8.83%	$5,870.36	314	$212.34	23
2	3,732	16.6%	$2,815.92	307	$157.69	23
3	14,215	63.3%	$3,443.63	295	$183.34	22
4	680	3.03%	$3,616.06	293	$144.30	24
5	175	0.779%	$9,024.91	115	$188.33	15
6	557	2.48%	$5,120.97	1	$75.72	0
7	75	0.334%	$13,606.06	1	$181.30	0
11	55	0.245%	$3,135.23	79	$221.64	7
12	620	2.76%	$2,838.06	388	$155.46	25
13	283	1.26%	$2,511.86	366	$141.37	28
14	83	0.37%	$2,963.20	292	$147.27	22

Note: Dollar values are in $US 2012.

Although all permits in the dataset receive greater than 40 percent of total revenues from scallop landings, it is clear that many trips taken in the dataset are not scallop targeting trips. Zone 7, the Northern NC Call, has the highest average revenue per trip, but only the fifth-highest revenue per hour and the lowest average pounds of scallops per trip. Many permits in the Scallop Limited Access General Category fishery are limited in total landings of scallops each year according to individual quota per-trip possession limits. This explains the relatively low scallop per hour measures for Zone 1, which includes scallop grounds on Georges Bank—the General Category permit limits make the travel to highly productive Georges Bank grounds irrational due to the limited amount of scallops that can be landed. Though each trip to Zone 1 has high average revenue per trip and per hour, these trips are composed of a wider mix of groundfish and scallops. The model accounts for all choice alternatives available to the fishery, which may include non-scallop trips.

Figure II-iv shows the grids used in modeling Cluster 2 GC as well as the fishing centroids used to calculate distance. Revenue intensity is also shown for the trips modeled. Grid areas without labeled centroids had less than 50 trips in the set and were dropped. The ports used to define Cluster 2 GC are labeled; other ports used by permits within Cluster 2 GC are indicated but are not labeled.

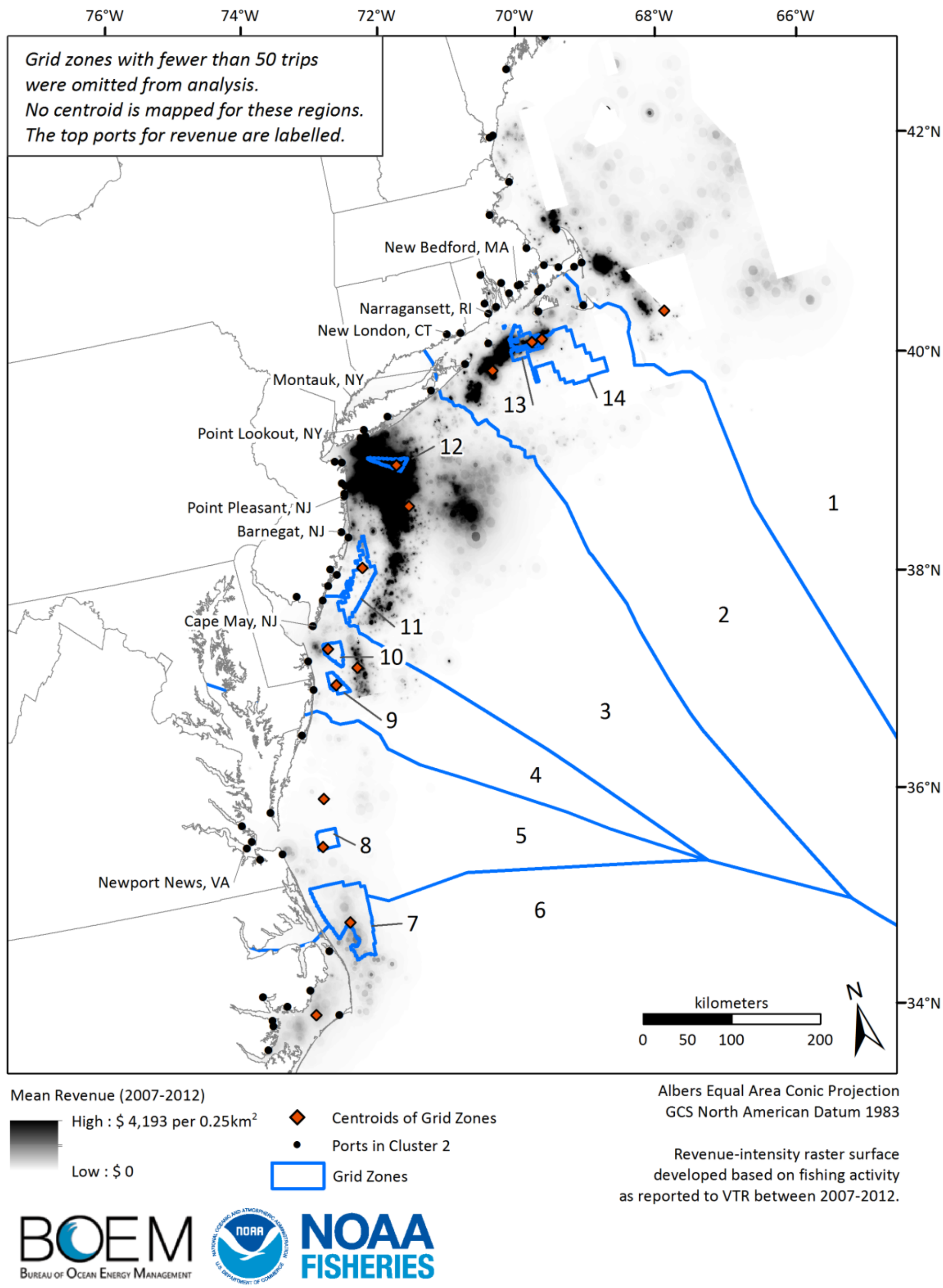


Figure II-iv. Cluster 2 GC grid, centroids, ports and revenue intensity.

II.ii.ii Revenue Estimates

For Cluster 2 GC, the specification is as follows (trip subscripts are suppressed for compactness):

$$\ln(Revenue)_{myzgpt} = \beta_0 + \beta_1\, Zone + \beta_2\, Month + \beta_3\, Year + \beta_4\, Month \times Year + \beta_5\, Gear + \beta_6\, Zone \times Gear + \beta_7\, Time + \beta_8\, Time^2 + \beta_9 \ln(Scallop\ Price) + \beta_{10}\, Source + \beta_{11}\, Permit$$

Where $\ln(Revenue)_{myzgp}$ is log-transformed revenue for a trip occurring in month *m,* year *y,* zone *z,* with gear *g,* permit *p,* and time *t.* Zone is the discrete zone in which the trip occurred, *Gear* is a categorical variable equal to 1 for all bottom trawl trips, 0 for all dredge trips, *Time* is the time at sea in hours, *scallop price* is the average ex-vessel price per pound of scallops (meat weight), *Source* is a dummy variable equal to 1 for all trips identified only using logbook data (no VMS data), and *Permit* is a categorical variable for vessel permit.

The result is a multi-way fixed effect model over permit, gear, zone, month, year, and source. Interactions between gear-zone and month-year allow for heterogeneous catch over zones (i.e., some areas may provide better landings for trawlers, while other zones may be better for dredges), consistent with known differences in bottom surfaces. Outliers were identified using Cook's Distance and were omitted from parameter estimates. Parameter estimates (with *Permit* fixed effects omitted for confidentiality) are shown in Table II-viii. Parameter signs and significance are consistent with prior expectations.

Table II-viii. Cluster 2 GC ln(revenue) model parameter estimates.

Variable	Estimate	Std. Error	t Value	Pr(> |t|)
Intercept	7.556	0.045	169.531	0.000
Zone 2	-0.004	0.019	-0.201	0.841
Zone 3	-0.103	0.030	-3.470	0.001
Zone 4	-0.100	0.043	-2.295	0.022
Zone 5	-0.585	0.181	-3.228	0.001
Zone 6	0.040	0.222	0.181	0.856
Zone 7	0.483	0.070	6.921	0.000
Zone 11	-0.070	0.143	-0.493	0.622
Zone 12	-0.062	0.057	-1.082	0.279
Zone 13	0.035	0.032	1.080	0.280
Zone 14	-0.024	0.057	-0.417	0.676
Bottom Trawl	-0.106	0.037	-2.867	0.004
February	0.105	0.042	2.487	0.013
March	-0.132	0.039	-3.428	0.001
April	0.013	0.036	0.353	0.724
May	-0.106	0.034	-3.129	0.002
June	-0.175	0.035	-5.052	0.000
July	-0.138	0.034	-4.068	0.000
August	-0.205	0.034	-6.005	0.000
September	-0.229	0.035	-6.544	0.000
October	-0.263	0.035	-7.504	0.000
November	-0.212	0.039	-5.406	0.000
December	-0.229	0.039	-5.818	0.000
2008	0.151	0.041	3.665	0.000

Variable	Estimate	Std. Error	t Value	Pr(> |t|)
2009	0.025	0.059	0.433	0.665
2010	-0.227	0.041	-5.603	0.000
2011	0.219	0.044	4.956	0.000
2012	0.370	0.043	8.649	0.000
Time	0.021	0.000	54.897	0.000
Time2	-0.000	0.000	-20.481	0.000
VTR	-0.209	0.010	-19.951	0.000
Zone 2 x Bottom Trawl	-0.266	0.044	-6.033	0.000
Zone 3 x Bottom Trawl	0.085	0.040	2.129	0.033
Zone 4 x Bottom Trawl	0.254	0.067	3.779	0.000
Zone 5 x Bottom Trawl	1.134	0.186	6.084	0.000
Zone 6 x Bottom Trawl	-0.698	0.224	-3.119	0.002
Zone 11 x Bottom Trawl	0.060	0.160	0.375	0.708
Zone 12 x Bottom Trawl	0.087	0.066	1.317	0.188
Zone 13 x Bottom Trawl	-0.533	0.155	-3.440	0.001
Zone 14 x Bottom Trawl	-0.143	0.128	-1.110	0.267
February 2008	-0.184	0.059	-3.132	0.002
March 2008	0.010	0.054	0.179	0.858
April 2008	-0.184	0.050	-3.698	0.000
May 2008	-0.076	0.047	-1.605	0.109
June 2008	-0.076	0.048	-1.568	0.117
July 2008	-0.091	0.049	-1.871	0.061
August 2008	-0.044	0.048	-0.927	0.354
September 2008	0.001	0.050	0.027	0.978
October 2008	-0.046	0.057	-0.811	0.417
November 2008	0.013	0.075	0.171	0.864
December 2008	-0.073	0.056	-1.301	0.193
February 2009	-0.275	0.099	-2.770	0.006
March 2009	-0.019	0.068	-0.283	0.777
April 2009	-0.168	0.065	-2.602	0.009
May 2009	-0.078	0.067	-1.175	0.240
June 2009	0.022	0.063	0.351	0.726
July 2009	-0.021	0.063	-0.328	0.743
August 2009	-0.226	0.074	-3.045	0.002
September 2009	0.127	0.065	1.969	0.049
October 2009	-0.050	0.076	-0.651	0.515
November 2009	-0.038	0.082	-0.468	0.640
December 2009	0.070	0.068	1.034	0.301
February 2010	0.181	0.085	2.123	0.034
March 2010	0.282	0.062	4.528	0.000
April 2010	0.093	0.057	1.634	0.102
May 2010	0.069	0.052	1.339	0.181
June 2010	0.186	0.052	3.599	0.000
July 2010	0.362	0.051	7.083	0.000
August 2010	0.400	0.053	7.576	0.000
September 2010	0.572	0.055	10.471	0.000
October 2010	0.533	0.054	9.785	0.000
November 2010	0.515	0.060	8.597	0.000
December 2010	0.689	0.058	11.962	0.000

Variable	Estimate	Std. Error	t Value	Pr(> |t|)
February 2011	-0.132	0.064	-2.069	0.039
March 2011	0.117	0.061	1.909	0.056
April 2011	0.009	0.061	0.146	0.884
May 2011	0.038	0.053	0.711	0.477
June 2011	0.087	0.052	1.652	0.099
July 2011	0.155	0.053	2.936	0.003
August 2011	0.236	0.055	4.271	0.000
September 2011	0.365	0.059	6.225	0.000
October 2011	0.385	0.059	6.537	0.000
November 2011	0.234	0.063	3.692	0.000
December 2011	0.384	0.059	6.563	0.000
February 2012	-0.047	0.060	-0.775	0.438
March 2012	0.122	0.060	2.050	0.040
April 2012	0.030	0.056	0.524	0.600
May 2012	0.043	0.053	0.819	0.413
June 2012	0.126	0.053	2.368	0.018
July 2012	0.076	0.052	1.468	0.142
August 2012	0.127	0.052	2.426	0.015
September 2012	0.225	0.055	4.075	0.000
October 2012	0.229	0.056	4.132	0.000
November 2012	0.200	0.062	3.200	0.001
December 2012	0.258	0.059	4.351	0.000
Observations	22,410			
Log-Likelihood	-191521			
AIC	383553			

Figure II-v shows the densities of the actual and estimated revenues. The mid-$2,500 range (the approximate value of the possession limit for scallops under a General Category trip) is under-predicted, but dispersion around the mean appears proportional to the actual distribution.

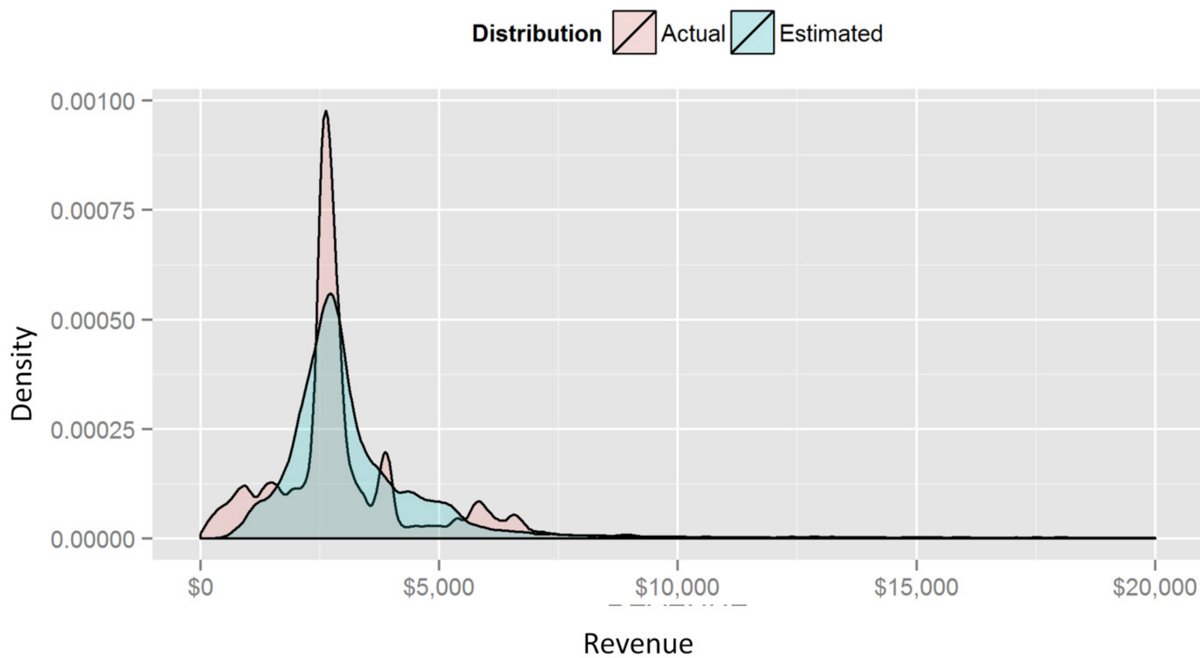


Figure II-v. Distribution of actual and estimated revenue for Cluster 2 GC.

RNVC are generated using cost estimates described in Appendix I.iii.iv and the predicted revenues, yielding an estimate for RNVC for every trip and across all zones, including the observed (chosen) zone. Bottom trawl trips show high revenue per hour in Zones 5 and 7 (see Figure II-vi), while dredge trips show similar revenue per hour across most zones except 5 and 7 (no dredge trips occurred in Zone 7). The General Category scallop fleet is limited to a 600-pound meat-weight possession limit, making dredge trips (which target scallops almost exclusively) somewhat lower revenue versus bottom trawl trips, which land scallops and other species simultaneously. Dredge vessels have a near-zero probability of visiting Zone 7; thus, in calculating expected RNVC, this revenue has little weight (Figure II-vi).

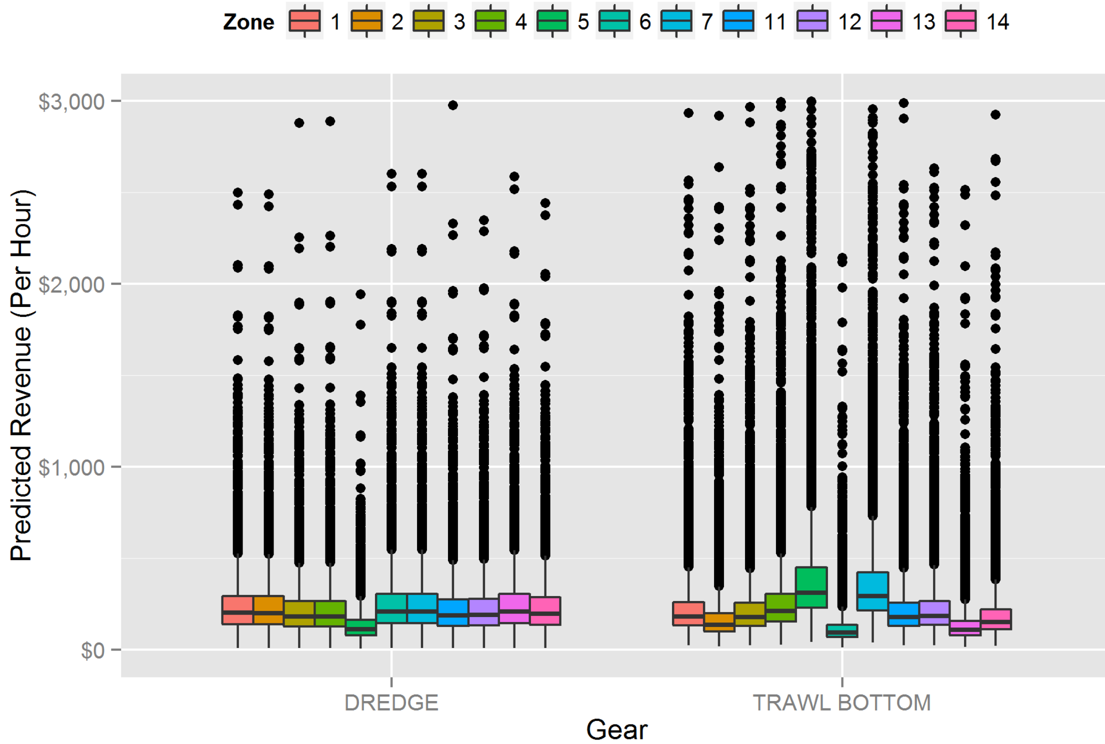


Figure II-vi. Estimated revenue by zone and gear for Cluster 2 GC.

II.ii.iii Location Choice Model

Parameters for the location choice model include wind speed, RNVC, the per-pound price of scallops, and a variable (*ever-visit)* indicating the permit-level share of visits to that zone over the study period (Table II-ix). This variable accounts for fishermen's particular knowledge or affinity for a given area. Given the wide range of areas fished within Cluster 2 GC, especially in areas at the southern extent off North Carolina, accounting for permit-level affinities with this variable is reasonable.

Table II-ix. Cluster 2 GC location choice model parameter estimates.

Variable	Estimate	Std. Error	t Value	Pr(> |t|)
Zone 2	4.5514	0.2709	16.80	0.0000
Zone 3	4.1334	0.4094	10.10	0.0000
Zone 4	5.3368	0.6107	8.74	0.0000
Zone 5	7.9728	0.7330	10.88	0.0000
Zone 6	3.5484	0.7644	4.64	0.0000
Zone 7	8.7698	1.1398	7.69	0.0000
Zone 11	7.0098	1.1024	6.36	0.0000
Zone 12	7.7205	0.6122	12.61	0.0000
Zone 13	10.9778	0.7686	14.28	0.0000
Zone 14	7.4977	0.9072	8.26	0.0000
RNVC*	-8.0726	0.0329	-245.59	0.0000
Std. Dev. RNVC	0.4767	0.0203	23.45	0.0000
Wind Speed	-0.1188	0.0369	-3.22	0.0013

Variable	Estimate	Std. Error	t Value	Pr(> |t|)
Ever-Visit	5.1536	0.0611	84.37	0.0000
Zone 2 x Per Pound Price	-0.5560	0.0297	-18.69	0.0000
Zone 3 x Per Pound Price	-0.5071	0.0445	-11.40	0.0000
Zone 4 x Per Pound Price	-0.7008	0.0691	-10.15	0.0000
Zone 5 x Per Pound Price	-1.2367	0.0851	-14.52	0.0000
Zone 6 x Per Pound Price	-0.3586	0.0849	-4.22	0.0000
Zone 7 x Per Pound Price	-1.4046	0.1333	-10.53	0.0000
Zone 11 x Per Pound Price	-1.0449	0.1345	-7.77	0.0000
Zone 12 x Per Pound Price	-0.8843	0.0714	-12.38	0.0000
Zone 13 x Per Pound Price	-1.3462	0.0974	-13.83	0.0000
Zone 14 x Per Pound Price	-1.0384	0.1116	-9.31	0.0000
Log-Likelihood	-9686			
AIC	19421			
McFadden R^2	.654			

* Parameter is estimated as log-normal. Value is positive when transformed to normal distribution. Reference level is Zone 1.

Inclusion of the *ever-visit* variable greatly improved model fit and predictive accuracy, and a score test strongly rejected the constrained model (without ever-visit). Transformation of the parameter on RNVC indicates a mean of .00035.

Model results are then used to calculate a discrete distribution of choice probabilities for each trip. Table II-x reports the predicted and actual choice shares for each zone in the model. Predicted shares are extremely close to actual shares with a maximum difference of -0.109 percent (Zone 3). Zones 7, 11, 12, 13, and 14, which contain the WEAs, are very well predicted. The model predicts the chosen zone correctly (based on the zone with highest probability) 86.6 percent of the time.

Table II-x. Actual and predicted trips shares by zone fished for Cluster 2 GC.

Zone	Predicted	Actual	Difference
1	8.8%	8.8%	-0.048%
2	16.8%	16.6%	0.136%
3	63.5%	63.3%	0.172%
4	2.9%	3.0%	-0.096%
5	1.0%	0.8%	0.178%
6	2.3%	2.5%	-0.192%
7	0.3%	0.3%	-0.021%
11	0.2%	0.2%	-0.012%
12	2.7%	2.8%	-0.056%
13	1.2%	1.3%	-0.042%
14	0.4%	0.4%	-0.019%

II.ii.iv Limited Access

The LA dataset contains 161 for the 209 Cluster 2 permits, and covers 3,444 trips. To address outliers and misreported data, trips with the top 1 percent and bottom 1 percent of revenue and revenue per hour were dropped, as were trips with zero revenue, trips of over 500 hours, and trips to zones with fewer than 50 visits. This resulted in a total of 2,659 trips by 156 unique permits. A scallop DAS allows the user to land any amount of scallops per day, and can be combined into a multi-day trip. Therefore, scallop trips are concentrated in a smaller number of zones with higher scallop yields—if one is spending a scallop DAS, areas that are low in scallop yields are not as profitable. Zones 6, 7, 11, and 14 had zero LA trips despite having 860 (4 percent) GC trips. Zones 6, 7, and 11 were shown to have the lowest GC scallop pounds per hour fished in Table II-xi. For Cluster 2 LA, WEA trips comprised 4.78 percent of all dropped trips, nearly identical to the 4.5 percent composition of WEA trips in the total dataset. The minimum number of trips per permit in the dataset is one, the maximum is 170. Summary statistics for the LA portion of Cluster 2 are presented in Table II-xii.

Table II-xi. Summary statistics for Cluster 2 LA.

Statistic	N	Mean	St. Dev.	Min	Max
Revenue	2,659	$139,734.30	$100,764.30	$316.73	$590,558.70
Time (Hours)	2,659	195.50	91.20	3.25	438.47
Revenue per Hour	2,659	$696.31	$391.51	$29.45	$3,059.88
Pounds Scallops	2,659	17,094.71	11,213.93	0	60,705
Price per Pound Scallops	2,659	$8.83	$1.20	$6.08	$16.60
Length (Feet)	2,659	76.67	10.78	38	96
Gross Tons	2,659	135.21	43.56	14	199
Average Fuel Price	2,659	$3.35	$0.63	$1.83	$5.33
Source = VMS	2,659	94.8%			
Dredge	2,659	98.8%			

Note: Dollar values are in $US 2012.

Table II-xii. Summary revenue/zone statistics for Cluster 2 LA.

Zone	Trips	Zone Share	Average Revenue per Trip	Average Scallop Pounds per Trip	Average Revenue per Hour	Average Scallop Pounds per Hour
1	542	20.4%	$157,296	19,052	$743.26	88
2	118	4.44%	$82,083.64	9,704	$741.79	63
3	1,943	73.1%	$138,084	16,977	$702.90	83
12	56	2.11%	$148,484	17,818	$801.33	100

Note: Dollar values are in $US 2012.

Per-trip revenues in Cluster 2 LA are among the highest in any fishery in the Atlantic U.S. The primary scallop zones are Zone 3 (Mid-Atlantic bight) and Zone 1, which includes Georges Bank. The NY WEA (Zone 12) has a high average scallop pounds per hour.

Figure II-vii shows the grids used in modeling Cluster 2 LA as well as the fishing centroids used to calculate distance. Revenue intensity is also shown for the trips modeled. Grid areas without labeled centroids had less than 100 trips in the set and were dropped. Major landing ports are labeled.

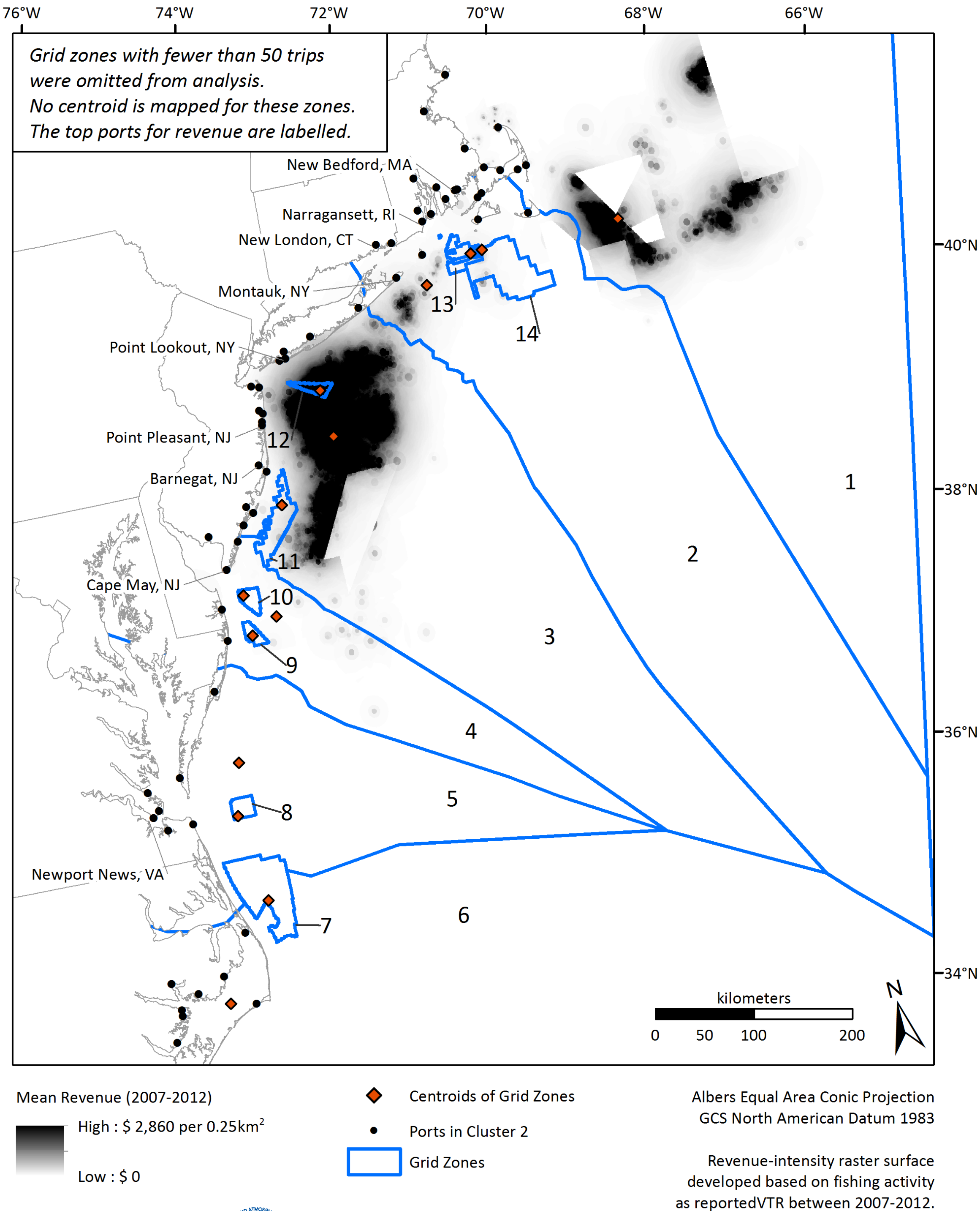


Figure II-vii. Grid, centroids, ports and revenue intensity for Cluster 2 LA.

II.ii.v Revenue Estimates

Revenue for each trip and each zone is generated using the following fixed effects model:

$$\ln(Revenue)_{qyzgpt} = \beta_0 + \beta_1\, Zone + \beta_2\, Quarter + \beta_3\, Year + \beta_4\, Quarter \times Year + \beta_5\, Gear + \beta_6\, Time + \beta_7\, Time^2 + \beta_8 \ln(Scallop\ Price) + \beta_9\, Permit$$

Where $\ln(Revenue)_{qyzgp}$ is log-transformed revenue for a trip occurring in quarter *q,* year *y,* zone *z,* with gear *g,* permit *p,* and time *t*. Zone is the discrete zone in which the trip occurred, *Gear* is a categorical variable equal to 1 for all bottom trawl trips and 0 for all dredge trips, *Time* is the time at sea in hours, *Scallop Price* is the average ex-vessel price per pound of scallops (meat weight), and *Permit* is a categorical variable for vessel permit. Unlike the Cluster 2 GC revenue estimation, *Source* was not a significant driver of variation in revenue. *Quarter* was used rather than month. Interaction terms for gear and zone was not included due to the low number of trips occurring in some zones.

The result is a multi-way fixed effect model over *permit, gear, zone, quarter,* and *year*. Interactions between gear-zone and quarter-year allow for heterogeneous catch over zones (i.e., some areas may provide better landings for bottom trawlers, while other zones may be better for dredges), consistent with known differences in bottom surfaces. Although the number of parameters estimated is 190, the purpose is to predict revenues for observed trips over all zones rather than causal inference. *N* is sufficient to support the estimation procedure. Outliers were identified using Cook's Distance and were omitted from parameter estimates. Parameter estimates (with *Permit* fixed effects omitted for confidentiality) are shown in Table II-xiii. Parameter signs and significance are consistent with prior expectations.

Table II-xiii. Cluster 2 LA ln(revenue) parameter estimates.

Variable	Estimate	Std. Error	t Value	Pr(> |t|)
Intercept	8.586	0.219	39.154	0.000
Zone 2	-0.086	0.044	-1.971	0.049
Zone 3	-0.062	0.021	-2.928	0.003
Zone 12	-0.032	0.050	-0.640	0.522
Bottom Trawl	-0.024	0.128	-0.186	0.853
2008	0.160	0.047	3.437	0.001
2009	0.357	0.042	8.417	0.000
2010	0.752	0.042	17.915	0.000
2011	1.028	0.040	25.434	0.000
2012	1.012	0.041	24.904	0.000
Second Quarter	-0.124	0.045	-2.758	0.006
Third Quarter	-0.162	0.037	-4.362	0.000
Fourth Quarter	0.001	0.042	0.019	0.985
Time	0.017	0.000	46.976	0.000
Time2	-0.000	0.000	-27.566	0.000
Log(Per Pound Price)	0.155	0.085	1.835	0.067
Second Quarter 2008	0.139	0.071	1.948	0.052
Second Quarter 2009	0.062	0.065	0.959	0.338
Second Quarter 2010	0.013	0.061	0.205	0.838
Second Quarter 2011	0.097	0.064	1.531	0.126
Second Quarter 2012	0.155	0.064	2.420	0.016
Third Quarter 2008	0.161	0.063	2.559	0.011

Variable	Estimate	Std. Error	t Value	Pr(> |t|)
Third Quarter 2009	0.180	0.063	2.875	0.004
Third Quarter 2010	0.051	0.059	0.867	0.386
Third Quarter 2011	0.174	0.061	2.867	0.004
Third Quarter 2012	0.163	0.057	2.841	0.005
Fourth Quarter 2008	-0.123	0.066	-1.877	0.061
Fourth Quarter 2009	-0.023	0.063	-0.368	0.713
Fourth Quarter 2010	-0.067	0.065	-1.034	0.301
Fourth Quarter 2011	0.038	0.060	0.629	0.530
Fourth Quarter 2012	-0.020	0.061	-0.331	0.741
Observations	2659			
Log Likelihood	-31212.5			
Akaike Inf. Crit	62786			

Figure II-viii shows the densities of the actual and estimated revenues. Expected revenues are highly similar to the estimated revenues across nearly all of the distribution, though some over-prediction occurs in the mid-$125,000 range.

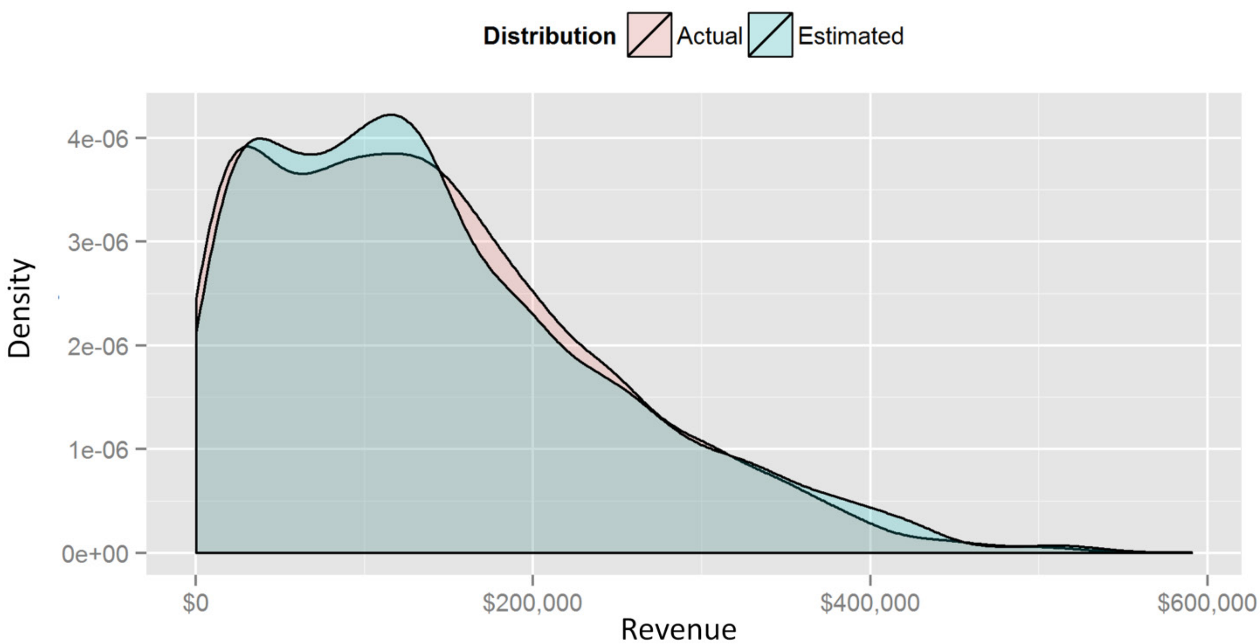


Figure II-viii. Distribution of actual and estimated revenue for Cluster 2 LA.

RNVC are generated using cost estimates described in Appendix I.iii and the predicted revenues, yielding an estimate for RNVC for every trip and across all zones, including the observed (chosen) zone.

II.ii.vi Location Choice Model

Parameters for the location choice model include wind speed, RNVC, the per-pound price of scallops, and a variable (*ever-visit)* indicating the permit-level share of visits to that zone over the study period (Table II-xiv). This variable accounts for fishermen's particular knowledge or affinity for a given area.

Table II-xiv. Location choice model parameter estimates for Cluster 2 LA (with Zone 1 as the reference zone).

Variable	Estimate	Std. Error	t Value	Pr(> |t|)
Zone 2 Intercept	-1.3072	1.0886	-1.20	0.2299
Zone 3 Intercept	1.8008	0.4589	3.92	0.0001
Zone 12 Intercept	0.7491	1.1356	0.66	0.5095
Revenues Net of Variable Cost (RNVC)	0.0000233	0.0000064	0.00	0.0002737
Std. Dev. RNVC Parameter (Triangle)	0.0486	0.0212	2.30	0.0216
Wind Speed	0.0547	0.1704	0.32	0.7480
Ever-Visit	3.6228	0.1650	21.96	0.0000
2: Scallop Price per Pound	0.0898	0.1182	0.76	0.4475
3: Scallop Price per Pound	-0.1864	0.0511	-3.65	0.0003
12: Scallop Price per Pound	-0.1881	0.1272	-1.48	0.1393
LogL	-1341			
AIC	2702			
McFadden R^2	.348			

Model results are then used to calculate a discrete distribution of choice probabilities for each trip. Table II-xv reports the predicted and actual choice shares for each zone in the model. Predicted shares are extremely close to actual shares with a maximum difference of +0.0297 percent (Zone 1). Zone 12, which contains the NY WEA, is very well predicted. The model predicts the chosen zone correctly 81.2 percent of the time.

Table II-xv. Actual and predicted trip shares by zone fished for Cluster 2 LA trips.

Zone	Predicted	Actual	Difference
1	20.4%	20.4%	0.0297%
2	4.4%	4.4%	-0.0211%
3	73.1%	73.1%	-0.0057%
12	2.1%	2.1%	-0.0028%

II.iii Cluster 3

Cluster 3 is composed of 44 permits in the surfclam and ocean quahog fishery landing in the Mid-Atlantic region. Although this cluster definition helps to identify a regional measure of exposure, for modeling purposes, a wider range of clam harvesting permits is germane. Including additional permits, regardless of landing area, helps to define potential alternative areas for harvesting. Furthermore, because the surfclam and ocean quahog fishery is well-rationalized and is prosecuted by a relatively small number of permit-holders that do not target other species, a simple rule for inclusion into the model is possible. For the purposes of this section, Cluster 3 is defined as all trips from permits with greater than 1 percent of total revenue (2007–2012) sourced from within a WEA. Although fewer permits are included in the refined Cluster 3, a larger amount of exposed revenue is present. Table II-xvii contrasts the original and refined Cluster 3 definitions.

Table II-xvi. Refining the surfclam and ocean quahog cluster (Cluster 3).

