# Spatiotemporal & Socioeconomic Analysis of Fishing Activity within the New York Bight Call Areas

New York Intergovernmental Task Force Meeting – May 9, 2018

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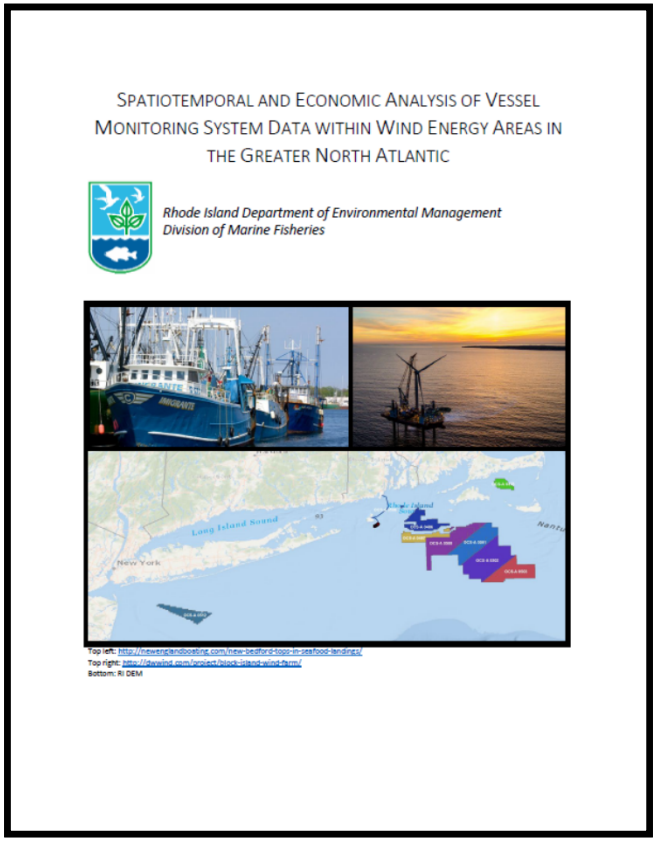
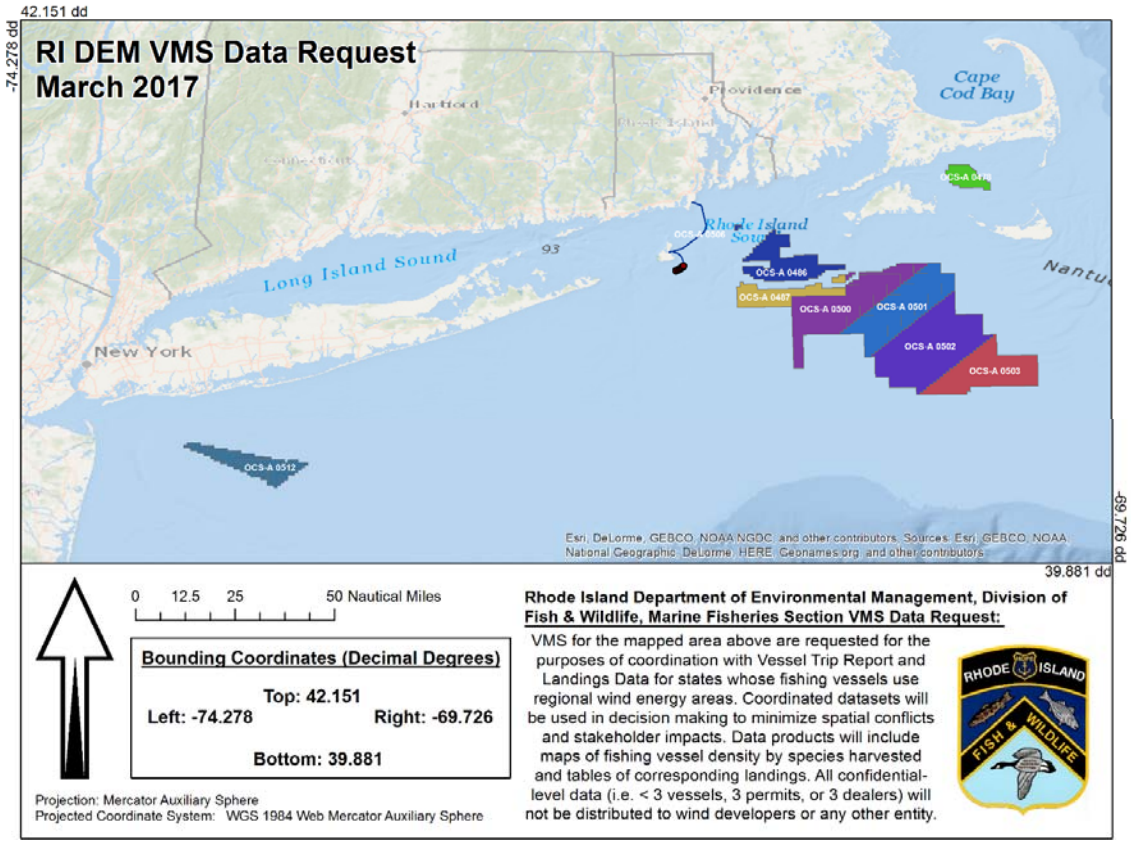
# Introduction

- Rhode Island fishing industry reached out to RIDEM in mid 2016 with concerns over some of the data being used to determine the value of various WEAs to the fishing industry.
- RIDEM DMF acquired VMS data in early 2017 to determine values of fish coming out of the WEAs offshore MA and RI, as well as off NY.
- Released our report in January 2018 for fish caught in the WEAs and landed in NH – NJ.



# Methods – VMS Study Area




- Covers the Statoil, Deepwater Wind, DONG Energy (Orsted), and Vineyard Wind lease areas, as well as the two areas offshore MA to be leased soon
- Does not cover the full NYSERDA study area or BOEM NY Bight Call Areas, as these areas were not yet identified at the time of the data requests
  - Work could be repeated to focus on that area with additional VMS data

# Methods - Data

- VMS obtained from NOAA's OLE for 2011 – 2016
  - Required an NDA
- VTRs obtained from SAFIS for 2011 – 2016 for NH, MA, RI, CT, NY and NJ
  - eVTRs automatically entered into SAFIS
  - Paper VTRs uploaded to NOAA VTR database and transferred into SAFIS
- Landings obtained from ACCSP Data Warehouse for 2011 – 2016 for NH, MA, RI, CT, NY, and NJ
  - Required individual access approval from each state and GARFO

# Methods - Mapping

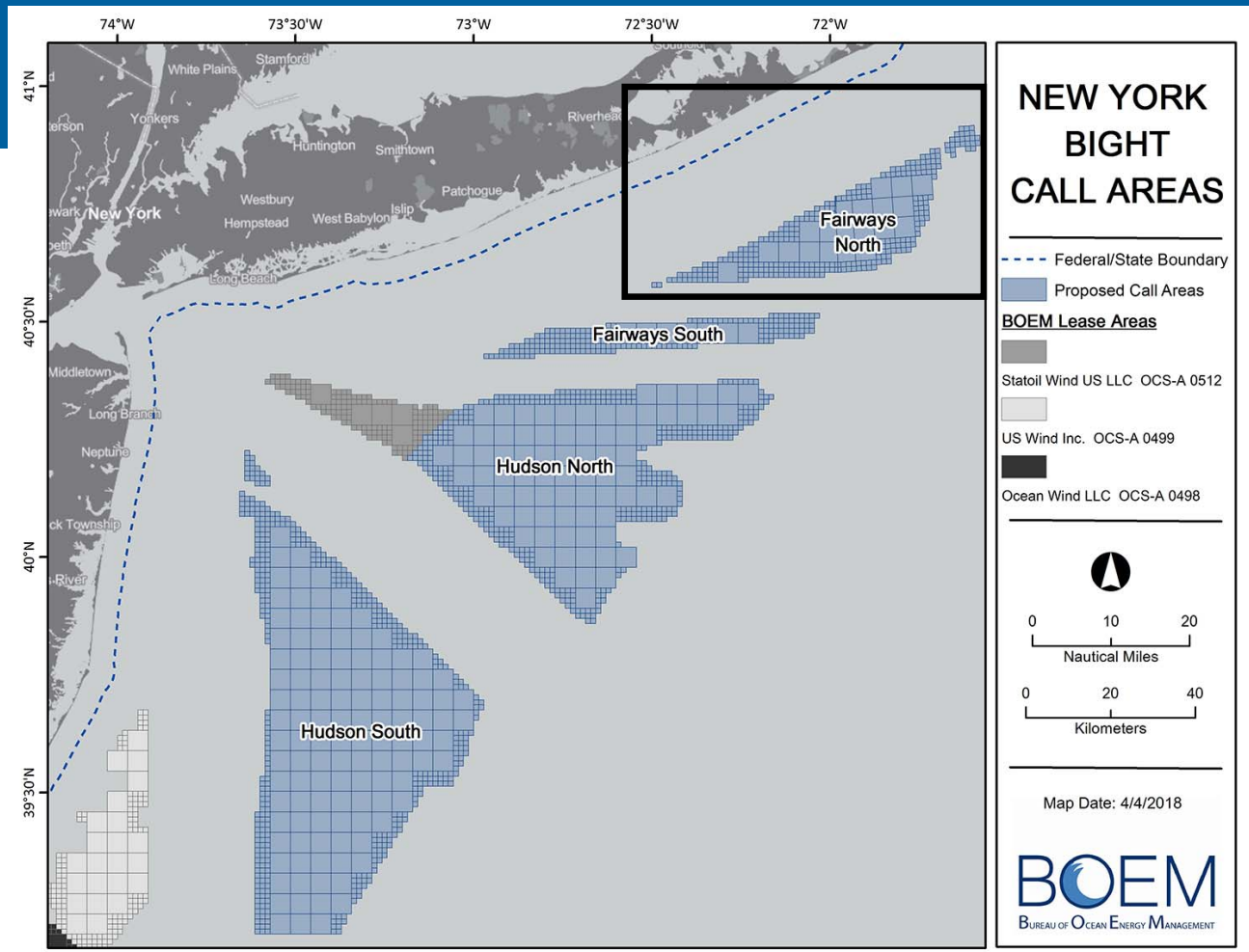
- Merged the VMS to the VTR based on the vessel federal permit number
- Merged the combined VMS/VTR to the dealer reports (landings), based on the VTR number
- Dropped all points where the vessel was moving at a speed unlikely to be fishing
  - All points > 4 knots were removed, with the exception of the scallop fishery (5 knots cutoff)
- Plotted out all remaining point data and converted to a raster (gridded dataset) where the grid cell color corresponds to the number of VMS fishing points that occurred in each cell
- Smoothed the cells to meet ACCSP confidentiality rules
- Mapped the results by fishery

# Methods – Economic Calculations

- Merged the VMS to the VTR based on the vessel federal permit number
- Merged the combined VMS/VTR to the dealer reports (landings), based on the VTR number
- Dropped all points where the vessel was moving at a speed unlikely to be fishing
  - All points > 4 knots were removed, with the exception of the scallop fishery (5 knots cutoff)
- Weighted each location based on fishing density and applied the weights to landings values
- Subsetted spatially (only kept points that fell within WEAs/Call Areas)
- Added landings values together based on fishery (gear used, species landed, or location landed)
- Removed all values from tables that did not comply with the ACCSP Rule of 3

# Findings

Fairways North



# Findings

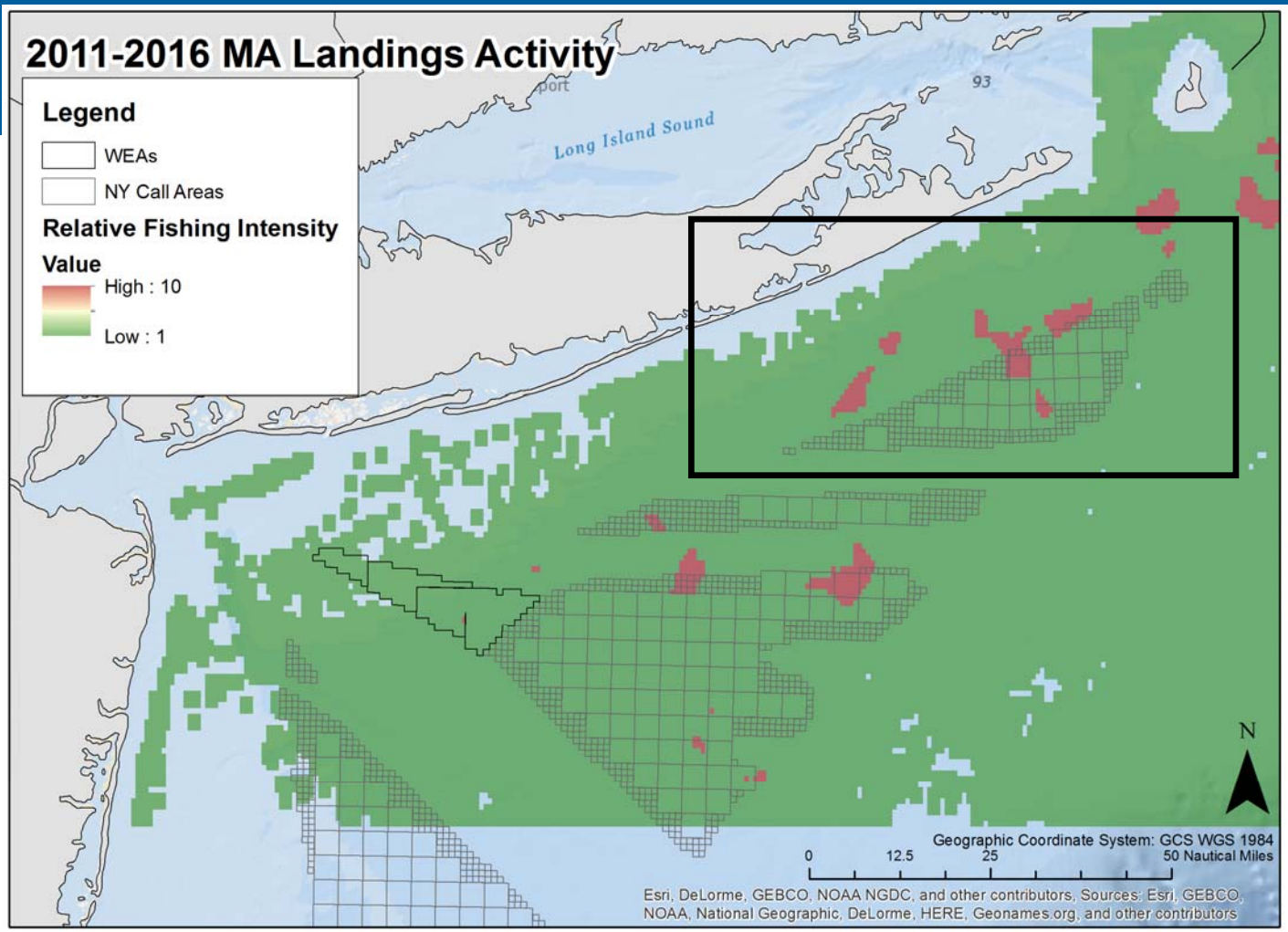
## Fairways North – Landings by State

| State | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|
| **CT** | $185,346.16 | $569,214.45 | $520,501.20 | $484,232.35 | C | $481,820.64 |
| **MA** | $4,361,503.62 | $1,250,853.45 | $2,587,973.11 | $8,053,086.67 | $1,057,328.11 | $2,520,828.83 |
| **NJ** | $24,396.80 | $185,058.89 | $266,361.15 | $861,950.31 | $434,025.25 | $147,605.95 |
| **NY** | $387,885.24 | $209,043.03 | $501,132.64 | $309,612.31 | $123,276.35 | $304,740.98 |
| **RI** | $35,916.47 | $269,405.67 | $833,747.16 | $891,796.82 | $63,696.66 | $289,183.44 |
| **Total** | $4,995,048.29 | $2,483,575.49 | $4,709,715.26 | $10,600,678.46 | $1,678,326.37 | $3,744,179.84 |

# Findings

## Fairways North

Landings by State



# Findings

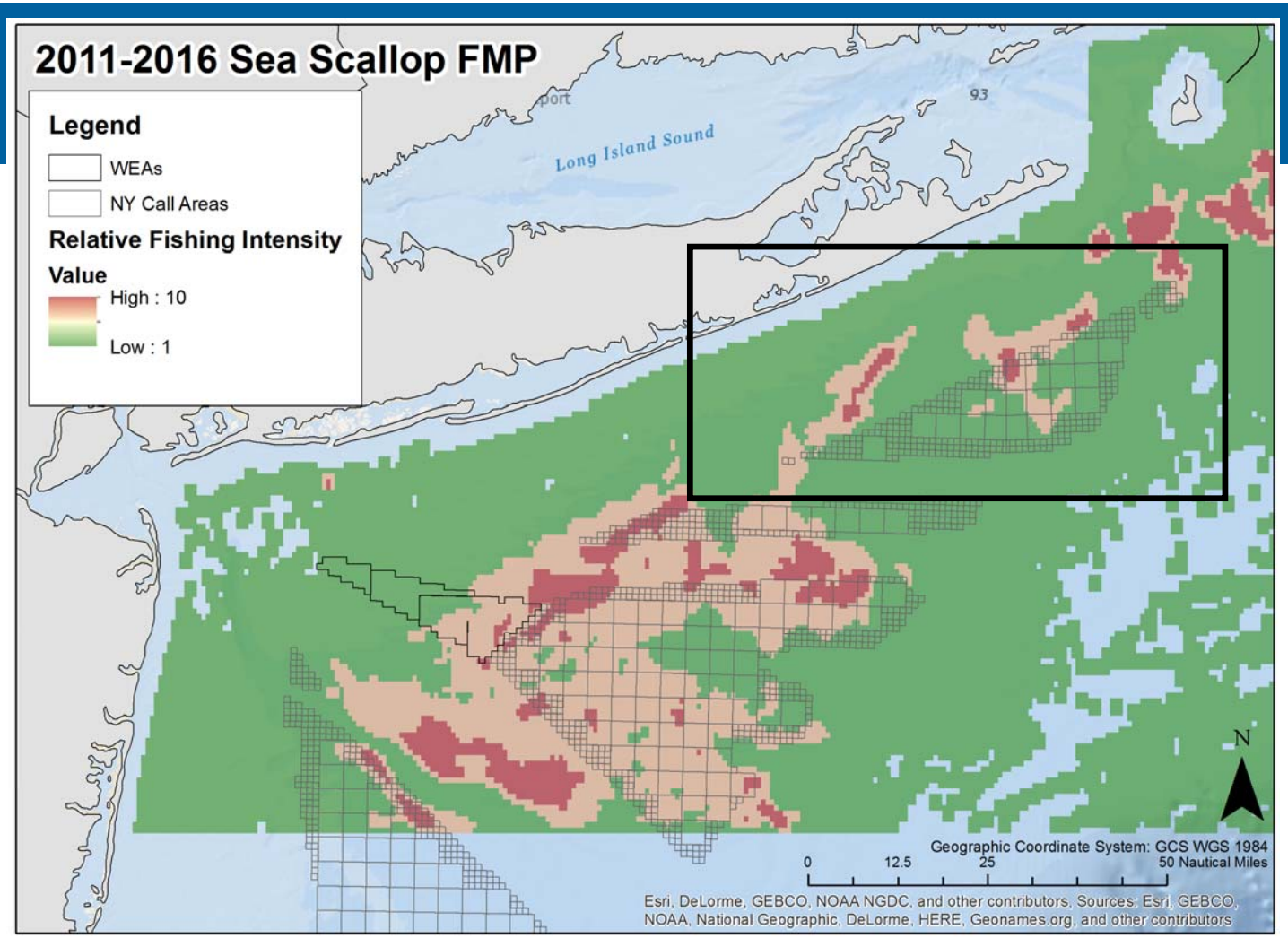
## Fairways North – Landings by Species (top 10 shown here)

| Species | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|
| BLUEFISH FMP | $1,988.19 | $4,468.29 | $437.17 | $664.81 | $2,267.43 | $4,389.74 |
| DOGFISH, SPINY | $5,979.11 | $1,517.56 | $574.24 | $1,344.07 | $315.38 | $15.92 |
| DORY, AMERICAN JOHN | $271.96 | $1,294.87 | $603.32 | $307.39 | $402.21 | $2,431.27 |
| MONKFISH FMP | $232,535.40 | $375,374.70 | $343,962.53 | $254,511.88 | $75,061.34 | $271,645.20 |
| NORTHEAST MULTISPECIES FMP | $56,091.83 | $8,375.94 | $181,705.57 | $53,232.66 | $36,674.16 | $19,640.25 |
| NORTHEAST SMALL MESH MULTISPECIES FMP | $19,847.65 | $59,857.60 | $7,169.38 | $14,851.87 | $2,906.06 | $33,068.78 |
| SEA SCALLOP FMP | $4,573,969.27 | $1,835,853.74 | $3,903,931.50 | $9,927,707.15 | $1,453,548.33 | $3,165,913.45 |
| SKATE FMP | C | C | $253.50 | $1,689.57 | $1,671.94 | $2,671.15 |
| SQUID MACKEREL BUTTERFISH FMP | $20,159.43 | $83,458.99 | $203,790.98 | $266,113.99 | $39,527.40 | $102,393.54 |
| SUMMER FLOUNDER, SCUP, BLACK SEA BASS FMP | $82,826.58 | $112,947.89 | $64,720.26 | $79,270.65 | $64,734.07 | $141,375.96 |
| NON-CONFIDENTIAL TOTAL | $4,994,648.98 | $2,483,291.65 | $4,707,780.62 | $10,600,620.57 | $1,678,111.63 | $3,743,677.79 |