	Original	Refined
Description of Cluster Definition	All trips by Permits Landing in Select NJ, RI, and MA Ports	All Trips by Permits Sourcing Greater Than 1 Percent of Total Revenues from a WEA
Unique Permits	44	27
Unique Trips	21,845	11,861
Total Revenue	$347.4 Million	$250.5 Million

Description of Cluster Definition	Original All trips by Permits Landing in Select NJ, RI, and MA Ports	Refined All Trips by Permits Sourcing Greater Than 1 Percent of Total Revenues from a WEA
Exposed Revenue	$25.7 Million	$28.1 Million
Percent Total Revenue Exposed	7.4%	11.2%
Share of Total Exposed Revenue Represented (of $84.3 Million)	30.53%	33.4%

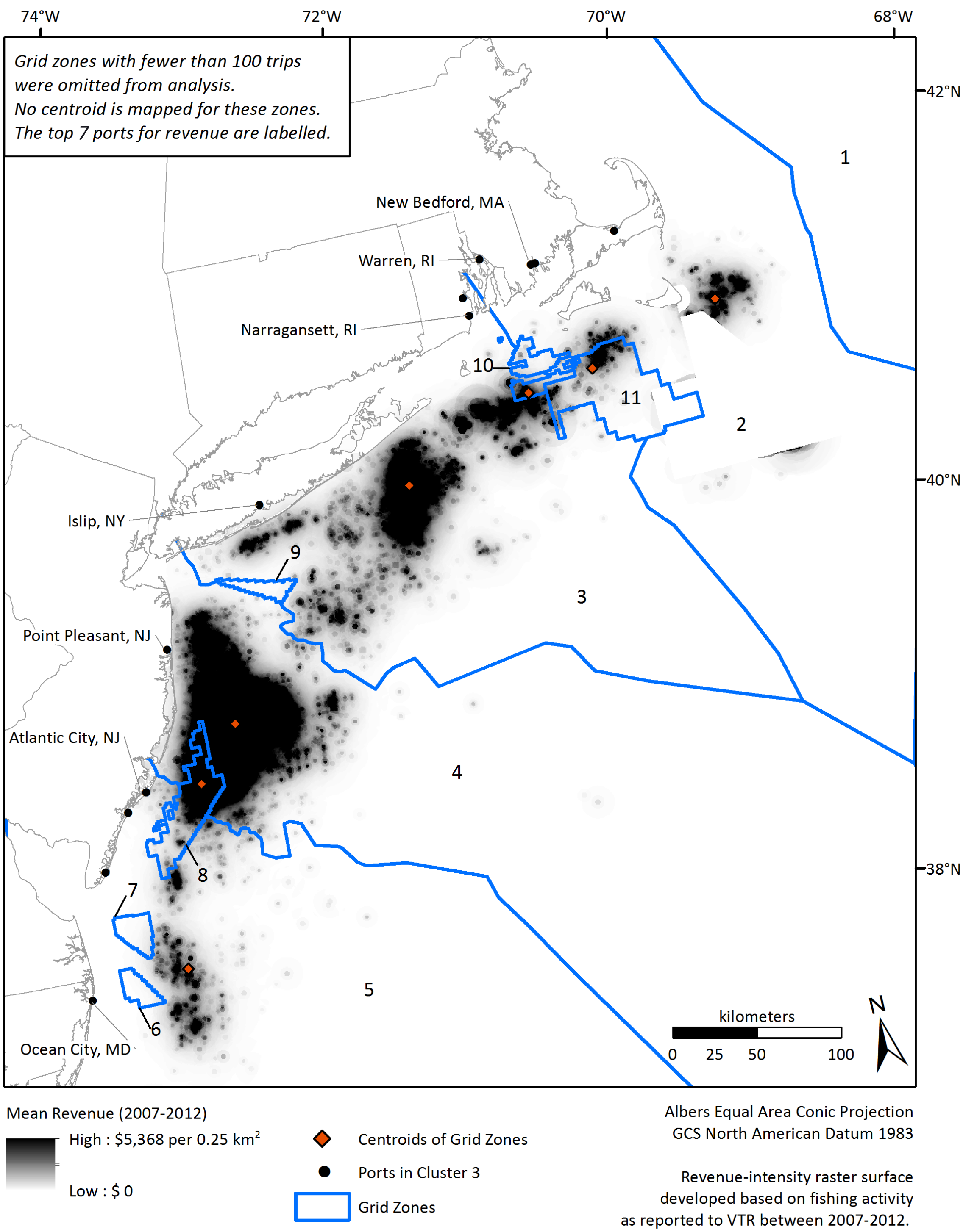
Note: Dollar values are in $US 2012.

Limiting this list of permits to only those with greater than one percent exposure, but expanding the list to include all permits, regardless of landing port, a total of 27 permits are identified over 11,861 trips. These 27 permits source approximately 10.0 percent of total region-wide revenues from within a WEA, primarily from the NJ WEA (Zone 8 in this cluster). Based on the logbook-reported latitude-longitude rather than the probabilistic exposure model, 12.6 percent of trips were to a WEA. A significant portion of the Georges Bank and Southern Gulf of Maine areas have been unfishable for clams since 1990 when the threat of Paralytic Shellfish Poisoning (PSP) forced the shutdown of those areas for clams. In recent years, some clam fishermen have been allowed to fish in these areas with special authorization and with a process in place to test harvested clams for the toxin. Because the process of testing clams is expensive and not available to all fishermen, the area is not part of all trips' choice set. Thus, all 231 trips to Zone 1 (which includes Georges Bank) are dropped, with 11,630 trips and 27 permits remaining in the cluster.

The fishery targets highly sessile organisms rather than the mobile stocks that most other fisheries target. Therefore, there is a potential for "fishing down" alternative areas or losing potential landings altogether. For example, if a WEA results in the inability to access clamming grounds, fishermen may target other alternative grounds but may find those areas already fished down. The biomass that remains in the closed area represents a lost opportunity for fishing, unlike other fisheries where stocks have some degree of mobility. Analysis in this section must be understood in this context. Estimates for changes in landings over intensity of fishing are not available for the scale of the spatial patches defined here; thus, this analysis represents the best available methods for assessing potential impacts.

Due to the clam fishery's compact and focused nature, data reporting is thorough and well-managed. No outliers were dropped, and no zero-revenue trips were reported. All 11,630 trips from all 27 permits were used in the analysis.

Figure II-ix shows the grids used in modeling Cluster 3 as well as the fishing centroids used to calculate distance. Revenue intensity is also shown for the trips modeled. Grid areas without labeled centroids had insufficient trips in the set and were dropped. The primary landing ports for Cluster 3 are labeled. Summary statistics for these data are contained in Table II-xvii, and the summary revenue and zone statistics are in indicated in Table II-xviii.



BOEM Bureau of Ocean Energy Management NOAA FISHERIES

Figure II-ix. Grid, centroids, ports and revenue intensity for Cluster 3.

Table II-xvii. Summary statistics for Cluster 3.

Statistic	N	Mean	St. Dev.	Min	Max
Revenue	11,630	$20,494.80	12,717.50	$257.72	$80,846.99
Time	11,630	36.59	10.06	0.80	104.00
RPH	11,630	$544.93	263.94	$11.71	$1,894.81
Length	11,630	97.40	21.36	68	145
Gross Tons	11,630	159.72	44.18	83	277
Average Fuel Price	11,630	$3.33	0.66	$1.88	$5.36
Surfclam Price	11,630	$12.06	1.08	$8.03	$17.79
Ocean Quahog Price	11,630	$6.64	0.39	$6.00	$8.00

Note: Dollar values are in $US 2012.

Table II-xviii. Summary revenue/zone statistics for Cluster 3.

Zone	Trips	Zone share	Average Revenue per trip	Average Revenue per hour fished	Average Revenue per hour
2	639	5.59%	$16,391.84	$920.03	$464.41
3	3,046	26.2%	$24,018.32	$1,113.38	$638.67
4	5,480	47.1%	$20,272.20	$723.90	$548.67
5	968	8.3%	$16,009.48	$606.80	$448.50
8	1,162	10.0%	$17,953.97	$626.12	$518.11
10	108	0.93%	$15,558.03	$786.20	$486.46
11	227	2.0%	$24,619.91	$1,132.37	$722.88

Zone 11 (the RI-MA WEA) is identified by the clam industry as a likely future target as changes in the distribution of both species of clams occur. Zone 3, the northeastern section of the Mid-Atlantic bight, yields the second-highest revenue per hour, while Zone 4, the southwest section of the Mid-Atlantic bight, is ranked third. The NJ WEA (Zone 8) is sixth of seven in revenue per hour fished, but is still the destination for nearly 10 percent of all trips.

Shifts in effort have been observed in the clam fishery since 2007, with a decline in overall trips, hours, and revenue, especially from Zone 4 and Zone 8 (the Southwestern half of the mid-Atlantic bight and the NJ WEA). Figure II-x shows the revenue per year by zone. Zone 3 (southern New England) and Zone 5 have seen slight increases in revenue since 2011.

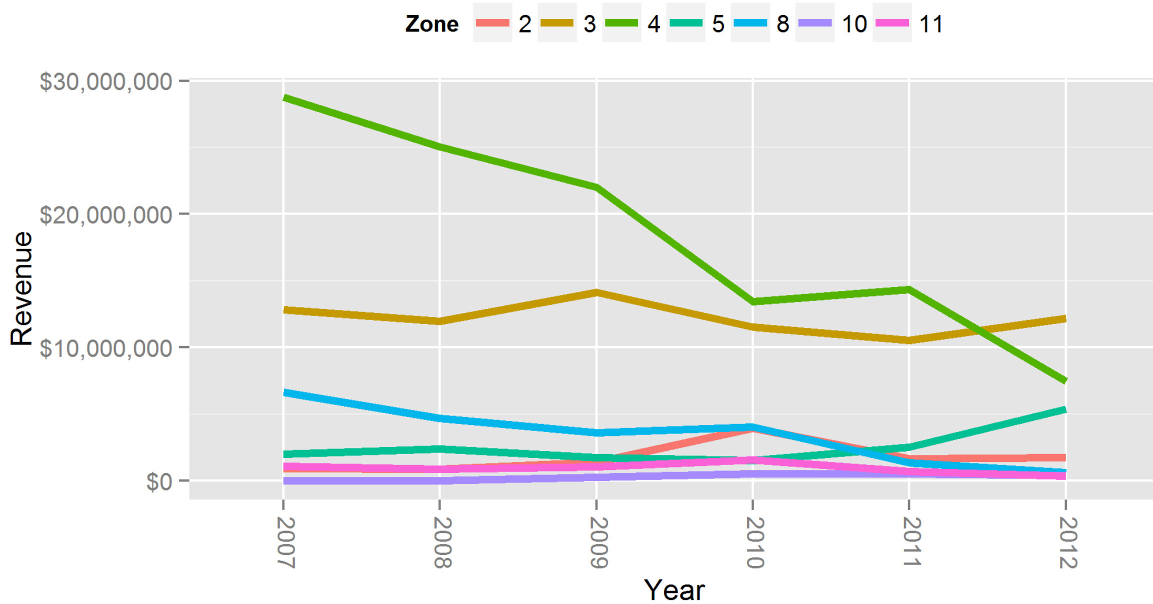


Figure II-x. Total revenue per year by zone—Cluster 3.

Zone 8 (NJ WEA) has seen a steady decline in revenue per hour fished over the study period, as have most other zones. Zones 3 and 5 are the only zones that have remained relatively steady since 2007 (Figure II-xi).

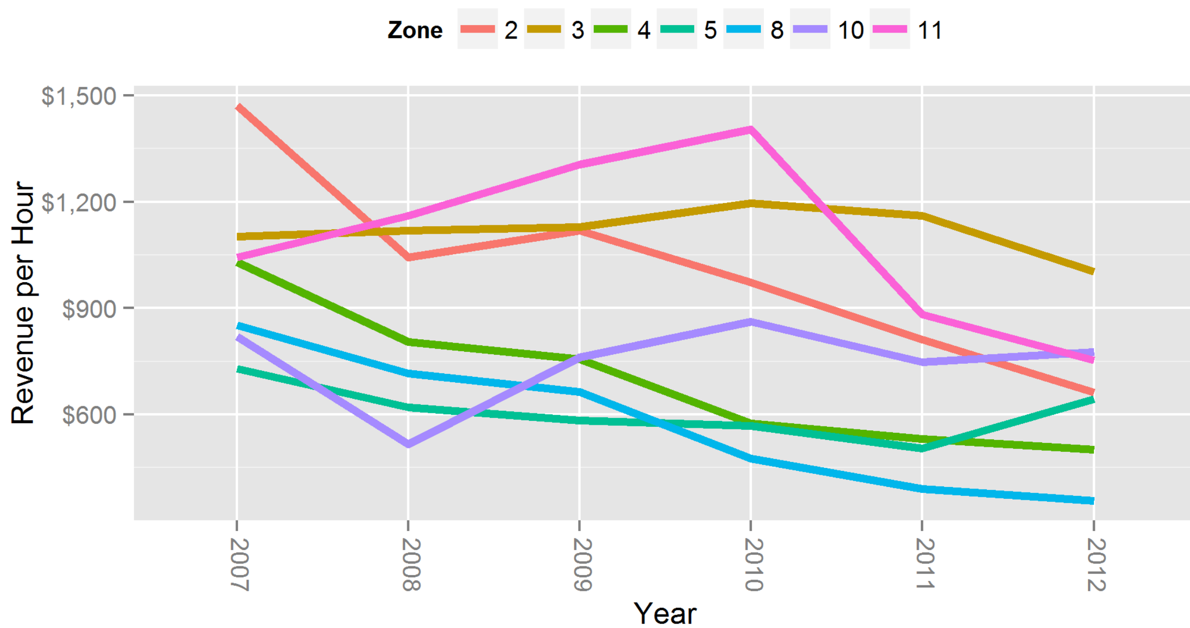


Figure II-xi. Revenue per hour by zone—Cluster 3.

II.iii.i Revenue Estimates

For Cluster 3, the specification for revenue is as follows (trip subscripts are suppressed for compactness):

$$\ln(Revenue)_{myztp} = \beta_0 + \beta_1\ Month + \ \beta_2\ Year + \ \beta_3\ Zone + \ \beta_5\ Month \times Year + \ \beta_4\ Zone \times Year + \ \beta_5\ Time + \ \beta_7\ Time\ Fished + \ \beta_8\ Time\ Fished^2 + \ \beta_9 Time\ Fished \times Permit + \ \beta_{10}\ Permit$$

Where $\ln(Revenue)_{myzp}$ is log-transformed revenue for a trip occurring in quarter *q,* year *y,* zone *z,* with permit *p* and at time *t. Zone* is the discrete zone in which the trip occurred, *Time* is the time at sea in hours, *Time Fished* is the reported fishing time, and *Permit* is a categorical variable for vessel permit. Gear is omitted as all trips use a hydraulic clam dredge.

The result is a multi-way fixed effect model over permit, zone, month, and year. Interactions between year-month and zone-year allow for heterogeneous catch over time periods and zones. The interaction of *Time Fished* and *Permit* allow for vessel specific efficiencies in catch. Outliers were identified using Cook's Distance and were omitted from parameter estimates. Parameter estimates (with *Permit* fixed effects and *Permit × Time Fished* omitted for confidentiality) are shown in Table II-xix.

Table II-xix. Cluster 3 ln(revenue) model parameter estimates.

Variable	Estimate	Std. Error	t Value	Pr(> |t|)
(Intercept)	8.35	0.06	137.10	0.00
factor(MONTH)2	0.07	0.03	2.37	0.02
factor(MONTH)3	0.06	0.03	2.17	0.03
factor(MONTH)4	0.07	0.03	2.39	0.02
factor(MONTH)5	0.05	0.03	2.02	0.04
factor(MONTH)6	-0.01	0.03	-0.42	0.68
factor(MONTH)7	0.04	0.03	1.40	0.16
factor(MONTH)8	0.03	0.03	1.06	0.29
factor(MONTH)9	0.02	0.03	0.67	0.50
factor(MONTH)10	0.03	0.03	1.22	0.22
factor(MONTH)11	-0.08	0.03	-2.77	0.01
factor(MONTH)12	-0.04	0.03	-1.23	0.22
factor(YEAR)2008	0.07	0.06	1.05	0.29
factor(YEAR)2009	0.12	0.06	1.99	0.05
factor(YEAR)2010	0.05	0.06	0.99	0.32
factor(YEAR)2011	0.00	0.06	0.04	0.97
factor(YEAR)2012	-0.10	0.06	-1.74	0.08
factor(ZONE)3	-0.01	0.04	-0.32	0.75
factor(ZONE)4	0.19	0.05	4.07	0.00
factor(ZONE)5	0.03	0.05	0.48	0.63
factor(ZONE)8	0.12	0.05	2.53	0.01
factor(ZONE)10	-0.19	0.18	-1.09	0.28
factor(ZONE)11	-0.04	0.05	-0.73	0.46
TIME	0.01	0.00	17.89	0.00
$TIMEFISHED^2$	-0.00	0.00	-58.21	0.00
TIMEFISHED	0.08	0.00	45.67	0.00
factor(MONTH)2:factor(YEAR)2008	-0.11	0.04	-2.58	0.01
factor(MONTH)3:factor(YEAR)2008	-0.13	0.04	-3.29	0.00
factor(MONTH)4:factor(YEAR)2008	-0.15	0.04	-3.93	0.00

Variable	Estimate	Std. Error	t Value	Pr(> |t|)
factor(MONTH)5:factor(YEAR)2008	-0.18	0.04	-4.87	0.00
factor(MONTH)6:factor(YEAR)2008	-0.12	0.04	-3.30	0.00
factor(MONTH)7:factor(YEAR)2008	-0.26	0.04	-7.09	0.00
factor(MONTH)8:factor(YEAR)2008	-0.20	0.04	-5.42	0.00
factor(MONTH)9:factor(YEAR)2008	-0.21	0.04	-5.61	0.00
factor(MONTH)10:factor(YEAR)2008	-0.21	0.04	-5.73	0.00
factor(MONTH)11:factor(YEAR)2008	-0.06	0.04	-1.42	0.16
factor(MONTH)12:factor(YEAR)2008	-0.12	0.04	-2.89	0.00
factor(MONTH)2:factor(YEAR)2009	-0.00	0.04	-0.09	0.93
factor(MONTH)3:factor(YEAR)2009	-0.03	0.04	-0.81	0.42
factor(MONTH)4:factor(YEAR)2009	-0.02	0.04	-0.65	0.51
factor(MONTH)5:factor(YEAR)2009	-0.08	0.04	-2.09	0.04
factor(MONTH)6:factor(YEAR)2009	0.07	0.04	1.88	0.06
factor(MONTH)7:factor(YEAR)2009	-0.00	0.04	-0.13	0.90
factor(MONTH)8:factor(YEAR)2009	-0.06	0.04	-1.59	0.11
factor(MONTH)9:factor(YEAR)2009	-0.04	0.04	-0.96	0.34
factor(MONTH)10:factor(YEAR)2009	-0.02	0.04	-0.49	0.63
factor(MONTH)11:factor(YEAR)2009	0.09	0.04	2.19	0.03
factor(MONTH)12:factor(YEAR)2009	-0.09	0.04	-2.30	0.02
factor(MONTH)2:factor(YEAR)2010	-0.15	0.04	-3.53	0.00
factor(MONTH)3:factor(YEAR)2010	-0.06	0.04	-1.66	0.10
factor(MONTH)4:factor(YEAR)2010	-0.08	0.04	-2.12	0.03
factor(MONTH)5:factor(YEAR)2010	-0.05	0.04	-1.25	0.21
factor(MONTH)6:factor(YEAR)2010	-0.00	0.04	-0.06	0.95
factor(MONTH)7:factor(YEAR)2010	-0.15	0.04	-3.95	0.00
factor(MONTH)8:factor(YEAR)2010	-0.09	0.04	-2.51	0.01
factor(MONTH)9:factor(YEAR)2010	-0.15	0.04	-4.05	0.00
factor(MONTH)10:factor(YEAR)2010	-0.08	0.04	-2.14	0.03
factor(MONTH)11:factor(YEAR)2010	-0.05	0.04	-1.26	0.21
factor(MONTH)12:factor(YEAR)2010	-0.10	0.04	-2.55	0.01
factor(MONTH)2:factor(YEAR)2011	-0.03	0.04	-0.77	0.44
factor(MONTH)3:factor(YEAR)2011	-0.05	0.04	-1.24	0.21
factor(MONTH)4:factor(YEAR)2011	-0.18	0.04	-4.41	0.00
factor(MONTH)5:factor(YEAR)2011	-0.12	0.04	-3.21	0.00
factor(MONTH)6:factor(YEAR)2011	-0.04	0.04	-1.03	0.30
factor(MONTH)7:factor(YEAR)2011	-0.10	0.04	-2.48	0.01
factor(MONTH)8:factor(YEAR)2011	-0.13	0.04	-3.46	0.00
factor(MONTH)9:factor(YEAR)2011	-0.11	0.04	-2.76	0.01
factor(MONTH)10:factor(YEAR)2011	-0.18	0.04	-4.54	0.00
factor(MONTH)11:factor(YEAR)2011	-0.07	0.04	-1.71	0.09
factor(MONTH)12:factor(YEAR)2011	-0.07	0.04	-1.79	0.07
factor(MONTH)2:factor(YEAR)2012	-0.03	0.04	-0.68	0.50
factor(MONTH)3:factor(YEAR)2012	-0.01	0.04	-0.19	0.85
factor(MONTH)4:factor(YEAR)2012	0.01	0.04	0.13	0.89
factor(MONTH)5:factor(YEAR)2012	-0.01	0.04	-0.32	0.75
factor(MONTH)6:factor(YEAR)2012	0.05	0.04	1.15	0.25
factor(MONTH)7:factor(YEAR)2012	-0.05	0.04	-1.11	0.27
factor(MONTH)8:factor(YEAR)2012	-0.00	0.04	-0.10	0.92
factor(MONTH)9:factor(YEAR)2012	-0.02	0.04	-0.42	0.67
factor(MONTH)10:factor(YEAR)2012	-0.04	0.04	-0.98	0.32
factor(MONTH)11:factor(YEAR)2012	0.02	0.04	0.45	0.65
factor(MONTH)12:factor(YEAR)2012	0.02	0.04	0.37	0.71
factor(YEAR)2008:factor(ZONE)3	-0.01	0.06	-0.11	0.91
factor(YEAR)2009:factor(ZONE)3	-0.18	0.05	-3.29	0.00
factor(YEAR)2010:factor(ZONE)3	-0.11	0.05	-2.14	0.03

Variable	Estimate	Std. Error	t Value	Pr(> |t|)
factor(YEAR)2011:factor(ZONE)3	-0.11	0.05	-2.15	0.03
factor(YEAR)2012:factor(ZONE)3	-0.10	0.05	-1.84	0.07
factor(YEAR)2008:factor(ZONE)4	-0.15	0.06	-2.47	0.01
factor(YEAR)2009:factor(ZONE)4	-0.37	0.05	-7.17	0.00
factor(YEAR)2010:factor(ZONE)4	-0.43	0.05	-8.89	0.00
factor(YEAR)2011:factor(ZONE)4	-0.51	0.05	-9.98	0.00
factor(YEAR)2012:factor(ZONE)4	-0.48	0.05	-9.12	0.00
factor(YEAR)2008:factor(ZONE)5	-0.04	0.07	-0.54	0.59
factor(YEAR)2009:factor(ZONE)5	-0.25	0.06	-4.08	0.00
factor(YEAR)2010:factor(ZONE)5	-0.19	0.06	-3.17	0.00
factor(YEAR)2011:factor(ZONE)5	-0.21	0.06	-3.67	0.00
factor(YEAR)2012:factor(ZONE)5	-0.08	0.06	-1.29	0.20
factor(YEAR)2008:factor(ZONE)8	-0.16	0.06	-2.59	0.01
factor(YEAR)2009:factor(ZONE)8	-0.35	0.06	-6.36	0.00
factor(YEAR)2010:factor(ZONE)8	-0.41	0.05	-7.95	0.00
factor(YEAR)2011:factor(ZONE)8	-0.58	0.06	-10.14	0.00
factor(YEAR)2012:factor(ZONE)8	-0.56	0.06	-8.74	0.00
factor(YEAR)2008:factor(ZONE)10	-0.18	0.30	-0.61	0.54
factor(YEAR)2009:factor(ZONE)10	0.02	0.19	0.11	0.91
factor(YEAR)2010:factor(ZONE)10	0.14	0.18	0.77	0.44
factor(YEAR)2011:factor(ZONE)10	0.10	0.19	0.55	0.58
factor(YEAR)2012:factor(ZONE)10	0.15	0.19	0.78	0.43
factor(YEAR)2008:factor(ZONE)11	-0.09	0.08	-1.08	0.28
factor(YEAR)2009:factor(ZONE)11	-0.25	0.08	-3.39	0.00
factor(YEAR)2010:factor(ZONE)11	0.00	0.07	0.00	1.00
factor(YEAR)2011:factor(ZONE)11	-0.03	0.07	-0.47	0.64
factor(YEAR)2012:factor(ZONE)11	-0.08	0.08	-1.01	0.31
Observations	11,569			
Log Likelihood	-113443.5			
Akaike Inf. Crit.	227215			

Figure II-xii shows the probability densities of the actual and estimated revenues. Revenues net of variable costs (RNVC) are generated using cost estimates described in previous sections. Densities of expected RNVC are shown in the subsequent figure (Figure II-xiii).

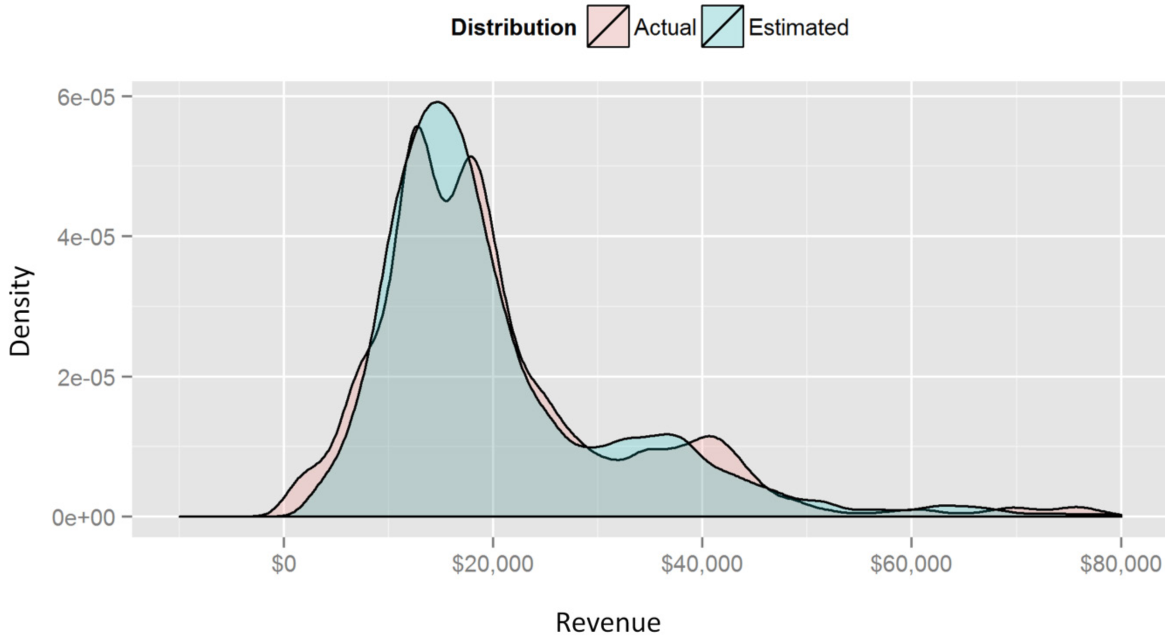


Figure II-xii. Distribution of actual and estimated revenue for Cluster 3.

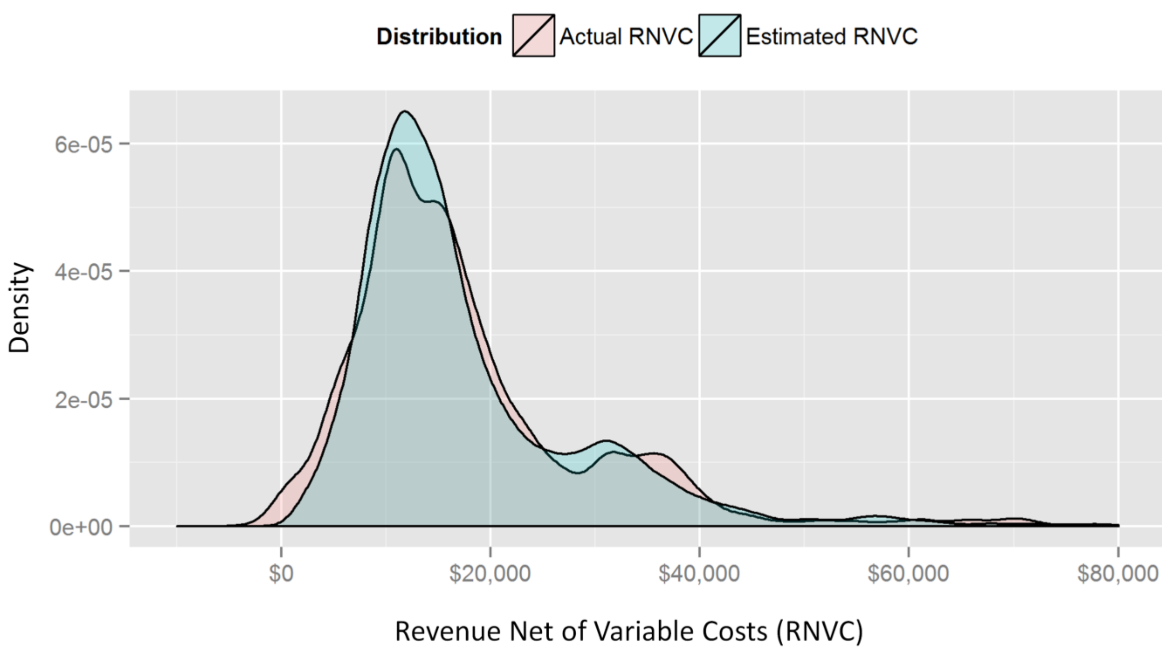


Figure II-xiii. Distribution of actual and estimated Revenue Net of Variable Costs (RNVC) for Cluster 3.

Unconditional revenue estimates—estimates of revenue for every trip-zone combination not limited to trips actually taken—are presented in Figure II-xiv. Outliers are not plotted for compactness. Based on observed data, the average revenue per hour for a trip to Zone 8 (NJ WEA) is considerably lower, all other factors held equal. Zones 4 and 5, the zones bordering Zone 8, are higher in revenue per hour, indicating the likelihood of an improved catch per hour fished from moving out of Zone 8. Figure II-xiv values are exclusive of costs.

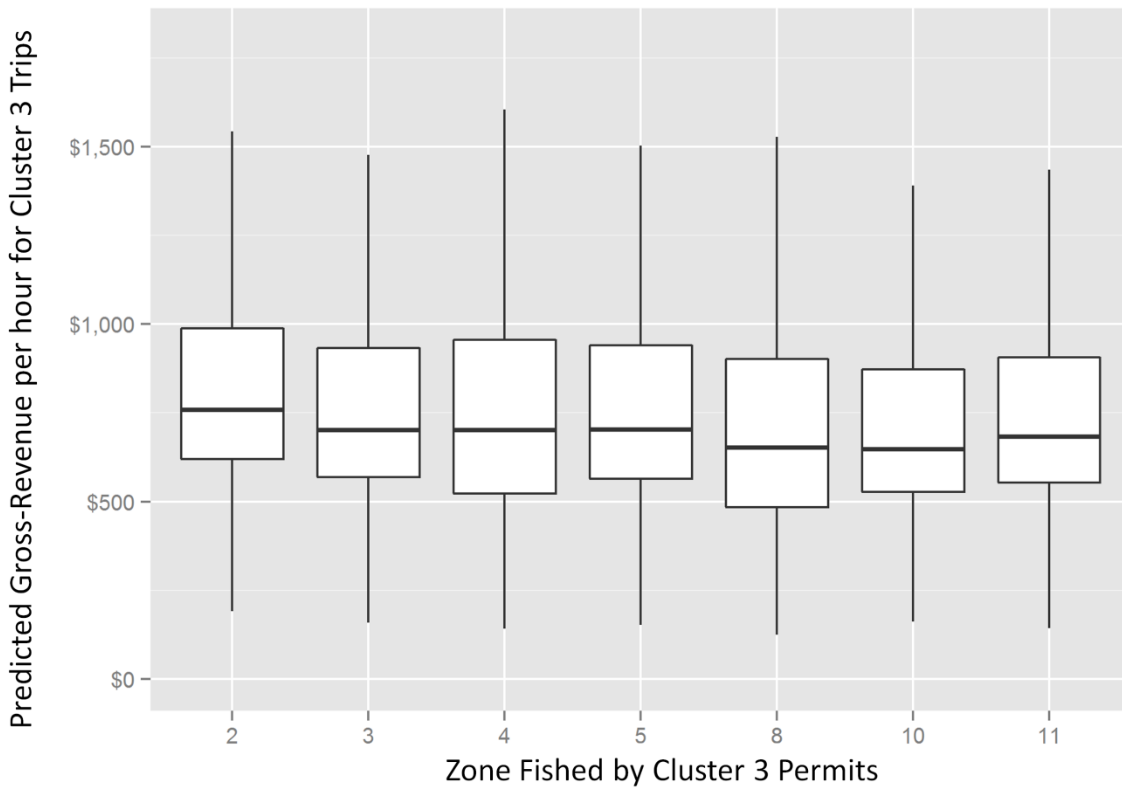


Figure II-xiv. Estimated (unconditional) gross revenue per hour—Cluster 3.

II.iii.ii Location Choice Model

Table II-xx presents the results of the location choice model. Parameters for the location choice model include wind speed, surfclam and ocean quahog prices, and *ever-visit*, a variable indicating the shares of areas visited by the vessel over the entire dataset. Revenues Net of Variable Cost (RNVC) was estimated as a random parameter with a log-normal specification. Transforming the coefficient for RNVC to a normal distribution yields a mean estimate of 0.00030. All parameters are consistent with expectations—RNVC is significant and positive (fishermen choose areas with higher net revenues, *ceteris paribus*), and wind speed is negative, but not significant in this case.

Table II-xx. Location choice model parameter estimates for Cluster 3 (with Zone 2 as the reference zone).

Variable	Estimate	Std. Error	t Value	Pr(> |t|)
Zone 3 Intercept	12.78	1.06	12.10	0.00
Zone 4 Intercept	4.32	1.27	3.41	0.00
Zone 5 Intercept	3.76	1.53	2.46	0.01
Zone 8 Intercept	9.42	1.38	6.84	0.00
Zone 10 Intercept	2.89	2.64	1.10	0.27
Zone 11 Intercept	14.96	1.64	9.11	0.00
RNVC	-8.10	0.03	-263.64	0.00
Std. Dev. RNVC Parameter	-0.03	0.14	-0.18	0.86
Wind Speed	-0.01	0.05	-0.26	0.79
Ever-Visit	4.20	0.06	67.39	0.00
3: SF Price	-0.08	0.05	-1.64	0.10
4: SF Price	-0.26	0.05	-4.98	0.00

Variable	Estimate	Std. Error	t Value	Pr(> |t|)
5: SF Price	-0.28	0.06	-4.47	0.00
8: SF Price	-0.38	0.06	-6.10	0.00
10: SF Price	-0.08	0.10	-0.88	0.38
11: SF Price	-0.04	0.07	-0.56	0.57
3: Q Price	-1.62	0.14	-11.97	0.00
4: Q Price	-0.02	0.17	-0.11	0.91
5: Q Price	0.10	0.20	0.49	0.62
8: Q Price	-0.46	0.18	-2.55	0.01
10: Q Price	-0.33	0.34	-0.95	0.34
11: Q Price	-2.10	0.22	-9.50	0.00
Log Likelihood	-9401.7			
AIC	18847			
McFadden R^2	.432			

The model was run with a specification that omitted the surfclam and ocean quahog prices (equivalent to constraining these parameters to zero). AIC is minimized in the unconstrained model, and a score test strongly rejected the constrained model in favor of the unconstrained model.

Model results are then used to calculate a discrete distribution of choice probabilities for each trip. Table II-xxi reports the predicted and actual choice shares for each zone in the model. Predicted shares are very close to actual shares with a maximum difference of -0.00121 percent (Zone 2). Zones 8, 10, and 11, which contain the WEAs, are predicted nearly perfectly. The model predicts the chosen zone correctly 72.4 percent of the time.

Table II-xxi. Actual and predicted trip shares by zone fished for Cluster 3 trips.

Zone	Predicted	Actual	Difference
2	5.5%	5.5%	0.00121%
3	26.2%	26.2%	-0.00034%
4	47.1%	47.1%	-0.00083%
5	8.3%	8.3%	-0.00007%
8	10.0%	10.0%	-0.00006%
10	0.9%	0.9%	0.00002%
11	2.0%	2.0%	0.00008%

II.iv Cluster 4

Cluster 4 encompasses 166 permits that landed on Roanoke Island an average of more than twice a year. These 166 permits average 2.53 percent exposure and account for 5.70 percent of all exposed revenue in the study area. Many permits fishing in the vicinity of the NC Calls are seasonal in the area and spend a large portion of the year in the Mid-Atlantic bight or Georges Bank. These permits often hold scallop permits or other limited access permits and thus have choice sets (and observed revenues) that are not relevant to permits that primarily land year-round in the VA/NC/SC region.

To refine Cluster 4 onto permits commonly fishing in the federal waters near the North Carolina outer banks, a subset of 15,943 trips over 131 permits were selected using the following criteria: Trips are taken only from permits landing (1) greater than 50 percent of all revenue in Virginia, North Carolina, or South Carolina; (2) landing greater than twice per year on Roanoke Island, NC; and (3) trips (from these permits) landing in Virginia, North Carolina, or South Carolina (Table II-xxii). These trips have an average exposure of 4.9 percent and represent nearly 3 percent of all exposed revenue in the study area.

Table II-xxii. Refining the Northern NC Cluster (Cluster 4).

Description of Cluster Definition	Original	Refined
	Permits Landing >2 Times per Year on Average on Roanoke Island	Permits That Land >50% of Revenue in VA, NC, or SC *and* Land at Least Twice per Year Average on Roanoke Island; from These Permits, Select Trips Landing in VA, NC, or SC
Unique Permits	166	131
Unique Trips	22,639	15,943
Total Revenue	$190.3 Million	$51.2 Million
Exposed Revenue	$4.8 Million	$2.5 Million
Percent of Total Revenue Exposed	2.5%	4.9%
Share of Total Exposed Revenue Represented (of $84.2 Million)	5.7%	3.0%

Note: Dollar values are in $US 2012.

Of these 15,943 trips, none reported zero revenue. The top and bottom 1 percent of trips by revenue per hour were dropped to eliminate outliers. Zones 9 (Southwest NC Call, 37 trips), 12 (VA WEA, 3 trips), and 16 (NY WEA, 1 trip) were dropped due to insufficient reported trips. Summary statistics on the remaining 15,584 trips are shown in Table II-xxiii and Table II-xxiv.

Table II-xxiii. Summary statistics for Cluster 4.

Statistic	N	Mean	St. Dev.	Min	Max
Revenue	15,584	3,081.65	5,966.98	10.00	87,967.73
Time	15,584	34.96	28.61	0.52	313.38
Revenue per Hour	15,584	74.65	100.60	0.77	899.95
Length	15,584	44.37	12.88	28.00	92.00
Gross Tons	15,584	30.70	36.06	4.00	172.00
Average Fuel Price	15,584	3.25	0.60	1.83	5.33
Season = Winter	15,584	0.43	—	—	—

Table II-xxiv. Summary revenue/zone statistics for Cluster 4.

Zone	Trips	Zone Share	Share—Mobile Gears	Share—Fixed Gears	Avg. Rev. per Hour—Mobile Gears	Avg. Rev. per Hour—Fixed Gears	Avg. Rev. per Trip—Mobile Gears	Avg. Rev. per Trip—Fixed Gears
1	247	1.6%	100%	—	$189.61	—	$23,770.97	—
2	137	0.9%	100%	—	$203.70	—	$23,953.65	—
3	176	1.1%	98.3%	1.7%	$183.86	$38.31	$18,114.48	$919.51
4	701	4.5%	48.2%	51.8%	$175.40	$91.15	$9,438.26	$2,043.16
5	574	3.7%	37.1%	62.9%	$189.35	$66.54	$9,814.92	$2,087.91
6	12,140	77.9%	24.5%	75.5%	$92.45	$55.18	$4,036.43	$1,536.61
7	236	1.5%	35.6%	64.4%	$39.59	$38.88	$1,202.39	$1,313.72
8	497	3.2%	49.3%	50.7%	$37.30	$20.52	$1,213.00	$537.46
11	876	5.6%	60%	40%	$104.12	$58.57	$3,046.10	$1,526.29

Note: Dollar values are in $US 2012.

Figure II-xv shows the grids used in modeling Cluster 4 as well as the fishing centroids used to calculate distance. Revenue intensity is also shown for the trips modeled. Grid areas without labeled centroids had insufficient trips in the dataset and were excluded from further study. The primary landing ports for the cluster are labeled.