# Findings

## Fairways North

Landings by Species



# Findings

## Fairways North – Landings

### By gear

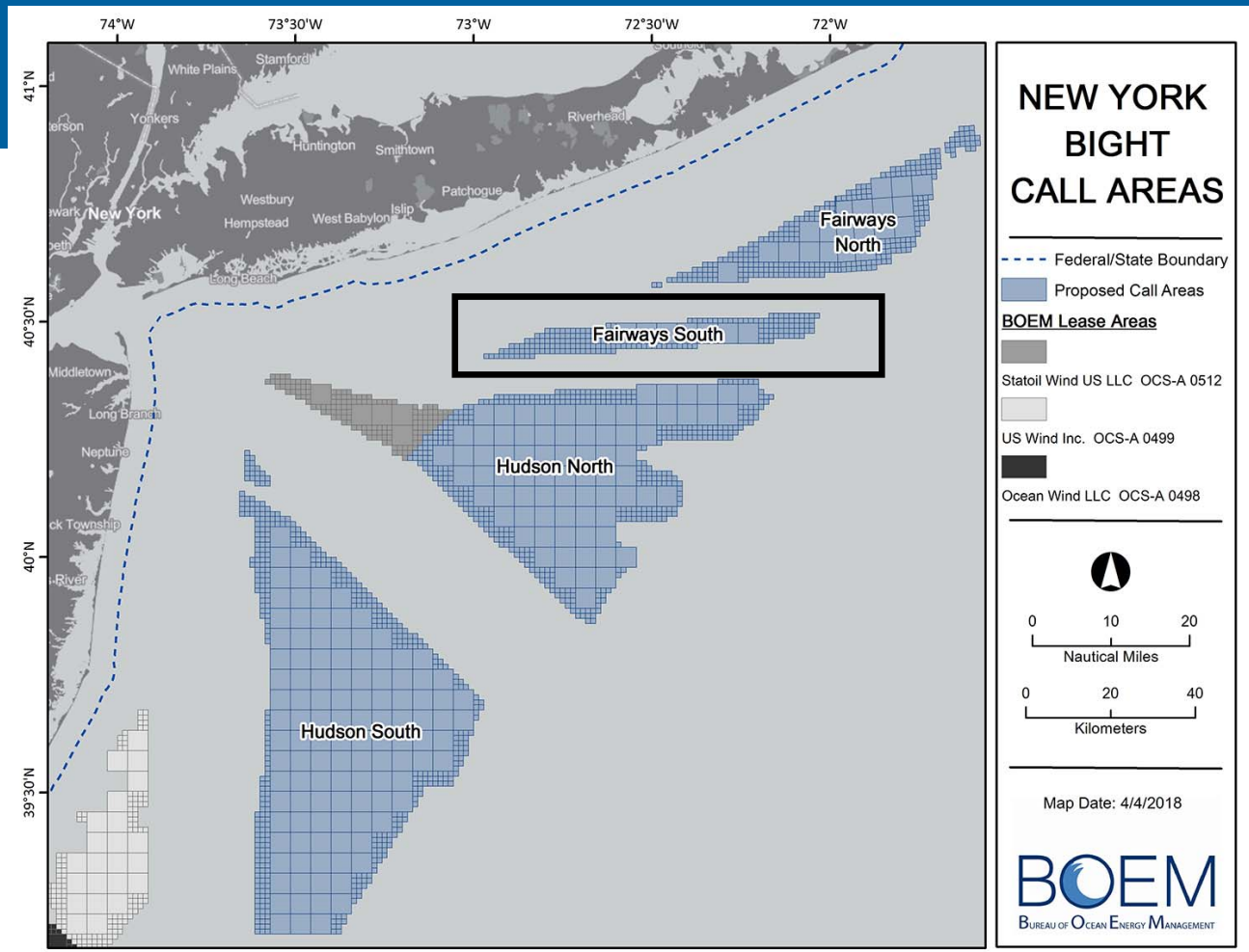
| Gear | % Landings over 6 Yrs |
|---|---|
| DREDGE, OCEAN QUAHOG/SURF CLAM | 0.47% |
| DREDGE, SCALLOP | 87.72% |
| GILL NET, SINK | 5.01% |
| OTTER TRAWL, BOTTOM,FISH | 6.34% |
| PAIR TRAWL, MIDWATER | 0.45% |

### By port

| Port | % Landings over 6 Yrs |
|---|---|
| Cape May, NJ | 5.83% |
| Hampton Bays, NY | 1.08% |
| Montauk, NY | 5.46% |
| New Bedford, MA | 70.84% |
| New London, CT | 6.65% |
| Point Judith, RI | 4.57% |
| Stonington, CT | 1.76% |

# Findings

Fairways South



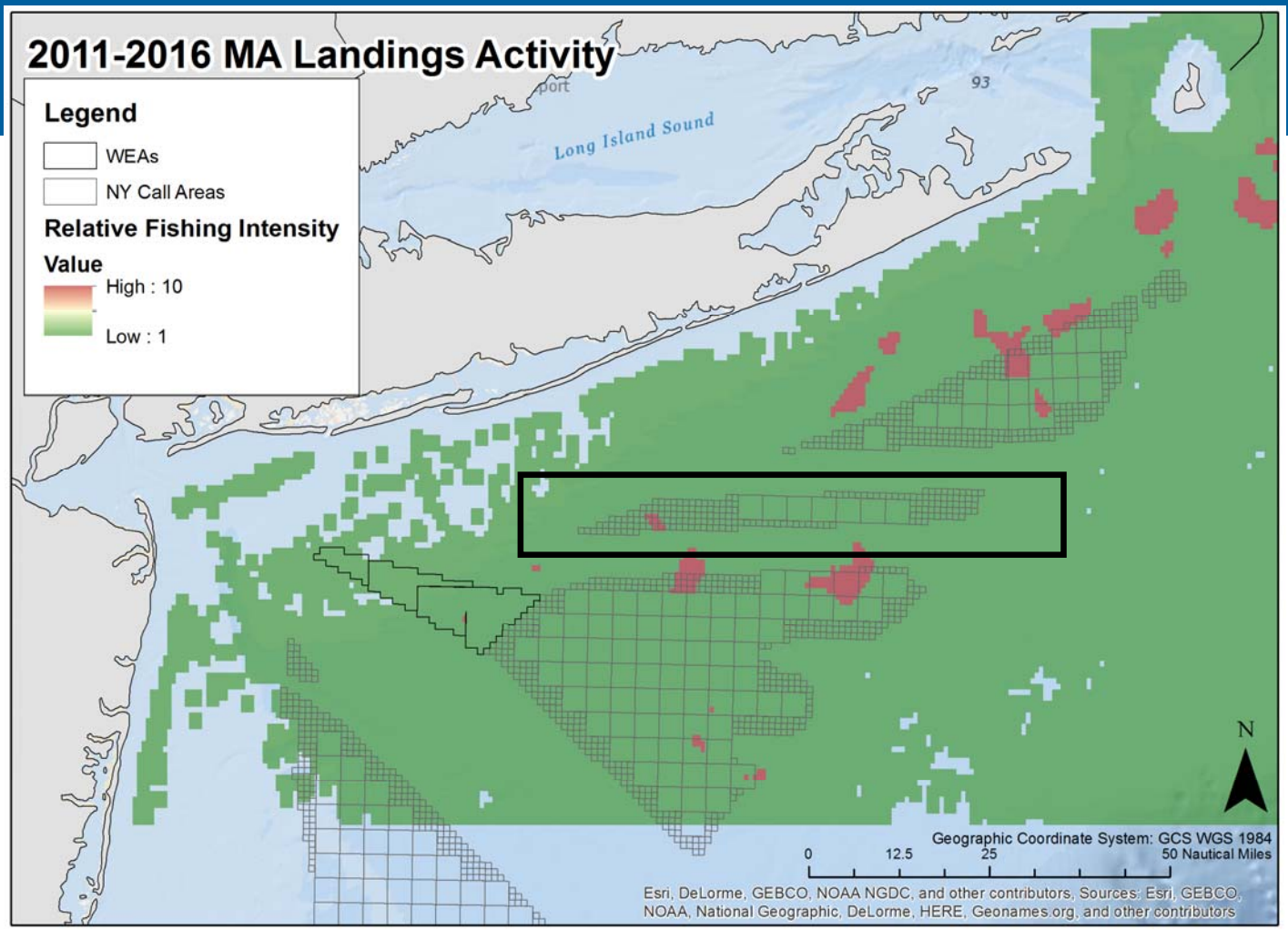
# Findings

## Fairways South – Landings by State

| State | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|
| **CT** | $468,970.15 | $631,033.91 | $390,039.85 | $116,803.71 | C | $83,109.90 |
| **MA** | $1,895,491.70 | $5,298,555.09 | $1,123,323.28 | $4,572,122.19 | $677,389.66 | $557,317.58 |
| **NJ** | $911,142.77 | $2,059,147.38 | $1,360,053.82 | $1,205,949.88 | $358,011.34 | $1,086,839.73 |
| **NY** | $134,114.28 | $658,678.67 | $213,223.59 | $61,301.74 | $70,566.62 | $38,587.69 |
| **RI** | $360,357.87 | $280,305.24 | $401,799.53 | $301,806.12 | $32,961.70 | $73,976.81 |
| **Total** | $3,770,076.77 | $8,927,720.29 | $3,488,440.07 | $6,257,983.64 | $1,138,929.32 | $1,839,831.71 |