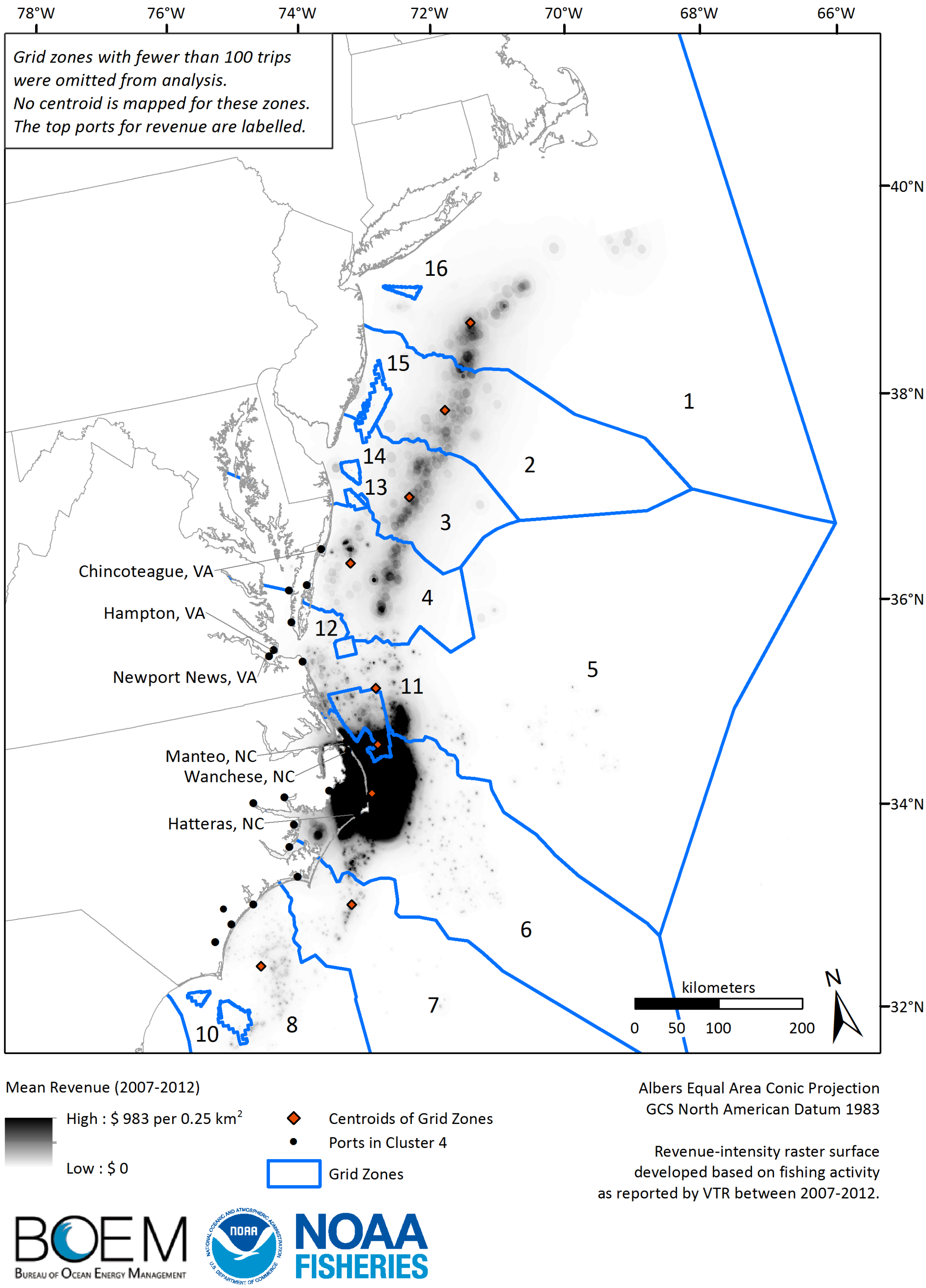


Figure II-xv. Grid, centroids, ports and revenue intensity—Cluster 4.

Zone 11, the Northern NC Call, is the only WEA with sufficient trips for further study. With an average revenue per hour of $87.17 ($104.12 per hour for mobile gears, $58.57 per hour for fixed gears), this area has lower average revenue per hour when compared to areas to the north, including

Zone 5 ($189.35 for mobile gears, $66.54 for fixed gears, $127.16 for both gears combined), which borders Zone 11 to the north. The southern reaches of the study area are, on a per-hour basis, generally less productive. Figure II-xv shows the grids used in modeling Cluster 4 as well as the fishing centroids used to calculate distance. Revenue intensity is also shown for the trips modeled. Grid areas without labeled centroids had insufficient trips in the set and were dropped. The primary landing ports for Cluster 4 are labeled; by definition of Cluster 4, all landings are in VA, NC, or SC.

II.iv.i Revenue Estimates

For Cluster 4, the revenue model specification is as follows (trip subscripts are suppressed for compactness):

$$\ln(Revenue)_{myztp} = \beta_0 + \beta_1\, Month + \beta_2\, Year + \beta_3\, Month \times Year + \beta_4\, Gear + \beta_5\, Month \times Gear + \beta_6\, Zone + \beta_7\, Time + \beta_8\, Time^2 + \beta_9 Permit + \beta_{10}\, Source$$

Where $\ln(Revenue)_{myzgp}$ is log-transformed revenue for a trip occurring in quarter *q,* year *y,* zone *z,* with permit *p,* gear *g,* and at time *t. Zone* is the discrete zone in which the trip occurred, *Time* is the time at sea in hours, *Gear* is the reported gear fished, and *Permit* is a categorical variable for vessel permit.

The result is a multi-way fixed effect model over permit, zone, month, and year. Interactions between year-month and zone-year allow for heterogeneous catch over time periods and zones. The interaction of *Time Fished* and *Permit* allow for vessel specific efficiencies in catch. Outliers were identified using Cook's Distance and were omitted from parameter estimates. Parameter estimates (with *Permit* fixed effects omitted for confidentiality) are shown in Table II-xxv.

Table II-xxv. Cluster 4 ln(revenue) model parameter estimates.

Variable	Estimate	Std. Error	t Value	Pr(> |t|)
Intercept	6.931	0.144	48.243	0.000
factor(MONTH)2	0.220	0.099	2.220	0.026
factor(MONTH)3	0.384	0.094	4.103	0.000
factor(MONTH)4	-0.053	0.110	-0.486	0.627
factor(MONTH)5	-0.258	0.097	-2.662	0.008
factor(MONTH)6	-0.381	0.099	-3.866	0.000
factor(MONTH)7	-0.392	0.104	-3.778	0.000
factor(MONTH)8	-0.419	0.111	-3.783	0.000
factor(MONTH)9	-0.138	0.101	-1.368	0.171
factor(MONTH)10	0.188	0.086	2.174	0.030
factor(MONTH)11	0.128	0.089	1.441	0.150
factor(MONTH)12	-0.017	0.092	-0.190	0.849
factor(YEAR)2008	0.242	0.088	2.741	0.006
factor(YEAR)2009	-0.146	0.081	-1.795	0.073
factor(YEAR)2010	-0.183	0.080	-2.286	0.022
factor(YEAR)2011	0.176	0.079	2.239	0.025
factor(YEAR)2012	-0.064	0.082	-0.778	0.437
Gear = HAND	0.014	0.111	0.128	0.898
Gear = LONGLINE	0.404	0.175	2.310	0.021
Gear = TRAWL BOTTOM	-0.028	0.285	-0.097	0.923
Gear = TRAWL MID	-0.024	0.078	-0.304	0.761
factor(ZONE)2	0.074	0.098	0.754	0.451
factor(ZONE)3	-0.118	0.090	-1.312	0.190

Variable	Estimate	Std. Error	t Value	Pr(> |t|)
factor(ZONE)4	-0.088	0.078	-1.120	0.263
factor(ZONE)5	-0.108	0.085	-1.266	0.206
factor(ZONE)6	-0.348	0.078	-4.474	0.000
factor(ZONE)7	-0.366	0.104	-3.534	0.000
factor(ZONE)8	-0.167	0.100	-1.666	0.096
factor(ZONE)11	-0.348	0.083	-4.202	0.000
TIME	0.022	0.001	23.371	0.000
$TIME^2$	-0.000	0.000	-13.687	0.000
Source = VTR	-0.654	0.052	-12.657	0.000
factor(MONTH)2:factor(YEAR)2008	0.089	0.130	0.681	0.496
factor(MONTH)3:factor(YEAR)2008	-0.192	0.131	-1.471	0.141
factor(MONTH)4:factor(YEAR)2008	0.110	0.144	0.759	0.448
factor(MONTH)5:factor(YEAR)2008	0.100	0.125	0.795	0.426
factor(MONTH)6:factor(YEAR)2008	-0.444	0.126	-3.520	0.000
factor(MONTH)7:factor(YEAR)2008	-0.380	0.134	-2.831	0.005
factor(MONTH)8:factor(YEAR)2008	-0.419	0.134	-3.126	0.002
factor(MONTH)9:factor(YEAR)2008	-0.383	0.147	-2.604	0.009
factor(MONTH)10:factor(YEAR)2008	-0.349	0.109	-3.202	0.001
factor(MONTH)11:factor(YEAR)2008	-0.536	0.108	-4.954	0.000
factor(MONTH)12:factor(YEAR)2008	-0.341	0.110	-3.115	0.002
factor(MONTH)2:factor(YEAR)2009	0.123	0.123	0.999	0.318
factor(MONTH)3:factor(YEAR)2009	-0.205	0.120	-1.714	0.087
factor(MONTH)4:factor(YEAR)2009	0.342	0.130	2.630	0.009
factor(MONTH)5:factor(YEAR)2009	0.559	0.118	4.732	0.000
factor(MONTH)6:factor(YEAR)2009	-0.086	0.119	-0.724	0.469
factor(MONTH)7:factor(YEAR)2009	-0.107	0.124	-0.862	0.389
factor(MONTH)8:factor(YEAR)2009	0.151	0.128	1.175	0.240
factor(MONTH)9:factor(YEAR)2009	0.164	0.120	1.365	0.172
factor(MONTH)10:factor(YEAR)2009	0.018	0.107	0.165	0.869
factor(MONTH)11:factor(YEAR)2009	0.201	0.106	1.894	0.058
factor(MONTH)12:factor(YEAR)2009	-0.278	0.106	-2.630	0.009
factor(MONTH)2:factor(YEAR)2010	0.132	0.121	1.089	0.276
factor(MONTH)3:factor(YEAR)2010	-0.137	0.116	-1.180	0.238
factor(MONTH)4:factor(YEAR)2010	0.325	0.127	2.568	0.010
factor(MONTH)5:factor(YEAR)2010	0.361	0.114	3.159	0.002
factor(MONTH)6:factor(YEAR)2010	0.030	0.116	0.255	0.798
factor(MONTH)7:factor(YEAR)2010	0.047	0.119	0.392	0.695
factor(MONTH)8:factor(YEAR)2010	0.251	0.126	1.992	0.046
factor(MONTH)9:factor(YEAR)2010	0.293	0.129	2.272	0.023
factor(MONTH)10:factor(YEAR)2010	-0.294	0.108	-2.728	0.006
factor(MONTH)11:factor(YEAR)2010	-0.005	0.116	-0.044	0.965
factor(MONTH)12:factor(YEAR)2010	0.182	0.117	1.559	0.119
factor(MONTH)2:factor(YEAR)2011	-0.450	0.120	-3.743	0.000
factor(MONTH)3:factor(YEAR)2011	-0.271	0.117	-2.307	0.021
factor(MONTH)4:factor(YEAR)2011	-0.361	0.137	-2.629	0.009
factor(MONTH)5:factor(YEAR)2011	-0.121	0.113	-1.074	0.283
factor(MONTH)6:factor(YEAR)2011	-0.559	0.126	-4.436	0.000
factor(MONTH)7:factor(YEAR)2011	-0.193	0.121	-1.598	0.110
factor(MONTH)8:factor(YEAR)2011	-0.200	0.129	-1.548	0.122
factor(MONTH)9:factor(YEAR)2011	-0.377	0.125	-3.012	0.003
factor(MONTH)10:factor(YEAR)2011	-0.646	0.108	-5.953	0.000
factor(MONTH)11:factor(YEAR)2011	-0.125	0.103	-1.206	0.228
factor(MONTH)12:factor(YEAR)2011	-0.471	0.108	-4.350	0.000
factor(MONTH)2:factor(YEAR)2012	-0.025	0.124	-0.199	0.842
factor(MONTH)3:factor(YEAR)2012	-0.120	0.119	-1.009	0.313

Variable	Estimate	Std. Error	t Value	Pr(> |t|)
factor(MONTH)4:factor(YEAR)2012	0.406	0.138	2.934	0.003
factor(MONTH)5:factor(YEAR)2012	0.458	0.120	3.809	0.000
factor(MONTH)6:factor(YEAR)2012	-0.053	0.124	-0.425	0.671
factor(MONTH)7:factor(YEAR)2012	-0.176	0.142	-1.233	0.218
factor(MONTH)8:factor(YEAR)2012	0.152	0.137	1.110	0.267
factor(MONTH)9:factor(YEAR)2012	-0.112	0.131	-0.854	0.393
factor(MONTH)10:factor(YEAR)2012	-0.378	0.119	-3.185	0.001
factor(MONTH)11:factor(YEAR)2012	-0.016	0.142	-0.112	0.911
factor(MONTH)12:factor(YEAR)2012	-0.031	0.138	-0.226	0.821
factor(MONTH)2:factor(GEARCAT2)HAND	-0.358	0.188	-1.902	0.057
factor(MONTH)3:factor(GEARCAT2)HAND	-0.260	0.162	-1.598	0.110
factor(MONTH)4:factor(GEARCAT2)HAND	-0.193	0.140	-1.379	0.168
factor(MONTH)5:factor(GEARCAT2)HAND	-0.028	0.135	-0.211	0.833
factor(MONTH)6:factor(GEARCAT2)HAND	0.592	0.136	4.342	0.000
factor(MONTH)7:factor(GEARCAT2)HAND	0.700	0.142	4.909	0.000
factor(MONTH)8:factor(GEARCAT2)HAND	0.524	0.142	3.683	0.000
factor(MONTH)9:factor(GEARCAT2)HAND	0.143	0.178	0.803	0.422
factor(MONTH)10:factor(GEARCAT2)HAND	0.181	0.172	1.050	0.294
factor(MONTH)11:factor(GEARCAT2)HAND	0.442	0.138	3.204	0.001
factor(MONTH)12:factor(GEARCAT2)HAND	0.272	0.136	1.997	0.046
factor(MONTH)2:factor(GEARCAT2)LONGLINE	0.055	0.252	0.220	0.826
factor(MONTH)3:factor(GEARCAT2)LONGLINE	-0.356	0.257	-1.384	0.166
factor(MONTH)4:factor(GEARCAT2)LONGLINE	0.070	0.225	0.309	0.757
factor(MONTH)5:factor(GEARCAT2)LONGLINE	0.137	0.193	0.709	0.478
factor(MONTH)6:factor(GEARCAT2)LONGLINE	0.690	0.193	3.584	0.000
factor(MONTH)7:factor(GEARCAT2)LONGLINE	0.488	0.191	2.556	0.011
factor(MONTH)8:factor(GEARCAT2)LONGLINE	0.406	0.190	2.141	0.032
factor(MONTH)9:factor(GEARCAT2)LONGLINE	0.064	0.201	0.317	0.751
factor(MONTH)10:factor(GEARCAT2)LONGLINE	0.118	0.209	0.563	0.573
factor(MONTH)11:factor(GEARCAT2)LONGLINE	-0.099	0.221	-0.450	0.653
factor(MONTH)12:factor(GEARCAT2)LONGLINE	-0.046	0.299	-0.155	0.877
factor(MONTH)2:factor(GEARCAT2)TRAWL BOTTOM	-0.185	0.083	-2.233	0.026
factor(MONTH)3:factor(GEARCAT2)TRAWL BOTTOM	-0.198	0.086	-2.302	0.021
factor(MONTH)4:factor(GEARCAT2)TRAWL BOTTOM	-0.137	0.118	-1.162	0.245
factor(MONTH)5:factor(GEARCAT2)TRAWL BOTTOM	-0.384	0.130	-2.961	0.003
factor(MONTH)6:factor(GEARCAT2)TRAWL BOTTOM	0.113	0.134	0.842	0.400
factor(MONTH)7:factor(GEARCAT2)TRAWL BOTTOM	0.118	0.101	1.166	0.244
factor(MONTH)8:factor(GEARCAT2)TRAWL BOTTOM	-0.348	0.100	-3.475	0.001
factor(MONTH)9:factor(GEARCAT2)TRAWL BOTTOM	-0.733	0.120	-6.099	0.000
factor(MONTH)10:factor(GEARCAT2)TRAWL BOTTOM	-0.738	0.095	-7.799	0.000
factor(MONTH)11:factor(GEARCAT2)TRAWL BOTTOM	-0.183	0.097	-1.883	0.060
factor(MONTH)12:factor(GEARCAT2)TRAWL BOTTOM	0.283	0.087	3.269	0.001
factor(MONTH)2:factor(GEARCAT2)TRAWL MID	-0.430	0.143	-3.019	0.003
factor(MONTH)3:factor(GEARCAT2)TRAWL MID	0.061	0.123	0.496	0.620
factor(MONTH)4:factor(GEARCAT2)TRAWL MID	-0.547	0.114	-4.810	0.000
factor(MONTH)5:factor(GEARCAT2)TRAWL MID	-0.154	0.109	-1.416	0.157
factor(MONTH)6:factor(GEARCAT2)TRAWL MID	0.888	0.110	8.098	0.000
factor(MONTH)7:factor(GEARCAT2)TRAWL MID	0.575	0.136	4.241	0.000
factor(MONTH)8:factor(GEARCAT2)TRAWL MID	0.304	0.140	2.172	0.030
factor(MONTH)9:factor(GEARCAT2)TRAWL MID	-0.057	0.154	-0.373	0.709
factor(MONTH)10:factor(GEARCAT2)TRAWL MID	0.101	0.094	1.065	0.287
factor(MONTH)11:factor(GEARCAT2)TRAWL MID	0.308	0.090	3.402	0.001
factor(MONTH)12:factor(GEARCAT2)TRAWL MID	0.115	0.092	1.251	0.211
Observations	15,581			
Log Likelihood	-129949			

Variable	Estimate	Std. Error	t Value	Pr(> |t|)
Akaike Inf. Crit.	260422			

Figure II-xvi shows the probability densities of the actual and estimated revenues. Revenues net of variable costs (RNVC) are generated using cost estimates described in previous sections. Densities of expected RNVC are shown in Figure II-xvii.

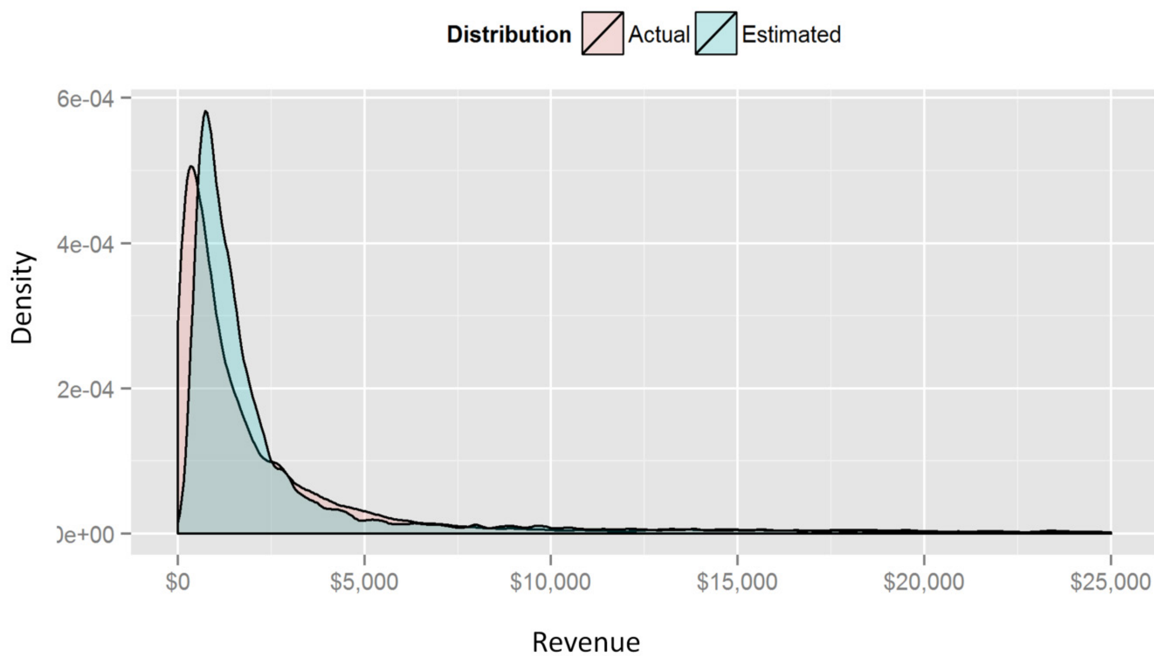


Figure II-xvi. Distribution of actual and estimated revenue for Cluster 4.

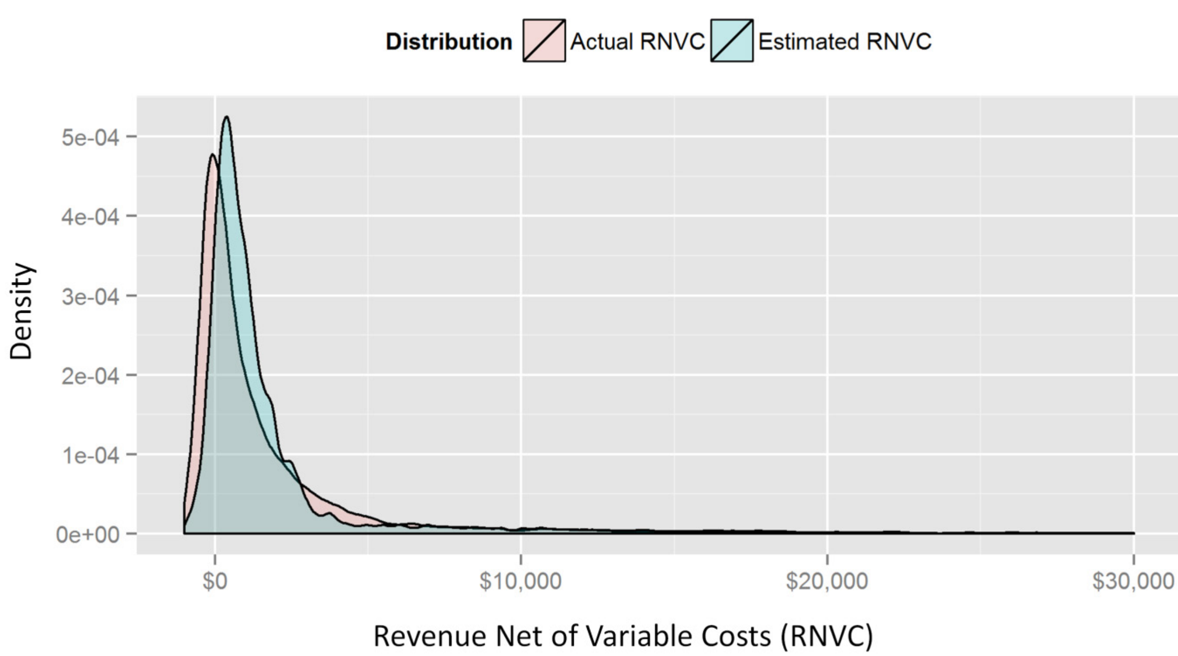


Figure II-xvii. Distribution of actual and estimated Revenue Net of Variable Costs (RNVC) for Cluster 4.

Estimated RNVC appears to be overpredicted in the low-$1000 range, and underpredicted in the mid-$4000 range. Notably, actual revenue minus predicted costs ("Actual RNVC") is below zero for a substantial portion of trips.

II.iv.ii Location Choice Model

Results of the Cluster 4 location choice model are presented in Table II-xxvi. Parameters for the location choice model include RNVC, wind speed, and *ever-visit*, a variable indicating the shares of areas visited by the vessel over the entire dataset. Revenues Net of Variable Cost (RNVC) is estimated as a random parameter with a log-normal specification. Transforming the coefficient for RNVC to a normal distribution yields a mean estimate of 0.00097. All parameters are consistent with expectations—RNVC is significant and positive (fishermen choose areas with higher net revenues, *ceteris paribus*), and wind speed is negative and significant.

Table II-xxvi. Location choice model parameter estimates for Cluster 4 (with Zone 1 as the reference zone).

Variable	Estimate	Std. Error	t Value	Pr(> |t|)
Zone 2 Intercept	-0.5619	1.2641	-0.44	0.6567
Zone 3 Intercept	-3.9813	0.9718	-4.10	0.0000
Zone 4 Intercept	0.3783	0.8035	0.47	0.6378
Zone 5 Intercept	2.1825	0.8115	2.69	0.0072
Zone 6 Intercept	0.0358	0.7946	0.05	0.9641
Zone 7 Intercept	2.3148	0.8784	2.64	0.0084
Zone 8 Intercept	8.4634	1.2917	6.55	0.0000
Zone 11 Intercept	2.1312	0.8067	2.64	0.0082
RNVC	-7.6157	0.0317	-240.29	0.0000
Std. Dev. RNVC Parameter	1.1722	0.0247	47.41	0.000
Wind Speed	-0.0259	0.0482	-0.54	0.5906
Ever-Visit	5.3714	0.0945	56.86	0.0000
2:Winter	-0.7107	0.2624	-2.71	0.0068
3:W. Winter	0.9850	0.2128	4.63	0.0000
4:W. Winter	-0.2508	0.1996	-1.26	0.2088
5:W. Winter	0.0425	0.2022	0.21	0.8337
6:W. Winter	0.7637	0.1797	4.25	0.0000
7:W. Winter	0.8469	0.2426	3.49	0.0005
8:W. Winter	-0.8938	0.2787	-3.21	0.0013
11:W. Winter	1.6304	0.1945	8.38	0.0000
2: Length	-0.0180	0.0171	-1.05	0.2936
3: Length	0.0365	0.0131	2.79	0.0052
4: Length	-0.0283	0.0110	-2.58	0.0098
5: Length	-0.0598	0.0111	-5.39	0.0000
6: Length	-0.0212	0.0105	-2.01	0.0440
7: Length	-0.0739	0.0142	-5.20	0.0000
8: Length	-0.2255	0.0291	-7.74	0.0000
11: Length	-0.0577	0.0109	-5.27	0.0000
Log Likelihood	-8535.81			
AIC	17127			
McFadden R^2	.423			

The model was run without including *ever-visit*. In this specification, AIC was not minimized and the models prediction of zone shares worsened.

Model results are then used to calculate a discrete distribution of choice probabilities for each trip. Table II-xxvii reports the predicted and actual choice shares for each zone in the model. Predicted shares are close to actual shares with a maximum difference of 1.3 percent (Zone 5). Zone 11, which contains the Northern NC Call, is predicted accurately. The model predicts the chosen zone correctly 83.2 percent of the time.

Table II-xxvii. Actual and predicted trip shares by zone fished for Cluster 4 trips.

Zone	Predicted	Actual	Difference
1	1.6%	1.6%	0.03%
2	1.1%	0.9%	0.21%
3	1.0%	1.1%	-0.13%
4	4.4%	4.5%	-0.15%
5	5.0%	3.7%	1.29%
6	76.7%	77.9%	-1.16%
7	1.4%	1.5%	-0.07%
8	3.1%	3.2%	-0.11%
11	5.7%	5.6%	0.06%

II.v Regional Input-Output Model

Cluster 1 is the only exposed group explicitly modeled presenting measurable impacts from WEA development (see Volume I, Section 6.2.9, Table 6-47). The concurrent and full closure of all WEAs represents the worst-case scenario, and thus the largest impacts to the regional economy.

Table II-xxviii to Table II-xxxi show the results of the Northeast Region Commercial Fishing Input-Output Model, described in Section I.iii, for the reductions in landings estimated in Volume I, Sections 6.2.5 to 6.2.8. The input-output model uses landings value by region as the input value while the location choice model probabilistically estimates both changes in revenue and cost. Changes in trip distance change trip cost through increased fuel use as well as increased ice use as well as other marginal costs; the impact of increased consumption of fuel and other variable inputs is not included in these model results. Modeled results are discussed more explicitly in Volume I, Section 6.4.

Table II-xxviii. Total New England coastal region income impacts—Cluster 1 full closure.

Sector	Downeast	Upper Mid-Coast	Lower Mid-Coast	Southern	NH Seacoast	Gloucester	Boston	Cape and Islands	New Bedford	Rhode Island	CT Sea-coast	Non-Maritime	Total
	ME	ME	ME	ME	NH	MA	MA	MA	MA	RI	CT	New England	New England
Commercial Fishing	Income ($)												
Inshore Lobster Traps	0	0	0	0	0	0	0	0	0	0	0	0	0
Offshore Lobster Traps	0	1	-8	0	-264	-396	0	-543	-19,661	-36,320	2	0	-57,190
Large Bottom Trawl	0	0	0	0	0	0	0	0	0	0	0	0	0
Medium Bottom Trawl	0	0	0	0	0	0	0	0	0	0	0	0	0
Small Bottom Trawl	0	0	0	0	0	-72	0	0	-3	-1	0	0	-76
Large Scallop Dredge	0	0	0	0	0	0	0	0	0	0	0	0	0
Medium Scallop Dredge	0	0	0	0	0	0	0	0	-672	0	0	0	-672
Small Scallop Dredge	0	0	0	0	0	0	0	-224	-492	0	0	0	-716
Surfclam, Ocean Quahog Dredge	0	0	0	0	0	0	0	-35	0	-2	0	0	-37
Small Dredge	0	0	0	0	0	0	0	0	0	0	0	0	0
Sink Gillnet	0	0	-283	0	-1,152	-8,928	-781	-22,006	-23,866	-23,430	-1,627	0	-82,074
Diving Gear	0	0	0	0	0	0	0	0	0	0	0	0	0
Midwater Trawl	0	0	0	0	0	0	0	0	0	-10	0	0	-10
Fish Pots and Traps	0	0	-2	0	0	0	0	-68	-500	-731	-1	0	-1,301
Bottom Longline	0	0	0	0	0	-316	0	-1,000	-259	-6	0	0	-1,581
Other Mobile Gear	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Fixed Gear	0	0	0	0	0	0	0	-3	-36	-244	-16	0	-299
Hand Gears	0	0	0	0	0	-245	0	-214	0	-31	-28	0	-519
Agriculture	-62	-10	-18	-4	-4	-2	-12	-2	-3	-6	-30	-2,482	-2,636
Mining	0	0	0	0	0	0	0	0	0	0	0	-161	-162
Transportation, Communications and Public Utilities	-12	-25	-239	-25	-273	-172	-1,749	-61	-149	-379	-1,024	-8,914	-13,023
Water Transportation	0	-8	-6	-4	-13	-6	-122	-28	-9	-16	-303	-264	-779
Warehousing and Storage	0	0	-50	-4	-62	-22	-185	0	-33	-26	-72	-1,027	-1,481
Construction	-2	-18	-76	-19	-94	-70	-555	-41	-44	-94	-273	-1,845	-3,132
Manufacturing	-2	-11	-103	-38	-226	-182	-718	-14	-109	-221	-663	-5,478	-7,763
Seafood Processing	-8	-45	-373	-106	-1,060	-18,489	-11,831	-28	-10,995	-15,927	-779	0	-59,641

Sector	Downeast	Upper Mid-Coast	Lower Mid-Coast	Southern	NH Seacoast	Gloucester	Boston	Cape and Islands	New Bedford	Rhode Island	CT Sea-coast	Non-Maritime	Total
	ME	ME	ME	ME	NH	MA	MA	MA	MA	RI	CT	New England	New England
Commercial Fishing	**Income ($)**												
Ice	0	-1	-6	0	-4	-1	-34	-1	-6	-14	-4	-103	-175
Boat Building	-1	-60	-22	-1	-5	-2	-44	-2	-2	-421	-17	-242	-819
Paperboard Containers	0	0	-1	0	-2	-4	-11	0	-4	-5	-12	-128	-167
Trade	-10	-54	-282	-66	-466	-292	-1,454	-145	-235	-345	-1,067	-7,376	-11,793
Seafood Dealers	0	-3	-5	0	-572	-1,410	-514	-9,972	-17,295	-19,513	-714	0	-49,999
Fish Exchanges/ Auctions	0	0	-33	0	0	-775	0	0	-225	0	0	0	-1,033
Wholesale Trade	-4	-34	-263	-27	-588	-388	-2,987	-49	-230	-378	-1,429	-7,890	-14,268
Finance, Insurance, and Real Estate	-2	-24	-326	-17	-351	-168	-3,043	-59	-75	-425	-1,689	-7,346	-13,525
Services	-35	-187	-1,312	-250	-1,660	-1,287	-11,030	-464	-734	-1,908	-5,660	-33,316	-57,843
Government	-1	-6	-21	-63	-42	-28	-255	-21	-23	-39	-78	-909	-1,485
Total	-140	-485	-3,430	-626	-6,838	-33,257	-35,325	-34,980	-75,659	-100,493	-15,484	-77,483	-384,198

Note: All values are in $US 2012.

Table II-xxix. Total New England Coastal Region employment impacts—Cluster 1 full closure.

Sector	Downeast	Upper Mid-Coast	Lower Mid-Coast	Southern	NH Seacoast	Gloucester	Boston	Cape and Islands	New Bedford	Rhode Island	CT Seacoast	Non-Maritime	Total
	ME	ME	ME	ME	NH	MA	MA	MA	MA	RI	CT	New England	New England
Commercial Fishing	**Employment (Jobs)**												
Inshore Lobster Traps	0	0	0	0	0	0	0	0	0	0	0	0	0
Offshore Lobster Traps	0	0	0	0	0	0	0	0	0	-1	0	0	-1
Large Bottom Trawl	0	0	0	0	0	0	0	0	0	0	0	0	0
Medium Bottom Trawl	0	0	0	0	0	0	0	0	0	0	0	0	0
Small Bottom Trawl	0	0	0	0	0	0	0	0	0	0	0	0	0
Large Scallop Dredge	0	0	0	0	0	0	0	0	0	0	0	0	0
Medium Scallop Dredge	0	0	0	0	0	0	0	0	0	0	0	0	0
Small Scallop Dredge	0	0	0	0	0	0	0	0	0	0	0	0	0

Sector	Downeast	Upper Mid-Coast	Lower Mid-Coast	Southern	NH Seacoast	Gloucester	Boston	Cape and Islands	New Bedford	Rhode Island	CT Seacoast	Non-Maritime	Total
	ME	ME	ME	ME	NH	MA	MA	MA	MA	RI	CT	New England	New England
Commercial Fishing	**Employment (Jobs)**												
Surfclam, Ocean Quahog Dredge	0	0	0	0	0	0	0	0	0	0	0	0	0
Small Dredge	0	0	0	0	0	0	0	0	0	0	0	0	0
Sink Gillnet	0	0	0	0	0	-1	0	-2	-2	-2	0	0	-6
Diving Gear	0	0	0	0	0	0	0	0	0	0	0	0	0
Midwater Trawl	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish Pots and Traps	0	0	0	0	0	0	0	0	0	0	0	0	0
Bottom Longline	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Mobile Gear	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Fixed Gear	0	0	0	0	0	0	0	0	0	0	0	0	0
Hand Gears	0	0	0	0	0	0	0	0	0	0	0	0	0
Agriculture	0	0	0	0	0	0	0	0	0	0	0	0	0
Mining	0	0	0	0	0	0	0	0	0	0	0	0	0
Transportation, Communications and Public Utilities	0	0	0	0	0	0	0	0	0	0	0	0	0
Water Transportation	0	0	0	0	0	0	0	0	0	0	0	0	0
Warehousing and Storage	0	0	0	0	0	0	0	0	0	0	0	0	0
Construction	0	0	0	0	0	0	0	0	0	0	0	0	0
Manufacturing	0	0	0	0	0	0	0	0	0	0	0	0	0
Seafood Processing	0	0	0	0	0	0	0	0	0	0	0	0	-1
Ice	0	0	0	0	0	0	0	0	0	0	0	0	0
Boat Building	0	0	0	0	0	0	0	0	0	0	0	0	0
Paperboard Containers	0	0	0	0	0	0	0	0	0	0	0	0	0
Trade	0	0	0	0	0	0	0	0	0	0	0	0	0
Seafood Dealers	0	0	0	0	0	0	0	0	0	0	0	0	-1
Fish Exchanges/Auctions	0	0	0	0	0	0	0	0	0	0	0	0	0
Wholesale Trade	0	0	0	0	0	0	0	0	0	0	0	0	0

Sector	Downeast	Upper Mid-Coast	Lower Mid-Coast	Southern	NH Seacoast	Gloucester	Boston	Cape and Islands	New Bedford	Rhode Island	CT Seacoast	Non-Maritime	Total
	ME	ME	ME	ME	NH	MA	MA	MA	MA	RI	CT	New England	New England
Commercial Fishing	**Employment (Jobs)**												
Finance, Insurance, and Real Estate	0	0	0	0	0	0	0	0	0	0	0	0	0
Services	0	0	0	0	0	0	0	0	0	0	0	-1	-1
Government	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**0**	**0**	**0**	**0**	**0**	**-1**	**-1**	**-2**	**-3**	**-3**	**0**	**-2**	**-12**

Table II-xxx. Total Mid-Atlantic Coastal Region income impacts—Cluster 1 full closure.

Sector	NY Seacoast	NJ North	NJ South	DE State	MD West	MD East	VA North	VA South	VA East	NC North	NC Central	NC South	Non-Maritime	Total
	NY	NJ	NJ	DE	MD	MD	VA	VA	VA	NC	NC	NC	Mid-Atlantic	Mid-Atlantic
Commercial Fishing	**Income ($)**													
Inshore Lobster Traps	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Offshore Lobster Traps	-567	0	39	0	0	0	0	0	71	0	0	0	0	-457
Large Bottom Trawl	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Medium Bottom Trawl	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Small Bottom Trawl	-79	0	0	0	0	0	0	0	0	0	0	0	0	-80
Large Scallop Dredge	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Medium Scallop Dredge	0	0	-4	0	0	0	0	0	0	0	0	0	0	-4
Small Scallop Dredge	0	0	-16	0	0	0	0	0	0	0	0	0	0	-16
Surfclam, Ocean Quahog Dredge	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Small Dredge	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sink Gillnet	-1,324	0	-297	0	0	0	0	0	-1	0	0	0	0	-1,622
Diving Gear	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Midwater Trawl	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish Pots and Traps	-25	0	0	0	0	0	0	0	0	0	0	0	0	-25
Bottom Longline	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Sector	NY Seacoast	NJ North	NJ South	DE State	MD West	MD East	VA North	VA South	VA East	NC North	NC Central	NC South	Non-Maritime	Total
	NY	NJ	NJ	DE	MD	MD	VA	VA	VA	NC	NC	NC	Mid-Atlantic	Mid-Atlantic
Commercial Fishing	**Income ($)**													
Other Mobile Gear	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Fixed Gear	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hand Gears	-2	0	0	0	0	0	0	0	0	0	0	0	0	-3
Agriculture	-19	-10	-90	0	-57	-38	-6	-18	-12	-48	-66	-97	-128	-588
Mining	-81	-10	-1	0	-12	0	-1	-31	0	0	0	0	-8	-143
Transportation, Communications and Public Utilities	-7,799	-3,520	-2,477	0	-2,123	-295	-805	-1,238	-11	-17	-83	-156	-461	-18,985
Water Transportation	-549	-328	-137	0	-164	-2	-4	-304	0	0	-7	-10	-14	-1,520
Warehousing and Storage	-297	-613	-352	0	-325	-4	-47	-160	0	0	-4	-8	-53	-1,863
Construction	-1,260	-424	-501	0	-560	-55	-221	-221	-2	-6	-33	-45	-95	-3,423
Manufacturing	-1,432	-1,593	-1,179	0	-658	-104	-95	-457	-30	-23	-46	-71	-283	-5,971
Seafood Processing	-5,636	-29	-39	0	2	17	0	0	0	-1	-4	0	0	-5,690
Ice	-43	-8	-17	0	-64	-2	-8	-7	0	0	-1	-1	-5	-156
Boat Building	-1	0	-286	0	-22	-28	-5	-10	0	-52	-326	-22	-13	-765
Paperboard Containers	-22	-31	-16	0	-17	-3	0	-20	0	0	0	-2	-7	-118
Trade	-4,062	-1,856	-2,056	0	-1,805	-218	-667	-853	-10	-32	-134	-150	-381	-12,223
Seafood Dealers	-4,591	-1	-69	0	0	24	0	0	0	0	-11	0	0	-4,646
Wholesale Trade	-7,608	-3,863	-3,113	0	-2,139	-107	-964	-945	-6	-19	-89	-81	-408	-19,343
Finance, Insurance, and Real Estate	-11,736	-2,765	-1,876	0	-1,858	-72	-713	-1,000	-3	-10	-52	-70	-380	-20,534
Services	-31,774	-9,432	-9,513	0	-8,417	-791	-3,874	-4,345	-38	-106	-421	-474	-1,721	-70,905
Government	-1,181	-267	-230	0	-341	-47	-153	-379	-3	-3	-48	-31	-47	-2,729
Total	**-80,088**	**-24,748**	**-22,231**	**0**	**-18,558**	**-1,725**	**-7,560**	**-9,991**	**-47**	**-317**	**-1,324**	**-1,218**	**-4,003**	**-171,809**

Note: All values are in $US 2012.

Table II-xxxi. Total Mid-Atlantic Coastal Region employment impacts—Cluster 1 full closure.

Sector	NY Seacoast	NJ North	NJ South	DE State	MD West	MD East	VA North	VA South	VA East	NC North	NC Central	NC South	Non-Maritime	Total
	NY	NJ	NJ	DE	MD	MD	VA	VA	VA	NC	NC	NC	Mid-Atlantic	Mid-Atlantic
Commercial Fishing	**Employment (Jobs)**													
Inshore Lobster Traps	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Offshore Lobster Traps	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Large Bottom Trawl	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Medium Bottom Trawl	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Small Bottom Trawl	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Large Scallop Dredge	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Medium Scallop Dredge	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Small Scallop Dredge	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Surfclam, Ocean Quahog Dredge	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Small Dredge	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sink Gillnet	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diving Gear	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Midwater Trawl	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish Pots and Traps	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bottom Longline	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Mobile Gear	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Fixed Gear	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hand Gears	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Agriculture	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mining	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Transportation, Communications and Public Utilities	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Water Transportation	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Warehousing and Storage	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Sector	NY Seacoast	NJ North	NJ South	DE State	MD West	MD East	VA North	VA South	VA East	NC North	NC Central	NC South	Non-Maritime	Total
	NY	NJ	NJ	DE	MD	MD	VA	VA	VA	NC	NC	NC	Mid-Atlantic	Mid-Atlantic
Commercial Fishing	**Employment (Jobs)**													
Construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Manufacturing	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Seafood Processing	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ice	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Boat Building	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Paperboard Containers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trade	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Seafood Dealers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wholesale Trade	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Finance, Insurance, and Real Estate	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Services	-1	0	0	0	0	0	0	0	0	0	0	0	0	-1
Government	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix III. Full Exposure Analysis

III.i Species

Table III-i presents the full list of revenue from landings estimated to have occurred in WEAs. See Appendix I.i.i for data caveats.

Table III-i. Revenue from WEA by species—federally reported VTR landings.

Species	Total Revenue for Species Sourced from WEA	Revenue for Species Sourced from a WEA/Total Revenue for Species (Percent)
Scallop, Sea	$25,880,550	1.0%
Surfclam	$18,483,583	8.7%
Ocean Quahog	$7,123,850	4.4%
Monkfish	$5,137,525	4.3%
Flounder, Summer	$3,982,769	3.0%
Squid (Loligo)	$3,088,514	2.1%
Lobster*	$2,928,922	0.2%
Hake, Silver	$2,334,016	4.1%
Skates	$2,078,831	5.7%
Sea Bass, Black	$1,702,738	5.2%
Menhaden*	$1,383,627	6.0%
Herring, Atlantic	$1,141,996	0.8%
Croaker, Atlantic	$1,019,490	5.5%
Mackerel, Atlantic	$876,371	2.8%
Mackerel, King	$676,262	10.3%
Crab, Jonah	$608,664	2.0%
Scup	$519,784	1.5%
Squid (Illex)	$450,522	0.8%
Skate, Little	$359,294	13.4%
Flounder, Winter	$356,805	0.6%
Whelk, Channeled	$312,948	2.2%
Skate, Winter (Big)	$288,893	3.7%
Flounder, Yellowtail	$275,491	0.8%
Cod	$265,743	0.2%
Bluefish	$229,832	2.4%
Hake, Red	$202,350	5.1%
Dogfish, Spiny	$194,709	1.5%
Snapper, Vermilion	$180,142	2.3%
Butterfish	$156,477	3.2%
Grouper, Red	$148,403	2.7%
Tilefish, Golden	$145,231	0.6%
Grouper	$137,537	2.3%
Dogfish, Smooth	$126,860	3.3%
Flounder, Southern	$120,687	7.5%
Crab, Rock	$117,493	5.4%
Hake, Offshore	$104,704	10.3%
Whiting, King	$103,898	3.5%
Bass, Striped	$94,558	0.8%
Hagfish	$90,142	1.0%

Species	Total Revenue for Species Sourced from WEA	Revenue for Species Sourced from a WEA/Total Revenue for Species (Percent)
Tilefish, Blueline	$81,575	2.1%
Grouper, Scamp	$77,805	2.6%
Crab, Red	$77,425	0.5%
Tautog	$59,794	2.5%
Crab, Blue	$53,192	1.5%
Triggerfish	$43,610	2.0%
Hake, White	$38,568	0.2%
Dolphinfish	$27,966	1.7%
Grunts	$22,140	3.9%
Mackerel, Chub	$19,940	5.3%
Shrimp (Pandalid)	$19,689	0.1%
Mackerel, Spanish	$18,545	0.8%
Crab, Horseshoe	$18,074	2.0%
Hogfish	$17,416	5.3%
Amberjack, Greater	$17,333	3.1%
Shark, Sandbar	$17,273	16.1%
Porgy, Red	$13,747	2.3%
Tuna, NK	$10,092	6.3%
Eel, NK	$9,898	6.7%
Tuna, Little	$9,498	5.0%
Tuna, Bluefin	$9,485	0.1%
Sheepshead	$8,173	18.3%
Weakfish, Squeteague	$7,861	0.9%
Grouper, Snowy	$7,024	1.1%
Bonito	$7,022	1.1%
Eel, Conger	$6,213	7.3%
Hind, Rock	$6,166	3.5%
Conchs	$6,117	0.3%
Swordfish	$5,791	0.4%
Shrimp (Penaeid)	$5,462	0.2%
Tuna, Albacore	$5,387	2.5%
Flounder, Am. Plaice	$4,974	0.0%
Cobia	$4,254	2.7%
Flounder, Sand-Dab	$4,146	0.7%
Flounder, Witch	$3,836	0.0%
Crab, NK	$3,415	6.3%
Cunner	$3,354	1.8%
Tuna, Yellowfin	$3,326	0.2%
Other Fish	$3,275	2.1%
Shark, Black Tip	$3,250	2.7%
Porgy, NK	$3,166	2.5%
Wahoo	$2,985	1.8%
Eel, American	$2,775	2.8%
Hind, Red	$2,650	2.2%
Whelk, Knobbed	$2,500	0.2%
Octopus	$2,474	12.3%
Shark, Thresher	$2,393	2.5%

Species	Total Revenue for Species Sourced from WEA	Revenue for Species Sourced from a WEA/Total Revenue for Species (Percent)
Snapper	$2,381	1.9%
Skate, Barndoor	$2,255	9.5%
John Dory	$2,227	0.3%
Flounder, Fourspot	$2,187	5.7%
Spot	$1,926	0.1%
Weakfish, Spotted	$1,826	0.4%
Haddock	$1,552	0.0%
Scallop, Calico	$1,518	7.6%
Lobster, Spiny	$1,469	7.3%
Snapper, Red	$1,374	1.0%
Pompano, Common	$1,115	4.5%
Whelk, Lightning	$1,060	0.4%
Shrimp (Mantis)	$1,009	0.2%
Sea Raven	$986	1.3%
Pollock	$905	0.0%
Tilefish (NK)	$890	0.4%
Shark, Atlantic Sharpnose	$882	2.6%
Hake Mix, Red and White	$851	0.1%
Pout, Ocean	$774	2.1%
Shark, Mako Shortfin	$772	4.0%
Drum, Black	$700	0.8%
Halibut, Atlantic	$564	0.1%
Tuna, Skipjack	$546	3.3%
Squids (NS)	$507	25.1%
Ribbonfish	$504	3.0%
Dogfish (NK)	$503	0.2%
Tuna, Blackfin	$396	2.8%
Mullets	$389	1.2%
Grouper, Yellowedge	$363	1.1%
Shark, Bull	$327	4.4%
Shark, Mako Longfin	$284	1.0%
Shark, Tiger	$277	6.0%
Sculpins	$268	0.8%
Shark, Sand Tiger	$254	12.1%
Skate, Thorny	$244	11.9%
Shark, Finetooth	$208	1.1%
Spadefish	$205	22.8%
Shark, Lemon	$205	0.8%
Shark, NK	$204	0.2%
Seatrout, NK	$198	0.4%
Tilefish, Sand	$177	0.2%
Shark, Blacknose	$165	1.7%
Redfish	$161	0.0%
Pigfish	$160	13.7%

Species	Total Revenue for Species Sourced from WEA	Revenue for Species Sourced from a WEA/Total Revenue for Species (Percent)
Skate, Smooth	$134	1.3%
Shark, Hammerhead	$116	2.1%
Puffer, Northern	$107	0.8%
Sea Robins	$104	0.3%
Harvest Fish	$99	1.7%
Rosefish, Black Bellied	$83	0.3%
Shark, Spinner	$75	0.8%
Blue Runner	$73	0.5%
Shark, Bonnethead	$72	1.4%
Shark, Mako	$65	0.3%
Squirrelfish	$59	0.9%
Tuna, Big Eye	$56	0.0%
Cusk	$41	0.0%
Sea Bass, NK	$40	1.1%
Flounders (NK)	$29	0.0%
Shark, Porbeagle	$28	0.2%
Shad, American	$27	0.1%
Crevalle	$26	1.4%
Drum, NK	$21	1.3%
Shrimp (NK)	$18	0.0%
Drum, Red	$17	0.3%
Scallop, Bay	$16	0.0%
Herring, Blue Back	$13	0.0%
Mackerel, Frigate	$11	0.0%
Shad, Hickory	$10	0.1%
Flounder, Gulfstream	$9	0.2%
Barrelfish	$8	8.1%
Shark, Blue	$6	0.1%
Alewife	$6	0.0%
Toadfish, Oyster	$6	0.0%
Crab, Spider	$5	0.2%
Cutlassfish, Atlantic	$5	0.1%
Amber Jack	$4	1.0%
Shark, Thresher Bigeye	$3	0.1%
Crab, Cancer	$1	0.0%
Wolffish	$1	0.0%
Ray, Cownose	$1	2.2%
Perch, White	$1	0.0%
Sea Urchins	$1	0.0%
Ladyfish	$0	0.2%
Crab, Green	$0	0.0%
Mussels	$0	0.0%
Shark, Dusky	$0	0.0%
Carp	$0	0.1%
Starfish	$0	0.1%

Species	Total Revenue for Species Sourced from WEA	Revenue for Species Sourced from a WEA/Total Revenue for Species (Percent)
Snapper, Dog	$0	0.1%
Shark, Silky	$0	0.0%
Other Shellfish	$0	0.0%

Note: Dollar values are in $US 2012; * = Federal VTR reporting is not complete; NK = not known; NS = not specified.

Table III-ii identifies the top 10 species by percent of total revenue exposed to each WEA.

Table III-ii. Top 10 exposed species by WEA.

WEA	Species	Species Average Exposed Revenue	Species Average Total Revenue	Exposed Species Revenue (Percent)
MA	Hake, Silver	$327,355	$9,592,553	3.4%
MA	Ocean Quahog	$851,030	$27,233,867	3.1%
MA	Skates	$119,890	$6,054,223	2.0%
MA	Angler	$340,775	$19,759,447	1.7%
MA	Crab, Jonah	$87,011	$5,130,697	1.7%
MA	Squid (Loligo)	$285,547	$24,867,195	1.1%
MA	Herring, Atlantic	$138,193	$23,241,713	0.6%
MA	Flounder, Summer	$90,433	$22,019,367	0.4%
MA	Lobster	$175,972	$212,474,994	0.1%
MA	Scallop, Sea	$203,180	$428,413,267	0.0%
RI-MA	Skates	$216,554	$6,054,223	3.6%
RI-MA	Angler	$436,897	$19,759,447	2.2%
RI-MA	Ocean Quahog	$300,009	$27,233,867	1.1%
RI-MA	Hake, Silver	$59,516	$9,592,553	0.6%
RI-MA	Scup	$25,090	$5,724,624	0.4%
RI-MA	Flounder, Summer	$54,224	$22,019,367	0.2%
RI-MA	Squid (Loligo)	$44,595	$24,867,195	0.2%
RI-MA	Cod	$39,661	$24,541,424	0.2%
RI-MA	Lobster	$282,195	$212,474,994	0.1%
RI-MA	Scallop, Sea	$337,292	$428,413,267	0.1%
NY	Mackerel, Chub	ND	ND	ND
NY	Mackerel, Atlantic	$70,862	$5,201,950	1.4%
NY	Scallop, Sea	$3,262,785	$428,413,267	0.8%
NY	Squid (Loligo)	$123,703	$24,867,195	0.5%
NY	Flounder, Summer	$37,654	$22,019,367	0.2%
NY	Angler	$28,340	$19,759,447	0.1%
NY	Herring, Atlantic	$28,086	$23,241,713	0.1%
NY	Ocean Quahog	$19,013	$27,233,867	0.1%
NY	Surfclam	$3,373	$35,291,040	0.0%
NY	Lobster	$4,413	$212,474,994	0.0%
NJ	Surfclam	$3,031,617	$35,291,040	8.6%
NJ	Menhaden	$137,788	$3,870,799	3.6%
NJ	Sea Bass, black	$62,734	$5,422,180	1.2%
NJ	Whelk, Channeled	$18,132	$2,419,819	0.7%
NJ	Croaker, Atlantic	$13,179	$3,081,688	0.4%
NJ	Angler	$38,816	$19,759,447	0.2%
NJ	Flounder, Summer	$40,688	$22,019,367	0.2%

WEA	Species	Species Average Exposed Revenue	Species Average Total Revenue	Exposed Species Revenue (Percent)
NJ	Squid (Illex)	$14,888	$9,961,263	0.1%
NJ	Scallop, Sea	$363,559	$428,413,267	0.1%
NJ	Ocean Quahog	$17,253	$27,233,867	0.1%
DE	Menhaden	$82,525	$3,870,799	2.1%
DE	Sea Bass, Black	$82,609	$5,422,180	1.5%
DE	Tautog	$2,629	$393,352	0.7%
DE	Whelk, Channeled	$7,463	$2,419,819	0.3%
DE	Croaker, Atlantic	$9,475	$3,081,688	0.3%
DE	Flounder, Summer	$29,159	$22,019,367	0.1%
DE	Surfclam	$36,640	$35,291,040	0.1%
DE	Scallop, Sea	$89,722	$428,413,267	0.0%
DE	Squid (Loligo)	$2,030	$24,867,195	0.0%
DE	Lobster	$5,093	$212,474,994	0.0%
MD	Crab, Horseshoe	$2,696	$153,524	1.8%
MD	Sea Bass, Black	$52,163	$5,422,180	1.0%
MD	Dogfish Smooth	$6,052	$631,373	1.0%
MD	Croaker, Atlantic	$8,214	$3,081,688	0.3%
MD	Dogfish Spiny	$5,302	$2,172,246	0.2%
MD	Menhaden	$6,599	$3,870,799	0.2%
MD	Flounder, Summer	$36,933	$22,019,367	0.2%
MD	Surfclam	$5,793	$35,291,040	0.0%
MD	Scallop, Sea	$40,202	$428,413,267	0.0%
MD	Lobster	$6,058	$212,474,994	0.0%
VA	Sea Bass, Black	$31,845	$5,422,180	0.6%
VA	Whelk, Channeled	$8,054	$2,419,819	0.3%
VA	Croaker, Atlantic	$2,925	$3,081,688	0.1%
VA	Hagfish	ND	ND	ND
VA	Squid (Illex)	$7,225	$9,961,263	0.1%
VA	Crab, Red	ND	ND	ND
VA	Shrimp (Pandalid)	$1,358	$4,844,490	0.0%
VA	Flounder, Summer	$4,737	$22,019,367	0.0%
VA	Squid (Loligo)	$3,816	$24,867,195	0.0%
VA	Lobster	$1,043	$212,474,994	0.0%
NC	Mackerel, King	$112,659	$1,089,857	10.3%
NC	Croaker, Atlantic	$136,043	$3,081,688	4.4%
NC	Grouper, Red	$24,734	$899,914	2.7%
NC	Grouper	$22,923	$976,023	2.3%
NC	Snapper, Vermillion	$30,024	$1,307,436	2.3%
NC	Flounder, Summer	$369,967	$22,019,367	1.7%
NC	Bluefish	$24,256	$1,578,705	1.5%
NC	Sea Bass, Black	$34,640	$5,422,180	0.6%
NC	Squid (Illex)	$51,707	$9,961,263	0.5%
NC	Squid (Loligo)	$47,449	$24,867,195	0.2%

Note: Dollar values are in $US 2012; ND = suppressed for confidentiality.

Table III-iii identifies the exposure of all Federal Fishery Management Plans (federal delineator of management) by WEA.

Table III-iii. By-WEA exposure, all FMPs.

WEA	FMP	FMP Average Annual Exposed Revenue	FMP Average Total Revenue	Exposed Annual Revenue (Percent)
MA	NE Multi Small	$368,710	$10,675,728	3.5%
MA	Skate NE	$199,021	$7,796,915	2.6%
MA	Monkfish Joint	$340,775	$19,759,447	1.7%
MA	Surfclam Ocean Quahog Mid-Atlantic	$854,205	$64,967,095	1.3%
MA	Mackerel Squid Butterfish Mid-Atlantic	$357,115	$40,849,295	0.9%
MA	Atlantic Herring NE	$138,193	$23,241,713	0.6%
MA	Sum Flounder Scup BSB Mid-Atlantic	$158,752	$33,166,172	0.5%
MA	None	$304,870	$248,316,185	0.1%
MA	NE Multi Large	$71,515	$76,625,579	0.1%
MA	Sea Scallop NE	$203,180	$428,413,267	0.1%
RI-MA	Skate NE	$243,046	$7,796,915	3.1%
RI-MA	Monkfish Joint	$436,897	$19,759,447	2.2%
RI-MA	NE Multi Small	$68,964	$10,675,728	0.7%
RI-MA	Surfclam Ocean Quahog Mid-Atlantic	$300,009	$64,967,095	0.5%
RI-MA	Sum Flounder Scup BSB Mid-Atlantic	$90,014	$33,166,172	0.3%
RI-MA	Mackerel Squid Butterfish Mid-Atlantic	$66,762	$40,849,295	0.2%
RI-MA	None	$301,739	$248,316,185	0.1%
RI-MA	NE Multi Large	$84,316	$76,625,579	0.1%
RI-MA	Atlantic Herring NE	$21,533	$23,241,713	0.1%
RI-MA	Sea Scallop NE	$337,292	$428,413,267	0.1%
NY	Sea Scallop NE	$3,262,785	$428,413,267	0.8%
NY	Mackerel Squid Butterfish Mid-Atlantic	$194,935	$40,849,295	0.5%
NY	Monkfish Joint	$28,340	$19,759,447	0.1%
NY	Atlantic Herring NE	$28,086	$23,241,713	0.1%
NY	SUM Flounder Scup BSB Mid-Atlantic	$39,452	$33,166,172	0.1%
NY	Surfclam Ocean Quahog Mid-Atlantic	$22,385	$64,967,095	~0%
NY	Skate NE	$1,395	$7,796,915	~0%
NY	NE Multi Small	$1,572	$10,675,728	~0%
NY	None	$10,959	$248,316,185	~0%
NY	NE Multi Large	$960	$76,625,579	~0%
NJ	Surfclam Ocean Quahog Mid-Atlantic	$3,048,870	$64,967,095	5.0%
NJ	Sum Flounder Scup BSB Mid-Atlantic	$103,854	$33,166,172	0.3%
NJ	Monkfish Joint	$38,816	$19,759,447	0.2%
NJ	Bluefish Mid-Atlantic	$2,517	$1,578,705	0.2%
NJ	Skate NE	$8,760	$7,796,915	0.1%
NJ	Sea Scallop NE	$363,559	$428,413,267	0.1%
NJ	None	$193,494	$248,316,185	0.1%
NJ	Mackerel Squid Butterfish Mid-Atlantic	$23,722	$40,849,295	0.1%
NJ	Atlantic Herring NE	$2,225	$23,241,713	~0%
NJ	NE Multi Small	$998	$10,675,728	~0%
DE	Sum Flounder Scup BSB Mid-Atlantic	$111,813	$33,166,172	0.3%
DE	Surfclam Ocean Quahog Mid-Atlantic	$36,640	$64,967,095	0.1%
DE	None	$113,306	$248,316,185	0.1%

WEA	FMP	FMP Average Annual Exposed Revenue	FMP Average Total Revenue	Exposed Annual Revenue (Percent)
DE	Sea Scallop NE	$89,722	$428,413,267	~0%
DE	Bluefish Mid-Atlantic	$191	$1,578,705	~0%
DE	Red Crab NE	ND	ND	ND
DE	Mackerel Squid Butterfish Mid-Atlantic	$3,627	$40,849,295	~0%
DE	Skate NE	$253	$7,796,915	~0%
DE	Monkfish Joint	$312	$19,759,447	~0%
DE	Atlantic Herring NE	$214	$23,241,713	~0%
MD	Sum Flounder Scup BSB Mid-Atlantic	$89,110	$33,166,172	0.3%
MD	Spiny Dogfish Joint	$5,302	$2,172,246	0.2%
MD	Bluefish Mid-Atlantic	$1,091	$1,578,705	0.1%
MD	Red Crab NE	ND	ND	ND
MD	Skate NE	$1,893	$7,796,915	~0%
MD	None	$35,087	$248,316,185	~0%
MD	Monkfish Joint	$2,237	$19,759,447	~0%
MD	Sea Scallop NE	$40,202	$428,413,267	~0%
MD	Mackerel Squid Butterfish Mid-Atlantic	$3,806	$40,849,295	~0%
MD	Surfclam Ocean Quahog Mid-Atlantic	$5,797	$64,967,095	~0%
VA	Sum Flounder Scup BSB Mid-Atlantic	$36,584	$33,166,172	0.1%
VA	Red Crab NE	ND	ND	ND
VA	Mackerel Squid Butterfish Mid-Atlantic	$11,060	$40,849,295	~0%
VA	Highly Migratory Species	$308	$1,824,519	~0%
VA	None	$16,322	$248,316,185	~0%
VA	Bluefish Mid-Atlantic	$85	$1,578,705	~0%
VA	Monkfish Joint	$226	$19,759,447	~0%
VA	Skate NE	$63	$7,796,915	~0%
VA	NE Multi Large	$32	$76,625,579	~0%
VA	Sea Scallop NE	$41	$428,413,267	~0%
NC	Bluefish Mid-Atlantic	$24,256	$1,578,705	1.5%
NC	Sum Flounder Scup BSB Mid-Atlantic	$404,634	$33,166,172	1.2%
NC	Red Crab NE	ND	ND	ND
NC	Highly Migratory Species	$6,082	$1,824,519	0.3%
NC	Mackerel Squid Butterfish Mid-Atlantic	$100,953	$40,849,295	0.3%
NC	None	$471,546	$248,316,185	0.2%
NC	Monkfish Joint	$8,652	$19,759,447	~0%
NC	Spiny Dogfish Joint	$766	$2,172,246	~0%
NC	Sea Scallop NE	$16,643	$428,413,267	~0%
NC	NE Multi Large	$950	$76,625,579	~0%

Note: Dollar values are in $US 2012; ND = suppressed for confidentiality.

III.ii Ports

Table III-iv presents the full list of cumulative revenue estimated to have been generated within WEAs, by port group, with vulnerability indicators based on Colburn and Jepson (2012) and Jepson and Colburn (2013) social indicators, to impacts, if and when they occur.

Table III-iv. Revenue from WEA by port group.

Port Group	Total Revenue Sourced from WEA	Revenue Sourced from a WEA/Total Port Revenue (Percent of Port Revenue)	Social Vulnerability Indicator[a]	Gentrification Pressure Vulnerability Indicator[a]
Nags Head, NC	$13,492	34.7%	Low	Low
Highlands, NJ	$43,485	24.1%	Low	Low
Little Compton, RI	$1,995,487	19.2%	Low	Moderate
Indian River, DE	$223,325	11.6%	Moderate	Low
Westport, MA	$752,732	11.1%	Low	Low
Atlantic City, NJ	$18,624,100	11.1%	High	Moderate
Chilmark, MA	$236,396	10.8%	Low	Moderate
Tiverton, RI	$535,242	10.7%	Low	Low
Other Suffolk, NY	$41,542	10.1%	NA	NA
Freeport, NY	$464,530	9.9%	Moderate	Low
Woods Hole, MA	$141,917	7.4%	Low	Moderate
Sea Isle City, NJ	$379,955	6.9%	Low	Moderate
Point Lookout, NY	$1,000,617	6.9%	Low	Low
Virginia Beach, VA	$333,041	4.9%	Low	Low
Wanchese, NC	$1,297,896	4.8%	Low	Low
Islip, NY	$103,636	4.8%	Low	Low
Beaufort, NC	$273,979	4.7%	Moderate	Low
Engelhard, NC	$608,586	4.4%	Moderate	Low
Oriental, NC	$317,933	4.2%	Low	Moderate
Narragansett, RI	$7,075,106	3.7%	Low	Low
Charleston County, SC	$11,103	3.3%	NA	NA
Newport, RI	$1,768,028	3.3%	Low	Low
Georgetown County, SC	$92,325	2.4%	NA	NA
New London, CT	$833,175	2.3%	High	Low
Fall River, MA	$275,579	2.3%	High	Low
Horry County, SC	$124,227	1.8%		
Montauk, NY	$1,685,501	1.7%	Low	Moderate
Point Pleasant, NJ	$3,138,223	1.7%	Low	Moderate
Newport News, VA	$3,827,717	1.7%	Moderate	Low
Belford, NJ	$303,636	1.6%	Low	Moderate
Other Beaufort, SC	$1,602	1.6%		
Other NY, NY	$4,008	1.5%	High	Low
Wildwood, NJ	$260,839	1.5%	High	Moderate
Long Beach, NJ	$552,724	1.5%	Low	High
Chincoteague, VA	$267,832	1.4%	Moderate	Moderate
Stonington, CT	$647,121	1.4%	Low	Low
Cape May, NJ	$6,381,071	1.4%	Low	High
Ocean City, MD	$686,194	1.2%	Low	Moderate
New Bedford, MA	$20,756,149	1.2%	High	Low
North Kingstown, RI	$656,659	1.1%	Low	Low
Belmar, NJ	$27,779	1.1%	Low	Low
Hampton, VA	$916,316	1.0%	Moderate	Low
Chatham, MA	$498,617	0.9%	Low	High

Port Group	Total Revenue Sourced from WEA	Revenue Sourced from a WEA/Total Port Revenue (Percent of Port Revenue)	Social Vulnerability Indicator[a]	Gentrification Pressure Vulnerability Indicator[a]
Sandwich, MA	$177,600	0.9%	Low	Low
Barnegat, NJ	$843,293	0.8%	Low	Low
Waretown, NJ	$13,122	0.8%	Low	Low
Neptune, NJ	$5,186	0.8%	Low	Low
Fairhaven, MA	$442,338	0.7%	Low	Low
Hatteras, NC	$9,139	0.6%	Moderate	Low
Cape Charles, VA	$4,246	0.6%	Moderate	Moderate
Nantucket, MA	$34,781	0.6%	Low	Moderate
Brielle, NJ	$9,346	0.5%	Low	Low
Other Dukes, MA	$553	0.5%	NA	NA
Seaford, VA	$391,008	0.4%	Low	Low
Gloucester, MA	$1,043,138	0.4%	Low	Low
New Shoreham, RI	$3,743	0.3%	Low	Moderate
Brooklyn, NY	$2,052	0.2%	High	Moderate
Harwich Port, MA	$21,845	0.2%	Low	Moderate
Hampton Bays, NY	$92,352	0.2%	Low	Moderate
Barnstable, MA	$37,312	0.2%	Low	Low
Other Nassau, NY	$9,438	0.1%	NA	NA
Island Park, NY	$67	0.0%	Low	Moderate
Portsmouth, NH	$1,036	0.0%	Low	Low
Hampton County, VA	ND	ND		
South Kingstown, RI	ND	ND	Low	Low
City of Virginia Beach County, VA	ND	ND	NA	NA
Warren, RI	ND	ND	Low	Low
Lewes, DE	ND	ND	Moderate	Moderate
Bayville, NJ	ND	ND	Low	Low
Wareham, MA	ND	ND	Low	Low
Not-specified County, VA	ND	ND	Moderate	Moderate
New Hanover County, NC	ND	ND	NA	NA
Brunswick County, NC	ND	ND	NA	NA
Washington County, RI	ND	ND	NA	NA
Dare County, NC	ND	ND	NA	NA
Worcester County, MD	ND	ND	NA	NA
Pamlico County, NC	ND	ND	NA	NA
Suffolk County, NY	ND	ND	NA	NA
Norfolk, VA	ND	ND	High	Low
Swan Quarter, NC	ND	ND	High	Low
Bristol, RI	ND	ND	Low	Low
Other York, VA	ND	ND	NA	NA
Absecon, NJ	ND	ND	Low	Low
Middletown, NJ	ND	ND	Low	Low
Other Atlantic, NJ	ND	ND	NA	NA
Lowland, NC	ND	ND	High	Low
Toms River, NJ	ND	ND	Low	Low
Morehead City, NC	ND	ND	Moderate	Low

Port Group	Total Revenue Sourced from WEA	Revenue Sourced from a WEA/Total Port Revenue (Percent of Port Revenue)	Social Vulnerability Indicator[a]	Gentrification Pressure Vulnerability Indicator[a]
Ocean City, NJ	ND	ND	Low	Moderate
Cape May County, NJ	ND	ND	NA	NA
Portsmouth, RI	ND	ND	Low	Low
Truro, MA	ND	ND	Low	Moderate
Belhaven, NC	ND	ND	High	Low
Ocean County, NJ	ND	ND	NA	NA
Falmouth, MA	ND	ND	Low	Moderate
Poquoson, VA	ND	ND	Low	Low
Other Beaufort (County), NC	ND	ND	NA	NA
Other Monmouth, NJ	ND	ND	NA	NA
Pender County, NC	ND	ND	NA	NA
Sussex County, DE	ND	ND	NA	NA
Hobucken, NC	ND	ND	Low	Low
Westport Island, ME	ND	ND	Low	Low
Accomack County, VA	ND	ND	NA	NA
Long Beach, NY	ND	ND	Low	Moderate
Little Egg Harbor, NJ	ND	ND	Low	Low
Jamestown, RI	ND	ND	Low	Low
Aquinnah, MA	ND	ND	Low	Moderate
Bayboro, NC	ND	ND	High	Low
Dartmouth, MA	ND	ND	Low	Low
Greenbackville, VA	ND	ND	Moderate	Moderate
South Yarmouth, MA	ND	ND	Low	Moderate
Hyde County, NC	ND	ND	NA	NA
Onslow County, NC	ND	ND	NA	NA
Wainscott, NY	ND	ND	Low	Moderate
Shelter Island, NY	ND	ND	Low	Moderate
Watertown, MA	ND	ND	High	Moderate
Other Newport, RI	ND	ND	NA	NA
Other City of Chesapeake, VA	ND	ND	NA	NA
Beaufort County, NC	ND	ND	NA	NA
New York, NY	ND	ND	High	Moderate
Brigantine, NJ	ND	ND	Low	Moderate
Avalon, NJ	ND	ND	Low	Moderate
East Hampton, NY	ND	ND	Low	High
Manasquan, NJ	ND	ND	Low	Moderate
Other Currituck, NC	ND	ND	NA	NA
Milford, DE	ND	ND	Moderate	Low
Greenport, NY	ND	ND	High	Moderate
Mattapoisett, MA	ND	ND	Low	Low
Monmouth County, NJ	ND	ND	NA	NA
Carteret County, NC	ND	ND	NA	NA
District 4 Northampton County, VA	ND	ND	Low	Low
Other Ocean, NJ	ND	ND	NA	NA
Yarmouth, MA	ND	ND	Low	Low

Port Group	Total Revenue Sourced from WEA	Revenue Sourced from a WEA/Total Port Revenue (Percent of Port Revenue)	Social Vulnerability Indicator[a]	Gentrification Pressure Vulnerability Indicator[a]
Lynn, MA	ND	ND	High	Low
Seaford, NY	ND	ND	Low	Moderate
Other Richmond, NY	ND	ND	Low	Moderate
Other Somerset, MD	ND	ND	NA	NA
Rockport, MA	ND	ND	Low	Moderate
Other Massachusetts, MA	ND	ND	NA	NA
Boston, MA	ND	ND	High	Moderate
Moriches, NY	ND	ND	Low	Low
Edgartown, MA	ND	ND	Low	Moderate
Tisbury, MA	ND	ND	Low	Moderate
Provincetown, MA	ND	ND	Low	Moderate
Oceanside, NY	ND	ND	Low	Low
Jamaica Bay-Rockaway, NY	ND	ND	Moderate	Low
Wachapreague, VA	ND	ND	Low	Moderate
Southold, NY	ND	ND	Low	Moderate
Rumson, NJ	ND	ND	Low	Low
Port Norris, NJ	ND	ND	Moderate	Low
Newington, NH	ND	ND	Low	Low
Orleans, MA	ND	ND	Low	High

Note: Dollar values are in $US 2012; ND = suppressed for confidentiality; NA = not available as of 6-24-14.

a Gentrification and social vulnerability scores are based on Colburn and Jepson (2012) and Jepson and Colburn (2013).

Table III-v presents revenue from WEAs by port group and FMP; it includes all port-FMP combinations with more than $1,000 per year average total revenue from any WEA.

Table III-v . Revenue from WEAs by port group and FMP.

State	Port Group	FMP	Total Revenue from WEA	% of Port-FMP Revenue
CT	NEW LONDON, CT	SEA SCALLOP NE	$765,095	3.2%
CT	NEW LONDON, CT	MONKFISH JOINT	$17,753	0.7%
CT	NEW LONDON, CT	MACKEREL SQUID BUTTERFISH MIDATLANTIC	ND	ND
CT	NEW LONDON, CT	NE MULTI SMALL	ND	ND
CT	STONINGTON, CT	SEA SCALLOP NE	$472,655	1.4%
CT	STONINGTON, CT	NE MULTI SMALL	$78,842	2.6%
CT	STONINGTON, CT	MACKEREL SQUID BUTTERFISH MIDATLANTIC	$42,499	1.7%
CT	STONINGTON, CT	MONKFISH JOINT	$24,804	3.7%
CT	STONINGTON, CT	SUM FLOUNDER SCUP BSB MIDATLANTIC	$22,308	0.6%
DE	INDIAN RIVER, DE	SUM FLOUNDER SCUP BSB MIDATLANTIC	ND	ND
DE	INDIAN RIVER, DE	None	ND	ND

State	Port Group	FMP	Total Revenue from WEA	% of Port-FMP Revenue
DE	LEWES, DE	SUM FLOUNDER SCUP BSB MIDATLANTIC	ND	ND
MA	BARNSTABLE, MA	MACKEREL SQUID BUTTERFISH MIDATLANTIC	$27,232	0.8%
MA	CHATHAM, MA	MONKFISH JOINT	$327,770	7.4%
MA	CHATHAM, MA	SKATE NE	$164,118	2.0%
MA	CHILMARK, MA	None	$168,326	11.0%
MA	CHILMARK, MA	SEA SCALLOP NE	ND	ND
MA	CHILMARK, MA	NE MULTI LARGE	ND	ND
MA	FAIRHAVEN, MA	None	$31,691	2.4%
MA	FAIRHAVEN, MA	MONKFISH JOINT	ND	ND
MA	FAIRHAVEN, MA	SKATE NE	ND	ND
MA	FAIRHAVEN, MA	SEA SCALLOP NE	ND	ND
MA	FAIRHAVEN, MA	SPINY DOGFISH JOINT	ND	ND
MA	FALL RIVER, MA	None	$56,874	1.5%
MA	FALL RIVER, MA	MACKEREL SQUID BUTTERFISH MIDATLANTIC	$35,490	1.5%
MA	FALL RIVER, MA	SKATE NE	ND	ND
MA	FALL RIVER, MA	SUM FLOUNDER SCUP BSB MIDATLANTIC	ND	ND
MA	FALL RIVER, MA	ATLANTIC HERRING NE	ND	ND
MA	FALL RIVER, MA	RED CRAB NE	ND	ND
MA	FALMOUTH, MA	SEA SCALLOP NE	ND	ND
MA	GLOUCESTER, MA	None	$410,118	1.0%
MA	GLOUCESTER, MA	ATLANTIC HERRING NE	$201,909	0.5%
MA	GLOUCESTER, MA	MACKEREL SQUID BUTTERFISH MIDATLANTIC	ND	ND
MA	HARWICH PORT, MA	SKATE NE	ND	ND
MA	NANTUCKET, MA	SEA SCALLOP NE	ND	ND
MA	NEW BEDFORD, MA	SEA SCALLOP NE	$10,052,862	0.7%
MA	NEW BEDFORD, MA	SURFCLAM OCEAN QUAHOG MIDATLANTIC *	$5,819,557	5.6%
MA	NEW BEDFORD, MA	MONKFISH JOINT	$1,483,700	6.4%
MA	NEW BEDFORD, MA	None	$1,062,069	2.4%
MA	NEW BEDFORD, MA	SKATE NE	$945,611	6.3%
MA	NEW BEDFORD, MA	ATLANTIC HERRING NE	$682,319	3.0%
MA	NEW BEDFORD, MA	MACKEREL SQUID BUTTERFISH MIDATLANTIC	$314,853	2.0%
MA	NEW BEDFORD, MA	NE MULTI SMALL	$209,014	1.1%
MA	NEW BEDFORD, MA	NE MULTI LARGE	$60,399	0.0%
MA	NEW BEDFORD, MA	SPINY DOGFISH JOINT	$36,708	20.1%
MA	NEW BEDFORD, MA	SUM FLOUNDER SCUP BSB MIDATLANTIC	$36,386	0.8%
MA	NEW BEDFORD, MA	RED CRAB NE	ND	ND
MA	SANDWICH, MA	None	ND	ND
MA	SANDWICH, MA	SEA SCALLOP NE	ND	ND
MA	WESTPORT, MA	None	$430,344	11.4%
MA	WESTPORT, MA	MONKFISH JOINT	$132,407	7.7%

State	Port Group	FMP	Total Revenue from WEA	% of Port-FMP Revenue
MA	WESTPORT, MA	SUM FLOUNDER SCUP BSB MIDATLANTIC	$60,475	11.7%
MA	WESTPORT, MA	SKATE NE	$53,425	11.7%
MA	WESTPORT, MA	SEA SCALLOP NE	ND	ND
MA	WESTPORT, MA	NE MULTI LARGE	ND	ND
MA	WOODS HOLE, MA	SEA SCALLOP NE	$128,982	17.3%
MA	WOODS HOLE, MA	MACKEREL SQUID BUTTERFISH MIDATLANTIC	$6,994	1.6%
MD	OCEAN CITY, MD	SUM FLOUNDER SCUP BSB MIDATLANTIC	$298,993	5.4%
MD	OCEAN CITY, MD	SURF CLAM OCEAN QUAHOG MIDATLANTIC *	$151,428	0.5%
MD	OCEAN CITY, MD	None	$139,172	3.5%
MD	OCEAN CITY, MD	SPINY DOGFISH JOINT	$32,676	5.8%
MD	OCEAN CITY, MD	SEA SCALLOP NE	$31,865	0.2%
MD	OCEAN CITY, MD	MONKFISH JOINT	$10,937	1.5%
MD	OCEAN CITY, MD	SKATE NE	$10,320	7.9%
MD	OCEAN CITY, MD	BLUEFISH MIDATLANTIC	$6,544	3.7%
NC	BEAUFORT, NC	SUM FLOUNDER SCUP BSB MIDATLANTIC	$243,499	5.4%
NC	BEAUFORT, NC	None	$28,189	3.0%
NC	BRUNSWICK COUNTY, NC	None	ND	ND
NC	BRUNSWICK COUNTY, NC	SUM FLOUNDER SCUP BSB MIDATLANTIC	ND	ND
NC	DARE COUNTY, NC	None	ND	ND
NC	DARE COUNTY, NC	BLUEFISH MIDATLANTIC	ND	ND
NC	DARE COUNTY, NC	HIGHLY MIGRATORY SPECIES	ND	ND
NC	ENGELHARD, NC	None	$88,548	1.5%
NC	ENGELHARD, NC	SUM FLOUNDER SCUP BSB MIDATLANTIC	ND	ND
NC	HATTERAS, NC	None	$8,083	0.7%
NC	HOBUCKEN, NC	SUM FLOUNDER SCUP BSB MIDATLANTIC	ND	ND
NC	LOWLAND, NC	SUM FLOUNDER SCUP BSB MIDATLANTIC	ND	ND
NC	LOWLAND, NC	SEA SCALLOP NE	ND	ND
NC	NAGS HEAD, NC	None	ND	ND
NC	NEW HANOVER COUNTY, NC	None	ND	ND
NC	NEW HANOVER COUNTY, NC	SUM FLOUNDER SCUP BSB MIDATLANTIC	ND	ND
NC	ONSLOW COUNTY, NC	None	ND	ND
NC	ONSLOW COUNTY, NC	SUM FLOUNDER SCUP BSB MIDATLANTIC	ND	ND
NC	ORIENTAL, NC	SUM FLOUNDER SCUP BSB MIDATLANTIC	ND	ND
NC	ORIENTAL, NC	None	ND	ND
NC	PENDER COUNTY, NC	None	ND	ND
NC	SWAN QUARTER, NC	SUM FLOUNDER SCUP BSB MIDATLANTIC	ND	ND