# Findings

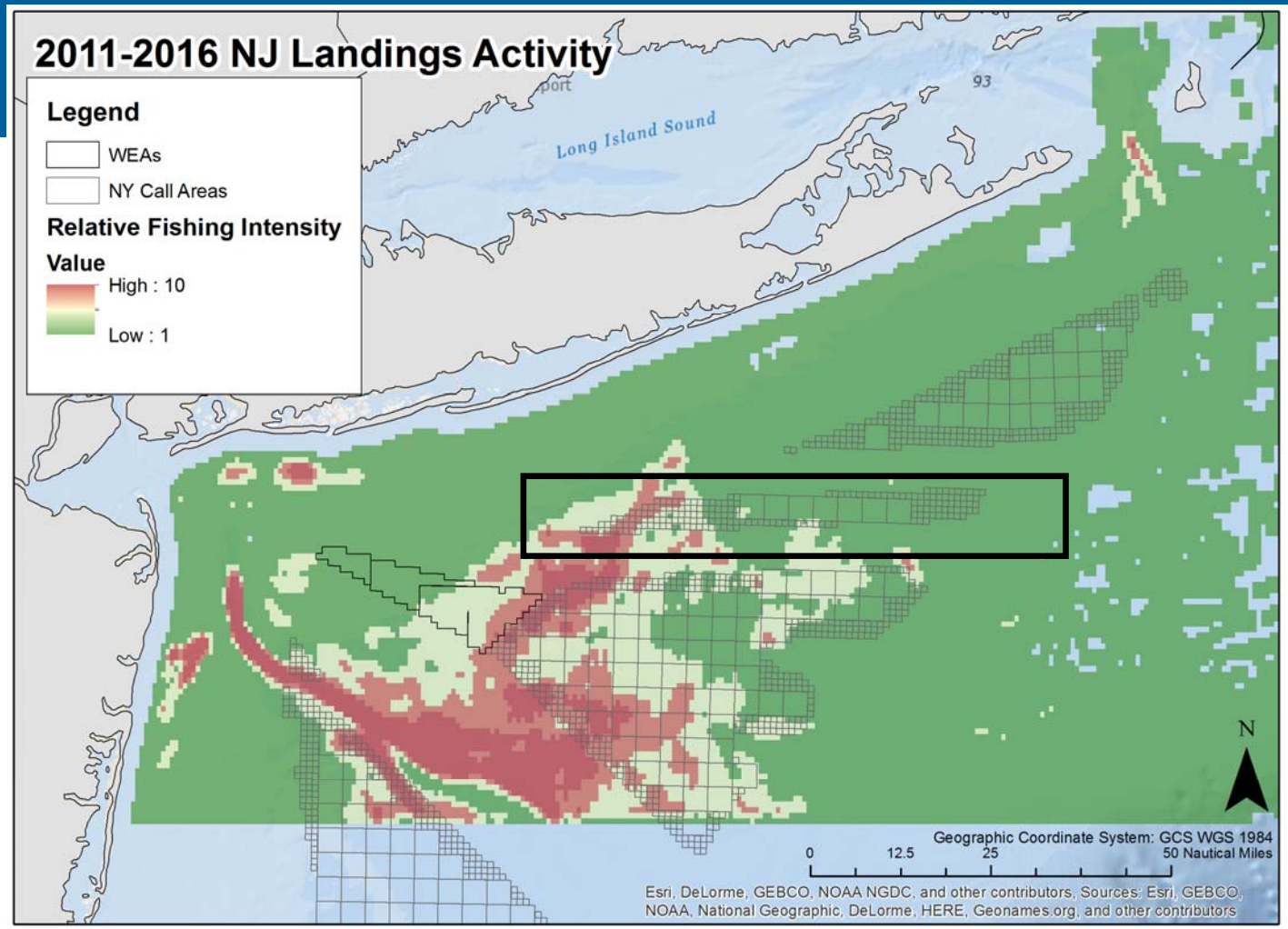
## Fairways South
Landings by State



# Findings

## Fairways South

Landings by State



# Findings

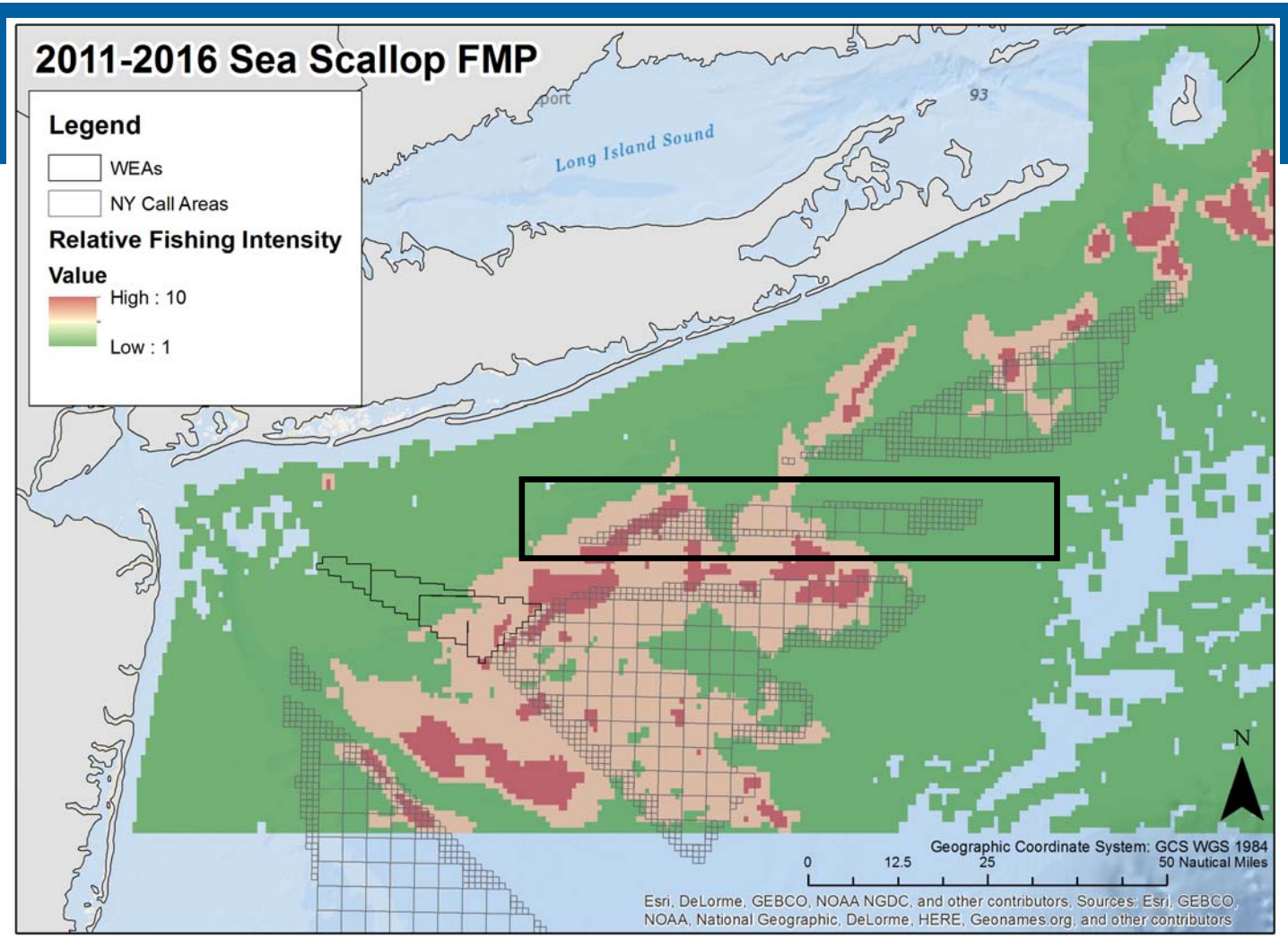
## Fairways South – Landings by Species (top 10 shown here)

| Species | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|
| BLUEFISH FMP | $571.94 | $8,894.74 | $236.83 | $499.42 | $1,356.39 | $212.53 |
| DOGFISH, SMOOTH | $122.30 | $431.90 | C | C | $437.78 | $30.86 |
| DOGFISH, SPINY | $1,366.45 | $6,193.90 | C | C | - | - |
| DORY, AMERICAN JOHN | C | $121.06 | C | C | $37.34 | $122.04 |
| MONKFISH FMP | $22,393.82 | $51,378.01 | $17,367.58 | $22,384.78 | $14,579.91 | $4,528.85 |
| NORTHEAST MULTISPECIES FMP | $545.69 | $37,515.37 | $344,403.48 | $9,341.53 | $1,931.55 | $56,143.90 |
| NORTHEAST SMALL MESH MULTISPECIES FMP | $2,854.85 | $30,196.11 | $1,960.55 | $668.58 | $1,343.66 | $548.69 |
| SEA SCALLOP FMP | $3,711,115.63 | $8,573,604.81 | $3,063,671.92 | $6,208,486.32 | $978,674.22 | $1,682,149.54 |
| SQUID MACKEREL BUTTERFISH FMP | $1,326.59 | $55,944.33 | $13,537.67 | $2,116.43 | $41,225.88 | $69,176.33 |
| SUMMER FLOUNDER, SCUP, BLACK SEA BASS FMP | $29,629.16 | $163,371.06 | $43,723.79 | $14,073.57 | $99,260.93 | $26,853.41 |
| NON-CONFIDENTIAL TOTAL | $3,769,926.43 | $8,927,651.29 | $3,484,901.82 | $6,257,570.63 | $1,138,878.68 | $1,839,806.82 |

# Findings

## Fairways South

Landings by Species



# Findings

## Fairways South – Landings

### By gear

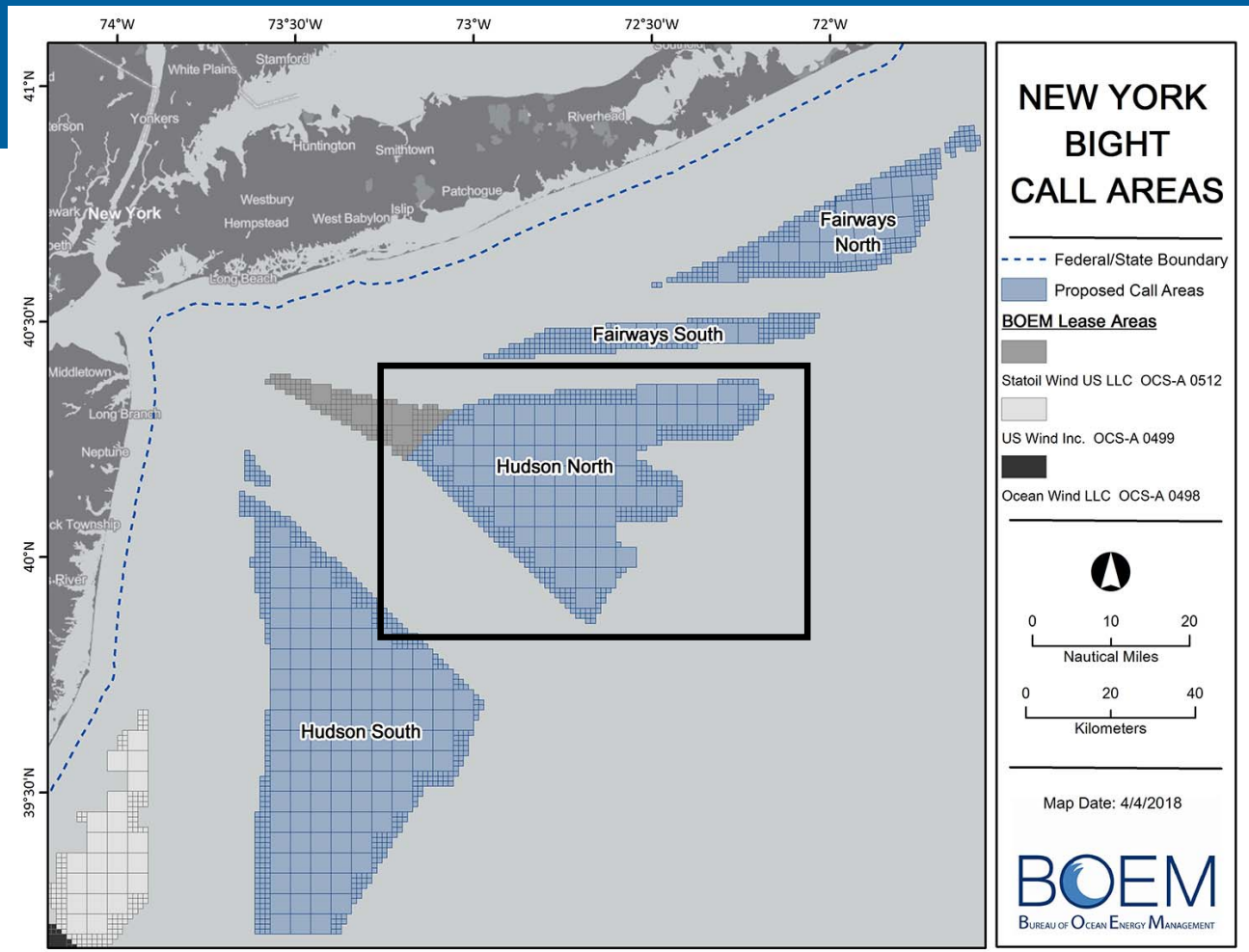
| Gear | % Landings over 6 Yrs |
|---|---|
| DREDGE, SCALLOP | 92.45% |
| GILL NET, SINK | 0.04% |
| OTTER TRAWL, BOTTOM,FISH | 5.56% |
| OTTER TRAWL, BOTTOM,SCALLOP | 0.49% |
| PAIR TRAWL, MIDWATER | 1.27% |

### By port

| Port | % Landings over 6 Yrs |
|---|---|
| Barnegat Light, NJ | 2.47% |
| Cape May, NJ | 13.28% |
| Hampton Bays, NY | 4.52% |
| Montauk, NY | 0.46% |
| New Bedford, MA | 63.41% |
| New London, CT | 1.22% |
| Point Judith, RI | 3.83% |
| Point Pleasant, NJ | 5.85% |
| Shinnecock Reservation, NY | 0.57% |
| Stonington, CT | 4.39% |