State	Port Group	FMP	Total Revenue from WEA	% of Port-FMP Revenue
NC	WANCHESE, NC	None	$598,802	4.6%
NC	WANCHESE, NC	SUM FLOUNDER SCUP BSB MIDATLANTIC	$502,488	5.2%
NC	WANCHESE, NC	BLUEFISH MIDATLANTIC	$121,787	6.0%
NC	WANCHESE, NC	MACKEREL SQUID BUTTERFISH MIDATLANTIC	$58,829	4.8%
NC	WANCHESE, NC	MONKFISH JOINT	$8,104	3.3%
NJ	ATLANTIC CITY, NJ	SURF CLAM OCEAN QUAHOG MIDATLANTIC *	$18,111,287	12.1%
NJ	ATLANTIC CITY, NJ	SUM FLOUNDER SCUP BSB MIDATLANTIC	$204,558	47.4%
NJ	ATLANTIC CITY, NJ	None	$167,251	16.9%
NJ	ATLANTIC CITY, NJ	SEA SCALLOP NE	$137,718	0.8%
NJ	BARNEGAT, NJ	SEA SCALLOP NE	$599,138	0.7%
NJ	BARNEGAT, NJ	MONKFISH JOINT	$139,477	2.0%
NJ	BARNEGAT, NJ	SUM FLOUNDER SCUP BSB MIDATLANTIC	$40,486	2.4%
NJ	BARNEGAT, NJ	SKATE NE	$33,697	3.0%
NJ	BARNEGAT, NJ	None	$16,679	1.1%
NJ	BARNEGAT, NJ	BLUEFISH MIDATLANTIC	$6,993	0.6%
NJ	BELFORD, NJ	SEA SCALLOP NE	$197,928	16.9%
NJ	BELFORD, NJ	SUM FLOUNDER SCUP BSB MIDATLANTIC	$54,159	0.7%
NJ	BELFORD, NJ	MACKEREL SQUID BUTTERFISH MIDATLANTIC	$32,406	2.2%
NJ	BELFORD, NJ	None	$7,211	0.2%
NJ	BELMAR, NJ	SEA SCALLOP NE	ND	ND
NJ	BRIELLE, NJ	SEA SCALLOP NE	ND	ND
NJ	CAPE MAY, NJ	SEA SCALLOP NE	$4,218,895	1.2%
NJ	CAPE MAY, NJ	None	$1,154,717	4.6%
NJ	CAPE MAY, NJ	SUM FLOUNDER SCUP BSB MIDATLANTIC	$506,087	4.5%
NJ	CAPE MAY, NJ	MACKEREL SQUID BUTTERFISH MIDATLANTIC	$432,109	0.7%
NJ	CAPE MAY, NJ	MONKFISH JOINT	$12,117	1.5%
NJ	CAPE MAY, NJ	ATLANTIC HERRING NE	ND	ND
NJ	HIGHLANDS, NJ	SEA SCALLOP NE	ND	ND
NJ	LONG BEACH, NJ	SEA SCALLOP NE	$320,342	1.1%
NJ	LONG BEACH, NJ	MONKFISH JOINT	$150,359	3.1%
NJ	LONG BEACH, NJ	SUM FLOUNDER SCUP BSB MIDATLANTIC	$51,313	10.3%
NJ	LONG BEACH, NJ	SKATE NE	$13,145	6.1%
NJ	LONG BEACH, NJ	None	$7,039	0.8%
NJ	LONG BEACH, NJ	BLUEFISH MIDATLANTIC	$6,369	1.1%
NJ	OTHER MONMOUTH, NJ	SUM FLOUNDER SCUP BSB MIDATLANTIC	ND	ND
NJ	POINT PLEASANT, NJ	SEA SCALLOP NE	$2,642,567	3.3%
NJ	POINT PLEASANT, NJ	SURF CLAM OCEAN QUAHOG MIDATLANTIC *	$287,521	0.4%

State	Port Group	FMP	Total Revenue from WEA	% of Port-FMP Revenue
NJ	POINT PLEASANT, NJ	SUM FLOUNDER SCUP BSB MIDATLANTIC	$120,566	0.7%
NJ	POINT PLEASANT, NJ	MACKEREL SQUID BUTTERFISH MIDATLANTIC	$30,114	1.5%
NJ	POINT PLEASANT, NJ	MONKFISH JOINT	$29,229	0.8%
NJ	POINT PLEASANT, NJ	None	$16,977	0.2%
NJ	SEA ISLE CITY, NJ	SUM FLOUNDER SCUP BSB MIDATLANTIC	$271,404	20.2%
NJ	SEA ISLE CITY, NJ	None	$100,216	2.7%
NJ	WARETOWN, NJ	MONKFISH JOINT	ND	ND
NJ	WILDWOOD, NJ	SURF CLAM OCEAN QUAHOG MIDATLANTIC *	ND	ND
NJ	WILDWOOD, NJ	SEA SCALLOP NE	ND	ND
NJ	WILDWOOD, NJ	SUM FLOUNDER SCUP BSB MIDATLANTIC	ND	ND
NJ	WILDWOOD, NJ	None	ND	ND
NY	FREEPORT, NY	SEA SCALLOP NE	$438,339	18.7%
NY	FREEPORT, NY	SUM FLOUNDER SCUP BSB MIDATLANTIC	$11,029	1.0%
NY	FREEPORT, NY	None	$6,940	1.1%
NY	HAMPTON BAYS, NY	MACKEREL SQUID BUTTERFISH MIDATLANTIC	$30,135	0.3%
NY	HAMPTON BAYS, NY	SEA SCALLOP NE	$28,006	0.2%
NY	HAMPTON BAYS, NY	SUM FLOUNDER SCUP BSB MIDATLANTIC	$7,559	0.1%
NY	HAMPTON BAYS, NY	NE MULTI SMALL	$6,758	0.4%
NY	HAMPTON BAYS, NY	GOLDEN TILEFISH MIDATLANTIC *	ND	ND
NY	ISLIP, NY	SEA SCALLOP NE	ND	ND
NY	MONTAUK, NY	NE MULTI SMALL	$701,576	6.0%
NY	MONTAUK, NY	MACKEREL SQUID BUTTERFISH MIDATLANTIC	$499,638	2.3%
NY	MONTAUK, NY	GOLDEN TILEFISH MIDATLANTIC *	$126,375	0.7%
NY	MONTAUK, NY	NE MULTI LARGE	$123,194	5.3%
NY	MONTAUK, NY	None	$86,624	0.8%
NY	MONTAUK, NY	SEA SCALLOP NE	$57,599	0.6%
NY	MONTAUK, NY	SUM FLOUNDER SCUP BSB MIDATLANTIC	$45,920	0.3%
NY	MONTAUK, NY	MONKFISH JOINT	$31,767	0.7%
NY	MONTAUK, NY	BLUEFISH MIDATLANTIC	$7,071	1.1%
NY	OTHER NASSAU, NY	SURF CLAM OCEAN QUAHOG MIDATLANTIC *	$8,625	0.1%
NY	OTHER SUFFOLK, NY	SEA SCALLOP NE	ND	ND
NY	POINT LOOKOUT, NY	SEA SCALLOP NE	$883,432	10.7%
NY	POINT LOOKOUT, NY	MACKEREL SQUID BUTTERFISH MIDATLANTIC	$89,684	3.4%
NY	POINT LOOKOUT, NY	SUM FLOUNDER SCUP BSB MIDATLANTIC	$19,057	1.1%

State	Port Group	FMP	Total Revenue from WEA	% of Port-FMP Revenue
RI	LITTLE COMPTON, RI	MONKFISH JOINT	$1,159,967	33.1%
RI	LITTLE COMPTON, RI	SKATE NE	$445,496	34.8%
RI	LITTLE COMPTON, RI	None	$182,025	7.3%
RI	LITTLE COMPTON, RI	NE MULTI LARGE	$76,060	29.0%
RI	LITTLE COMPTON, RI	SUM FLOUNDER SCUP BSB MIDATLANTIC	$62,817	3.1%
RI	LITTLE COMPTON, RI	SPINY DOGFISH JOINT	$62,483	11.0%
RI	NARRAGANSETT, RI	MACKEREL SQUID BUTTERFISH MIDATLANTIC	$1,856,770	3.3%
RI	NARRAGANSETT, RI	NE MULTI SMALL	$1,598,863	13.4%
RI	NARRAGANSETT, RI	None	$1,158,410	3.0%
RI	NARRAGANSETT, RI	SUM FLOUNDER SCUP BSB MIDATLANTIC	$873,710	2.6%
RI	NARRAGANSETT, RI	NE MULTI LARGE	$541,952	3.6%
RI	NARRAGANSETT, RI	MONKFISH JOINT	$402,180	4.3%
RI	NARRAGANSETT, RI	SEA SCALLOP NE	$393,356	2.4%
RI	NARRAGANSETT, RI	SKATE NE	$111,781	1.5%
RI	NARRAGANSETT, RI	ATLANTIC HERRING NE	$65,823	1.8%
RI	NARRAGANSETT, RI	BLUEFISH MIDATLANTIC	$39,517	4.8%
RI	NARRAGANSETT, RI	SPINY DOGFISH JOINT	$30,386	6.1%
RI	NEWPORT, RI	MONKFISH JOINT	$733,889	23.7%
RI	NEWPORT, RI	SKATE NE	$480,826	11.7%
RI	NEWPORT, RI	None	$262,612	1.1%
RI	NEWPORT, RI	SUM FLOUNDER SCUP BSB MIDATLANTIC	$65,394	4.1%
RI	NEWPORT, RI	SEA SCALLOP NE	$63,777	0.4%
RI	NEWPORT, RI	NE MULTI LARGE	$59,797	3.7%
RI	NEWPORT, RI	ATLANTIC HERRING NE	$46,842	5.2%
RI	NEWPORT, RI	MACKEREL SQUID BUTTERFISH MIDATLANTIC	$44,963	1.6%
RI	NEWPORT, RI	NE MULTI SMALL	$6,718	4.5%
RI	NORTH KINGSTOWN, RI	MACKEREL SQUID BUTTERFISH MIDATLANTIC	$564,145	1.2%
RI	NORTH KINGSTOWN, RI	ATLANTIC HERRING NE	ND	ND
RI	NORTH KINGSTOWN, RI	NE MULTI SMALL	ND	ND
RI	SOUTH KINGSTOWN, RI	SUM FLOUNDER SCUP BSB MIDATLANTIC	ND	ND
RI	TIVERTON, RI	SKATE NE	$247,217	32.3%
RI	TIVERTON, RI	SUM FLOUNDER SCUP BSB MIDATLANTIC	$149,531	21.6%
RI	TIVERTON, RI	MONKFISH JOINT	$82,400	6.5%
RI	TIVERTON, RI	None	$11,731	0.6%
RI	TIVERTON, RI	NE MULTI LARGE	ND	ND
RI	WARREN, RI	SURF CLAM OCEAN QUAHOG MIDATLANTIC *	ND	ND
SC	CHARLESTON COUNTY, SC	None	$7,127	3.2%
SC	GEORGETOWN COUNTY, SC	None	$82,741	2.3%
SC	GEORGETOWN COUNTY, SC	SUM FLOUNDER SCUP BSB MIDATLANTIC	$9,579	4.7%

State	Port Group	FMP	Total Revenue from WEA	% of Port-FMP Revenue
SC	HORRY COUNTY, SC	None	$89,494	1.5%
SC	HORRY COUNTY, SC	SUM FLOUNDER SCUP BSB MIDATLANTIC	$34,729	3.4%
VA	CHINCOTEAGUE, VA	SUM FLOUNDER SCUP BSB MIDATLANTIC	$163,164	2.2%
VA	CHINCOTEAGUE, VA	None	$43,474	1.3%
VA	CHINCOTEAGUE, VA	MONKFISH JOINT	$38,430	1.3%
VA	CHINCOTEAGUE, VA	SEA SCALLOP NE	$15,872	0.4%
VA	HAMPTON COUNTY, VA	HIGHLY MIGRATORY SPECIES	ND	ND
VA	HAMPTON, VA	SEA SCALLOP NE	$351,407	0.5%
VA	HAMPTON, VA	SUM FLOUNDER SCUP BSB MIDATLANTIC	$346,123	2.5%
VA	HAMPTON, VA	None	$205,124	9.8%
VA	HAMPTON, VA	MACKEREL SQUID BUTTERFISH MIDATLANTIC	$7,890	0.5%
VA	NEWPORT NEWS, VA	SEA SCALLOP NE	$3,169,554	1.5%
VA	NEWPORT NEWS, VA	SUM FLOUNDER SCUP BSB MIDATLANTIC	$402,589	2.9%
VA	NEWPORT NEWS, VA	None	$222,419	5.7%
VA	NEWPORT NEWS, VA	RED CRAB NE	ND	ND
VA	NORFOLK, VA	SUM FLOUNDER SCUP BSB MIDATLANTIC	ND	ND
VA	OTHER YORK, VA	SEA SCALLOP NE	ND	ND
VA	SEAFORD, VA	SEA SCALLOP NE	$388,642	0.4%
VA	VIRGINIA BEACH, VA	None	$147,192	3.4%
VA	VIRGINIA BEACH, VA	SUM FLOUNDER SCUP BSB MIDATLANTIC	ND	ND

Note: Dollar values are in $US 2012; * = Federal VTR reporting is not complete; ND = suppressed for confidentiality.

Table III-vi presents the full list of cumulative revenue estimated to have been generated within WEAs, by port and gear.

Table III-vi. Revenue from WEA by port group and gear.

State	Port Group	Gear	Total Revenue from WEA	% of Port-Gear Revenue
CT	New London, CT	EF	$772,960	3.2%
CT	New London, CT	Gillnet	$9,835	0.4%
CT	New London, CT	Trawl Bottom	ND	ND
CT	New London, CT	Hand	ND	ND
CT	New London, CT	Pot Lobster	ND	ND
CT	Stonington, CT	Dredge	$492,236	1.4%
CT	Stonington, CT	Trawl Bottom	$154,877	1.4%
CT	Stonington, CT	Pot Lobster	ND	ND
DE	Indian River, DE	Pot	ND	ND
DE	Indian River, DE	Pot Lobster	ND	ND
DE	Indian River, DE	Dredge	ND	ND

State	Port Group	Gear	Total Revenue from WEA	% of Port-Gear Revenue
DE	Indian River, DE	Hand	ND	ND
DE	Indian River, DE	Gillnet	ND	ND
DE	Lewes, DE	Pot	ND	ND
DE	Milford, DE	Gillnet	ND	ND
DE	Sussex County, DE	Hand	ND	ND
DE	Sussex County, DE	Trawl Mid	ND	ND
MA	Aquinnah, MA	Trawl Bottom	ND	ND
MA	Barnstable, MA	Trawl Bottom	$31,177	0.5%
MA	Barnstable, MA	Pot	ND	ND
MA	Barnstable, MA	Dredge	ND	ND
MA	Boston, MA	Trawl Bottom	ND	ND
MA	Chatham, MA	Gillnet	$498,592	2.2%
MA	Chatham, MA	Trawl Bottom	ND	ND
MA	Chatham, MA	Pot Lobster	ND	ND
MA	Chilmark, MA	Pot Lobster	$168,392	11.0%
MA	Chilmark, MA	Trawl Bottom	$32,479	5.7%
MA	Chilmark, MA	Dredge	ND	ND
MA	Chilmark, MA	Pot	ND	ND
MA	Chilmark, MA	Hand	ND	ND
MA	Dartmouth, MA	Pot	ND	ND
MA	Edgartown, MA	Pot Lobster	ND	ND
MA	Fairhaven, MA	Pot Lobster	$31,714	2.6%
MA	Fairhaven, MA	Gillnet	ND	ND
MA	Fairhaven, MA	Dredge	ND	ND
MA	Fairhaven, MA	Trawl Bottom	ND	ND
MA	Fairhaven, MA	Pot	ND	ND
MA	Fall River, MA	Trawl Bottom	ND	ND
MA	Fall River, MA	Trawl Mid	ND	ND
MA	Fall River, MA	Pot Lobster	ND	ND
MA	Fall River, MA	Pot	ND	ND
MA	Fall River, MA	Seine	ND	ND
MA	Fall River, MA	Gillnet	ND	ND
MA	Falmouth, MA	Dredge	ND	ND
MA	Falmouth, MA	Trawl Bottom	ND	ND
MA	Gloucester, MA	Trawl Mid	$630,192	1.4%
MA	Gloucester, MA	Seine	ND	ND
MA	Gloucester, MA	Gillnet	ND	ND
MA	Gloucester, MA	Trawl Bottom	ND	ND
MA	Gloucester, MA	Dredge	ND	ND
MA	Gloucester, MA	Pot Lobster	ND	ND

State	Port Group	Gear	Total Revenue from WEA	% of Port-Gear Revenue
MA	Harwich Port, MA	Gillnet	ND	ND
MA	Harwich Port, MA	Dredge	ND	ND
MA	Harwich Port, MA	Pot	ND	ND
MA	Harwich Port, MA	Hand	ND	ND
MA	Lynn, MA	Pot Lobster	ND	ND
MA	Mattapoisett, MA	Pot	ND	ND
MA	Mattapoisett, MA	Pot Lobster	ND	ND
MA	Nantucket, MA	Trawl Bottom	$6,448	0.2%
MA	Nantucket, MA	Dredge	ND	ND
MA	New Bedford, MA	Dredge	$15,899,572	1.1%
MA	New Bedford, MA	Gillnet	$2,220,077	21.2%
MA	New Bedford, MA	Pot Lobster	$1,050,800	3.5%
MA	New Bedford, MA	Trawl Mid	$916,010	2.8%
MA	New Bedford, MA	Trawl Bottom	$613,373	0.3%
MA	New Bedford, MA	Pot	$56,318	0.5%
MA	Orleans, MA	Pot Lobster	ND	ND
MA	Other Dukes, MA	Pot Lobster	ND	ND
MA	Other Dukes, MA	Trawl Bottom	ND	ND
MA	Other Massachusetts, MA	Trawl Bottom	ND	ND
MA	Provincetown, MA	Dredge	ND	ND
MA	Rockport, MA	Pot Lobster	ND	ND
MA	Sandwich, MA	Pot Lobster	ND	ND
MA	Sandwich, MA	Dredge	ND	ND
MA	Sandwich, MA	Gillnet	ND	ND
MA	South Yarmouth, MA	Hand	ND	ND
MA	Tisbury, MA	Pot Lobster	ND	ND
MA	Tisbury, MA	Pot	ND	ND
MA	Truro, MA	Hand	ND	ND
MA	Wareham, MA	Hand	ND	ND
MA	Watertown, MA	Pot Lobster	ND	ND
MA	Westport, MA	Pot Lobster	$429,204	11.5%
MA	Westport, MA	Gillnet	$208,889	9.1%
MA	Westport, MA	Dredge	ND	ND
MA	Westport, MA	Pot	ND	ND
MA	Westport, MA	Trawl Bottom	ND	ND
MA	Westport, MA	Hand	ND	ND
MA	Woods Hole, MA	Dredge	$130,000	17.4%
MA	Woods Hole, MA	Trawl Bottom	$8,052	0.8%
MA	Woods Hole, MA	Pot Lobster	ND	ND
MA	Woods Hole, MA	Trawl Mid	ND	ND
MA	Yarmouth, MA	Hand	ND	ND
MD	Ocean City, MD	Trawl Bottom	$215,786	3.6%

State	Port Group	Gear	Total Revenue from WEA	% of Port-Gear Revenue
MD	Ocean City, MD	Dredge	$180,826	0.4%
MD	Ocean City, MD	Pot	$149,334	6.3%
MD	Ocean City, MD	Gillnet	$118,619	5.3%
MD	Ocean City, MD	Pot Lobster	$19,601	1.5%
MD	Ocean City, MD	Longline	ND	ND
MD	Ocean City, MD	Hand	ND	ND
MD	Other Somerset, MD	Pot	ND	ND
MD	Other Somerset, MD	Gillnet	ND	ND
MD	Worcester County, MD	Gillnet	ND	ND
MD	Worcester County, MD	Trawl Mid	ND	ND
ME	Westport Island, ME	Pot Lobster	ND	ND
NC	Bayboro, NC	Dredge	ND	ND
NC	Beaufort County, NC	Gillnet	ND	ND
NC	Beaufort, NC	Trawl Bottom	$273,891	5.0%
NC	Beaufort, NC	Dredge	ND	ND
NC	Belhaven, NC	Trawl Bottom	ND	ND
NC	Brunswick County, NC	Hand	ND	ND
NC	Brunswick County, NC	Trawl Mid	ND	ND
NC	Brunswick County, NC	Pot	ND	ND
NC	Brunswick County, NC	Other	ND	ND
NC	Carteret County, NC	Hand	ND	ND
NC	Carteret County, NC	Trawl Mid	ND	ND
NC	Dare County, NC	Trawl Mid	ND	ND
NC	Dare County, NC	Gillnet	ND	ND
NC	Dare County, NC	Hand	ND	ND
NC	Dare County, NC	Longline	ND	ND
NC	Dare County, NC	Pot	ND	ND
NC	Dare County, NC	Other	ND	ND
NC	Engelhard, NC	Trawl Bottom	$572,300	5.8%
NC	Engelhard, NC	Gillnet	ND	ND
NC	Engelhard, NC	Pot	ND	ND
NC	Engelhard, NC	Dredge	ND	ND
NC	Hatteras, NC	Gillnet	$9,139	0.7%
NC	Hatteras, NC	Hand	ND	ND
NC	Hobucken, NC	Trawl Bottom	ND	ND
NC	Hobucken, NC	Dredge	ND	ND
NC	Hyde County, NC	Gillnet	ND	ND
NC	Hyde County, NC	Trawl Mid	ND	ND
NC	Hyde County, NC	Hand	ND	ND
NC	Lowland, NC	Trawl Bottom	ND	ND
NC	Lowland, NC	Dredge	ND	ND
NC	Morehead City, NC	Trawl Bottom	ND	ND
NC	Nags Head, NC	Gillnet	ND	ND

State	Port Group	Gear	Total Revenue from WEA	% of Port-Gear Revenue
NC	Nags Head, NC	Hand	ND	ND
NC	New Hanover County, NC	Hand	ND	ND
NC	New Hanover County, NC	Trawl Mid	ND	ND
NC	New Hanover County, NC	Pot	ND	ND
NC	Onslow County, NC	Pot	ND	ND
NC	Onslow County, NC	Hand	ND	ND
NC	Onslow County, NC	Trawl Mid	ND	ND
NC	Oriental, NC	Trawl Bottom	$317,894	4.4%
NC	Oriental, NC	Dredge	ND	ND
NC	Other Beaufort(County), NC	Trawl Bottom	ND	ND
NC	Other Currituck, NC	Trawl Bottom	ND	ND
NC	Pamlico County, NC	Other	ND	ND
NC	Pender County, NC	Hand	ND	ND
NC	Pender County, NC	Trawl Mid	ND	ND
NC	Pender County, NC	Pot	ND	ND
NC	Swan Quarter, NC	Trawl Bottom	ND	ND
NC	Swan Quarter, NC	Gillnet	ND	ND
NC	Wanchese, NC	Trawl Bottom	$1,027,772	4.8%
NC	Wanchese, NC	Gillnet	$209,835	4.8%
NC	Wanchese, NC	Pot	ND	ND
NC	Wanchese, NC	Longline	ND	ND
NC	Wanchese, NC	Hand	ND	ND
NC	Wanchese, NC	Seine	ND	ND
NC	Wanchese, NC	Dredge	ND	ND
NH	Newington, NH	Pot Lobster	ND	ND
NH	Portsmouth, NH	Gillnet	ND	ND
NH	Portsmouth, NH	Pot Lobster	ND	ND
NH	Portsmouth, NH	Trawl Bottom	ND	ND
NJ	Absecon, NJ	Trawl Bottom	ND	ND
NJ	Absecon, NJ	Gillnet	ND	ND
NJ	Atlantic City, NJ	Dredge	$18,251,821	11.0%
NJ	Atlantic City, NJ	Pot	$330,526	27.1%
NJ	Atlantic City, NJ	Seine	ND	ND
NJ	Atlantic City, NJ	Trawl Bottom	ND	ND
NJ	Atlantic City, NJ	Pot Lobster	ND	ND
NJ	Atlantic City, NJ	Gillnet	ND	ND
NJ	Avalon, NJ	Dredge	ND	ND
NJ	Barnegat, NJ	Dredge	$600,350	0.7%
NJ	Barnegat, NJ	Gillnet	$192,441	1.8%
NJ	Barnegat, NJ	Trawl Bottom	$42,144	1.7%

State	Port Group	Gear	Total Revenue from WEA	% of Port-Gear Revenue
NJ	Barnegat, NJ	Hand	ND	ND
NJ	Barnegat, NJ	Pot	ND	ND
NJ	Barnegat, NJ	Longline	ND	ND
NJ	Bayville, NJ	Pot Lobster	ND	ND
NJ	Belford, NJ	Trawl Bottom	$296,018	2.1%
NJ	Belford, NJ	Dredge	ND	ND
NJ	Belford, NJ	Pot Lobster	ND	ND
NJ	Belford, NJ	Gillnet	ND	ND
NJ	Belford, NJ	Seine	ND	ND
NJ	Belmar, NJ	Pot Lobster	$3,518	0.2%
NJ	Belmar, NJ	Trawl Bottom	ND	ND
NJ	Belmar, NJ	Dredge	ND	ND
NJ	Brielle, NJ	Dredge	ND	ND
NJ	Brielle, NJ	Gillnet	ND	ND
NJ	Brigantine, NJ	Gillnet	ND	ND
NJ	Cape May County, NJ	Longline	ND	ND
NJ	Cape May County, NJ	Trawl Mid	ND	ND
NJ	Cape May, NJ	Dredge	$4,190,515	1.2%
NJ	Cape May, NJ	Trawl Bottom	$771,613	1.1%
NJ	Cape May, NJ	Pot	$338,461	11.1%
NJ	Cape May, NJ	Seine	ND	ND
NJ	Cape May, NJ	Trawl Mid	ND	ND
NJ	Cape May, NJ	Pot Lobster	ND	ND
NJ	Cape May, NJ	Hand	ND	ND
NJ	Cape May, NJ	Gillnet	ND	ND
NJ	Highlands, NJ	Trawl Bottom	ND	ND
NJ	Highlands, NJ	Pot	ND	ND
NJ	Highlands, NJ	Hand	ND	ND
NJ	Little Egg Harbor, NJ	Hand	ND	ND
NJ	Long Beach, NJ	Dredge	$304,807	1.0%
NJ	Long Beach, NJ	Gillnet	$166,438	2.7%
NJ	Long Beach, NJ	Trawl Bottom	$80,607	7.6%
NJ	Long Beach, NJ	Longline	ND	ND
NJ	Long Beach, NJ	Hand	ND	ND
NJ	Manasquan, NJ	Trawl Bottom	ND	ND
NJ	Manasquan, NJ	Pot Lobster	ND	ND
NJ	Middletown, NJ	Dredge	ND	ND
NJ	Monmouth County, NJ	Hand	ND	ND
NJ	Neptune, NJ	Pot Lobster	ND	ND
NJ	Neptune, NJ	Dredge	ND	ND
NJ	Neptune, NJ	Pot	ND	ND
NJ	Ocean City, NJ	Dredge	ND	ND

State	Port Group	Gear	Total Revenue from WEA	% of Port-Gear Revenue
NJ	Ocean City, NJ	Trawl Bottom	ND	ND
NJ	Ocean City, NJ	Gillnet	ND	ND
NJ	Ocean County, NJ	Gillnet	ND	ND
NJ	Ocean County, NJ	Longline	ND	ND
NJ	Ocean County, NJ	Hand	ND	ND
NJ	Ocean County, NJ	Trawl Mid	ND	ND
NJ	Other Atlantic, NJ	Pot	ND	ND
NJ	Other Monmouth, NJ	Trawl Bottom	ND	ND
NJ	Other Ocean, NJ	Trawl Bottom	ND	ND
NJ	Point Pleasant, NJ	Dredge	$2,421,603	1.8%
NJ	Point Pleasant, NJ	Trawl Bottom	$677,261	2.3%
NJ	Point Pleasant, NJ	Pot Lobster	$12,376	0.1%
NJ	Point Pleasant, NJ	Gillnet	$12,125	0.3%
NJ	Point Pleasant, NJ	Pot	ND	ND
NJ	Point Pleasant, NJ	Hand	ND	ND
NJ	Port Norris, NJ	Dredge	ND	ND
NJ	Rumson, NJ	Hand	ND	ND
NJ	Sea Isle City, NJ	Pot	$356,185	14.7%
NJ	Sea Isle City, NJ	Pot Lobster	$9,728	0.4%
NJ	Sea Isle City, NJ	Trawl Bottom	ND	ND
NJ	Sea Isle City, NJ	Dredge	ND	ND
NJ	Sea Isle City, NJ	Hand	ND	ND
NJ	Sea Isle City, NJ	Gillnet	ND	ND
NJ	Toms River, NJ	Trawl Bottom	ND	ND
NJ	Waretown, NJ	Gillnet	ND	ND
NJ	Waretown, NJ	Pot Lobster	ND	ND
NJ	Wildwood, NJ	Dredge	$170,427	1.0%
NJ	Wildwood, NJ	Pot	ND	ND
NJ	Wildwood, NJ	Hand	ND	ND
NJ	Wildwood, NJ	Pot Lobster	ND	ND
NJ	Wildwood, NJ	Gillnet	ND	ND
NJ	Wildwood, NJ	Trawl Bottom	ND	ND
NY	Brooklyn, NY	Gillnet	ND	ND
NY	Brooklyn, NY	Pot Lobster	ND	ND
NY	Brooklyn, NY	Hand	ND	ND
NY	Brooklyn, NY	Trawl Bottom	ND	ND
NY	Brooklyn, NY	Pot	ND	ND
NY	East Hampton, NY	Gillnet	ND	ND
NY	Freeport, NY	Trawl Bottom	$455,121	11.7%
NY	Freeport, NY	Dredge	$969	1.1%

State	Port Group	Gear	Total Revenue from WEA	% of Port-Gear Revenue
NY	Freeport, NY	Hand	$490	0.3%
NY	Freeport, NY	Pot Lobster	ND	ND
NY	Freeport, NY	Gillnet	ND	ND
NY	Freeport, NY	Pot	ND	ND
NY	Greenport, NY	Trawl Bottom	ND	ND
NY	Hampton Bays, NY	Trawl Bottom	$73,155	0.2%
NY	Hampton Bays, NY	Longline	ND	ND
NY	Hampton Bays, NY	Dredge	ND	ND
NY	Hampton Bays, NY	Pot Lobster	ND	ND
NY	Hampton Bays, NY	Pot	ND	ND
NY	Hampton Bays, NY	Gillnet	ND	ND
NY	Island Park, NY	Hand	ND	ND
NY	Island Park, NY	Pot	ND	ND
NY	Islip, NY	Trawl Bottom	ND	ND
NY	Islip, NY	Dredge	ND	ND
NY	Islip, NY	Gillnet	ND	ND
NY	Islip, NY	Pot	ND	ND
NY	Jamaica Bay-Rockaway, NY	Hand	ND	ND
NY	Long Beach, NY	Trawl Bottom	ND	ND
NY	Montauk, NY	Trawl Bottom	$1,402,527	2.8%
NY	Montauk, NY	Longline	$149,627	0.8%
NY	Montauk, NY	Pot Lobster	$67,314	1.2%
NY	Montauk, NY	Dredge	$47,766	0.5%
NY	Montauk, NY	Hand	$11,171	0.2%
NY	Montauk, NY	Gillnet	$7,005	0.1%
NY	Montauk, NY	Pot	ND	ND
NY	Moriches, NY	Gillnet	ND	ND
NY	New York, NY	Pot Lobster	ND	ND
NY	New York, NY	Pot	ND	ND
NY	New York, NY	Trawl Bottom	ND	ND
NY	Oceanside, NY	Hand	ND	ND
NY	Other Nassau, NY	Dredge	ND	ND
NY	Other Nassau, NY	Trawl Bottom	ND	ND
NY	Other NY, NY	Trawl Bottom	ND	ND
NY	Other NY, NY	Pot Lobster	ND	ND
NY	Other NY, NY	Pot	ND	ND
NY	Other Richmond, NY	Hand	ND	ND
NY	Other Suffolk, NY	Trawl Bottom	ND	ND
NY	Other Suffolk, NY	Pot	ND	ND
NY	Other Suffolk, NY	Gillnet	ND	ND

State	Port Group	Gear	Total Revenue from WEA	% of Port-Gear Revenue
NY	Other Suffolk, NY	Hand	ND	ND
NY	Other Suffolk, NY	Pot Lobster	ND	ND
NY	Point Lookout, NY	Trawl Bottom	$988,985	7.1%
NY	Point Lookout, NY	Dredge	ND	ND
NY	Point Lookout, NY	Pot Lobster	ND	ND
NY	Point Lookout, NY	Hand	ND	ND
NY	Point Lookout, NY	Gillnet	ND	ND
NY	Point Lookout, NY	Pot	ND	ND
NY	Seaford, NY	Hand	ND	ND
NY	Seaford, NY	Pot	ND	ND
NY	Shelter Island, NY	Hand	ND	ND
NY	Southold, NY	Hand	ND	ND
NY	Suffolk County, NY	Hand	ND	ND
NY	Wainscott, NY	Pot	ND	ND
RI	Bristol, RI	Trawl Bottom	ND	ND
RI	Jamestown, RI	Pot Lobster	ND	ND
RI	Jamestown, RI	Hand	ND	ND
RI	Little Compton, RI	Gillnet	$1,808,700	27.0%
RI	Little Compton, RI	Pot Lobster	$169,571	9.4%
RI	Little Compton, RI	Pot	$16,781	0.9%
RI	Little Compton, RI	Hand	ND	ND
RI	Little Compton, RI	Trawl Bottom	ND	ND
RI	Narragansett, RI	Trawl Bottom	$5,348,629	4.0%
RI	Narragansett, RI	Pot Lobster	$1,050,031	3.0%
RI	Narragansett, RI	Dredge	$372,898	2.3%
RI	Narragansett, RI	Gillnet	$251,768	4.7%
RI	Narragansett, RI	Pot	$12,511	0.6%
RI	Narragansett, RI	Hand	$10,758	2.2%
RI	Narragansett, RI	Trawl Mid	ND	ND
RI	Narragansett, RI	Longline	ND	ND
RI	Narragansett, RI	Seine	ND	ND
RI	New Shoreham, RI	Trawl Bottom	$2,131	0.9%
RI	New Shoreham, RI	Pot Lobster	$287	0.3%
RI	New Shoreham, RI	Gillnet	ND	ND
RI	New Shoreham, RI	Dredge	ND	ND
RI	Newport, RI	Gillnet	$953,540	26.7%
RI	Newport, RI	Trawl Bottom	$486,320	4.5%
RI	Newport, RI	Pot Lobster	$261,529	1.1%
RI	Newport, RI	Dredge	$63,933	0.4%
RI	Newport, RI	Pot	ND	ND
RI	Newport, RI	Trawl Mid	ND	ND
RI	Newport, RI	Hand	ND	ND

State	Port Group	Gear	Total Revenue from WEA	% of Port-Gear Revenue
RI	North Kingstown, RI	Trawl Bottom	$628,064	1.3%
RI	North Kingstown, RI	Trawl Mid	ND	ND
RI	North Kingstown, RI	Dredge	ND	ND
RI	North Kingstown, RI	Pot Lobster	ND	ND
RI	Other Newport, RI	Pot Lobster	ND	ND
RI	Other Newport, RI	Trawl Bottom	ND	ND
RI	Other Newport, RI	Pot	ND	ND
RI	Portsmouth, RI	Pot Lobster	ND	ND
RI	Portsmouth, RI	Trawl Bottom	ND	ND
RI	South Kingstown, RI	Hand	ND	ND
RI	South Kingstown, RI	Pot Lobster	ND	ND
RI	Tiverton, RI	Gillnet	$136,809	8.4%
RI	Tiverton, RI	Trawl Bottom	ND	ND
RI	Tiverton, RI	Pot Lobster	ND	ND
RI	Tiverton, RI	Longline	ND	ND
RI	Tiverton, RI	Pot	ND	ND
RI	Warren, RI	Dredge	ND	ND
RI	Washington County, RI	Hand	ND	ND
RI	Washington County, RI	Trawl Mid	ND	ND
SC	Charleston County, SC	Hand	ND	ND
SC	Charleston County, SC	Pot	ND	ND
SC	Charleston County, SC	Longline	ND	ND
SC	Charleston County, SC	Trawl Mid	ND	ND
SC	Georgetown County, SC	Hand	$83,240	2.4%
SC	Georgetown County, SC	Pot	$8,896	5.6%
SC	Georgetown County, SC	Trawl Bottom	ND	ND
SC	Georgetown County, SC	Trawl Mid	ND	ND
SC	Georgetown County, SC	Longline	ND	ND
SC	Horry County, SC	Hand	$89,930	1.5%
SC	Horry County, SC	Pot	$32,712	3.4%
SC	Horry County, SC	Trawl Mid	$670	2.6%
SC	Horry County, SC	Longline	ND	ND
SC	Other Beaufort, SC	Trawl Bottom	ND	ND
VA	Accomack County, VA	Longline	ND	ND
VA	Accomack County, VA	Gillnet	ND	ND
VA	Accomack County, VA	Hand	ND	ND
VA	Cape Charles, VA	Trawl Bottom	ND	ND
VA	Cape Charles, VA	Pot	ND	ND
VA	Chincoteague, VA	Trawl Bottom	$208,845	2.1%
VA	Chincoteague, VA	Gillnet	ND	ND
VA	Chincoteague, VA	Hand	ND	ND

State	Port Group	Gear	Total Revenue from WEA	% of Port-Gear Revenue
VA	Chincoteague, VA	Pot	ND	ND
VA	Chincoteague, VA	Dredge	ND	ND
VA	City of Virginia Beach County, VA	Trawl Mid	ND	ND
VA	District 4 Northampton County, VA	Pot	ND	ND
VA	District 4 Northampton County, VA	Dredge	ND	ND
VA	Greenbackville, VA	Gillnet	ND	ND
VA	Hampton County, VA	Longline	ND	ND
VA	Hampton, VA	Trawl Bottom	$561,237	3.2%
VA	Hampton, VA	Dredge	$352,749	0.5%
VA	Hampton, VA	Hand	ND	ND
VA	Hampton, VA	Gillnet	ND	ND
VA	Newport News, VA	Dredge	$3,174,114	1.5%
VA	Newport News, VA	Trawl Bottom	$540,120	3.4%
VA	Newport News, VA	Pot	ND	ND
VA	Newport News, VA	Pot Lobster	ND	ND
VA	Norfolk, VA	Hand	ND	ND
VA	Norfolk, VA	Trawl Bottom	ND	ND
VA	Not-Specified County, VA	Trawl Mid	ND	ND
VA	Not-Specified County, VA	Gillnet	ND	ND
VA	Other City OF Chesapeake, VA	Trawl Bottom	ND	ND
VA	Other York, VA	Dredge	ND	ND
VA	Poquoson, VA	Hand	ND	ND
VA	Seaford, VA	Dredge	$390,977	0.4%
VA	Seaford, VA	Trawl Bottom	ND	ND
VA	Virginia Beach, VA	Pot	$324,940	7.8%
VA	Virginia Beach, VA	Hand	$5,764	1.5%
VA	Virginia Beach, VA	Gillnet	ND	ND
VA	Wachapreague, VA	Pot	ND	ND

Note: Dollar values are in $US 2012; ND = suppressed for confidentiality.

Table III-vii presents the list of cumulative revenue estimated to have been generated from WEAs, by port and vessel category. This list only includes port-vessel category combinations estimated to have generated average annual revenue greater than $1,000. Small vessels are less than or equal to 50 feet in length. Large vessels are greater than 50 feet in length.

Table III-vii. Revenue from WEA by port group and vessel category (50' cutoff)—all port-vessel length combinations with greater than $1,000 per year average revenue from any WEA.

State	Port Group	Vessel Length Category (50' Cutoff)	Total Revenue from WEA	% of Port-FMP Revenue
CT	New London, CT	Large	$813,397	2.5%
CT	New London, CT	Small	$19,778	0.5%

State	Port Group	Vessel Length Category (50' Cutoff)	Total Revenue from WEA	% of Port-FMP Revenue
CT	Stonington, CT	Large	$628,859	1.5%
CT	Stonington, CT	Small	$18,263	0.6%
DE	Indian River, DE	Small	$223,102	12.2%
MA	Barnstable, MA	Large	$32,840	0.2%
MA	Chatham, MA	Small	$498,617	0.9%
MA	Chilmark, MA	Large	$32,221	6.7%
MA	Chilmark, MA	Small	$204,175	12.0%
MA	Fairhaven, MA	Large	$203,841	0.3%
MA	Fairhaven, MA	Small	$238,497	18.9%
MA	Fall River, MA	Large	$275,543	2.3%
MA	Gloucester, MA	Large	$1,040,577	0.6%
MA	Harwich Port, MA	Small	$21,845	0.2%
MA	Nantucket, MA	Small	$6,289	0.3%
MA	New Bedford, MA	Large	$17,805,360	1.0%
MA	New Bedford, MA	Small	$2,922,884	16.2%
MA	Westport, MA	Small	$746,701	11.3%
MA	Woods Hole, MA	Large	$74,110	6.1%
MD	Ocean City, MD	Large	$432,006	1.0%
MD	Ocean City, MD	Small	$253,362	2.0%
NC	Beaufort, NC	Large	$247,614	4.5%
NC	Engelhard, NC	Small	$120,357	5.2%
NC	Hatteras, NC	Small	$9,139	0.6%
NC	Oriental, NC	Large	$317,933	4.2%
NC	Wanchese, NC	Large	$1,028,304	4.7%
NC	Wanchese, NC	Small	$269,592	5.3%
NJ	Atlantic City, NJ	Large	$18,291,333	11.1%
NJ	Atlantic City, NJ	Small	$332,576	13.3%
NJ	Barnegat, NJ	Large	$646,722	0.8%
NJ	Barnegat, NJ	Small	$196,427	1.0%
NJ	Belford, NJ	Large	$284,459	2.2%
NJ	Belford, NJ	Small	$19,165	0.4%
NJ	Belmar, NJ	Small	$27,779	1.1%
NJ	Cape May, NJ	Large	$5,789,641	1.3%
NJ	Cape May, NJ	Small	$560,180	3.4%
NJ	Long Beach, NJ	Large	$350,290	1.3%
NJ	Long Beach, NJ	Small	$202,433	2.0%
NJ	Point Pleasant, NJ	Large	$2,828,514	1.8%
NJ	Point Pleasant, NJ	Small	$306,538	1.3%
NJ	Sea Isle City, NJ	Small	$357,024	12.2%
NJ	Waretown, NJ	Small	$13,122	0.8%
NJ	Wildwood, NJ	Large	$143,056	1.3%
NJ	Wildwood, NJ	Small	$117,783	1.9%
NY	Freeport, NY	Large	$452,427	12.4%
NY	Freeport, NY	Small	$11,053	1.1%
NY	Hampton Bays, NY	Large	$63,922	0.3%
NY	Hampton Bays, NY	Small	$27,813	0.1%
NY	Montauk, NY	Large	$1,528,327	2.1%
NY	Montauk, NY	Small	$157,174	0.7%

State	Port Group	Vessel Length Category (50' Cutoff)	Total Revenue from WEA	% of Port-FMP Revenue
NY	Other Nassau, NY	Large	$9,438	0.1%
NY	Point Lookout, NY	Large	$862,235	7.1%
NY	Point Lookout, NY	Small	$138,382	6.0%
RI	Little Compton, RI	Small	$1,966,058	24.8%
RI	Narragansett, RI	Large	$5,361,503	3.4%
RI	Narragansett, RI	Small	$1,708,220	4.9%
RI	Newport, RI	Large	$742,434	1.5%
RI	Newport, RI	Small	$1,025,579	21.1%
RI	North Kingstown, RI	Large	$656,652	1.1%
RI	Tiverton, RI	Small	$136,440	9.4%
SC	Charleston County, SC	Unknown	$11,061	3.4%
SC	Georgetown County, SC	Unknown	$91,666	2.5%
SC	Horry County, SC	Unknown	$124,044	1.8%
VA	Chincoteague, VA	Large	$201,481	1.8%
VA	Chincoteague, VA	Small	$66,351	0.9%
VA	Hampton, VA	Large	$913,765	1.0%
VA	Newport News, VA	Large	$3,812,733	1.7%
VA	Seaford, VA	Large	$390,977	0.4%
VA	Virginia Beach, VA	Small	$317,595	4.8%
DE	Lewes, DE	Small	ND	ND
MA	Falmouth, MA	Small	ND	ND
MA	Nantucket, MA	Large	ND	ND
MA	New Bedford, MA	Unknown	ND	ND
MA	Sandwich, MA	Large	ND	ND
MA	Sandwich, MA	Unknown	ND	ND
MA	Woods Hole, MA	Unknown	ND	ND
NC	Beaufort, NC	Small	ND	ND
NC	Brunswick County, NC	Unknown	ND	ND
NC	Dare County, NC	Small	ND	ND
NC	Dare County, NC	Unknown	ND	ND
NC	Engelhard, NC	Large	ND	ND
NC	Hobucken, NC	Large	ND	ND
NC	Lowland, NC	Large	ND	ND
NC	Nags Head, NC	Small	ND	ND
NC	New Hanover County, NC	Unknown	ND	ND
NC	Onslow County, NC	Unknown	ND	ND
NC	Pender County, NC	Unknown	ND	ND
NC	Swan Quarter, NC	Large	ND	ND
NJ	Brielle, NJ	Unknown	ND	ND
NJ	Cape May, NJ	Unknown	ND	ND
NJ	Highlands, NJ	Large	ND	ND
NJ	Other Monmouth, NJ	Small	ND	ND
NJ	Sea Isle City, NJ	Large	ND	ND
NY	Islip, NY	Large	ND	ND
NY	Islip, NY	Small	ND	ND

State	Port Group	Vessel Length Category (50' Cutoff)	Total Revenue from WEA	% of Port-FMP Revenue
NY	Other Suffolk, NY	Small	ND	ND
RI	Little Compton, RI	Large	ND	ND
RI	South Kingstown, RI	Small	ND	ND
RI	Tiverton, RI	Large	ND	ND
RI	Warren, RI	Large	ND	ND
VA	Hampton County, VA	Unknown	ND	ND
VA	Newport News, VA	Small	ND	ND
VA	Norfolk, VA	Small	ND	ND
VA	Other York, VA	Large	ND	ND
VA	Virginia Beach, VA	Unknown	ND	ND

Note: Dollar values are in $US 2012; ND = suppressed for confidentiality.

Table III-viii presents the full assessment of exposure for the ports most vulnerable, based on Colburn and Jepson (2012) and Jepson and Colburn (2013) social indicators, to impacts, if and when they occur.

Table III-viii. WEA exposure of most vulnerable port groups (2007–2012).

Port Group	Revenue Sourced from a WEA/Port Group Total Revenue (Percent)	Total Port Revenue from Commercial Fishing	Social Vulnerability[a]	Gentrification Pressure Vulnerability[a]
Atlantic City, NJ	11.1%	$167,382,733	High	Moderate
Wildwood, NJ	1.5%	$17,363,886	High	Moderate
New York, NY	0.2%	$189,593	High	Moderate
Brooklyn, NY	0.2%	$987,375	High	Moderate
Greenport, NY	0.1%	$960,484	High	Moderate
Lewes, DE	ND	ND	Moderate	Moderate
Norfolk, VA	ND	ND	High	Low
Swan Quarter, NC	3.0%	$991,579	High	Low
New London, CT	2.3%	$36,610,259	High	Low
Fall River, MA	2.3%	$12,186,151	High	Low
Lowland, NC	ND	ND	High	Low
Long Beach, NJ	1.5%	$37,864,871	Low	High
Other NY, NY	1.5%	$260,819	High	Low
Chincoteague, VA	1.4%	$18,785,339	Moderate	Moderate
Cape May, NJ	1.4%	$454,485,595	Low	High
New Bedford, MA	1.2%	$1,753,754,355	High	Low
Chatham, MA	0.9%	$54,221,724	Low	High
Cape Charles, VA	0.6%	$713,965	Moderate	Moderate
East Hampton, NY	0.1%	$583,064	Low	High
Little Compton, RI	19.2%	$10,406,064	Low	Moderate
Georgetown, ME	16.5%	$1,901,739	Low	Moderate

Port Group	Revenue Sourced from a WEA/Port Group Total Revenue (Percent)	Total Port Revenue from Commercial Fishing	Social Vulnerability[a]	Gentrification Pressure Vulnerability[a]
Freeport, NY	12.6%	$8,603,133	Moderate	Low
Indian River, DE	11.6%	$1,924,223	Moderate	Low
Chilmark, MA	10.8%	$2,188,287	Low	Moderate
Woods Hole, MA	7.3%	$1,934,922	Low	Moderate
Sea Isle City, NJ	6.9%	$5,472,745	Low	Moderate
Beaufort, NC	4.7%	$5,774,402	Moderate	Low
Engelhard, NC	4.4%	$13,843,170	Moderate	Low
Oriental, NC	4.2%	$7,636,353	Low	Moderate
Belford, NJ	2.4%	$21,575,801	Low	Moderate
Morehead City, NC	1.9%	$157,945	Moderate	Low
Ocean City, NJ	1.8%	$129,593	Low	Moderate
Montauk, NY	1.8%	$96,493,597	Low	Moderate
Point Pleasant, NJ	1.8%	$183,874,183	Low	Moderate
Newport News, VA	1.7%	$230,016,608	Moderate	Low
Truro, MA	1.3%	$101,751	Low	Moderate
Ocean City, MD	1.2%	$55,653,152	Low	Moderate
Falmouth, MA	1.2%	$954,452	Low	Moderate
Hampton, VA	1.0%	$92,064,160	Moderate	Low
Long Beach, NY	0.7%	$321,716	Low	Moderate
Hatteras, NC	0.6%	$1,434,630	Moderate	Low
Nantucket, MA	0.6%	$6,157,381	Low	Moderate
South Yarmouth, MA	0.5%	$584,608	Low	Moderate
Wainscott, NY	0.4%	$84,142	Low	Moderate
New Shoreham, RI	0.3%	$1,071,390	Low	Moderate
Shelter Island, NY	0.3%	$87,245	Low	Moderate
Boothbay Harbor, ME	0.3%	$21,067,558	Low	Moderate
Rockland, ME	0.3%	$24,623,418	Moderate	Low
Harwich Port, MA	0.2%	$10,949,503	Low	Moderate
Hampton Bays, NY	0.2%	$60,160,289	Low	Moderate
Portland, ME	0.2%	$75,377,556	Moderate	Low
South Bristol, ME	0.2%	$25,368,681	Low	Moderate
Harpswell, ME	0.1%	$61,976,624	Low	Moderate
Manasquan, NJ	0.1%	$394,417	Low	Moderate
Friendship, ME	0.1%	$44,774,184	Low	Moderate
South Kingstown, RI	28.2%	$64,158	Low	Low
Highlands, NJ	24.1%	$180,709	Low	Low

Port Group	Revenue Sourced from a WEA/Port Group Total Revenue (Percent)	Total Port Revenue from Commercial Fishing	Social Vulnerability[a]	Gentrification Pressure Vulnerability[a]
Warren, RI	ND	ND	Low	Low
Westport, MA	11.1%	$6,755,443	Low	Low
Tiverton, RI	10.7%	$5,009,347	Low	Low
Point Lookout, NY	7.7%	$21,588,217	Low	Low
Virginia Beach, VA	4.9%	$6,733,171	Low	Low
Wanchese, NC	4.8%	$26,898,894	Low	Low
Islip, NY	4.8%	$2,178,422	Low	Low
Narragansett, RI	3.7%	$192,737,213	Low	Low
Newport, RI	3.3%	$53,214,814	Low	Low
Bristol, RI	2.9%	$158,227	Low	Low
Portsmouth, RI	ND	ND	Low	Low
Stonington, CT	1.4%	$45,647,571	Low	Low
Belmar, NJ	1.2%	$2,481,734	Low	Low
North Kingstown, RI	1.1%	$57,330,872	Low	Low
Sandwich, MA	0.9%	$20,095,488	Low	Low
Barnegat, NJ	0.8%	$100,263,380	Low	Low
Waretown, NJ	0.8%	$1,701,399	Low	Low
Neptune, NJ	0.8%	$676,669	Low	Low
Fairhaven, MA	0.7%	$60,160,695	Low	Low
Hobucken, NC	0.7%	$1,707,213	Low	Low
Jamestown, RI	0.6%	$607,028	Low	Low
Brielle, NJ	0.5%	$1,754,448	Low	Low
Seaford, VA	0.4%	$92,348,351	Low	Low
Gloucester, MA	0.4%	$259,287,185	Low	Low
Phippsburg, ME	0.4%	$16,827,661	Low	Low
Brunswick, ME	ND	ND	Low	Low
Barnstable, MA	0.2%	$22,670,871	Low	Low

Note: Dollar values are in $US 2012; ND = suppressed for confidentiality; only port groups with more than $10,000 per year revenue.

a Gentrification and social vulnerability scores are based on Colburn and Jepson (2012) and Jepson and Colburn (2013).

Table III-ix identifies the top 10 ports exposed to each WEA.

Table III-ix. Top 10 exposed ports by WEA.

WEA	Port Group	Port Average Exposed Revenue	Port Average Total Revenue	Exposed Revenue/Port Total Revenue (Percent)
MA	Warren, RI	ND	ND	ND
MA	Tiverton, RI	$64,543	$834,891	7.7%
MA	Little Compton, RI	$59,391	$1,734,344	3.4%
MA	Narragansett, RI	$666,623	$32,122,869	2.1%
MA	Montauk, NY	$211,825	$16,077,058	1.3%
MA	Chatham, MA	$83,020	$9,036,954	0.9%
MA	Newport, RI	$80,447	$8,869,136	0.9%

WEA	Port Group	Port Average Exposed Revenue	Port Average Total Revenue	Exposed Revenue/Port Total Revenue (Percent)
MA	Fairhaven, MA	$58,891	$10,026,783	0.6%
MA	New Bedford, MA	$1,416,869	$292,229,242	0.5%
MA	Gloucester, MA	$53,061	$43,210,602	0.1%
RI-MA	Little Compton, RI	$273,190	$1,734,344	15.8%
RI-MA	Westport, MA	$83,203	$1,125,907	7.4%
RI-MA	Warren, RI	ND	ND	ND
RI-MA	Chilmark, MA	$22,043	$364,715	6.0%
RI-MA	Woods Hole, MA	$17,971	$318,762	5.6%
RI-MA	Tiverton, RI	$24,664	$834,891	3.0%
RI-MA	Newport, RI	$212,144	$8,869,136	2.4%
RI-MA	Narragansett, RI	$461,407	$32,122,869	1.4%
RI-MA	New Bedford, MA	$686,991	$292,229,242	0.2%
RI-MA	Montauk, NY	$28,050	$16,077,058	0.2%
NY	Freeport, NY	$77,363	$783,641	9.9%
NY	Point Lookout, NY	$166,664	$2,417,162	6.9%
NY	New London, CT	$112,670	$6,101,710	1.8%
NY	Point Pleasant, NJ	$478,290	$30,335,241	1.6%
NY	Newport News, VA	$398,210	$38,319,620	1.0%
NY	Long Beach, NJ	$57,165	$6,226,706	0.9%
NY	Stonington, CT	$61,099	$7,607,928	0.8%
NY	Cape May, NJ	$562,111	$75,665,163	0.7%
NY	Barnegat, NJ	$97,142	$16,706,499	0.6%
NY	New Bedford, MA	$1,264,815	$292,229,242	0.4%
NJ	Atlantic City, NJ	$3,073,911	$27,890,274	11.0%
NJ	Sea Isle City, NJ	$28,920	$912,124	3.2%
NJ	Wildwood, NJ	$28,188	$2,893,981	1.0%
NJ	Long Beach, NJ	$34,604	$6,226,706	0.6%
NJ	Cape May, NJ	$235,212	$75,665,163	0.3%
NJ	Newport News, VA	$115,741	$38,319,620	0.3%
NJ	Barnegat, NJ	$35,637	$16,706,499	0.2%
NJ	Gloucester, MA	$63,324	$43,210,602	0.1%
NJ	Point Pleasant, NJ	$44,351	$30,335,241	0.1%
NJ	New Bedford, MA	$43,678	$292,229,242	0.0%
DE	Sea Isle City, NJ	$34,379	$912,124	3.8%
DE	Indian River, DE	$4,753	$320,704	1.5%
DE	Wildwood, NJ	$11,150	$2,893,981	0.4%
DE	Cape May, NJ	$185,954	$75,665,163	0.2%
DE	Ocean City, MD	$21,747	$9,242,687	0.2%
DE	Chincoteague, VA	$6,432	$3,130,890	0.2%
DE	Atlantic City, NJ	$20,907	$27,890,274	0.1%
DE	Seaford, VA	$8,031	$15,391,392	0.1%
DE	Newport News, VA	$18,817	$38,319,620	0.0%
DE	New Bedford, MA	$31,222	$292,229,242	0.0%
MD	Indian River, DE	$31,457	$320,704	9.8%
MD	Other York, VA	ND	ND	ND
MD	Ocean City, MD	$82,188	$9,242,687	0.9%
MD	Chincoteague, VA	$7,030	$3,130,890	0.2%
MD	Cape May, NJ	$29,074	$75,665,163	0.0%

WEA	Port Group	Port Average Exposed Revenue	Port Average Total Revenue	Exposed Revenue/Port Total Revenue (Percent)
MD	Hampton, VA	$5,359	$15,344,027	0.0%
MD	Seaford, VA	$5,350	$15,391,392	0.0%
MD	North Kingstown, RI	$1,719	$9,555,145	0.0%
MD	Newport News, VA	$4,567	$38,319,620	0.0%
MD	New Bedford, MA	$8,273	$292,229,242	0.0%
VA	Virginia Beach, VA	$40,251	$1,122,195	3.6%
VA	Norfolk, VA	ND	ND	ND
VA	North Kingstown, RI	$9,530	$9,555,145	0.1%
VA	Engelhard, NC	$2,109	$2,307,195	0.1%
VA	Oriental, NC	$1,087	$1,272,725	0.1%
VA	Chincoteague, VA	$808	$3,130,890	0.0%
VA	Newport News, VA	$5,633	$38,319,620	0.0%
VA	Hampton, VA	$1,176	$15,344,027	0.0%
VA	Cape May, NJ	$1,437	$75,665,163	0.0%
VA	New Bedford, MA	$926	$292,229,242	0.0%
NC	New Hanover County, NC	$57,461	$838,758	6.9%
NC	Brunswick County, NC	$68,009	$1,163,775	5.8%
NC	Dare County, NC	$118,875	$2,245,733	5.3%
NC	Wanchese, NC	$212,589	$4,483,149	4.7%
NC	Beaufort, NC	$44,294	$962,400	4.6%
NC	Engelhard, NC	$97,390	$2,307,195	4.2%
NC	Oriental, NC	$49,621	$1,272,725	3.9%
NC	North Kingstown, RI	$60,758	$9,555,145	0.6%
NC	Hampton, VA	$68,237	$15,344,027	0.4%
NC	Newport News, VA	$92,824	$38,319,620	0.2%

Note: Dollar values are in $US 2012; ND = suppressed for confidentiality.

III.iii Commercial Fisheries

This section presents the full analysis of commercial fisheries exposure to WEA development. Vessel home ports can differ from port of landing, and presents a secondary avenue by which on-shore communities are exposed to changes in offshore fishing. Table III-x shows only those home ports where greater than 20 percent of permits home ported are above the threshold of 1 percent or $100,000 in annual revenue sourced within WEAs. Table III-xi identifies the home ports of the highly exposed permits, sourcing more than 15 percent of their annual revenue from WEAs.

Table III-x. Home ports of exposed vessels.

State	Home Port	Number of Exposed Permits	Total Number of Permits
CT	Mystic, CT	1	3
DE	Indian River, DE	1	3
DE	Lewes, DE	2	3
DE	Milford, DE	2	3
MA	Chilmark, MA	6	13
MA	Dartmouth, MA	2	3
MA	Fairhaven, MA	10	25
MA	Marion, MA	1	3
MA	Nantucket, MA	2	6
MA	New Bedford, MA	68	265

State	Home Port	Number of Exposed Permits	Total Number of Permits
MA	Vineyard Haven, MA	2	5
MA	Westport, MA	16	23
MD	Ocean City, MD	15	33
ME	Bath, ME	1	3
ME	Long Island, ME	1	4
ME	Mount Desert, ME	1	4
ME	South Thomaston, ME	1	3
NC	Atlantic Beach, NC	1	3
NC	Atlantic, NC	3	3
NC	Aurora, NC	2	4
NC	Bayboro, NC	3	3
NC	Beaufort, NC	10	22
NC	Belhaven, NC	6	8
NC	Engelhard, NC	8	18
NC	Hatteras, NC	14	22
NC	Lowland, NC	8	14
NC	Manns Harbor, NC	3	3
NC	Manteo, NC	6	8
NC	NA, NC	2	8
NC	New Bern, NC	6	22
NC	Oriental, NC	9	13
NC	Scranton, NC	3	3
NC	Sneads Ferry, NC	3	7
NC	Swan Quarter, NC	6	17
NC	Wanchese, NC	46	73
NJ	Atlantic City, NJ	16	28
NJ	Barnegat Light, NJ	27	81
NJ	Brigantine, NJ	1	4
NJ	Cape May, NJ	57	169
NJ	NA, NJ	1	4
NJ	Point Pleasant, NJ	18	62
NJ	Sea Isle City, NJ	7	13
NJ	Waretown, NJ	2	7
NJ	Wildwood, NJ	3	9
NY	Greenport, NY	2	7
NY	Islip, NY	1	4
NY	New York, NY	17	73
NY	Northport, NY	1	4
NY	Oceanside, NY	2	3
NY	Point Lookout, NY	2	3
NY	Shelter Island, NY	2	4
PA	Philadelphia, PA	10	16
RI	Little Compton, RI	13	14
RI	Narragansett, RI	69	141
RI	Newport, RI	12	29
RI	South Kingstown, RI	4	12
RI	Tiverton, RI	3	8
RI	Wakefield-Peacedale, RI	5	11
VA	Gloucester Point, VA	2	4

State	Home Port	Number of Exposed Permits	Total Number of Permits
VA	Newport News, VA	9	26
VA	Norfolk, VA	10	30
VA	Poquoson, VA	1	3
VA	Virginia Beach, VA	6	20
VA	Westville, VA	2	3
NA	Unrecognized Port	260	960

Notes:

- NA = not applicable
- "Exposed permits" are permits with greater than 1 percent or $100,000 of annual revenue from a WEA.
- Only ports with greater than 20 percent of permits above threshold are listed.
- Thirty-nine ports were omitted for confidentiality reasons.

Table III-xi. Home ports of highly exposed permits (all ports with one or more highly exposed vessels).

Home Port	Number of Highly Exposed Permits	Total Number of Permits	Percentage of Highly Exposed Permits
Indian River, DE	1	3	33.3%
Chilmark, MA	2	13	15.4%
Dartmouth, MA	2	3	66.7%
Fairhaven, MA	3	25	12.0%
New Bedford, MA	12	265	4.5%
Plymouth, MA	2	28	7.1%
Vineyard Haven, MA	1	5	20.0%
Westport, MA	3	23	13.0%
Belhaven, NC	1	8	12.5%
Engelhard, NC	1	18	5.6%
Hatteras, NC	1	22	4.5%
Manteo, NC	1	8	12.5%
Sneads Ferry, NC	1	7	14.3%
Swan Quarter, NC	1	17	5.9%
Wanchese, NC	6	73	8.2%
Atlantic City, NJ	9	28	32.1%
Belford, NJ	1	23	4.3%
Brigantine, NJ	1	4	25.0%
Sea Isle City, NJ	2	13	15.4%
Wildwood, NJ	1	9	11.1%
Freeport, NY	1	16	6.2%
Oceanside, NY	1	3	33.3%
Philadelphia, PA	2	16	12.5%
Little Compton, RI	5	14	35.7%
Newport, RI	5	29	17.2%
South Kingstown, RI	3	12	25.0%
Tiverton, RI	1	8	12.5%
Chincoteague, VA	1	10	10.0%
Norfolk, VA	3	30	10.0%
Virginia Beach, VA	2	20	10.0%
Unrecognized Port	55	960	5.7%

Note: Five ports were omitted for confidentiality purposes.

III.iv Recreational Fisheries

This section presents additional recreational fisheries exposure results to WEA development, by state and port group.

Table III-xii presents the total average annual gross revenues for for-hire boats from 2007 to 2012 by homeport state, as well as the percent of revenue related to for-hire boat trips considered exposed. Total average annual for-hire boat gross revenues are $378.3 million, 6.3 percent ($23.9 million) of which is considered exposed to WEAs. Table III-xiii shows the total overall exposure for combined estimated angler trips (i.e., for-hire and private boat angler trips). Approximately 103 million for-hire and private boat angler trips were taken near all WEAs during the study period, of which approximately 4 million, or 3.83 percent, are considered exposed.

Table III-xii. Total average annual for-hire boat gross revenues during 2007–2012 by homeport state; percent of revenue related to for-hire boat trips considered exposed.

State	Average Annual For-Hire Boat Gross Revenues (2007–2012)	Total Average Annual For-Hire Boat Gross Revenues Considered Exposed (2007–2012)	Percent of Total Average Annual For-Hire Boat Gross Revenues Considered Exposed (2007–2012)
CT	$14,519,809	$38,567	0.27%
DE	$6,255,284	$592,516	9.47%
MA	$62,405,111	$42,089	0.07%
MD	$6,465,899	$517,123	8.00%
NC	$38,835,847	$6,977,974	17.97%
NH	$25,807,845	*	*
NJ	$69,870,400	$3,894,952	5.57%
NY	$86,219,176	$ 893,866	1.04%
RI	$15,606,829	$1,039,999	6.66%
SC	$47,793,143	$9,715,939	20.33%
VA	$4,475,392	$155,055	3.46%
Total	$378,254,736	$23,868,776	6.31%

* Confidential; all revenues are in $US 2012.

Table III-xiii. Total combined estimated angler trips (for-hire and private boat).

State	Total Number of Angler Trips (2007–2012)	Total Number of Angler Trips Exposed to WEAs (2007–2012)	Percent of Total Angler Trips Exposed to WEAs
CT	5,764,188	280	0.00%
DE	3,211,662	149,943	4.67%
MA	11,800,674	45,485	0.39%
MD	10,301,628	39,012	0.38%
NC	13,519,728	1,008,061	7.46%
NH	1,247,532	113,751	9.12%
NJ	19,095,006	2,129,329	11.2%
NY	16,680,924	233,418	1.40%
RI	3,397,956	135,051	3.97%
SC	7,066,956	81,762	1.15%
VA	11,822,106	44,729	0.38%
Total	103,908,360	3,980,820	3.83%

The exposure of recreational for-hire boat trips, for-hire and private boat angler trips, and angler expenditures to WEA development, by state, is shown in Table III-xiv to Table III-xxiv. According to Northeast VTR data, 1,314 for-hire boat trips left from CT waters, annually, on average, during the study period. Approximately 0.2 percent of those boat trips are estimated to be exposed to WEA development (Table III-xiv). In terms of angler trips, 961 thousand private boat and for-hire angler trips occurred in CT, on average, each year, during the study period. Less than 0.1 percent of those angler trips are estimated to be exposed to WEA development. According to MRIP data, no private boat angler trips from CT fished in federal waters between 2007 and 2012. This is due to the fact that, by definition, the entire body of water between CT and Long Island, from Fishers Island eastward (drawing a straight line from Napatree Point, RI to Orient Point, NY) is designated as Long Island Sound, and inland body of water. Anglers fishing from private boats rarely report fishing outside Long Island Sound during the study period. Although it is possible that some private boat trips leave from CT travel to the ocean, those trips appear to be rare, and do not appear in the data. Thus, CT anglers fishing from private boats will not likely be exposed to any WEA. Given the low level of angler trip exposure to WEA development in CT, angler expenditures associated with exposed trips is also low. Less than 0.1 percent of angler trip expenditures are estimated to be exposed to WEA development. Overall, the estimated low level of exposure is distributed relatively evenly across 6 port groups in CT.

Table III-xiv. CT annual recreational fishing exposure to WEAs.

Port Group	Exposed For-Hire Boat Trips	Percent For-Hire Boat Trips Exposed	Exposed For-Hire Angler Trips	Exposed Private Boat Angler Trips	Percent Total Angler Trips Exposed	Total Expenditures (Private Boat and For-Hire)	Percent Total Expenditures Exposed
Branford	0	0	0	0	0	$884,459	0
Bridgeport	0	0	0	0	0	$2,688,479	0
Clinton	~0	0.4	1	0	~0	$1,468,878	~0
Groton	1	0.4	29	0	~0	$3,722,520	~0
Mystic	0	0	0	0	0	$802,485	0
New London	~0	0.2	1	0	~0	$1,175,211	~0
Niantic	0	0	0	0	0	$6,281,353	0
Noank	~0	0.4	~0	0	~0	$331,229	~0
Norwalk	0	0	0	0	0	$675,511	0
Old Saybrook	0	0	0	0	0	$6,823,556	0
Pawcatuck	1	7.9	3	0	~0	$406,830	~0
Stonington	0	0	0	0	0	$4,778,159	0
Waterford	~0	0.1	12	0	~0	$2,099,002	~0
Total	**3**	**0.2**	**47**	**0**	**~0**	**$32,137,672**	**~0**

Note: Dollar values are in $US 2012.

Of the 1,093 for-hire boat trips that left from DE, annually, on average, during the study period, approximately 6.5 percent are estimated to be exposed to WEA development (Table III-xv). In terms of angler trips, 535 thousand private boat and for-hire angler trips occurred in DE, on average, each year, during the study period. Approximately 4.6 percent those angler trips are estimated to be exposed to WEA development and associated expenditures on those trips equates to be about $1.1 million. The port groups of Indian River and Lewes are most exposed to development of the WEAs.

Table III-xv. DE annual recreational fishing exposure to WEAs.

Port Group	Exposed For-Hire Boat Trips	Percent For-Hire Boat Trips Exposed	Exposed For-Hire Angler Trips	Exposed Private Boat Angler Trips	Percent Total Angler Trips Exposed	Total Expenditures (Private and For-Hire)	Percent Total Expenditures Exposed
Indian River	36	10.2	648	5,429	6.3	$4,473,090	7.3
Lewes	34	4.7	533	8,298	6.0	$6,813,618	6.1
Milford	1	30.8	3	0	~0	$2,092,891	~0
Other Delaware	0	0	0	0	0	$2,965,795	0
Other Sussex	~0	2.0	1	9,581	5.9	$6,391,579	5.9
Total	**71**	**6.5**	**1,185**	**23,308**	**4.6**	**$22,736,972**	**4.9**

Note: Dollar values are in $US 2012.

Of the 3,972 for-hire boat trips that left from MA, annually, on average, during the study period, less than 1.0 percent is estimated to be exposed to WEA development (Table III-xvi). In terms of angler trips, almost 2.0 million private boat and for-hire angler trips occurred in MA, on average, each year, during the study period. Only about 2.0 percent of those angler trips are estimated to be exposed to WEA development and associated expenditures on those trips equates to be about $2.5 million (1.8 percent of total angler trip expenditures). The port groups of Falmouth and Westport are most exposed to development of the WEAs.

Table III-xvi. Massachusetts annual recreational fishing exposure to WEAs.

Port Group	Exposed For-Hire Boat Trips	Percent For-Hire Boat Trips Exposed	Exposed For-Hire Angler Trips	Exposed Private Boat Angler Trips	Percent Total Angler Trips Exposed	Total Expenditures (Private Boat and For-Hire)	Percent Total Expenditures Exposed
Barnstable	2	0.6	10	0	~0	$10,871,936	~0
Beverly	0	0	0	0	0	$637,428	0
Boston	0	0	0	0	0	$237,685	0
Bourne	0	0	0	0	0	$5,059,512	0
Chatham	0	0	0	0	0	$3,788,173	0
Chilmark	0	0	0	287	9.8	$186,517	9.8
Danvers	0	0	0	0	0	$209,092	0
Dennis	0	0	0	0	0	$6,209,414	0
Edgartown	~0	8.3	1	337	9.8	$221,693	9.8
Fairhaven	0	0	0	3,191	9.8	$2,074,312	9.8
Fall River	0	0	0	4,051	9.8	$2,632,396	9.8
Falmouth	2	1.4	10	9,947	9.6	$7,155,353	8.9
Gloucester	0	0	0	0	0	$8,518,769	0
Harwich Port	—	—	—	—	0	$3,011,697	0
Hull	—	—	—	—	0	$369,295	0
Lynn	—	—	—	—	0	$1,314,704	0
Marblehead	—	—	—	—	0	$1,130,203	0
Marshfield	~0	~0	~0	—	~0	$9,322,900	~0
Nantucket	1	2.4	3	3,700	9.8	$2,441,297	9.7
New Bedford	~0	0.6	1	3,985	9.4	$3,180,682	8.0
Newburyport	—	—	—	—	0	$10,180,272	0

Port Group	Exposed For-Hire Boat Trips	Percent For-Hire Boat Trips Exposed	Exposed For-Hire Angler Trips	Exposed Private Boat Angler Trips	Percent Total Angler Trips Exposed	Total Expenditures (Private Boat and For-Hire)	Percent Total Expenditures Exposed
Oak Bluffs	1	40.0	4	612	9.9	$401,243	10.0
Onset	1	1.8	7	169	5.6	$567,858	2.3
Orleans	—	—	—	—	0	$3,836,819	0
Other Dukes	—	—	—	285	9.8	$185,329	9.8
Other MA	—	—	—	167	9.8	$108,930	9.8
Plymouth	—	—	—	—	0	$9,762,963	0
Provincetown	—	—	—	—	0	$176,931	0
Quincy	—	—	—	—	0	$315,531	0
Rockport	—	—	—	—	0	$648,032	0
Salisbury	—	—	—	—	0	$8,747,435	0
Sandwich	—	—	—	—	0	$9,056,321	0
Scituate	—	—	—	—	0	$1,746,001	0
South Yarmouth	—	—	—	—	0	$541,516	0
Tisbury	1	37.5	2	3,047	9.8	$1,981,008	9.8
Truro	—	—	—	—	0	$3,145,610	0
Wareham	—	—	—	—	0	$4,829,920	0
Wellfleet	—	—	—	—	0	$1,933,105	0
Westport	—	—	—	9,655	9.8	$6,273,640	9.8
Weymouth	—	—	—	—	0	$3,233,083	0
Winthrop	—	—	—	—	0	$949,153	0
Yarmouth	—	—	—	—	0	$2,255,509	0
Total	**7**	**0.2**	**37**	**39,433**	**2.0**	**$139,449,266**	**1.8**

Note: Dollar values are in $US 2012.

Of the 696 for-hire boat trips that left from MD, annually, on average, during the study period, approximately 7.8 percent (54 boat trips) are estimated to be exposed to WEA development (Table III-xvii). All of the exposed for-hire boat trips are located in the port group of Ocean City, MD. In terms of angler trips, 1.7 million private boat and for-hire angler trips occurred in MD, on average, each year, during the study period. Only about 0.6 percent of the angler trips are estimated to be exposed to WEA development. Associated expenditures on the exposed angler trips amounts to about $445 thousand. The port groups of Ocean City and Pocomoke City are the only port groups in MD exposed to development of the WEAs.

Table III-xvii. Maryland annual recreational fishing exposure to WEAs.

Port Group	Exposed For-Hire Boat Trips	Percent For-Hire Boat Trips Exposed	Exposed For-Hire Angler Trips	Exposed Private Boat Angler Trips	Percent Total Angler Trips Exposed	Total Expenditures (Private Boat and For-Hire)	Percent Total Expenditures Exposed
Chesapeake Beach	—	—	—	—	0	$2,795,303	0
Ocean City	54	7.8	994	3,447	1.9	$12,328,325	3.1
Other Anne Arundel	—	—	—	—	0	$15,068,198	0
Other Calvert	—	—	—	—	0	$7,254,117	0
Other MD	—	—	—	—	0	$34,932,736	0

Port Group	Exposed For-Hire Boat Trips	Percent For-Hire Boat Trips Exposed	Exposed For-Hire Angler Trips	Exposed Private Boat Angler Trips	Percent Total Angler Trips Exposed	Total Expenditures (Private Boat and For-Hire)	Percent Total Expenditures Exposed
Pocomoke City	—	—	—	1,396	1.6	$3,794,153	1.6
Total	**54**	**7.8**	**994**	**4,843**	**0.3**	**$76,172,831**	**0.6**

Note: Dollar values are in $US 2012.

Of the 1,586 for-hire boat trips that left from NC, annually, on average, during the study period, approximately 24 percent (381 boat trips) are estimated to be exposed to WEA development (Table III-xviii). All but 19 of the for-hire boat trips are located in Swansboro, NC. In terms of angler trips, 2.3 million private boat and for-hire angler trips occurred in NC, on average, each year, during the study period. About 7.3 percent of the angler trips are estimated to be exposed to WEA development. Associated expenditures on the exposed angler trips amounts to about $14.1 million. The port groups of Manteo, Nags Head, Other Dare, Swansboro, and Wanchese are most exposed to development of the WEAs.

Table III-xviii. North Carolina annual recreational fishing exposure to WEAs.

Port Group	Exposed For-Hire Boat Trips	Percent For-Hire Boat Trips Exposed	Exposed For-Hire Angler Trips	Exposed Private Boat Angler Trips	Percent Total Angler Trips Exposed	Total Expenditures (Private Boat and For-Hire)	Percent Total Expenditures Exposed
Beaufort	—	—	—	—	0	$13,709,138	0
Hatteras	1	0.9	35	—	0.1	$5,596,329	0.2
Manteo	14	38.3	290	12,650	13.2	$6,979,961	13.9
Morehead City	~0	0.1	7	—	~	$18,177,072	~0
Nags Head	3	4.4	13	31,471	13.0	$16,865,044	13.0
Ocracoke	—	—	—	—	0	$1,443,080	0
Other Carteret	—	—	—	—	0	$36,095,283	0
Other Dare	1	1.6	4	3,655	12.9	$2,014,918	12.6
Swansboro	362	34.0	9,841	105,427	13.8	$65,229,497	16.1
Wanchese	—	—	—	1,631	12.8	$921,595	12.3
Total	**381**	**24.0**	**10,189**	**154,833**	**7.3**	**$167,031,917**	**8.4**

Note: Dollar values are in $US 2012.

Of the 1,992 for-hire boat trips that left from NH, annually, on average, during the study period, only 2 trips (0.2 percent of the total for-hire boat trips) are estimated to be exposed to WEA development (Table III-xix). Both for-hire boat trips are located in the Portsmouth port group. In terms of angler trips, approximately 208 thousand private boat and for-hire angler trips occurred in NH, on average, each year, during the study period. Less than .01 percent of those angler trips are estimated to be exposed to WEA development. Given the low level of angler trip exposure to WEA development in NH, angler expenditures associated with exposed trips is also low. Less than 0.1 percent of angler trip expenditures are estimated to be exposed to WEA development. Overall, little to no exposure is expected for recreational fishing businesses and anglers in NH to WEA development.

Table III-xix. New Hampshire annual recreational fishing exposure to WEAs.

Port Group	Exposed For-Hire Boat Trips	Percent For-Hire Boat Trips Exposed	Exposed For-Hire Angler Trips	Exposed Private Boat Angler Trips	Percent Total Angler Trips Exposed	Total Expenditures (Private Boat and For-Hire)	Percent Total Expenditures Exposed
Greenland	—	—	—	—	0	$156,130	0
Hampton	—	—	—	—	0	$4,651,981	0
New Castle	—	—	—	—	0	$50,377	0
Portsmouth	~0	0.2	8	—	~0	$3,717,740	~0
Rye	—	—	—	—	0	$2,341,890	0
Seabrook	—	—	—	—	0	$3,433,414	0
Total	**~0**	**~0**	**8**	—	**~0**	**$14,351,533**	**~0**

Note: Dollar values are in $US 2012.

Of the 8,177 for-hire boat trips that left from NJ, annually, on average, during the study period, approximately 6.9 percent (561 boat trips) are estimated to be exposed to WEA development (Table III-xx). Cape May and Atlantic City's for-hire boat trips are most exposed to WEA development. In terms of angler trips, 3.2 million private boat and for-hire angler trips occurred in NJ, on average, each year, during the study period. About 10 percent of the angler trips are estimated to be exposed to WEA development. Associated expenditures on the exposed angler trips amounts to about $20.5 million. Overall, exposure to WEA development is relatively consistent across port groups in NJ, and every port group in NJ shows some level of exposure except for Sayreville, NJ.

Table III-xx. New Jersey annual recreational fishing exposure to WEAs.

Port Group	Exposed For-Hire Boat Trips	Percent For-Hire Boat Trips Exposed	Exposed For-Hire Angler Trips	Exposed Private Boat Angler Trips	Percent Total Angler Trips Exposed	Total Expenditures (Private Boat and For-Hire)	Percent Total Expenditures Exposed
Absecon	4	29.9	23	14,532	10.4	$8,817,397	10.5
Atlantic City	148	73.4	1,500	2,078	16.5	$1,481,501	21.2
Avalon	9	4.2	116	2,839	9.4	$2,224,241	8.7
Barnegat	64	9.2	1,678	20,631	10.4	$14,550,903	10.4
Belmar	2	0.2	39	9,955	8.9	$8,117,633	7.8
Brielle	3	0.5	70	4,432	8.1	$4,266,892	6.8
Brigantine	4	5.1	30	15,623	10.4	$9,633,502	10.3
Cape May	172	13.2	2,354	49,384	10.6	$32,011,401	10.6
Eagleswood	2	10.1	7	1,109	10.4	$680,056	10.4
Forked River	—	—	—	6,165	10.4	$3,738,344	10.4
Galloway	6	57.8	37	332	11.4	$208,874	12.2
Highlands	~0	~0	1	931	3.3	$2,893,798	2.0
Jersey City	—	—	—	1,839	10.3	$1,152,601	10.1
Keyport	—	—	—	7,828	10.2	$4,935,741	10.0
Little Egg Harbor	25	34.4	132	990	11.4	$646,028	12.2
Long Beach	51	9.8	1,239	1,397	10.8	$2,177,627	11.0
Manasquan	—	—	—	1,052	10.4	$646,370	10.3
Margate City	6	18.6	22	11,716	10.4	$7,177,014	10.4

Port Group	Exposed For-Hire Boat Trips	Percent For-Hire Boat Trips Exposed	Exposed For-Hire Angler Trips	Exposed Private Boat Angler Trips	Percent Total Angler Trips Exposed	Total Expenditures (Private Boat and For-Hire)	Percent Total Expenditures Exposed
Middle	—	—	—	7,727	10.4	$4,697,579	10.4
Middletown	—	—	—	23,539	10.4	$14,270,895	10.4
Neptune	—	—	—	6,533	10.4	$3,961,675	10.4
Ocean City	37	28.3	871	2,130	12.9	$1,646,222	14.6
Old Bridge	—	—	—	1,831	10.4	$1,110,866	10.4
Other Atlantic	~0	1.9	2	27,083	10.4	$16,423,263	10.4
Other Cape May	—	—	—	5,975	10.4	$3,621,507	10.4
Other Cumberland	—	—	—	14,178	10.4	$8,603,913	10.4
Other Gloucester	—	—	—	402	10.4	$244,232	10.4
Other Monmouth	—	—	—	14,211	10.4	$8,618,106	10.4
Other Ocean	~0	1.2	1	4,817	10.4	$2,926,625	10.4
Point Pleasant	4	0.2	76	4,360	6.1	$6,400,534	4.5
Port Norris	—	—	—	11,881	10.4	$7,202,550	10.4
Sayreville	—	—	—	—	0	$1,676,244	0
Sea Isle City	9	7.4	205	3,476	10.4	$2,373,273	10.3
Stone Harbor	~0	2.2	~0	3,454	10.4	$2,095,571	10.4
Toms River	~0	2.4	1	493	10.4	$301,910	10.3
Tuckerton	3	11.8	17	5,954	10.4	$3,626,342	10.4
Waretown	~0	1.7	4	5,762	10.4	$3,509,089	10.4
Wildwood	12	2.4	156	11,002	9.5	$8,104,510	8.8
Woodbridge	~0	0.4	4	—	~0	$3,388,585	~0
Total	**561**	**6.9**	**8,584**	**307,638**	**9.9**	**$210,163,413**	**9.8**

Note: Dollar values are in $US 2012.