# Findings

## Hudson North



# Findings

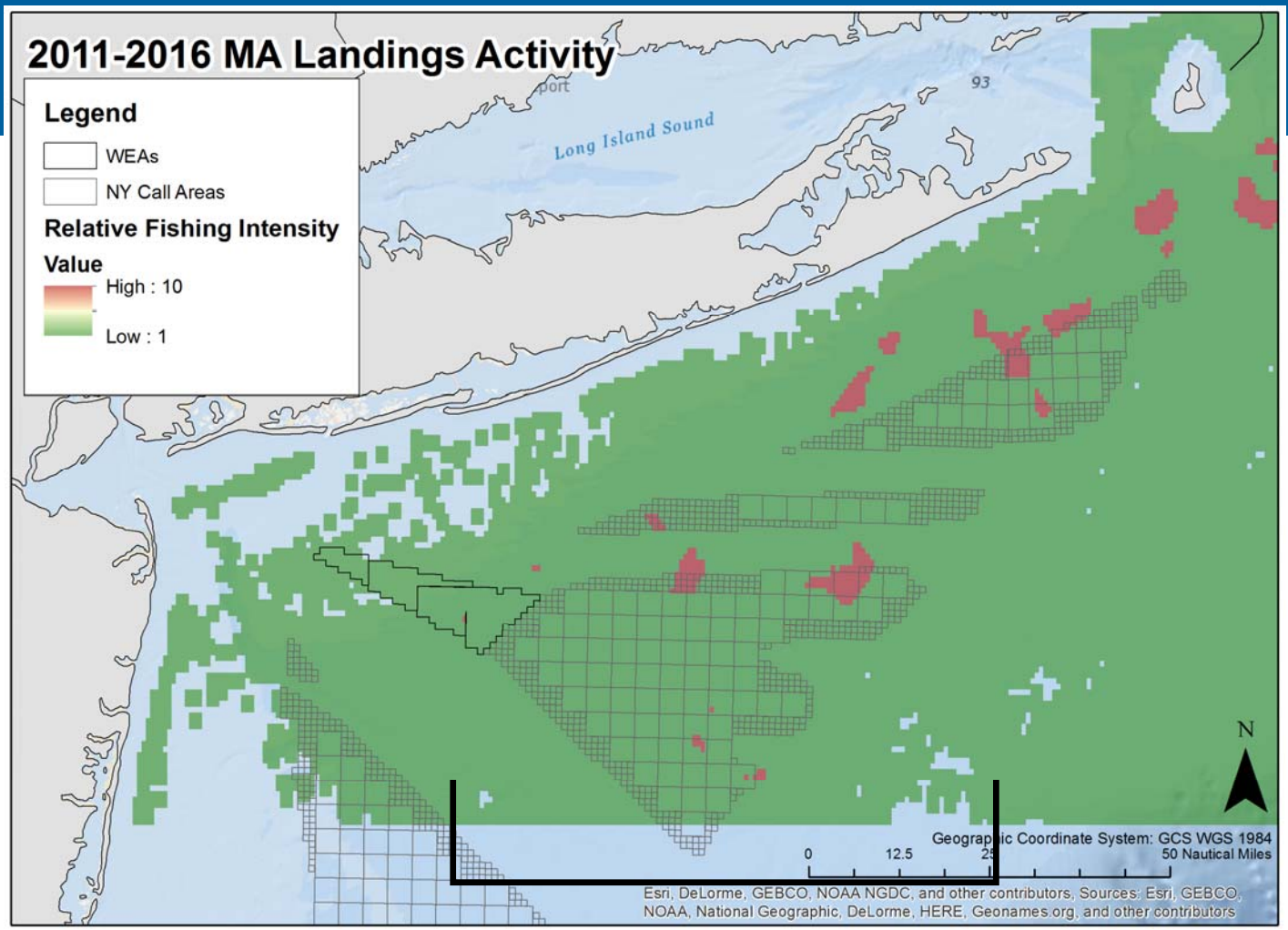
## Hudson North – Landings by State

| State | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|
| **CT** | $1,266,033.41 | $973,893.55 | $338,382.32 | $1,230,793.70 | C | $1,698,017.18 |
| **MA** | $15,823,402.30 | $8,830,138.33 | $3,955,757.61 | $33,680,942.33 | $6,441,286.96 | $24,555,269.22 |
| **NJ** | $6,562,446.83 | $9,970,016.45 | $6,200,787.61 | $13,354,988.40 | $8,679,234.66 | $16,717,813.65 |
| **NY** | $119,009.93 | $197,544.50 | $157,661.54 | $243,376.59 | $64,707.11 | $420,770.84 |
| **RI** | $476,730.86 | $2,307,159.55 | $528,173.11 | $1,425,867.87 | $102,915.46 | $3,188,303.59 |
| **Total** | $24,247,623.33 | $22,278,752.38 | $11,180,762.19 | $49,935,968.89 | $15,288,144.19 | $46,580,174.48 |

# Findings

## Hudson North

Landings by State



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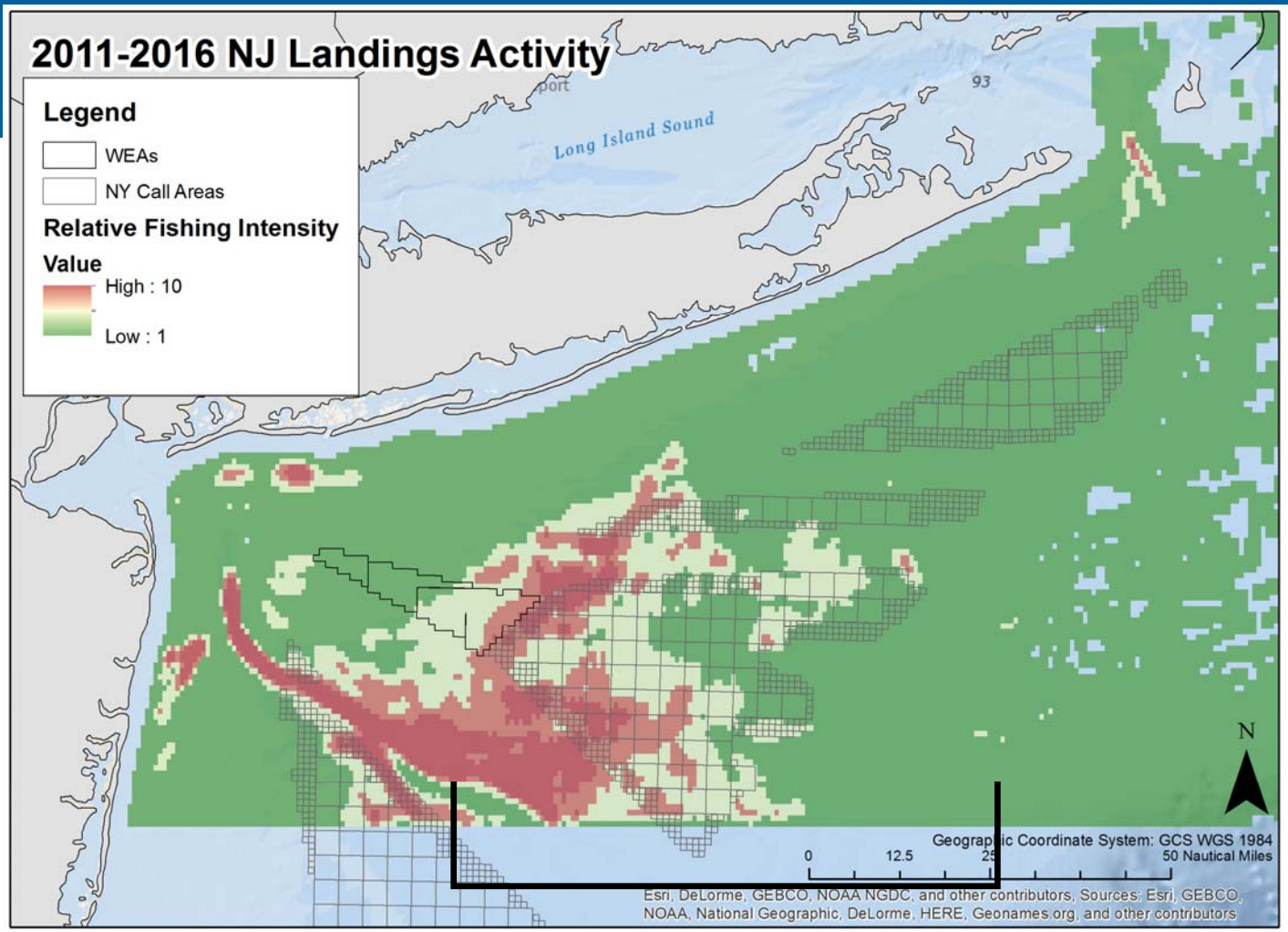


# Findings

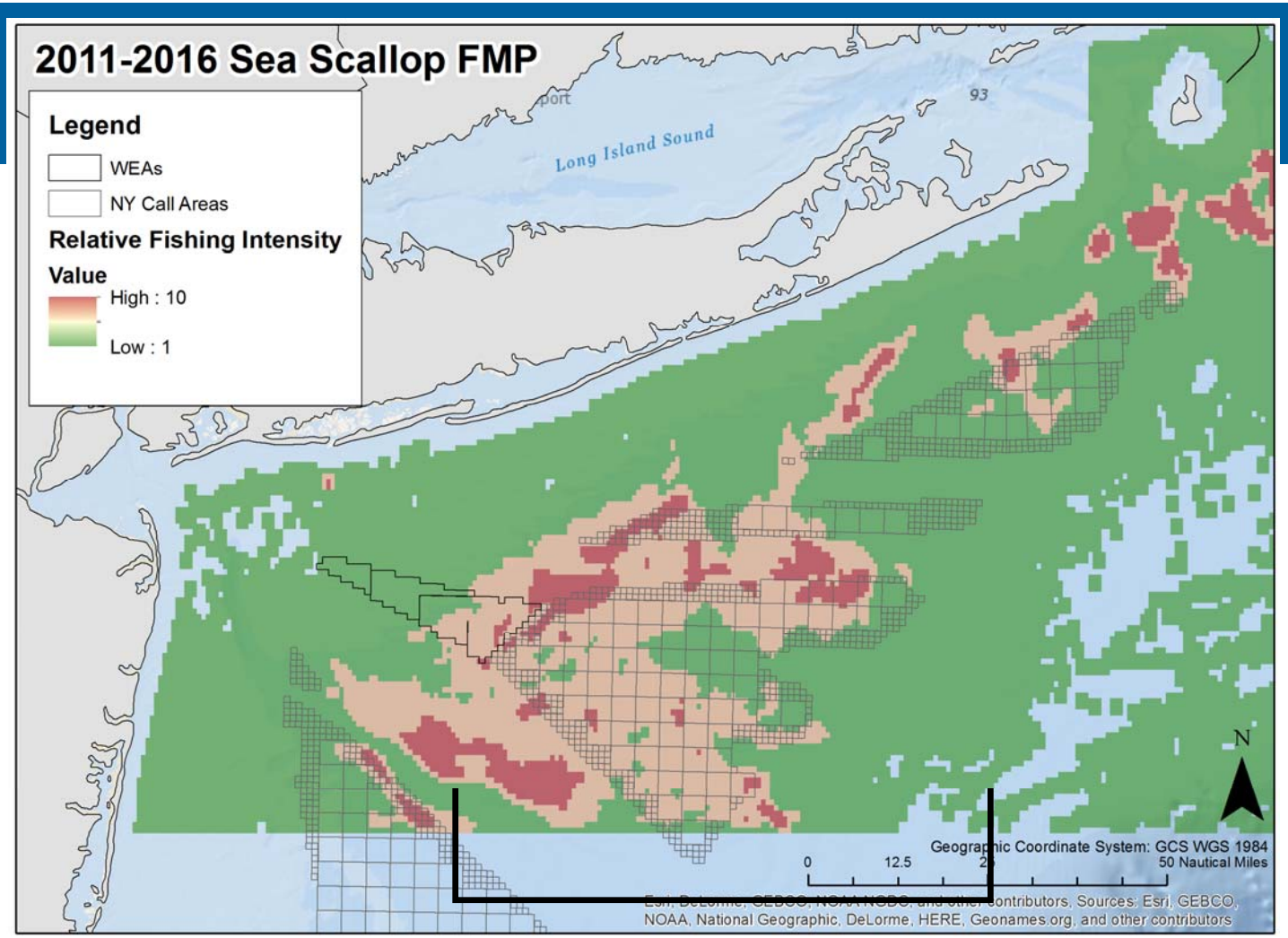
## Hudson North – Landings by Species (top 10 shown here)

| Species | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|
| BLUEFISH FMP | $155.08 | $846.53 | $397.00 | $429.95 | $4,009.57 | $6,123.18 |
| DOGFISH, SMOOTH | $178.77 | $142.09 | $68.52 | C | $644.50 | $2,612.97 |
| DORY, AMERICAN JOHN | $1,085.40 | $308.45 | $178.05 | $120.58 | $633.57 | $1,614.87 |
| MONKFISH FMP | $480,655.22 | $347,848.96 | $144,723.15 | $277,879.01 | $225,151.64 | $153,592.80 |
| NORTHEAST MULTISPECIES FMP | $95,138.28 | $114,231.28 | $385,874.43 | $25,233.94 | $20,146.22 | $78,066.19 |
| NORTHEAST SMALL MESH MULTISPECIES FMP | $3,686.41 | $40,926.85 | $2,723.06 | $6,938.68 | $1,871.00 | $5,738.92 |
| SEA SCALLOP FMP | $23,493,973.23 | $20,304,672.96 | $9,839,287.92 | $49,168,607.48 | $14,586,357.84 | $44,616,336.72 |
| SKATE FMP | C | $1,963.85 | C | $1,144.45 | $2,326.48 | $3,103.62 |
| SQUID MACKEREL BUTTERFISH FMP | $129,059.16 | $1,441,891.38 | $110,080.41 | $168,353.48 | $94,640.65 | $485,626.49 |
| SUMMER FLOUNDER, SCUP, BLACK SEA BASS FMP | $43,562.86 | $25,540.88 | $86,063.73 | $206,567.70 | $350,152.43 | $1,225,189.26 |
| NON-CONFIDENTIAL TOTAL | $24,247,494.41 | $22,278,373.23 | $10,569,396.27 | $49,855,275.27 | $15,285,933.90 | $46,578,005.02 |