Of the 7,027 for-hire boat trips that left from NY, annually, on average, during the study period, approximately 1.3 percent (88 boat trips) are estimated to be exposed to WEA development (Table III-xxi). The majority of the exposed for-hire boat trips leave from Montauk, NY. In terms of angler trips, 2.8 million private boat and for-hire angler trips occurred in NY, on average, each year, during the study period. Only about 1.3 percent of those angler trips are estimated to be exposed to WEA development. Associated expenditures on the exposed angler trips amounts to about $2.2 million. Overall exposure to WEA development across port groups in NY is relatively consistent, with the exception of exposed for-hire boat trips in Montauk, NY.

Table III-xxi. New York annual recreational fishing exposure to WEAs.

Port Group	Exposed For-Hire Boat Trips	Percent For-Hire Boat Trips Exposed	Exposed For-Hire Angler Trips	Exposed Private Boat Angler Trips	Percent Total Angler Trips Exposed	Total Expenditures (Private Boat and For-Hire)	Percent Total Expenditures Exposed
Brooklyn	4	0.5	84	1,681	1.7	$7,614,106	1.5
City Island	~0	0.2	11	—	~0	$2,472,905	0.1
East Hampton	—	—	—	—	0	$381,054	0.0

Port Group	Exposed For-Hire Boat Trips	Percent For-Hire Boat Trips Exposed	Exposed For-Hire Angler Trips	Exposed Private Boat Angler Trips	Percent Total Angler Trips Exposed	Total Expenditures (Private Boat and For-Hire)	Percent Total Expenditures Exposed
Freeport	4	1.6	47	780	1.8	$3,313,952	1.6
Greenport	1	2.9	3	—	~0	$3,627,097	~
Hampton Bays	—	—	—	—	0	$12,114,520	0
Hempstead	—	—	—	—	0	$1,585,965	0
Island Park	—	—	—	49	1.9	$150,351	1.9
Jamaica Bay—Rockaway	—	—	—	328	1.9	$1,012,290	1.9
Long Beach	—	—	—	483	1.9	$1,489,506	1.9
Mattituck	—	—	—	—	0	$1,189,398	0
Montauk	67	2.3	1,014	—	~0	$17,066,175	0.9
Moriches	—	—	—	—	0	$4,910,842	0
New York	—	—	—	2,021	1.9	$6,608,751	1.8
Northport	—	—	—	—	0	$5,697,151	0
Oak Beach—Captree	3	0.2	57	1,645	1.3	$11,890,056	0.9
Oceanside	~0	0.6	1	346	1.9	$1,086,507	1.9
Orient	~0	0.2	4	—	~0	$586,841	0.1
Other Bronx	—	—	—	185	1.8	$709,717	1.6
Other Nassau	—	—	—	3,999	1.9	$12,320,410	1.9
Other NY	—	—	—	—	0	$5,642,642	0
Other Richmond	6	21.1	25	—	20.8	$18,970	20.7
Other Suffolk	—	—	—	19,820	1.9	$61,226,193	1.9
Point Lookout	3	0.6	82	1,227	1.7	$6,190,136	1.4
Port Jefferson	—	—	—	—	0	$5,514,991	0
Queens	—	—	—	886	1.9	$2,731,943	1.9
Shelter Island	~0	16.7	1	—	~0	$255,837	0.1
Southold	—	—	—	—	0	$1,218,795	0
Total	**88**	**1.3**	**1,328**	**33,450**	**1.3**	**$178,627,101**	**1.2**

Note: Dollar values are in $US 2012.

Of the 2,264 for-hire boat trips that left from RI, annually, on average, during the study period, approximately 4.8 percent (109 boat trips) are estimated to be exposed to WEA development (Table III-xxii). All but 13 of the exposed for-hire boat trips are located in the Narragansett port group. In terms of angler trips, 566 thousand private boat and for-hire angler trips occurred in RI, on average, each year, during the study period. About 3.8 percent of the angler trips are estimated to be exposed to WEA development. Associated expenditures on the exposed angler trips amounts to about $1.1 million. Recreational fishing exposure to WEA development is generally consistent across port groups in RI, with the exception of exposed for-hire boat trips in the Narragansett port group. In addition, recreational fishing activity in Providence is not estimated to be exposed to WEA development.

Table III-xxii. Rhode Island annual recreational fishing exposure to WEAs.

Port Group	Exposed For-Hire Boat Trips	Percent For-Hire Boat Trips Exposed	Exposed For-Hire Angler Trips	Exposed Private Boat Angler Trips	Percent Total Angler Trips Exposed	Total Expenditures (Private Boat and For-Hire)	Percent Total Expenditures Exposed
Barrington	—	—	—	247	4.1	$238,673	4.1
Bristol	—	—	—	1,382	4.1	$1,357,341	4.0
Charlestown	~0	1.2	1	2,424	4.1	$2,347,895	4.1
East Greenwich	~0	0.3	1	2,289	4.1	$2,241,747	4.1
Little Compton	—	—	—	501	4.1	$483,178	4.1
Narragansett	96	5.5	1,496	3,877	4.7	$7,788,984	5.6
New Shoreham	—	—	—	48	3.2	$108,699	1.8
Newport	1	3.2	2	1,204	4.1	$1,179,298	4.1
Portsmouth	—	—	—	1,054	4.1	$1,029,241	4.1
Providence	—	—	—	—	0	$2,333,056	0
South Kingstown	8	6.8	48	2,312	4.2	$2,369,047	4.3
Tiverton	1	7.6	3	256	4.1	$255,127	4.2
Warren	~0	0.4	1	—	0.1	$76,456	0.2
Warwick	~0	1.6	2	3,135	4.1	$3,035,874	4.1
Westerly	3	3.5	17	1,168	4.1	$1,215,813	4.1
Total	**109**	**4.8**	**1,570**	**19,898**	**3.8**	**$26,060,428**	**4.2**

Note: Dollar values are in $US 2012.

Of the 1,447 for-hire boat trips that left from SC, annually, on average, during the study period, approximately 22 percent (322 boat trips) are estimated to be exposed to WEA development (Table III-xxiii). About 75 percent of the exposed for-hire boat trips are located in the Little River port group. In terms of angler trips, 1.1 million private boat and for-hire angler trips occurred in SC, on average, each year, during the study period. Less than 1.0 percent of those angler trips are estimated to be exposed to WEA development. Associated expenditures on the exposed angler trips amounts to about $3.9 million. The port groups of Little River and North Myrtle Beach are most exposed to development of the WEAs.

Table III-xxiii. South Carolina annual recreational fishing exposure to WEAs.

Port Group	Exposed For-Hire Boat Trips	Percent For-Hire Boat Trips Exposed	Exposed For-Hire Angler Trips	Exposed Private Boat Angler Trips	Percent Total Angler Trips Exposed	Total Expenditures (Private Boat and For-Hire)	Percent Total Expenditures Exposed
Hilton Head	—	—	—	—	0	$4,012,638	0
Hilton Head Island	—	—	—	—	0	$7,350,563	0
Little River	246	33.7	4,940	251	22.3	$5,301,262	38.8
Mount Pleasant	—	—	—	—	0	$26,657,625	0
Murrells Inlet	10	4.6	745	—	0.3	$17,453,678	1.8
North Myrtle Beach	66	50.1	3,484	1,075	7.9	$5,173,380	28.8
Total	**322**	**22.3**	**9,168**	**1,325**	**0.9**	**$65,949,146**	**5.9**

Note: Dollar values are in $US 2012.

Of the 694 for-hire boat trips that left from VA, annually, on average, during the study period, approximately 2.5 percent (18 boat trips) are estimated to be exposed to WEA development. The majority of the exposed for-hire boat trips are located in the Virginia Beach port group. In terms of angler trips, about 2.0 million private boat and for-hire angler trips occurred in VA, on average, each year, during the study period. About 1.5 percent of the angler trips are estimated to be exposed to WEA development. Associated expenditures on the exposed angler trips amounts to about $1.8 million. The Virginia Beach port group is the only port group in VA that seems to be exposed to WEA development.

Table III-xxiv. Virginia annual recreational fishing exposure to WEAs.

Port Group	For-Hire Boat Trips		Exposed For-Hire Angler Trips	Exposed Private Boat Angler Trips	% Total Angler Trips Exposed	Total Expenditures (Private and For-Hire)	% Total Expenditures Exposed
	# Exposed	% Exposed					
Cape Charles	—	—	—	—	0	$4,640,748	0
Chincoteague	—	—	—	—	0	$6,939,999	0
Northampton County	—	—	—	—	0	$3,709,663	0
Greenbackville	—	—	—	—	0	$290,057	0
Hampton	—	—	—	—	0	$17,362,996	0
Norfolk	1	2.5	3	—	~0	$10,035,665	0
Other Northumberland	—	—	—	—	0	$1,037,383	0
Other VA	—	—	—	—	0	$41,679,377	0
Quinby	—	—	—	—	0	$7,481,413	0
Saxis	—	—	—	—	0	$828,478	0
Virginia Beach	15	3.2	393	28,570	8.5	$21,666,428	8.3
Wachapreague	2	1.4	9	—	~0	$5,877,014	0
Total	**18**	**2.5**	**404**	**28,570**	**1.5**	**$121,549,221**	**1.5**

Note: Dollar values are in $US 2012.

III.v Shoreside Dependents

The Input-Output model used to assess the potential income impacts on shoreside dependents of commercial and recreational fisheries are described in Section I.ii.iii. Table III-xxv through Table III-xxviii provide the income and employment impact of commercial fisheries in the New England and Mid-Atlantic regions. Table III-xxix through Table III-xxxii provide the income and employment impacts of the proportion of these fisheries that are exposed to WEAs. Income measures proprietor's income, and wages and salaries; employment includes both part-time and full-time jobs. In the New England region, the total income impacts of all fishery revenue support over $769 million in income; of this, over $8.2 million (about 1.1 percent) in income is supported by fisheries revenue considered exposed to potential WEAs. In the Mid-Atlantic region, the total income impacts of all fishery revenue support over $684 million in income; of this, over $12.9 million (about 1.9 percent) in income is supported by fisheries revenue considered exposed to potential WEAs. In terms of employment, in the New England region, 17,484 jobs were supported by revenue from the region's fisheries and support industries; about 199 of those jobs were supported by revenue considered exposed to WEAs. In the Mid-Atlantic region, 17,017 jobs were supported by fisheries' revenue, and about 338 of those jobs were supported by revenue considered exposed to WEAs.

Table III-xxv. Total New England Coastal Region income impacts—all fishery revenue.

Sector	Down East	Upper Mid-Coast	Lower Mid-Coast	Southern	NH Seacoast	Gloucester	Boston	Cape and Islands	New Bedford	Rhode Island	CT Seacoast	Non-Maritime	Total
	ME	ME	ME	ME	NH	MA	MA	MA	MA	RI	CT	New England	New England
Commercial Fishing	Income ($)												
Offshore Lobster Traps	15,121,453	36,608,877	12,588,910	3,686,302	4,350,239	3,272,330	1,171,927	2,688,017	2,684,253	4,353,377	161,399	0	86,687,085
Large Bottom Trawl	0	623	683,075	0	0	5,786,657	4,711,801	261,701	19,526,513	11,411,773	1,358,757	0	43,740,899
Medium Bottom Trawl	0	153,745	1,399,727	89,391	308,645	4,682,666	1,931,275	957,041	2,741,235	6,270,411	427,172	0	18,961,308
Small Bottom Trawl	1,202	437,413	998,110	202,266	603,886	1,605,018	251,753	689,806	52,569	875,303	151,327	0	5,868,653
Large Scallop Dredge	0	0	0	0	0	384,212	0	119,740	97,615,963	2,192,553	0	0	100,312,467
Medium Scallop Dredge	0	3,337	0	0	0	117,782	8,789	930,913	5,904,682	0	0	0	6,965,503
Small Scallop Dredge	41,319	16,038	29,224	0	23,571	225,344	20,465	2,397,549	426,380	333,024	26,090	0	3,539,004
Surfclam, Ocean Quahog Dredge	957,315	0	0	0	0	1,193	4,992	233,867	7,365,675	511,903	0	0	9,074,945
Small Dredge	182	0	0	0	0	0	0	0	0	0	0	0	182
Sink Gillnet	0	340	702,221	180,571	1,061,730	2,204,326	385,977	1,367,398	820,875	1,072,339	167,144	0	7,962,922
Diving Gear	0	0	0	0	0	394	0	1,618	0	10	0	0	2,021
Midwater Trawl	0	3,748,951	2,520,943	0	116,747	4,632,495	0	0	0	3,853,090	0	0	14,872,225
Fish Pots and Trap	108,659	0	136,123	0	113	227,598	13,788	430,384	957,343	264,011	20,835	0	2,158,854
Bottom Longline	0	6,984	19,554	0	0	202,761	54,907	380,372	2,714	10,519	0	0	677,811
Other Mobile Gear	0	0	0	0	0	124	5,217	28,924	0	0	0	0	34,264
Other Fixed Gear	0	0	1,544	0	47	4,361	3,262	7,386	43,996	14,702	532	0	75,830
Hand Gears	47	1,651	3,443	569	15,845	100,920	37,658	168,139	11,704	23,300	2,400	0	365,675
Agriculture	152,940	25,075	43,325	9,325	9,967	6,113	30,624	4,951	7,290	15,345	72,188	4,578,766	4,955,910
Mining	16	34	87	69	118	53	1,058	52	45	147	638	383,987	386,303
Transportation, Communications and Public Utilities	29,779	63,092	595,541	63,194	680,257	430,768	4,397,284	152,233	370,979	952,938	2,577,890	16,340,338	26,654,292
Water Transportation	0	22,044	17,978	12,702	37,674	15,967	347,456	78,271	24,249	45,196	861,234	541,356	2,004,126
Warehousing and Storage	662	889	124,998	11,177	153,561	54,269	460,396	750	82,359	64,713	180,428	1,874,865	3,009,067
Construction	5,565	43,064	184,740	47,169	229,087	171,040	1,350,885	100,450	106,338	227,172	667,212	3,314,012	6,446,735
Manufacturing	4,364	26,316	246,744	95,531	559,068	458,586	1,807,593	35,860	277,981	523,124	1,626,397	10,115,118	15,776,682

Sector	Down East	Upper Mid-Coast	Lower Mid-Coast	Southern	NH Seacoast	Gloucester	Boston	Cape and Islands	New Bedford	Rhode Island	CT Seacoast	Non-Maritime	Total
	ME	ME	ME	ME	NH	MA	MA	MA	MA	RI	CT	New England	New England
Commercial Fishing	**Income ($)**												
Seafood Processing	1,175,387	6,676,638	2,836,045	803,548	3,046,389	37,068,185	23,720,332	53,409	21,194,146	7,769,505	598,562	0	104,942,146
Ice	0	2,561	21,512	138	16,064	5,248	128,181	4,931	22,152	54,914	16,854	289,559	562,113
Boat Building	2,014	83,395	30,491	933	6,967	2,257	60,631	2,904	3,050	586,038	23,901	244,354	1,046,935
Paperboard Containers	0	0	2,857	704	4,269	9,206	28,336	0	10,240	12,190	28,777	233,395	329,974
Trade	24,533	138,053	717,243	168,708	1,176,706	738,288	3,688,632	367,941	593,985	870,486	2,705,281	13,716,497	24,906,352
Seafood Dealers	5,957,878	14,826,902	5,254,414	1,469,723	2,690,387	3,262,147	2,287,886	3,017,145	42,599,467	7,964,804	298,788	0	89,629,542
Fish Exchanges/ Auctions	0	0	434,537	0	0	797,939	221,621	0	1,187,257	0	0	0	2,641,354
Wholesale Trade	11,177	89,906	688,996	69,315	1,538,242	1,015,605	7,812,013	128,241	601,198	987,934	3,736,262	15,067,600	31,746,490
Finance, Insurance, and Real Estate	4,127	60,955	815,066	42,395	881,172	420,557	7,631,373	148,041	186,792	1,060,507	4,243,330	13,507,766	29,002,082
Services	83,181	449,165	3,160,816	597,596	4,021,752	3,168,776	27,425,595	1,151,503	1,795,545	4,689,292	14,002,824	59,982,988	120,529,032
Government	2,309	14,830	52,941	160,341	106,442	72,283	650,079	53,333	59,580	98,964	198,837	1,688,172	3,158,112
Total	**23,684,109**	**63,500,878**	**34,311,203**	**7,711,668**	**21,638,946**	**71,145,465**	**90,651,787**	**15,962,867**	**207,276,554**	**57,109,587**	**34,155,059**	**141,878,773**	**769,026,896**

Note: All values are in $US 2012.

Table III-xxvi. Total New England Coastal Region employment impacts—all fishery revenue.

Sector	Down East	Upper Mid-Coast	Lower Mid-Coast	Southern	NH Seacoast	Gloucester	Boston	Cape and Islands	New Bedford	Rhode Island	CT Seacoast	Non-Maritime	Total
	ME	ME	ME	ME	NH	MA	MA	MA	MA	RI	CT	New England	New England
Commercial Fishing	**Employment (Jobs)**												
Offshore Lobster Traps	303	733	267	78	87	66	23	54	54	87	3	0	1,754
Large Bottom Trawl	0	0	13	0	0	107	87	5	358	219	25	0	813
Medium Bottom Trawl	0	4	39	3	8	127	55	26	74	167	11	0	513
Small Bottom Trawl	0	30	69	14	43	119	18	46	4	58	10	0	410
Large Scallop Dredge	0	0	0	0	0	9	0	3	2,178	48	0	0	2,237
Medium Scallop Dredge	0	0	0	0	0	5	0	40	257	0	0	0	303

Sector	Down East	Upper Mid-Coast	Lower Mid-Coast	Southern	NH Seacoast	Gloucester	Boston	Cape and Islands	New Bedford	Rhode Island	CT Seacoast	Non-Maritime	Total
	ME	ME	ME	ME	NH	MA	MA	MA	MA	RI	CT	New England	New England
Commercial Fishing	**Employment (Jobs)**												
Small Scallop Dredge	4	1	3	0	2	22	2	234	42	32	3	0	346
Surfclam, Ocean Quahog Dredge	65	0	0	0	0	0	0	17	192	28	0	0	302
Sink Gillnet	0	0	49	13	78	165	27	96	55	71	11	0	565
Diving Gear	0	0	0	0	0	0	0	0	0	0	0	0	0
Midwater Trawl	0	61	43	0	2	76	0	0	0	63	0	0	244
Fish Pots and Traps	9	0	12	0	0	20	1	37	83	23	2	0	186
Bottom Longline	0	1	2	0	0	21	6	43	0	1	0	0	73
Other Mobile Gear	0	0	0	0	0	0	0	1	0	0	0	0	1
Other Fixed Gear	0	0	0	0	0	1	1	1	8	3	0	0	14
Hand Gears	0	0	1	0	1	11	2	24	1	2	0	0	41
Agriculture	15	3	4	2	2	1	3	1	1	3	6	270	313
Mining	0	0	0	0	0	0	0	0	0	0	1	6	7
Transportation, Communications and Public Utilities	1	2	11	1	12	8	68	3	6	15	32	291	451
Water Transportation	0	1	0	0	0	0	4	2	0	1	7	5	21
Warehousing and Storage	0	0	3	0	3	1	9	0	2	2	3	44	67
Construction	0	1	5	1	4	3	18	2	2	5	11	76	129
Manufacturing	0	1	6	2	10	8	28	1	6	11	21	193	286
Seafood Processing	63	262	89	37	86	633	433	2	633	200	12	0	2,449
Ice	0	0	0	0	0	0	2	0	0	1	0	6	10
Boat Building	0	2	1	0	0	0	1	0	0	12	0	6	23
Paperboard Containers	0	0	0	0	0	0	0	0	0	0	0	4	6
Trade	1	6	29	7	38	25	112	13	22	33	77	543	906
Seafood Dealers	71	177	63	18	32	39	27	36	508	95	4	0	1,068
Fish Exchanges/ Auctions	0	0	15	0	0	17	5	0	26	0	0	0	63
Wholesale Trade	0	2	13	1	20	13	89	2	11	17	41	272	483

Sector	Down East	Upper Mid-Coast	Lower Mid-Coast	Southern	NH Seacoast	Gloucester	Boston	Cape and Islands	New Bedford	Rhode Island	CT Seacoast	Non-Maritime	Total
	ME	ME	ME	ME	NH	MA	MA	MA	MA	RI	CT	New England	New England
Commercial Fishing	Employment (Jobs)												
Finance, Insurance, and Real Estate	0	2	16	2	16	10	85	5	5	19	48	256	466
Services	4	15	85	19	95	79	503	33	53	126	253	1,623	2,887
Government	0	0	1	2	2	1	7	1	1	1	3	28	47
Total	538	1,303	837	201	542	1,586	1,617	727	4,583	1,341	586	3,624	17,484

Table III-xxvii. Total Mid-Atlantic Coastal region income impacts—all fishery revenue.

Sector	NY Seacoast	NJ North	NJ South	DE State	MD West	MD East	VA North	VA South	VA East	NC North	NC Central	NC South	Non-Maritime	Total
	NY	NJ	NJ	DE	MD	MD	VA	VA	VA	NC	NC	NC	Mid-Atlantic	Mid-Atlantic
Commercial Fishing	Income ($)													
Offshore Lobster Traps	597,368	0	1,229,259	11,535	0	88,867	0	0	50,663	0	0	0	0	1,977,691
Large Bottom Trawl	3,085,393	0	8,150,896	0	0	270,465	0	2,740,726	678,311	0	3,773,063	0	0	18,698,853
Medium Bottom Trawl	5,703,902	0	2,905,508	0	0	311,199	0	608,963	265,194	0	867,553	0	0	10,662,319
Small Bottom Trawl	1,818,981	0	643,127	0	0	0	0	37,179	63,305	0	49,122	0	0	2,611,714
Large Scallop Dredge	0	0	29,157,365	0	0	0	0	25,903,643	239,913	0	507,564	0	0	55,808,485
Medium Scallop Dredge	0	0	9,653,978	0	0	660,830	0	1,559,996	40,450	0	27,470	0	0	11,942,724
Small Scallop Dredge	250,395	0	3,236,715	0	0	0	0	0	0	0	0	0	0	3,487,109
Surfclam, Ocean Quahog Dredge	697,636	0	14,159,622	0	0	2,041,307	0	0	0	0	0	0	0	16,898,565
Small Dredge	2,541	0	122,548	2,416	0	0	0	152,690	15,834	0	0	0	0	296,029
Sink Gillnet	829,981	3,417	1,268,426	1,010	0	126,698	23	203,222	418,237	0	455,215	0	0	3,306,229
Diving Gear	384	0	0	0	0	0	0	0	0	0	0	0	0	384
Midwater Trawl	0	0	2,465,031	0	0	171	0	0	0	0	373,437	0	0	2,838,638
Fish Pots and Traps	175,208	0	548,602	88,501	6	156,363	0	549,911	485,796	0	0	0	0	2,004,386
Bottom Longline	1,322,228	0	237,342	0	0	7,563	0	0	0	0	196,610	0	0	1,763,743
Other Mobile Gear	277,382	0	0	0	0	0	0	0	0	0	39,965	0	0	317,347
Other Fixed Gear	21,271	0	230,117	94	357	33,384	0	7,084	63,804	0	317,633	761	0	674,505
Hand Gears	255,797	0	25,952	336	0	2,488	0	18,679	10,517	0	308,566	455,899	0	1,078,233
Agriculture	47,354	23,612	223,561	83,662	138,617	81,857	14,116	43,178	27,516	114,859	161,051	237,187	2,103,517	3,300,087
Mining	274,259	32,137	2,178	6,372	39,483	44	1,836	107,357	4	0	37	225	176,406	640,338

Sector	NY Seacoast	NJ North	NJ South	DE State	MD West	MD East	VA North	VA South	VA East	NC North	NC Central	NC South	Non-Maritime	Total
	NY	NJ	NJ	DE	MD	MD	VA	VA	VA	NC	NC	NC	Mid-Atlantic	Mid-Atlantic
Commercial Fishing	**Income ($)**													
Transportation, Communications and Public Utilities	19,730,519	8,869,320	6,210,137	874,208	5,310,586	741,754	2,025,514	3,106,671	27,864	41,289	205,953	391,185	7,506,864	55,041,863
Water Transportation	1,560,714	931,352	390,263	21,541	465,776	6,598	11,340	864,611	0	0	21,160	27,700	248,703	4,549,758
Warehousing and Storage	741,270	1,528,030	877,081	90,827	809,490	10,946	117,036	399,815	0	929	9,249	19,740	861,326	5,465,739
Construction	3,079,281	1,031,869	1,221,337	253,528	1,367,042	135,085	537,283	538,968	4,157	14,514	81,162	109,002	1,522,480	9,895,707
Manufacturing	3,640,191	4,207,601	3,167,452	613,015	1,666,709	221,359	239,708	1,181,781	49,927	44,706	113,527	189,673	4,646,956	19,982,605
Seafood Processing	6,499,750	9,288,200	12,594,055	24,870	59,464	541,494	4,520,551	4,944,308	1,330,046	192,916	811,788	93,758	0	40,901,200
Ice	163,900	28,541	64,034	21,068	243,160	7,074	29,766	28,073	226	1,116	3,735	3,346	133,025	727,065
Boat Building	1,039	429	397,306	10,298	30,063	38,550	6,528	14,606	378	73,038	453,912	30,793	112,258	1,169,200
Paperboard Containers	54,476	76,654	40,797	6,159	42,178	8,055	0	48,792	0	472	547	4,053	107,223	389,407
Trade	10,291,447	4,696,611	5,195,151	845,019	4,580,767	547,972	1,679,321	2,148,911	26,050	81,083	336,585	376,640	6,301,454	37,107,009
Seafood Dealers	5,293,724	97,958	22,419,607	39,625	149	768,834	10	11,655,428	1,433,179	0	1,851,401	319,584	0	43,879,499
Wholesale Trade	19,896,737	10,102,905	8,142,136	882,360	5,593,776	281,016	2,521,436	2,471,983	16,946	48,585	231,573	212,000	6,922,160	57,323,612
Finance, Insurance, and Real Estate	29,529,082	6,942,916	4,704,168	1,188,859	4,651,773	180,394	1,787,145	2,503,630	8,484	23,762	130,376	173,544	6,205,562	58,029,695
Services	79,224,867	23,298,524	23,300,254	5,426,106	20,750,614	1,901,620	9,580,035	10,562,856	91,734	248,588	1,030,817	1,156,874	27,556,601	204,129,491
Government	3,013,675	681,784	586,156	88,659	870,463	119,349	389,849	969,397	7,392	8,007	120,731	80,322	775,558	7,711,342
Total	**198,080,751**	**71,841,859**	**163,570,159**	**10,580,069**	**46,620,473**	**9,291,333**	**23,461,496**	**73,372,460**	**5,355,928**	**893,865**	**12,479,802**	**3,882,286**	**65,180,093**	**684,610,575**

Note: All values are in $US 2012.

Table III-xxviii. Total Mid-Atlantic Coastal Region employment impacts—all fishery revenue.

Sector	NY Seacoast	NJ North	NJ South	DE State	MD West	MD East	VA North	VA South	VA East	NC North	NC Central	NC South	Non-Maritime	Total
	NY	NJ	NJ	DE	MD	MD	VA	VA	VA	NC	NC	NC	Mid-Atlantic	Mid-Atlantic
Commercial Fishing	**Employment (Jobs)**													
Offshore Lobster Traps	14	0	29	0	0	2	0	0	1	0	0	0	0	47
Large Bottom Trawl	73	0	193	0	0	6	0	65	16	0	89	0	0	442
Medium Bottom Trawl	178	0	89	0	0	10	0	19	8	0	27	0	0	330
Small Bottom Trawl	93	0	32	0	0	0	0	2	3	0	2	0	0	133
Large Scallop Dredge	0	0	1,279	0	0	0	0	1,137	11	0	22	0	0	2,449
Medium Scallop Dredge	0	0	380	0	0	26	0	61	2	0	1	0	0	470
Small Scallop Dredge	8	0	470	0	0	0	0	0	0	0	0	0	0	478
Surfclam, Ocean Quahog Dredge	207	0	592	0	0	224	0	0	0	0	0	0	0	1,023
Small Dredge	1	0	25	0	0	0	0	31	3	0	0	0	0	60
Sink Gillnet	57	0	87	0	0	9	0	14	29	0	31	0	0	226
Diving Gear	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Midwater Trawl	0	0	59	0	0	0	0	0	0	0	9	0	0	69
Fish Pots and Traps	24	0	74	12	0	21	0	74	66	0	0	0	0	271
Bottom Longline	63	0	11	0	0	0	0	0	0	0	9	0	0	84
Other Mobile Gear	10	0	0	0	0	0	0	0	0	0	1	0	0	12
Other Fixed Gear	3	0	32	0	0	5	0	1	9	0	44	0	0	94
Hand Gears	21	0	2	0	0	0	0	2	2	0	71	107	0	205
Agriculture	2	4	29	3	9	5	2	5	2	5	11	11	124	213
Mining	2	1	0	0	1	0	0	0	0	0	0	0	3	8
Transportation, Communications and Public Utilities	256	121	90	14	81	13	26	57	1	1	5	8	134	807
Water Transportation	20	10	3	0	6	0	0	8	0	0	0	0	3	50
Warehousing and Storage	13	26	16	2	13	0	2	9	0	0	0	0	20	102
Construction	45	15	20	6	24	3	9	11	0	1	2	3	35	174
Manufacturing	69	51	44	11	27	5	4	20	2	2	3	3	89	327

Sector	NY Seacoast	NJ North	NJ South	DE State	MD West	MD East	VA North	VA South	VA East	NC North	NC Central	NC South	Non-Maritime	Total
	NY	NJ	NJ	DE	MD	MD	VA	VA	VA	NC	NC	NC	Mid-Atlantic	Mid-Atlantic
Commercial Fishing	Employment (Jobs)													
Seafood Processing	121	263	388	1	2	19	145	150	53	10	45	6	0	1,202
Ice	2	0	1	0	4	0	1	1	0	0	0	0	3	12
Boat Building	0	0	8	0	1	1	0	1	0	1	11	1	3	27
Paperboard Containers	1	1	1	0	1	0	0	1	0	0	0	0	2	7
Trade	297	126	161	32	152	23	55	88	1	4	15	16	250	1,220
Seafood Dealers	63	1	267	0	0	9	0	139	17	0	22	4	0	523
Wholesale Trade	256	132	109	14	81	7	28	42	0	1	5	5	125	807
Finance, Insurance, and Real Estate	264	87	81	21	86	8	29	49	0	1	5	6	118	754
Services	1,380	441	483	109	499	64	182	285	4	11	41	43	745	4,287
Government	36	9	9	2	11	2	5	14	0	0	2	2	13	105
Total	**3,577**	**1,290**	**5,067**	**229**	**998**	**463**	**488**	**2,284**	**230**	**36**	**476**	**215**	**1,665**	**17,017**

Table III-xxix. Total New England Coastal Region income impacts—WEA revenue.

Sector	Down-east	Upper Mid-Coast	Lower Mid-Coast	Southern	NH Seacoast	Gloucester	Boston	Cape and Islands	New Bedford	Rhode Island	CT Seacoast	Non-Maritime	Total
	ME	ME	ME	ME	NH	MA	MA	MA	MA	RI	CT	New England	New England
Commercial Fishing	Income ($)												
Offshore Lobster Traps	0	0	3	0	5	109	1	23,968	109,818	104,821	2	0	238,727
Large Bottom Trawl	0	0	0	0	0	59	160	16	48,083	355,442	15,512	0	419,272
Medium Bottom Trawl	0	0	0	0	0	0	275	6,662	28,064	285,962	4,381	0	325,345
Small Bottom Trawl	0	0	0	0	1	0	0	607	73	13,264	67	0	14,012
Large Scallop Dredge	0	0	0	0	0	0	0	1,971	743,044	2,628	0	0	747,644
Medium Scallop Dredge	0	0	0	0	0	0	0	8,968	67,265	0	0	0	76,233
Small Scallop Dredge	0	0	0	0	0	46	0	5,089	14,943	29,181	1,002	0	50,261
Surfclam, Ocean Quahog Dredge	0	0	0	0	0	0	0	0	377,076	73,084	0	0	450,160
Sink Gillnet	0	0	0	0	53	93	0	29,640	165,563	189,560	596	0	385,507

Sector	Down-east	Upper Mid-Coast	Lower Mid-Coast	Southern	NH Seacoast	Gloucester	Boston	Cape and Islands	New Bedford	Rhode Island	CT Seacoast	Non-Maritime	Total
	ME	ME	ME	ME	NH	MA	MA	MA	MA	RI	CT	New England	New England
Commercial Fishing	Income ($)												
Diving Gear	0	0	0	0	0	0	0	0	0	0	0	0	0
Midwater Trawl	0	0	0	0	0	99,652	0	0	0	98,798	0	0	198,451
Fish Pots and Traps	0	0	0	0	0	0	5	267	7,215	2,024	0	0	9,512
Bottom Longline	0	0	0	0	0	0	0	0	0	10	0	0	10
Other Mobile Gear	0	0	0	0	0	4	0	888	0	0	0	0	892
Other Fixed Gear	0	0	0	0	0	0	0	0	291	1,617	0	0	1,908
Hand Gears	0	0	0	0	0	0	7	139	2	1,142	3	0	1,294
Agriculture	2,266	368	628	137	145	90	445	73	106	226	1,054	45,501	51,040
Mining	0	1	1	1	2	1	16	1	1	2	10	4,170	4,205
Transportation, Communications and Public Utilities	450	942	8,904	941	10,137	6,424	65,664	2,269	5,521	14,229	38,546	165,079	319,106
Water Transportation	0	365	298	210	624	265	5,756	1,297	402	749	14,267	6,062	30,294
Warehousing and Storage	10	13	1,855	166	2,279	806	6,834	11	1,222	961	2,678	18,810	35,645
Construction	83	639	2,739	699	3,401	2,539	20,052	1,491	1,578	3,379	9,894	33,244	79,737
Manufacturing	62	376	3,567	1,386	8,235	6,673	26,205	514	4,016	7,312	23,466	98,986	180,799
Seafood Processing	1,058	6,013	2,250	637	4,968	354,102	226,594	526	208,923	272,454	3,841	0	1,081,367
Ice	0	52	436	3	326	106	2,599	100	449	1,114	342	3,969	9,496
Boat Building	28	1,158	423	13	97	31	842	40	42	8,136	332	2,293	13,436
Paperboard Containers	0	0	42	10	63	136	420	0	152	181	427	2,338	3,770
Trade	345	1,953	10,206	2,396	16,771	10,472	52,434	5,216	8,402	12,355	38,460	131,605	290,613
Seafood Dealers	342	15,575	3,272	968	5,520	14,167	7,891	26,074	542,037	328,668	1,819	0	946,334
Fish Exchanges/ Auctions	0	0	1,347	0	0	58	10	0	8,020	0	0	0	9,435
Wholesale Trade	166	1,333	10,216	1,028	22,808	15,058	115,829	1,901	8,914	14,648	55,398	151,009	398,308
Finance, Insurance, and Real Estate	61	897	12,140	627	13,116	6,242	113,109	2,186	2,767	15,729	62,951	135,846	365,672
Services	1,212	6,557	46,318	8,721	58,959	46,459	403,315	16,880	26,311	68,658	205,859	594,490	1,483,740
Government	34	219	782	2,344	1,571	1,071	9,568	786	883	1,465	2,945	16,860	38,528
Total	6,117	36,460	105,430	20,289	149,079	564,666	1,058,032	137,582	2,381,183	1,907,801	483,850	1,410,263	8,260,752

Note: All values are in $US 2012.

Table III-xxx. Total New England Coastal Region employment impacts—WEA revenue.

Sector	Downeast	Upper Mid-Coast	Lower Mid-Coast	Southern	NH Seacoast	Gloucester	Boston	Cape and Islands	New Bedford	Rhode Island	CT Seacoast	Non-Maritime	Total
	ME	ME	ME	ME	NH	MA	MA	MA	MA	RI	CT	New England	New England
Commercial Fishing	**Employment (Jobs)**												
Offshore Lobster Traps	0	0	0	0	0	0	0	0	2	2	0	0	5
Large Bottom Trawl	0	0	0	0	0	0	0	0	1	7	0	0	8
Medium Bottom Trawl	0	0	0	0	0	0	0	0	1	8	0	0	9
Small Bottom Trawl	0	0	0	0	0	0	0	0	0	1	0	0	1
Large Scallop Dredge	0	0	0	0	0	0	0	0	17	0	0	0	17
Medium Scallop Dredge	0	0	0	0	0	0	0	0	3	0	0	0	3
Small Scallop Dredge	0	0	0	0	0	0	0	0	1	3	0	0	5
Surfclam, Ocean Quahog Dredge	0	0	0	0	0	0	0	0	10	4	0	0	14
Sink Gillnet	0	0	0	0	0	0	0	2	11	12	0	0	26
Midwater Trawl	0	0	0	0	0	2	0	0	0	2	0	0	3
Fish Pots and Traps	0	0	0	0	0	0	0	0	1	0	0	0	1
Agriculture	0	0	0	0	0	0	0	0	0	0	0	3	3
Transportation, Communications and Public Utilities	0	0	0	0	0	0	1	0	0	0	0	3	5
Warehousing and Storage	0	0	0	0	0	0	0	0	0	0	0	0	1
Construction	0	0	0	0	0	0	0	0	0	0	0	1	2
Manufacturing	0	0	0	0	0	0	0	0	0	0	0	2	3
Seafood Processing	0	0	0	0	0	6	4	0	6	7	0	0	24
Trade	0	0	0	0	1	0	2	0	0	0	1	5	10
Seafood Dealers	0	0	0	0	0	0	0	0	6	4	0	0	11
Wholesale Trade	0	0	0	0	0	0	1	0	0	0	1	3	6
Finance, Insurance, and Real Estate	0	0	0	0	0	0	1	0	0	0	1	3	6
Services	0	0	1	0	1	1	7	0	1	2	4	16	35
Government	0	0	0	0	0	0	0	0	0	0	0	0	1
Total	0	1	3	1	3	10	18	5	61	53	8	36	199

Table III-xxxi. Total Mid-Atlantic Coastal Region income impacts—WEA revenue.