# Findings

## Hudson North

Landings by Species



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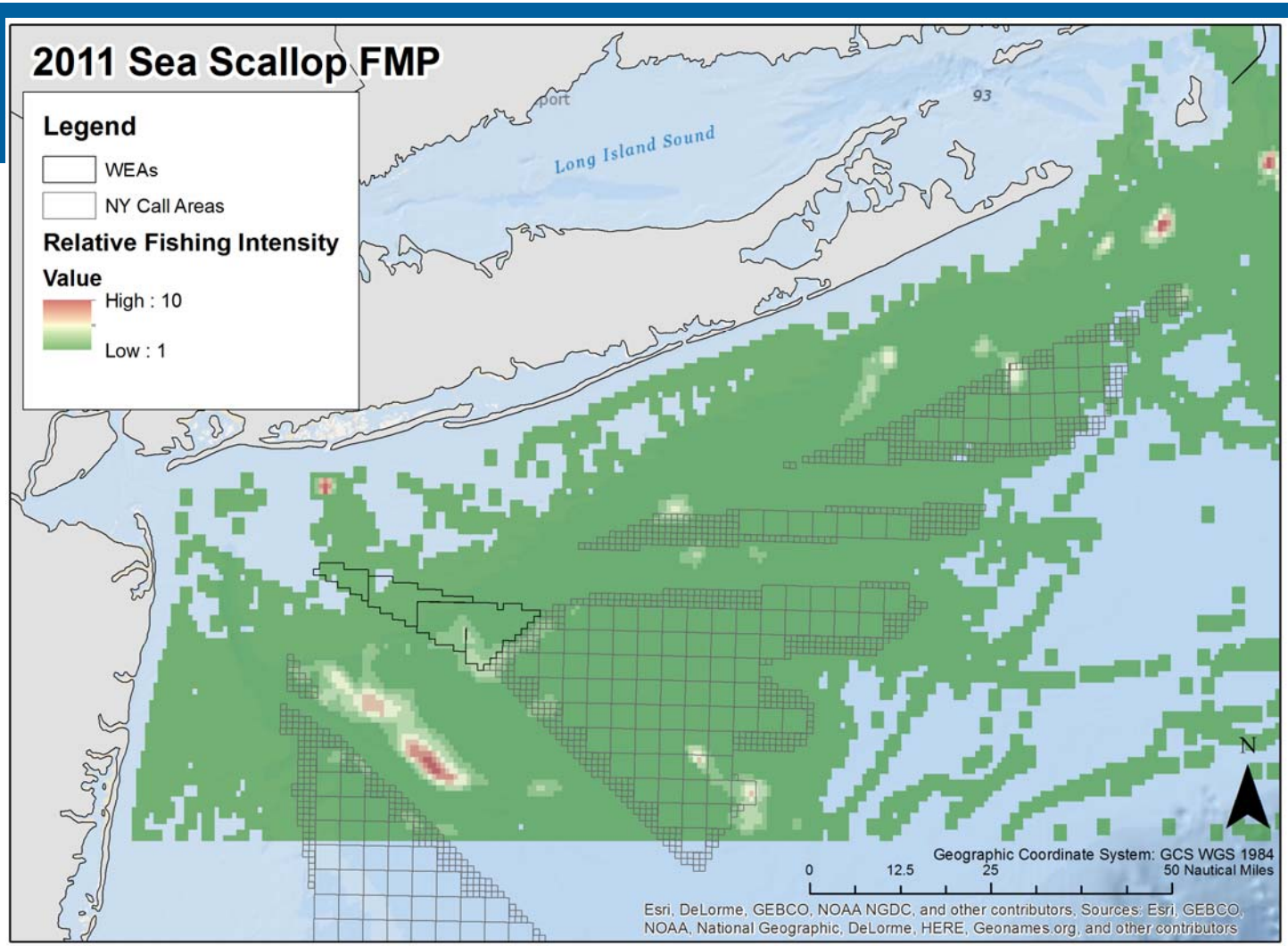
Landings by Species



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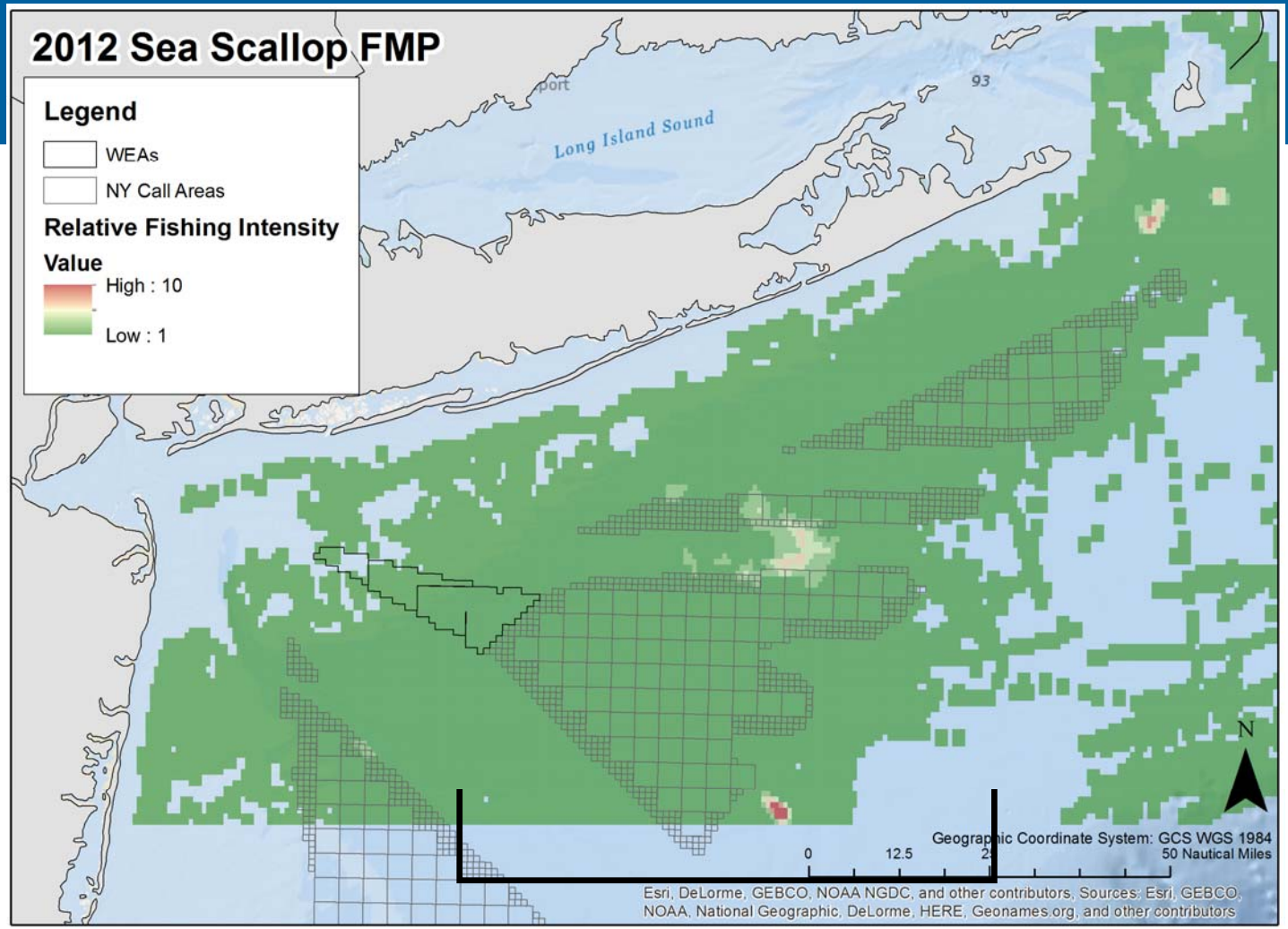

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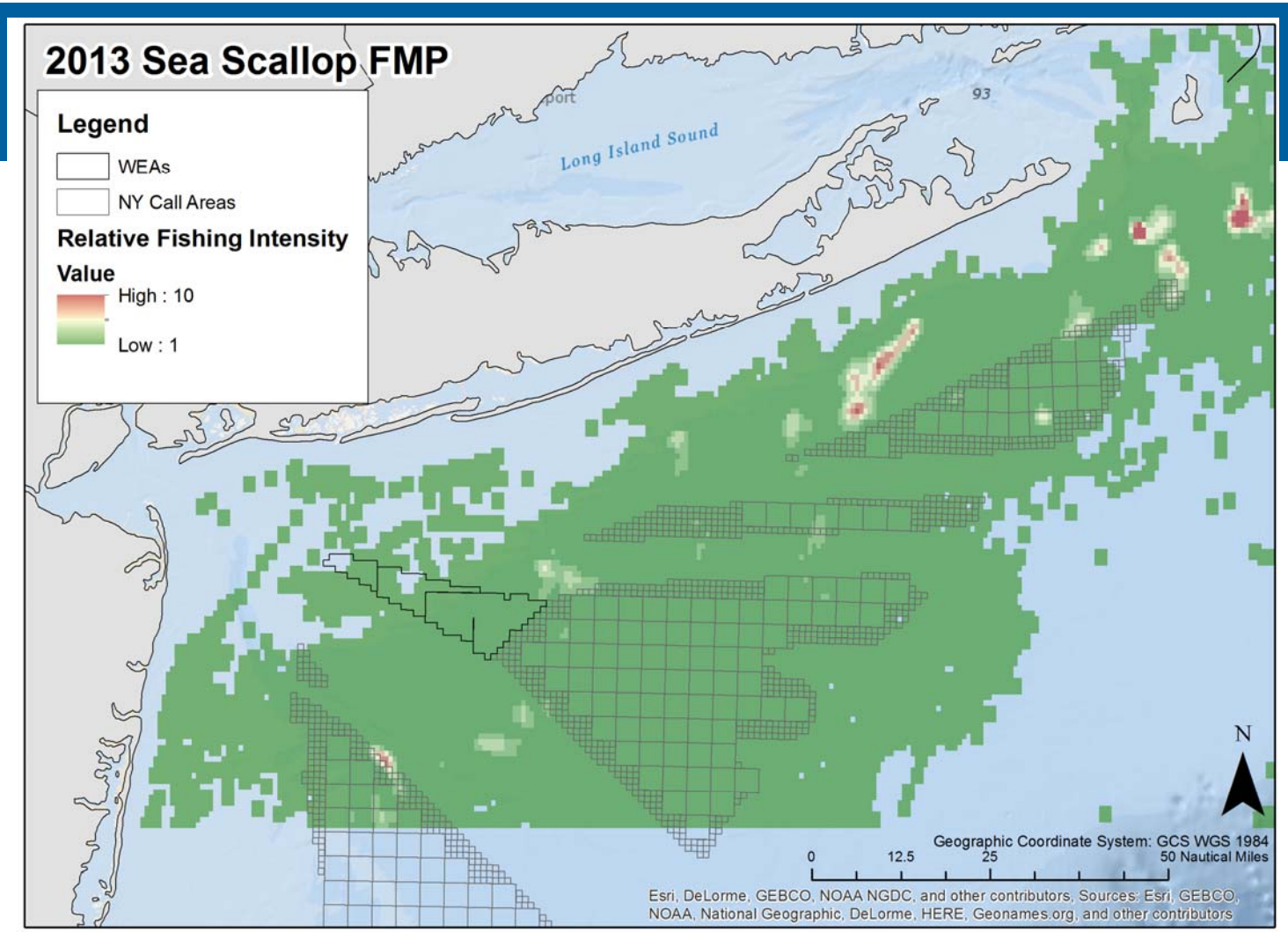