Sector	NY Seacoast	NJ North	NJ South	DE State	MD West	MD East	VA North	VA South	VA East	NC North	NC Central	NC South	Non-Maritime	Total
	NY	NJ	NJ	DE	MD	MD	VA	VA	VA	NC	NC	NC	Mid-Atlantic	Mid-Atlantic
Commercial Fishing	**Income ($)**													
Offshore Lobster Traps	5,409	0	3,297	1,544	0	1,372	0	0	251	0	0	0	0	11,874
Large Bottom Trawl	118,730	0	94,135	0	0	4,696	0	73,627	17,666	0	161,343	0	0	470,197
Medium Bottom Trawl	146,352	0	69,638	0	0	16,096	0	34,140	2,477	0	61,973	0	0	330,677
Small Bottom Trawl	20,151	0	22,164	0	0	0	0	564	807	0	7,409	0	0	51,095
Large Scallop Dredge	0	0	421,088	0	0	0	0	281,904	1,039	0	488	0	0	704,519
Medium Scallop Dredge	0	0	103,427	0	0	667	0	5,073	0	0	17	0	0	109,183
Small Scallop Dredge	3,642	0	13,402	0	0	0	0	0	0	0	0	0	0	17,045
Surfclam, Ocean Quahog Dredge	1,219	0	1,195,738	0	0	10,317	0	0	0	0	0	0	0	1,207,274
Small Dredge	0	0	0	0	0	0	0	4,982	8	0	0	0	0	4,991
Sink Gillnet	529	110	22,431	0	0	6,840	0	158	2,843	0	17,447	0	0	50,358
Midwater Trawl	0	0	104,944	0	0	13	0	0	0	0	45,046	0	0	150,003
Fish Pots and Traps	125	0	72,383	13,243	0	9,557	0	27,827	8,626	0	0	0	0	131,762
Bottom Longline	10,081	0	47	0	0	584	0	0	0	0	4,522	0	0	15,234
Other Mobile Gear	15,151	0	0	0	0	0	0	0	0	0	747	0	0	15,897
Other Fixed Gear	132	0	675	2	0	363	0	0	2	0	6,550	0	0	7,725
Hand Gears	465	0	654	89	0	15	0	521	442	0	2,745	19,133	0	24,064
Agriculture	690	345	3,275	1,201	2,026	1,173	206	636	402	1,689	2,382	3,511	52,740	70,276
Mining	4,454	520	34	103	641	1	29	1,745	0	0	1	4	4,834	12,363
Transportation, Communications and Public Utilities	294,574	133,682	92,908	13,114	79,405	11,215	29,958	46,937	414	614	3,068	5,903	191,344	903,136
Water Transportation	25,855	15,429	6,465	357	7,716	109	188	14,323	0	0	351	459	7,026	78,278
Warehousing and Storage	11,003	22,681	13,019	1,348	12,015	162	1,737	5,934	0	14	137	293	21,803	90,147
Construction	45,665	15,313	18,124	3,765	20,276	2,004	7,975	8,000	62	216	1,205	1,619	38,533	162,755
Manufacturing	52,655	61,922	47,480	9,207	24,109	3,093	3,500	17,478	702	636	1,655	2,838	114,736	340,010
Seafood Processing	145,389	264,835	359,095	3,598	1,041	9,476	77,013	84,233	22,659	8,012	33,713	3,894	0	1,012,957
Ice	3,324	579	1,299	427	4,931	143	604	569	5	23	76	68	4,601	16,647
Boat Building	14	6	5,516	143	417	535	91	203	5	1,014	6,302	428	2,658	17,332
Paperboard Containers	807	1,136	605	91	625	119	0	723	0	7	8	60	2,710	6,893
Trade	146,220	66,881	73,748	12,004	65,163	7,746	23,847	30,553	367	1,149	4,771	5,343	152,544	590,337
Seafood Dealers	118,412	1,401	640,540	5,733	0	13,456	0	156,498	69,786	0	76,680	13,493	0	1,095,999
Wholesale Trade	295,010	149,796	120,724	13,083	82,939	4,167	37,386	36,652	251	720	3,434	3,143	175,035	922,341
Finance, Insurance, and Real Estate	436,480	103,149	69,882	17,570	69,048	2,672	26,420	37,117	125	351	1,928	2,572	157,460	924,774

Sector	NY Seacoast	NJ North	NJ South	DE State	MD West	MD East	VA North	VA South	VA East	NC North	NC Central	NC South	Non-Maritime	Total
	NY	NJ	NJ	DE	MD	MD	VA	VA	VA	NC	NC	NC	Mid-Atlantic	Mid-Atlantic
Commercial Fishing	**Income ($)**													
Services	1,165,220	343,397	342,422	79,659	304,628	27,811	141,302	155,094	1,341	3,640	15,086	16,964	689,077	3,285,641
Government	44,485	10,064	8,659	1,312	12,819	1,757	5,728	14,215	109	119	1,780	1,181	19,543	121,770
Total	3,112,245	1,191,246	3,927,817	177,594	687,800	136,160	355,982	1,039,706	130,390	18,203	460,863	80,905	1,634,645	12,953,556

Note: All values are in $US 2012.

Table III-xxxii. Total Mid-Atlantic Coastal Region employment impacts—WEA revenue.

Sector	NY Seacoast	NJ North	NJ South	DE State	MD West	MD East	VA North	VA South	VA East	NC North	NC Central	NC South	Non-Maritime	Total
	NY	NJ	NJ	DE	MD	MD	VA	VA	VA	NC	NC	NC	Mid-Atlantic	Mid-Atlantic
Commercial Fishing	**Employment (Jobs)**													
Large Bottom Trawl	3	0	2	0	0	0	0	2	0	0	4	0	0	11
Medium Bottom Trawl	5	0	2	0	0	0	0	1	0	0	2	0	0	10
Small Bottom Trawl	1	0	1	0	0	0	0	0	0	0	0	0	0	3
Large Scallop Dredge	0	0	18	0	0	0	0	12	0	0	0	0	0	31
Medium Scallop Dredge	0	0	4	0	0	0	0	0	0	0	0	0	0	4
Small Scallop Dredge	0	0	2	0	0	0	0	0	0	0	0	0	0	2
Surfclam, Ocean Quahog Dredge	0	0	50	0	0	1	0	0	0	0	0	0	0	51
Small Dredge	0	0	0	0	0	0	0	1	0	0	0	0	0	1
Sink Gillnet	0	0	2	0	0	0	0	0	0	0	1	0	0	3
Midwater Trawl	0	0	3	0	0	0	0	0	0	0	1	0	0	4
Fish Pots and Traps	0	0	10	2	0	1	0	4	1	0	0	0	0	18
Bottom Longline	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Other Mobile Gear	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Other Fixed Gear	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Hand Gears	0	0	0	0	0	0	0	0	0	0	1	4	0	5
Agriculture	0	0	0	0	0	0	0	0	0	0	0	0	3	4
Transportation, Communications and Public Utilities	4	2	1	0	1	0	0	1	0	0	0	0	3	14
Water Transportation	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Warehousing and Storage	0	0	0	0	0	0	0	0	0	0	0	0	1	2
Construction	1	0	0	0	0	0	0	0	0	0	0	0	1	3
Manufacturing	1	1	1	0	0	0	0	0	0	0	0	0	2	6

Sector	NY Seacoast	NJ North	NJ South	DE State	MD West	MD East	VA North	VA South	VA East	NC North	NC Central	NC South	Non-Maritime	Total
	NY	NJ	NJ	DE	MD	MD	VA	VA	VA	NC	NC	NC	Mid-Atlantic	Mid-Atlantic
Commercial Fishing	**Employment (Jobs)**													
Seafood Processing	3	8	11	0	0	0	2	3	1	0	2	0	0	30
Trade	4	2	2	0	2	0	1	1	0	0	0	0	6	20
Seafood Dealers	1	0	8	0	0	0	0	2	1	0	1	0	0	13
Wholesale Trade	4	2	2	0	1	0	0	1	0	0	0	0	3	13
Finance, Insurance, and Real Estate	4	1	1	0	1	0	0	1	0	0	0	0	3	12
Services	20	6	7	2	7	1	3	4	0	0	1	1	19	71
Government	1	0	0	0	0	0	0	0	0	0	0	0	0	2
Total	53	23	128	5	15	6	7	33	4	1	14	6	42	338

Appendix IV. Synthesis of Potential Impacts

To assess the potential economic impact of offshore wind, it is necessary to account for the potential effect of WEA development on the region's ecological systems, as well as how these changes will in turn affect fishing behavior in commercial and recreational fleets. This section describes potential drivers of impacts, as described in research on wind turbines around the globe, with particular attention to the experiences of fishermen in European waters. This synthesis of potential impacts is based on experience and ongoing research concerning wind turbines' ecological and economic impacts. It includes a literature review of research on direct and indirect impacts, as well as first-hand knowledge from a UK fisherman who works as a liaison between the fishing industry and wind companies.

This section reviews the current literature on how marine organisms react to the installation and operation of wind turbines and similar artificial structures. It also reviews the latest research on how ecological systems adapt to this development. It goes on to summarize how wind turbine installation may affect both recreational and commercial fishing activity. The potential impacts on commercial fisheries are described in terms of direct and indirect drivers. The section then provides additional context for European experiences in offshore wind development, in terms of how fishing activities can change after installation is complete.

IV.i Potential Impacts on Fish Populations

Across the world, there is only a small number of large-scale offshore wind farms, and most of these have yet to exist long enough for empirical analysis of fish and fishermen responses to be appropriate. The installation and the ongoing operation of wind turbines may have unforeseen disruptive impacts on life cycle activity in fish populations (including feeding, spawning, and migration) that are of commercial and recreational interest. Although methods for mitigating the potential negative ecological impacts of wind turbine installation are outside the scope of this report, they are mentioned here to provide context on how fish populations, and thus fishing, may be affected.

IV.i.i Impact of Turbine Structure

Near-shore fixed turbines have been demonstrated to act as fish aggregating devices (FADs) (Wilhelmsson et al. 2006). Research on floating and fixed artificial structures suggests that offshore wind turbines are likely to act as FADs (Vella et al. 2001, Rodmell and Johnson 2003, Reubens et al. 2011), which can greatly increase the catchability of fish (Itano and Holland 2000). Depth, location (Moffit et al. 1989), and the surrounding habitat (Einbinder 2006) may influence the degree to which a turbine attracts fish.

Research in the Belgian part of the North Sea shows that Atlantic cod and pouting had greater CPUE near windmill artificial reefs (ARs), indicating distinct aggregation around the hard-structure turbine foundations (Reubens, Vandendriessche, et al. 2013). After installation, offshore structures become home to sessile invertebrates, which become the basis of a complex food web; they attract larger, commercially and recreationally harvested species, which in turn attract human fishing activity (Kaiser 2006, MBC Applied Environmental Sciences 1987, Krone et al. 2013, Coates et al. 2014). In a study on the impacts of offshore windfarms on bluefin tuna and other commercially and recreationally harvested species in the Adriatic Sea, Fayram and de Risi (2007) suggest that increased catch rates (due to the aggregating effect of wind turbines) will almost certainly result in increased recreational harvest.

Beyond the literature on the impacts associated with WEA development, insight may be gained from three related areas of study: marine protected areas (MPAs), ARs, and oil platforms. MPAs are relatively new innovations in ocean management that are growing in popularity. These “closed areas” range from complete vessel exclusion to restrictions on fishing effort or gear configurations intended to protect a specific population or habitat. MPAs have been studied from both biological and economic viewpoints, with particular emphasis on “no-take zones” where fishing is forbidden. The location of an MPA can result in either increased or decreased fishery profits (Rassweiler et al. 2012). However, the ecological and biological changes that are likely to occur within a WEA makes for a flawed comparison with the ecological and biological changes that are likely to occur in “no-take” MPAs. The ecological impact of turbine towers and associated scour protection are not replicated within an MPA. Therefore, literature on the economic impact of “no-take” MPAs is primarily useful to understand fishery response and the associated economic impacts.

ARs and their floating cousins, FADs, are any type of artificial, manmade structures that are placed in the ocean to provide increased habitat for fish, usually with the intention of increasing the attractiveness of fishing in that area. While ARs are most commonly used in the U.S. for enhancing recreational fishing experiences, ARs are also used in commercial fisheries. Studies have found that FADs can linearly increase fish counts (Rountree 1989) and have increased CPUE (Higashi 1994, Matsumoto et al. 1981). Early studies on ARs in the Florida Keys found substantial increases in biomass (Stone et al. 1979) comparable to natural reefs, and later studies found increases in the biomass of benthic invertebrates (Foster et al. 1994). The biological impact and the resulting change in fishery effort that occurs after the construction of an AR provides information useful for understanding the impacts of WEA development; specifically, ARs provide a valid comparison to WEAs when WEAs are assumed to provide additional habitat, increased biodiversity, and increased CPUE. However, the fishery response to ARs may be a flawed comparison, as no ARs have been associated with reduced access to the AR area. In this respect, ARs are only partially useful in understanding fishery responses to WEA development.

Oil platforms are frequently studied as ARs, even when their primary purpose is not ecological. Retired platforms are often “donated” as reefs under the federal government’s “Rigs to Reefs” program (Dauterive 2000). Recognizing the value of these structures, the Louisiana Artificial Reef Initiative was organized in 1984 to provide a structured protocol for safely retiring oil and gas structures (Wilson and Van Sickle 1987) to prevent the loss of valuable fishing sites. Oil and gas platforms in California have even been considered as potential Essential Fish Habitat because certain managed groundfish species inhabit the platforms. Several studies (Helvey 2002, Macreadie et al. 2011, Stanley and Wilson 1996) suggest that the oil and gas platform decommissioning process should recognize the important ecological role that retired energy platforms play. Offshore oil platforms have many parallels with offshore wind platforms; they involve hard, artificial structures that extend throughout the water column and likely include base scour protection. Few oil platforms have existed in Atlantic waters; making inferences about the impacts of oil platforms on development of offshore wind must consider this important difference.

The biological effects presented in the literature on MPAs, ARs, and oil platforms are primarily changes in biomass, changes in species distribution, and changes in aggregation of commercially viable and recreationally desired fish species. A literature review by Bohnsack and Sutherland (1985) identifies myriad effects from ARs, FADs, and oil platforms, including the potential for increased food production at lower trophic levels; increased protection from predators; significant increases in biomass and fish abundance between natural and ARs and between ARs and open bottom areas (from four to 32 times the biomass, with few studies finding no difference); and larger schools of fish in ARs. However, the same paper also states that “most fish biomass around oil platforms in the Gulf of Mexico represents species that are trophically independent from the platform" and that "(t)he quantity of attached and affiliated organisms on bottom reefs is not correlated with the abundance of migratory species." Attraction to the hard surfaces of ARs and oil platforms, rather than increases in primary production, may be the key drivers of biomass changes around these structures.

As Bohnsack and Sutherland (1985) note, it is unclear whether ARs, FADs, and oil platforms aggregate fish without changing the total number of fish, or increase the number of fish in the ocean (Polovina 1991). Results have ranged from no increase (flatfishes) to evidence of increased overall biomass (octopi) within a single study (Polovina and Sakai 1989). Whether an AR is an aggregator or a population enhancer may be influenced by the degree of habitat limitation in surrounding areas, the reef design (Pickering and Whitmarsh 1997), and the age structure of the species (Bohnsack 1989). Management assumptions must allow for both aggregation and enhancement, as information is insufficient to determine the extent of habitat limitation in most areas (Grossman et al. 1997). Aggregation versus enhancement is highly relevant to any fishery study—if turbine towers simply attract fish that would otherwise be caught elsewhere, the resulting changes in harvest would be different from the case where there are more fish to be caught overall. Regardless, existing information suggests an increase in both recreationally and commercially exploitable biomass around wind turbines.

Estimates for changes in biomass from the literature are listed in Table IV-i.

In most of the research publications, the change in biomass is estimated for areas directly over scour protection or hard surfaces. WEA development would not place hard surfaces over the entire extent of the area; this means changes in biomass would be localized near the turbine and would not extend over the entire WEA.

Table IV-i. Summary of information on changes in biomass and catch in the literature reviewed.

Authors	Type of Observation	Change in Biomass	Change in Catch
(Bohnsack and Sutherland 1985) "Artificial reef research: a review with recommendations for future priorities"	Literature review	Estimates of 0x, 4x, 8x, 9x, and 35x	Negative in years 1–2. Positive for recreational fishing. Little change for most commercial fishing.
(Andersson and Öhman 2010) "Fish and sessile assemblages associated with wind-turbine constructions in the Baltic Sea"	Visual transect survey—Swedish Baltic Sea wind farm Utgrunden	6x adult abundance within 1 m; no effect at 20 m	
(Bergström et al. 2013) "Effects of an offshore wind farm on temporal and spatial patterns in the demersal fish community"	Before-After Control-Impact fyke net survey—Swedish Baltic Sea wind farm Lillgrund	No increase in fish density observed (not tested immediately adjacent to base).	
(Couperus et al. 2010) "Use of high resolution sonar for near turbine fish observations (DIDSON)"	Sonar measures of fish density—Dutch OWEZ wind farm	"Overall fish density was on average a factor of 37 higher above the scour bed around the monopoles than in the open water habitats in between monopoles."	
(Polovina and Sakai 1989) "Impacts of artificial reefs on fishery production in Shimamaki, Japan"	Time series of catch and effort near Shimamaki, Japan		4-percent increase in octopus catch. Not significant impact on flatfishes, but did observe aggregation.
(Reubens, Braeckman, et al. 2013) "Aggregation at windmill artificial reefs: CPUE of Atlantic cod and pouting"	Handline fishing of turbine vs. control—Belgian North Sea wind farm Thorntonbank.		Cod and pouting CPUE increased 4x—6x over turbine scour protection (44 m diameter, similar to some proposed U.S. turbine bases) compared to shipwreck.
Vandendriessche et al. in (Degraer et al. 2012) "Ch. 5: Monitoring the effects of offshore wind farms on the epifauna and demersal fish fauna of soft-bottom sediments"	Trawl survey—Belgian North Sea wind farm on Bligh Bank	Increase in commercially important flatfish, but decrease in demersal fish in general.	
(Burkhard et al. 2011) "Ecosystem based modeling and indication of ecological integrity in the German North Sea—Case study offshore wind parks"	Model sim. of ecological functions, specifically accounts for suspended sediments	"Very minor change in biomass….". Increase in predator biomass of +1.20 percent.	
(Leonhard and Pedersen 2006) "Benthic communities at Horns Rev before, during, and after construction of Horns Rev"	Gillnet survey of Danish North Sea wind farm Horns Rev	+7 percent increase in area-wide biomass	

Authors	Type of Observation	Change in Biomass	Change in Catch
(Lindeboom et al. 2011) "Short-term ecological effects of an offshore wind farm in the Dutch coastal zone; a compilation"	Benthic survey, video survey, acoustic survey, and trawl survey—Dutch OWEZ	"No short-term effects on local benthic fauna composition." No impact on bivalve recruitment. Cod observed to seek refuge in turbine vicinity (see also Winter et al. 2010).	
(Løkkeborg et al. 2002) "Spatio-temporal variations in gillnet catch rates in the vicinity of North Sea oil platforms"	Gillnet surveys around oil platforms in the North Sea		Catch rates were 3x to 4x higher within 150–300 m of platform.
(Wilhelmsson et al. 2006) "The influence of offshore windpower on demersal fish"	Visual transect survey—Swedish Baltic Sea wind farms Utgrunden and Yttre Stengrund	Abundance 1–5 m from turbine base was approximately 2x the control transects. At 20 m, abundance was no different from control.	

IV.i.ii Impact of Electromagnetic Fields

Research on the effect of electromagnetic fields (EMF) on a variety of species is ongoing, following concerns regarding the behavioral and ecological impacts of submarine cables associated with offshore WEAs. Some fishes such as elasmobranchs, which include spiny dogfish and most species within the NE Skate Complex, are known to sense EMF, and other fishes including sturgeon may also be affected. In a 2011 study, Normandeau Associates stated:

> There are suggestions that if navigation is affected then migratory species may be slowed or deviated from their intended routes with subsequent potential problems for populations if they do not reach essential feeding, spawning or nursery grounds. On a more local scale species that use EMF for finding food may be confused and spend time hunting EMF that is non-biological and hence reducing daily food/energy intake. Species that use EMF to detect predators…could unnecessarily alter their behavior, or this capability could be undermined by anthropogenic EMF sources. The consequence is that if enough individuals are affected then the population and communities that these species belong to may be adversely affected. Nevertheless, these impacts are all currently speculation and it is essential to gain direct evidence to assess if these potential impacts are real and of ecological significance.

Although general conclusions regarding commercially exploitable fishes may be drawn from this study, Normandeau Associates et al. (2011) state that "project and site specific analyses of potential EMF impacts to local fish species are essential."

It is uncertain how changes in fish behavior in response to introduced EMF translate into changes in commercially exploitable biomass. Predation patterns may change as a result of EMF interference, and migratory or spawning habits may be interrupted. It should be noted that the area of seabed that would have a sufficient EMF to cross the threshold of sensitivity for most species would be limited.

Table IV-ii lists the commercially exploitable species that were found to have a response to EMF in a literature review (Normandeau Associates et al. 2011). The table lists both the specific response, as well as the threshold of sensitivity found (if published). This study models the maximum EMF strength of a cable buried at 1 m as 0.00765 μV/cm; the species' threshold relative to the modeled maximum is listed as well. In general, elasmobranchs are sensitive to fields in the range of 0.005 to 1 μV/cm (Gill 2005).

Table IV-ii. Commercial species with study response and sensitivity to EMF fields.

Species	Sensitivity to EMF
Spiny dogfish	None observed (Gill et al. 2009).
Smooth dogfish	Behavioral (observed) changes. Minimum threshold of sensitivity is below maximum modeled field strength.
Thorny skate	Anatomical/theoretical sensitivity. Unknown threshold.
Barndoor skate	Anatomical/theoretical sensitivity. Unknown threshold.
Little skate	Physiological, behavioral, and anatomical evidence of sensitivity (multiple studies). Minimum threshold of sensitivity may be below the maximum modeled field strength.
Winter skate	Physiological and behavioral (observed) changes. Unknown threshold.
Clearnose skate	Physiological and behavioral (observed) changes. Unknown threshold.
American eel	Physiological, behavioral (observed), and anatomical evidence. Minimum threshold is not below the maximum modeled field strength.
Atlantic salmon	Physiological, anatomical, and behavioral (observed) evidence. Minimum threshold is not below the maximum modeled field strength.

Species	Sensitivity to EMF
Atlantic cod	Possibly behavioral (Regnart 1931). Unknown threshold.
Yellowfin tuna	Behavioral (observed) and anatomical evidence. Unknown threshold.

Based on familial relations to a species observed to have some sensitivity to EMF, the following species may also be sensitive: Atlantic sturgeon (based on sensitivity of Russian sturgeon; sensitivity threshold is not below the maximum modeled field strength); Arctic cod, haddock, and pollock (based on possible sensitivity of Atlantic cod); Acadian redfish (based on sensitivity of darkbanded rockfish); Wahoo, mackerel, and tuna species including bonito, Atlantic and king mackerel, Spanish mackerel, albacore tuna, bigeye tuna, bluefin tuna (based on sensitivity of yellowfin tuna); Atlantic halibut, yellowtail flounder, Winter flounder (based on sensitivity of European plaice).

No conclusions may be drawn regarding the change in biomass of commercially exploitable species resulting from EM fields. Existing studies have shown a mix between attraction and repellence over studied species. Gill (2005) and in-situ studies on existing Danish wind turbine areas have shown no correlation between EMF strength and phenomena observed over the cable route (Danish Energy Authority 2006). The area exposed to EMFs is limited only to the immediate vicinity of the submarine cables, and studies have only shown that some EMF sensitivity is either observed or theoretically possible; none have ventured as far as establishing an ecological impact or a change in commercially exploitable biomass. This study assumes that the impact of EMFs from cabling will be best approximated within the overall ecological impact of offshore wind development, rather than as an independent factor, due to the limited area of EMF exposure.

IV.i.iii Impact of Noise

Noise during the construction phase (e.g., pile driving) and during the operational phase (i.e., turbine vibration under operating conditions) may alter the behavior and commercially exploitable biomass of fishes in the vicinity of the developed WEAs. Research on fish hearing has been performed for more than 50 years, but large knowledge gaps in the understanding of the relationship between hearing mechanism and sound production, and its relevance to fish behavior persist (Popper and Fay 2011). There are currently more than 31,000 identified species of fish and an unknown number of unidentified species (Froese and Pauly 2010). A small fraction of identified species has been studied in terms of their abilities to detect sound pressure and motion. The teleost group of fish is a large and extremely diverse group of ray-finned, bony fishes, and includes many important commercial and recreational fishes (e.g., cod, herrings, perches, salmon and trout), as well as a much larger number of lesser-known species. All teleost fish have inner ears, equipped to detect motion, and some teleost species have a swim bladder. For detection of sound pressure, fish must have a swim bladder, or other gas-filled chamber, to convert the pressure into motion and be detected by the otolith. Swim bladders vary in size, shape and location between species, and some fish have developed swim bladder extensions to enhance the transfer of pressure into motion. The extensions connecting the gas-filled chamber more closely to the inner ear result in higher sensitivity in terms of frequency, with a lower sound pressure threshold is achieved. Many teleost species of fish (e.g., herring) have evolved anterior extensions of the swim bladder that come close to or directly contact the inner ears (Andersson 2011; Schulz-Mirbach et al. 2012). Species that have swim bladders, but do not have a specialized morphologic structure to increase their hearing sensitivity (e.g., cod and salmon) can detect sound pressure, but are more limited in sensitivity. Species without a swim bladder, including benthic species (e.g., flatfishes, gobies and sculpins) and fast swimming pelagic species (e.g., tuna and mackerels) are only sensitive to particle motion. Few species have been tested in terms of sensitivity to particle motion. Dual sensitivity to sound pressure and particle motion for some species is also largely unexamined. (Andersson 2011; Popper and Fay 2011; Sand and Karlsen 2000).

IV.i.iii.i Impact of Noise Associated with Construction

Pile driving is the only man-made, non-blasting, sound source that has killed and caused hearing damage in fish in the natural environment. Pile driving activities have the potential to cause direct fish mortality by damaging internal organs at distances of less than 50 m. However, many studies found no statistically significant change in direct mortality, even at distances of less than 10 m (Popper and Hastings 2009). Seawater can attenuate severe impacts from noise even at short distances from the noise source (Bailey et al. 2010). Pile driving activities can also damage the sensory hair cells in the otolith organs, leading to temporary or permanent hearing loss (Popper and Hastings 2009). Fish recover within hours or days from temporary hearing loss, with recovery time varying with both noise duration and frequency (Amoser and Ladich 2003; Scholik and Yan 2001).

At greater distances, fish behavioral changes are primarily changes in swimming speed. Behavioral changes do not directly contribute to mortality, but may result in changes in spawning, affecting future biomass levels. Few behavioral studies on pile driving noise exist or have been subjected to a peer review process (Andersson 2011). Bergstrom et al. (2014) provide a general assessment of the current state of knowledge regarding the effects of offshore wind facilities on marine wildlife in Swedish waters; synthesizing the impacts in terms of the temporal and spatial extent of the disruption, the effect within each ecosystem component, and the level of certainty. The analysis suggests that installation activities with low intensity noise from drilling, dredging, or increased vessel traffic may induce fish and mammals to leave the area, but that animals are likely to return soon after the noise ceases. Extreme noise during the construction phase, such as from pile driving, is more likely to cause mortality and tissue damage in fish. The report summarizes available studies by suggesting that construction activities should be planned to occur outside important recruitment areas for fish, as well as outside biologically sensitive periods of the year for migrating species (Bergstrom et al. 2014).

IV.i.iii.ii Impact of Noise Associated with Normal Operation

Far fewer studies have identified impacts associated with normal operational turbine noise. No studies have observed or posited a direct mortality from operational noise. Operational noise is heterogeneous over observed turbine installations. Furthermore, there is cross-species and cross-individual heterogeneity in responses to consistent operational noise, possibly based on a range of factors including age and sex. Finally, acoustic properties of a given patch of ocean may vary based on many environmental factors. If the ambient sound from wind, waves, rain and biological noise are higher than noise from the operating wind turbines, fish will be unable to detect noise from operating wind turbines (Andersson 2011).

Fish may habituate to operational noise over time, with tolerance thresholds depending on age, sex, condition, season and habitat preferences (Hawkins 1993; Mitson 2000; Popper et al. 2004). Fish without a swim bladder or other sound pressure detector are estimated to perceive wind turbine noise around 10 m (Enger 1973; Horodysky et al. 2008). Fishes with a swim bladder sensitive to sound pressure, but without any enhanced hearing ability (e.g., salmon, trout, and eel), will possibly detect the noise up to 1 km distance. Species having better hearing than previously mention species, e.g., cod, haddock, and herring, could detect wind farm noise at distances ranging from of several kilometers and up to tens of kilometers. Species with swim bladder extensions that enhance pressure detection can detect the wind turbine noise at more than 20 km distance (Andersson

2011). There is no conclusive evidence of the impacts of wind turbine noise from normal operation on commercially exploitable biomass. Many of the studies of fish behavioral changes due to noise within the range of detectability have not been peer reviewed.

Concerns have been raised over the effect of noise and vibration on longfin and Illex squid commonly harvested in the areas south of Rhode Island. Squid employ statocysts, which act as accelerometers and are primarily used for balance and motion detection for the animal while swimming (Mooney et al. 2010). Particle acceleration thresholds for detection by similar species were recorded as low as 0.004 ms^{-2} (Packard et al. 1990), which is less than half of the particle acceleration measured at 4–7 m from a turbine base in (Wahlberg and Westerberg 2005). On a large scale, it is not likely that vibrations from turbine operation would affect squid species significantly.

Operational noise may be sufficient at close distances to impede spawning in species that use grunts and sounds in the mating process (Wahlberg and Westerberg 2005). Haddock are known to employ grunts in spawning that are audible to other haddock at 4 m or less under normal circumstances. Operational noise may mask these grunts by a factor of 2 or more, though the actual effect on spawning rates cannot be estimated from these data alone. Overall, fish exposed to operational noise may "exhibit behavioral responses; the effect of which is unknown and will be dependent on the properties of the received sound and receptor characteristics and condition" (Gill et al. 2012).

IV.ii Potential Impacts on Recreational Fisheries

The discussion below provides a qualitative depiction of the potential economic impacts of WEA development, including how the range of potential biological impacts overviewed in Section IV.i may affect recreational anglers.

Generally offshore wind turbines are expected to act similarly to other offshore artificial structures, such as oil and gas platforms. In the Gulf of Mexico, oil and gas platforms have long been known as popular destinations for recreational anglers (Dauterive 2000, Harville 1983, Reggio 1989). Past research on retired oil platforms found that these reefs were a key recreational fishing destination in 70 percent of all recreational angling trips in the Exclusive Economic Zone (Reggio 1987) and 37 percent of all saltwater recreational angling trips off the coast of Louisiana (Witzig 1986). According to one study (Stanley and Wilson 1990), fishing off oil and gas platforms produced the highest catch rates of all recreational fisheries in the United States. Although few studies have attempted to calculate the recreational value of ARs, the travel cost method and contingent valuation method have been used to estimate their value in Taiwan. The results suggest that substantial economic benefits can be derived from ARs (Chen et al. 2013).

IV.iii Potential Impacts on Commercial Fisheries

Potential biological impacts are overviewed in Section IV.i, with the existing literature indicating the likelihood of increases in fish density either through aggregation or increases in biomass. Aggregation could contribute towards increased CPUE, while increases in biomass could portend increase in both CPUE and total catch. Studies of gillnets in the North Sea identified catches within 150 m of the base of the platform, which were three to four times higher than elsewhere (Løkkeborg et al. 2002). Polovina and Sakai (1989) found, for studied species, increases in catch around an AR despite mixed changes in biomass. Although many studies have found no increase in CPUE around an AR, this is usually attributed to increases in fishing effort that coincide with increases in local biomass as opposed to a lack of benefits generally (Pickering and Whitmarsh 1997).

IV.iii.i Boundary Effects

To the extent that a WEA acts as an MPA via reduced access or as a de facto closure, and as a result of changes in biomass within the area and around the periphery, higher stock density may be observed outside the WEA (Rowley 1994, Kellner et al. 2008, Halpern et al. 2009). This can lead to higher CPUE (Kellner et al. 2007), especially in stocks where fish density plays a significant role in CPUE (White 2009). Although theory shows potential increases in overall catch (Gerber et al. 2003), overall fishery yields may also decline or have no observable change (Russ and Alcala 2004).

An empirical study in an artisanal fishery in the Philippines observed a 50 percent increase in CPUE centered at 200 m from the closed area boundary and over a long time period (Russ et al. 2003). In a semi-empirical study, Halpern et al. (2009) found that boundary effects compensated, at least partially, for the yield lost due to restricted access, even for closed areas where fishing was previously at sustainable levels. A similar result was empirically observed in McClanahan and Mangi (2000). Kellner et al. (2007) found that during the fishing off-season, fish density in a 500 m buffer zone outside of an MPA in California were 5 to 10 times higher than during the fishing season, while changes inside MPA were much less pronounced, which the authors attributed to significant increases in effort associated with increased CPUE. On the border of a Mediterranean Sea protected area, total lobster catch weight increased by 10 percent over a 17-year period (Goñi et al. 2010). On the same area's border, CPUE increased over time, despite constant fishing pressure (Stobart et al. 2009).

Changes in CPUE along a closed area boundary are highly dependent on (1) the current health and density of stocks in the area to be closed (state dependence), (2) the dynamics of larval dispersion and stock mobility, (3) stock effects within the existing fishery, (4) fishery effort reallocation dynamics (Halpern et al. 2004), and (5) the size and extent of the closed area. This raises significant uncertainty over the range of expected impacts. Large changes in CPUE are unlikely to be observed due to dissipation from increased effort. However, Vandeperre et al. (2011) and Stobart et al. (2009) suggest that, when these so-called spillover effects are present, fishing along the boundary is the preferred alternative for many vessels. A reasonable range of increased CPUE, based on the empirical and theoretical evidence discussed here, is zero to ten percent. An increase of 50 percent as seen in Russ et al. (2003) is not likely in U.S. waters due to fleet mobility, pressure to maximize profitability, and the non-artisanal nature of the Atlantic fisheries.

IV.iii.ii Congestion Effects

If aggregation or enhancement of biomass within a WEA occurs, congestion effects and gear conflicts may increase as a result (Samples and Sproul 1985). This is especially true with intense boundary fishing (Stobart et al. 2009). Boundary fishing is widely observed around closed areas in Northeast VMS data (NOAA/NMFS Northeast Regional Office 2013). An increase in fishing between two WEAs in Denmark was observed for some, but not all, gear types (Degraer et al. 2011). However, in this case, the WEA was fully closed to all fishing and no congestion effects were noted. Different vessels can respond very differently to area closures and assuming a single response (e.g., all vessels will choose a similar alternative fishing ground) may lead to erroneous models and conclusions (Smith 2004).

Gear conflicts or congestion effects can also arise in cases where biomass increases occur within a WEA with no fishing exclusion. Empirical estimates of congestion resulting from increased CPUE within a WEA do not exist and are not incorporated within this study. The scale of areas proposed for wind development in the study area suggests that boundary effects (reallocation of effort out of a proposed WEA and into boundary areas due to exclusion from the WEA), though potentially significant in the immediate vicinity of the boundary, are not likely to be substantial. While some local boundary fishing will likely be observed, the change in catch would likely be unobservable, meaning congestion effects are not expected.

IV.iv Area Accessibility to Fishing Vessels

In addition to information on biological and ecological impacts of offshore wind, summarized is the existing knowledge of the expected impacts of both direct and indirect exclusion of fishing vessels from WEAs. The summary was built upon a review of grey literature on the potential changes in fishery effort, including meetings, interviews, and other data gathered in the U.S.

Although the European Union (EU) offshore wind experience is useful for understanding potential impacts, inferences must be made with caveats. An ecological response to turbine installation observed in Europe may not occur in the same manner in the U.S. due to differences in species composition, sediment profiles of the ocean floor, and external pressures. Furthermore, there are general differences between the U.S. and EU fishing economies that must be considered, including differences in fleet composition, fishery history, market demands for species, and regulatory structures. Each of these differences could potentially lead to different outcomes from identical wind turbine construction on either side of the Atlantic Ocean. Conclusions from the EU experience should be considered with this caveat in mind.

Most Dutch and Belgian offshore wind developments in the North Sea are closed to fishing activities (Bergman et al. 2012). In the United Kingdom, entire wind farms are not automatically designated as exclusionary zones; rather, 50 m operational safety zones are in place around each turbine base (see Table 15.1 in RWE npower Renewables 2011). In the U.S., an exclusionary zone is sometimes established around operating oil production platforms in the Gulf of Mexico. Title 33 of the U.S. Code of Federal Regulations (U.S. Code of Federal Regulations, 1982) establishes 500 m exclusionary zones around a variety of specifically named production platforms. By definition, the upper-bound for reductions in access due to WEA development would be “complete closure,” as is seen in many European areas.

Under current regulations, the USCG is responsible for determining any type of safety or exclusionary zone around any structure placed in the open ocean. The USCG has stated that it does not plan to create exclusionary zones around wind turbines with the exception of safety zones during construction and decommissioning. National Environmental Policy Act documentation for the development of the Cape Wind project off MA indicates that no exclusionary zone was sought or required by the USCG around that development (MMS 2009). Although the location of Cape Wind (in a sheltered shoal) is different from the open-ocean locations studied here, a scenario where no official exclusion exists is a reasonable lower-bound for reductions in access.

Construction of wind turbines in fishing grounds may result in informal, de facto exclusion if fishing vessel operators perceive or are not actually able to safely navigate the area, either in transit or while fishing. Some fishermen have noted their reluctance to enter a developed WEA during inclement weather, especially during low visibility events. Small mechanical problems, such as a temporarily malfunctioning engine, could result in an allision with a structure as the vessel drifts during repair. *De facto* exclusionary zones are likely to occur as fishermen exhibit reluctance to navigate or fish within a WEA.

Concerns over safety of navigation and insurance costs may lead vessels to avoid a WEA. In the UK, this concern was voiced by fishermen, and was of particular concern to those operating vessels greater than 10 m (33 feet) (RWE Renewables 2011). In the U.S., the same concern was voiced during BOEM Mitigation Measure npower workshops (BOEM 2014), in informal interviews with fishermen, and in previous reports (Industrial Economics, Inc. 2012). While some vessel operators suggested that, if turbines aggregated commercially exploitable fish species, they would specifically target the WEAs, others indicated that they would not do so regularly.

Vessels using mobile gear (dredge, trawl) expressed greater concern over WEA fishing, while fixed-gear vessels expressed concerns about other navigation issues due to the relatively low risk of fishing with pots, traps, or gillnets within the WEA. Therefore, a de facto closure may occur for one gear type and not another, or for larger vessels but not smaller vessels, even in the same WEA. In planning for the Triton Knoll development in the UK, it was noted that "some operators of smaller vessels based in Grimsby and Skegness have developed experience of operating in the existing Lyn and Inner Dowsing site. Skippers of two of these Grimsby based vessels that are known to fish with the (proposed) site have consequently stated their intention to return to their current potting operations" (RWE npower Renewables 2011).

In the UK, fishing within operating WEAs has been observed. In a presentation to the Mid-Atlantic Fishery Management Council (MAFMC), available at www.mafmc.org/briefing/april-2014, an experienced UK trawl fisherman discussed at length the effects of the Ormonde, Barrow, and Walney Wind Farms located off the coast of Fleetwood, Cumbria, England, in the East Irish Sea. In his report, fishermen testimonies established little difference in general operating patterns within and outside the wind farm. Photographs of pot fishing, shrimp beam trawling, and otter trawling were included, as were maps of observed otter trawl tracks and pot fishing tracks which showed successful fishing between the turbines (Watson 2014). The presentation noted that many mobile gear operators were wary of entering the turbines, but that fixed gear fishermen, primarily pot fishermen, appeared to be attracted to the area. In addition to pot fishermen, recreational anglers were highly attracted to the area, which reportedly lead to occasional congestion. It was further noted during the meeting's Q&A session that each fisherman's information on fishing within the WEAs was not widely shared—for those vessels that entered the area, knowledge of the quality of catch was closely held as a competitive advantage. It was further noted that fishing was observed within the area up to "Force 5 winds" on the Beaufort Scale, corresponding to approximately 9.35 m/s, a point where white caps begin to appear on the water. In general, the presentation established that the fishery had strong preferences *against* the development of WEAs, but that the worst fears of the fishery had failed to materialize. Although the wind energy developments required adaptation, the traditional methods of fishing in the area had continued.

In scoping meetings, the issue of a potential increase in vessel insurance costs for vessels regularly fishing within a WEA was raised on multiple occasions (BOEM 2014). While no specific incidences of increased premiums have been cited and marine insurance underwriting relies on the insurer's individual experience with each customer, insurance costs could potentially contribute to a de facto closure. Consideration for this impact is inseparable from other potential impacts to access, and is thus not broken out further.

WEAs may also act as transit impediments for vessels with no intent of fishing within the turbines. Depending on placement and weather conditions, vessels may be forced to steam around a developed wind energy facility, adding transit time and fuel cost.

Empirical observations during the operational phase of reduced fishery access range from "no reduction" to a full closure. The gradient between the two extremes may be defined over vessel length or by gear (fixed vs. mobile). Navigational (transit) access would be impacted in a case-by-case manner based on locations of home ports and fishing grounds, and would depend on the size and location of each proposed WEA as well as the existence of a transit lane through the WEA. During construction periods, fully exclusionary safety zones were established in every wind farm development. Construction within a development would be done in a phased manner, minimizing the area affected. In general, the construction phase lasts between one and two years.

Appendix V. References

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The Department of the Interior Mission

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The Department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

The Bureau of Ocean Energy Management

As a bureau of the Department of the Interior, the Bureau of Ocean Energy (BOEM) primary responsibilities are to manage the mineral resources located on the Nation's Outer Continental Shelf (OCS) in an environmentally sound and safe manner.

The BOEM Environmental Studies Program

The mission of the Environmental Studies Program (ESP) is to provide the information needed to predict, assess, and manage impacts from offshore energy and marine mineral exploration, development, and production activities on human, marine, and coastal environments.