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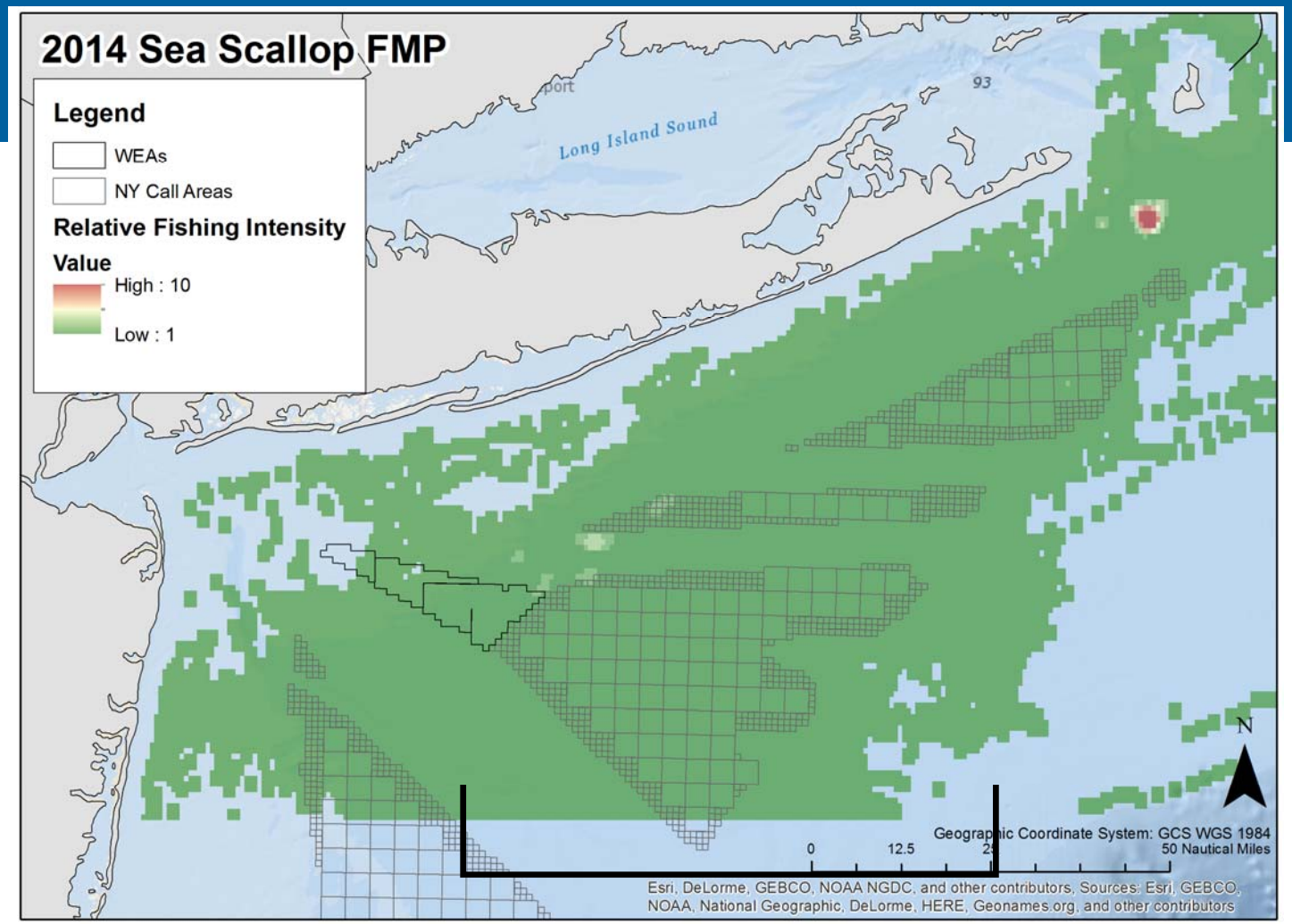

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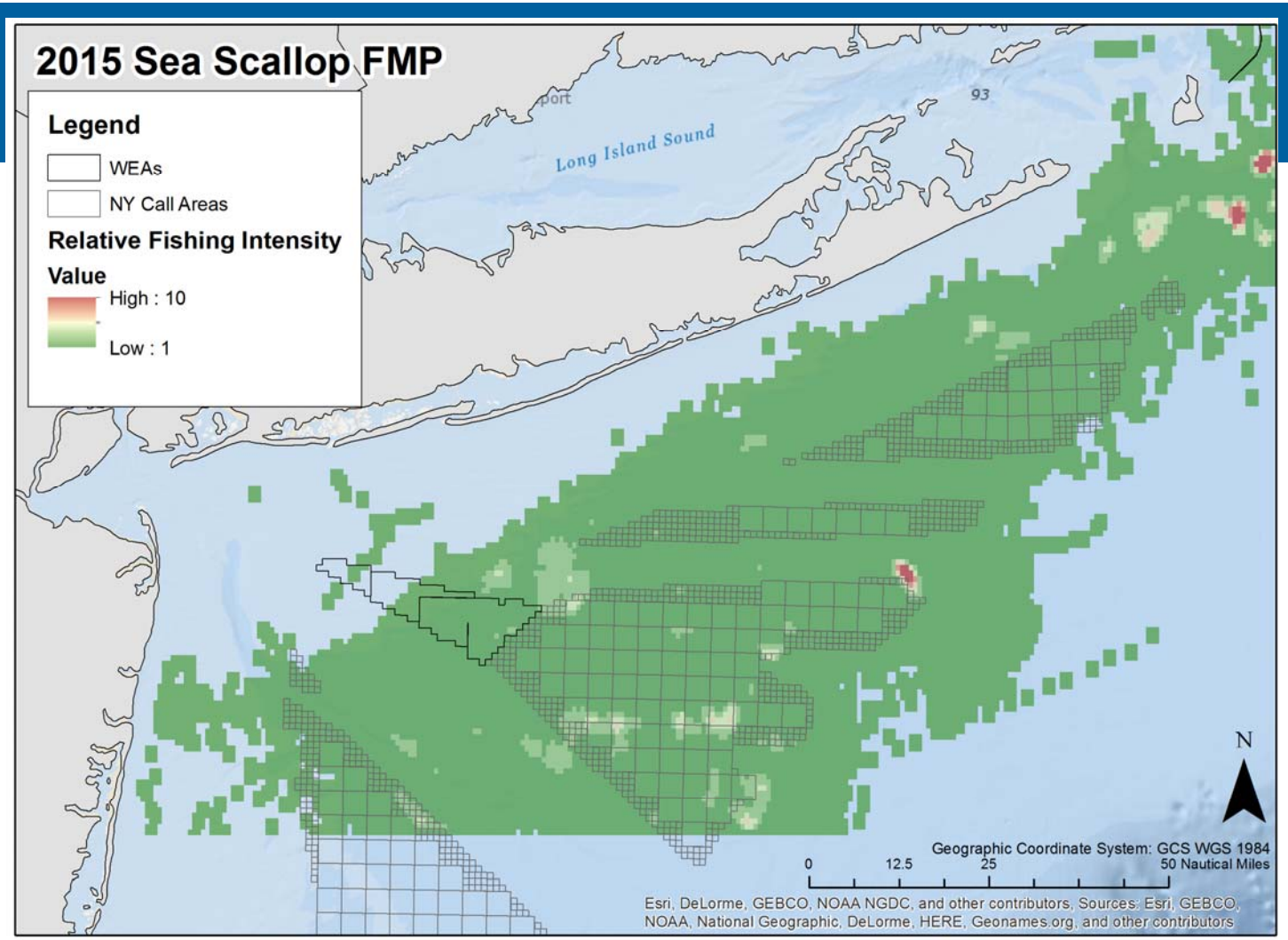

# Findings

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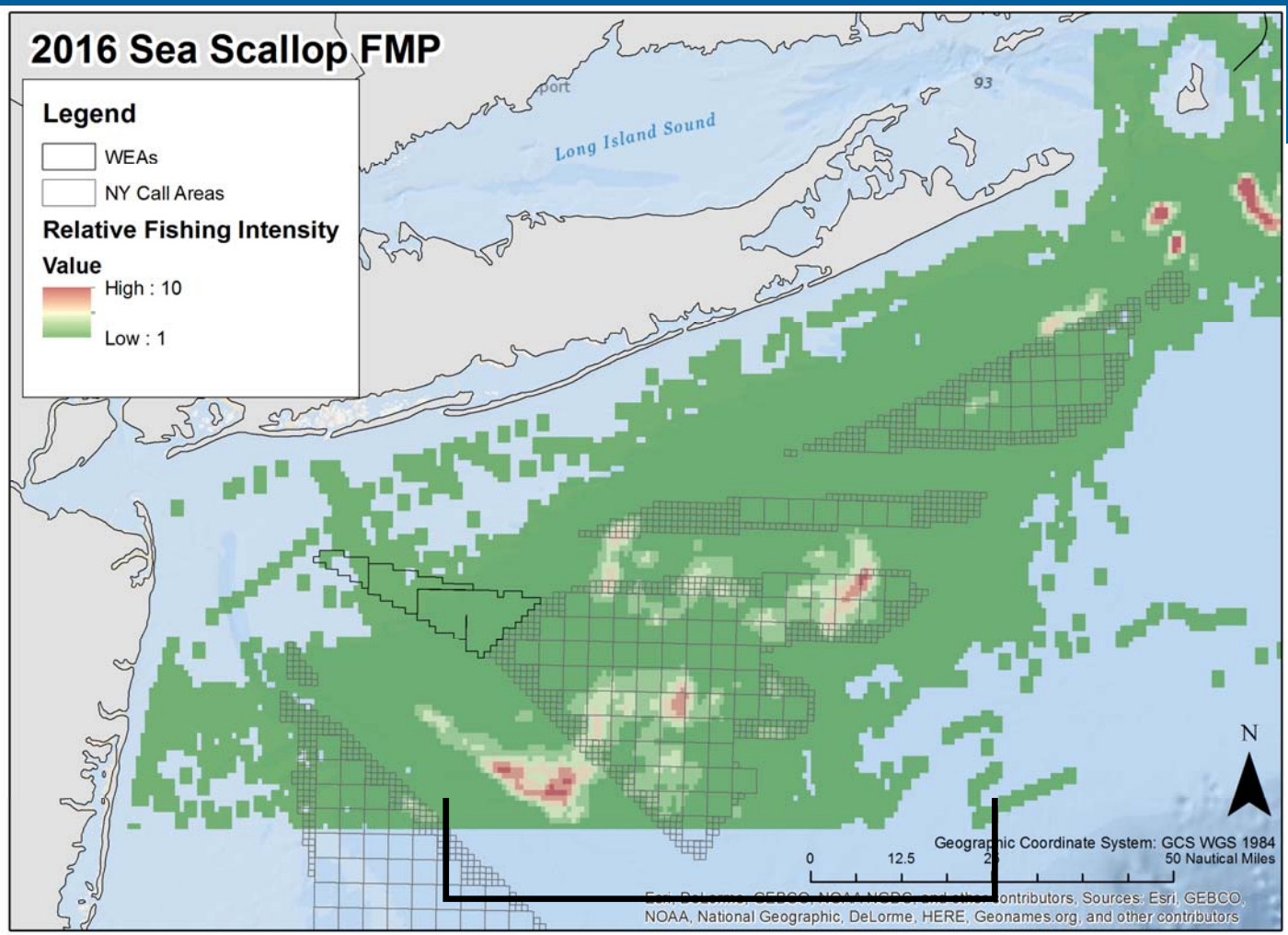

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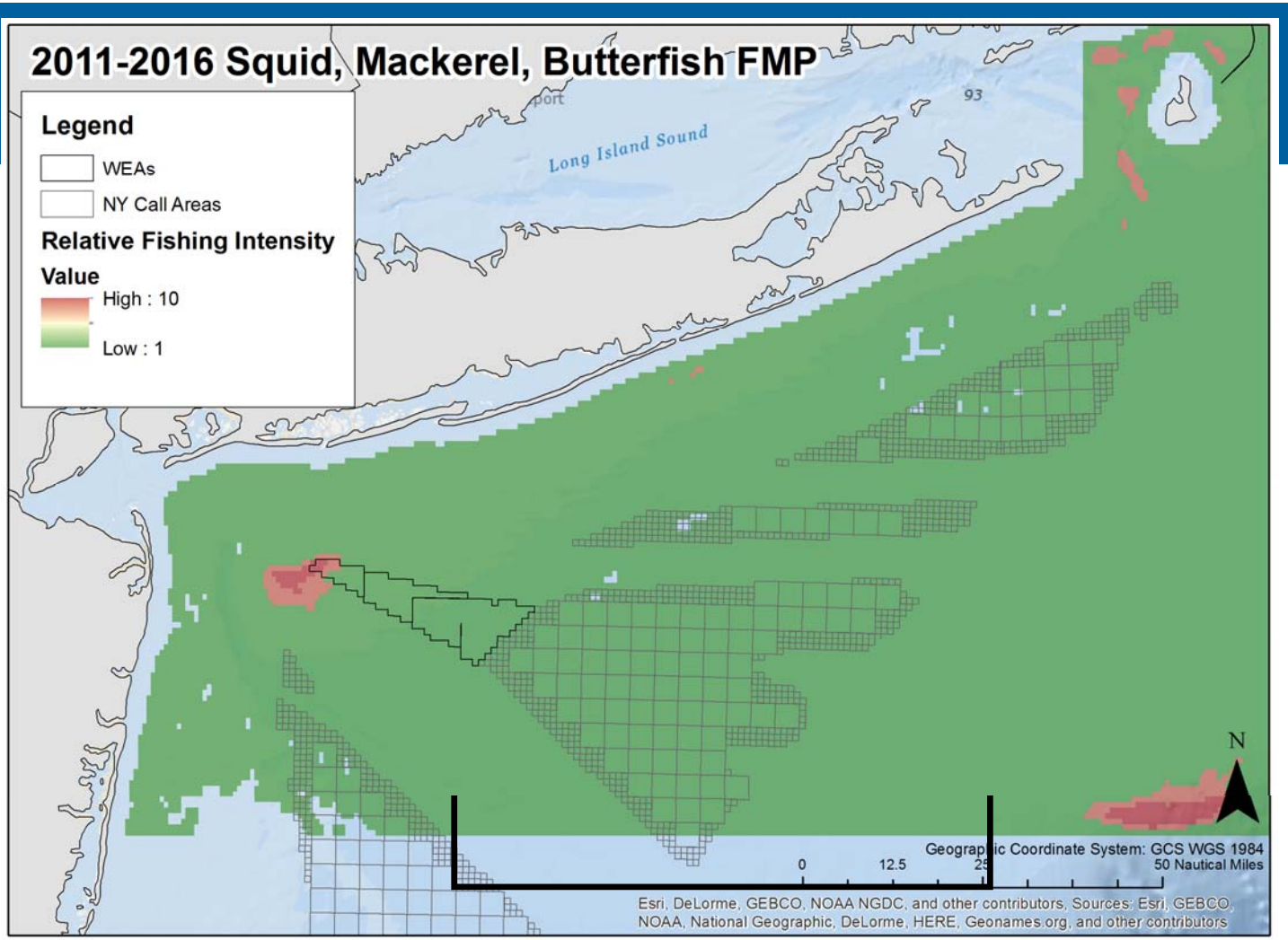

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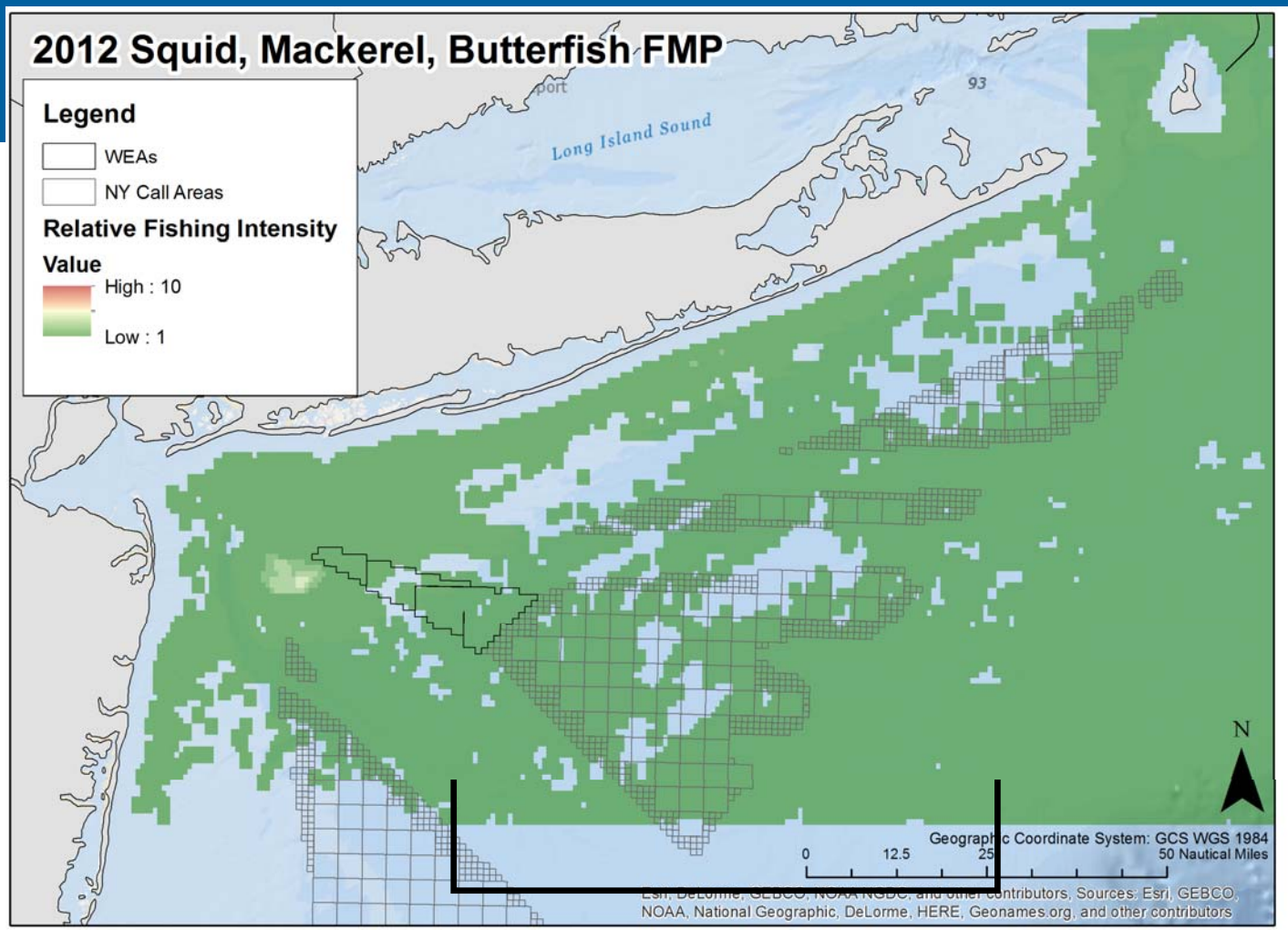
Landings by Species



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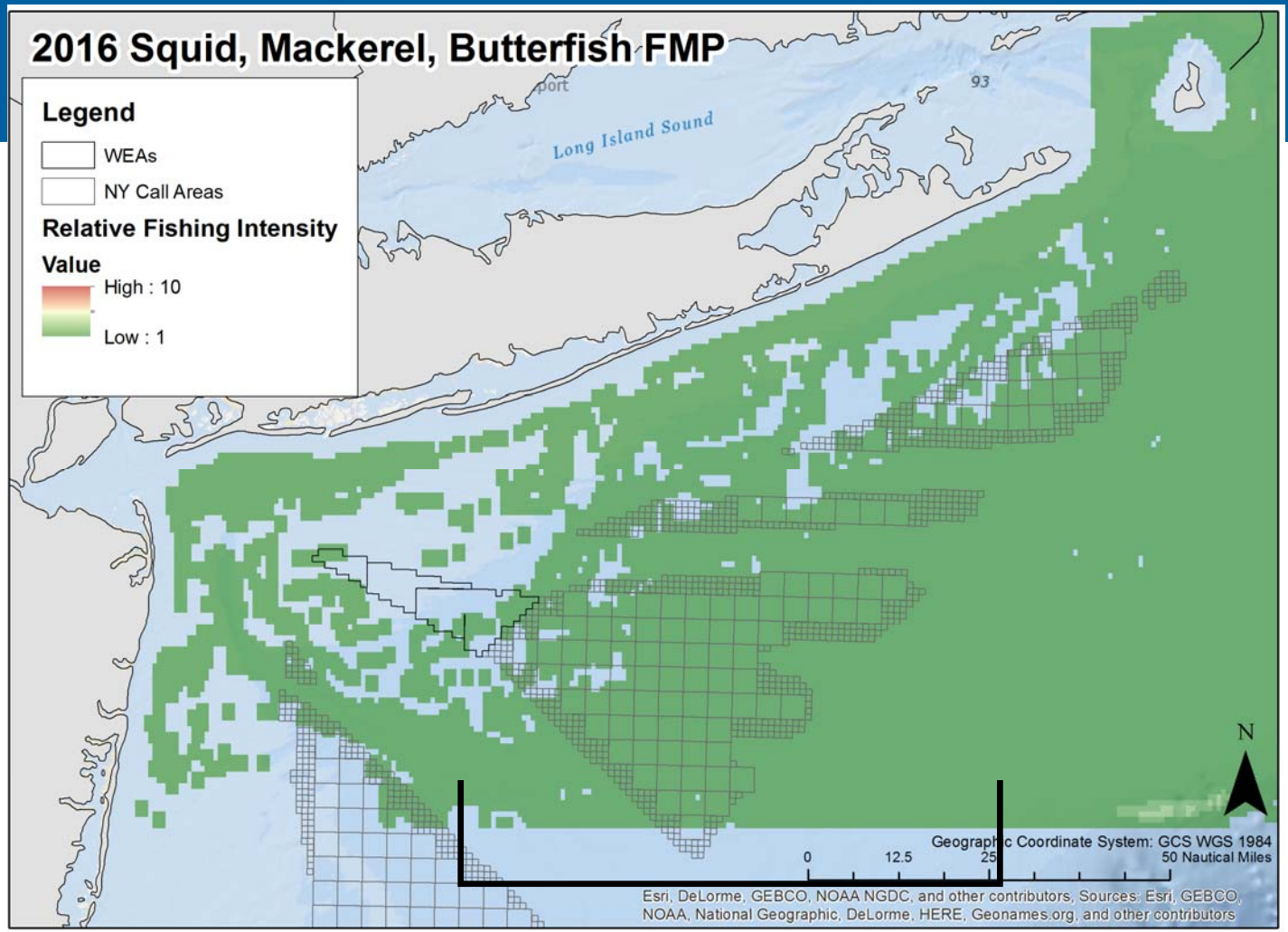
Landings by Species



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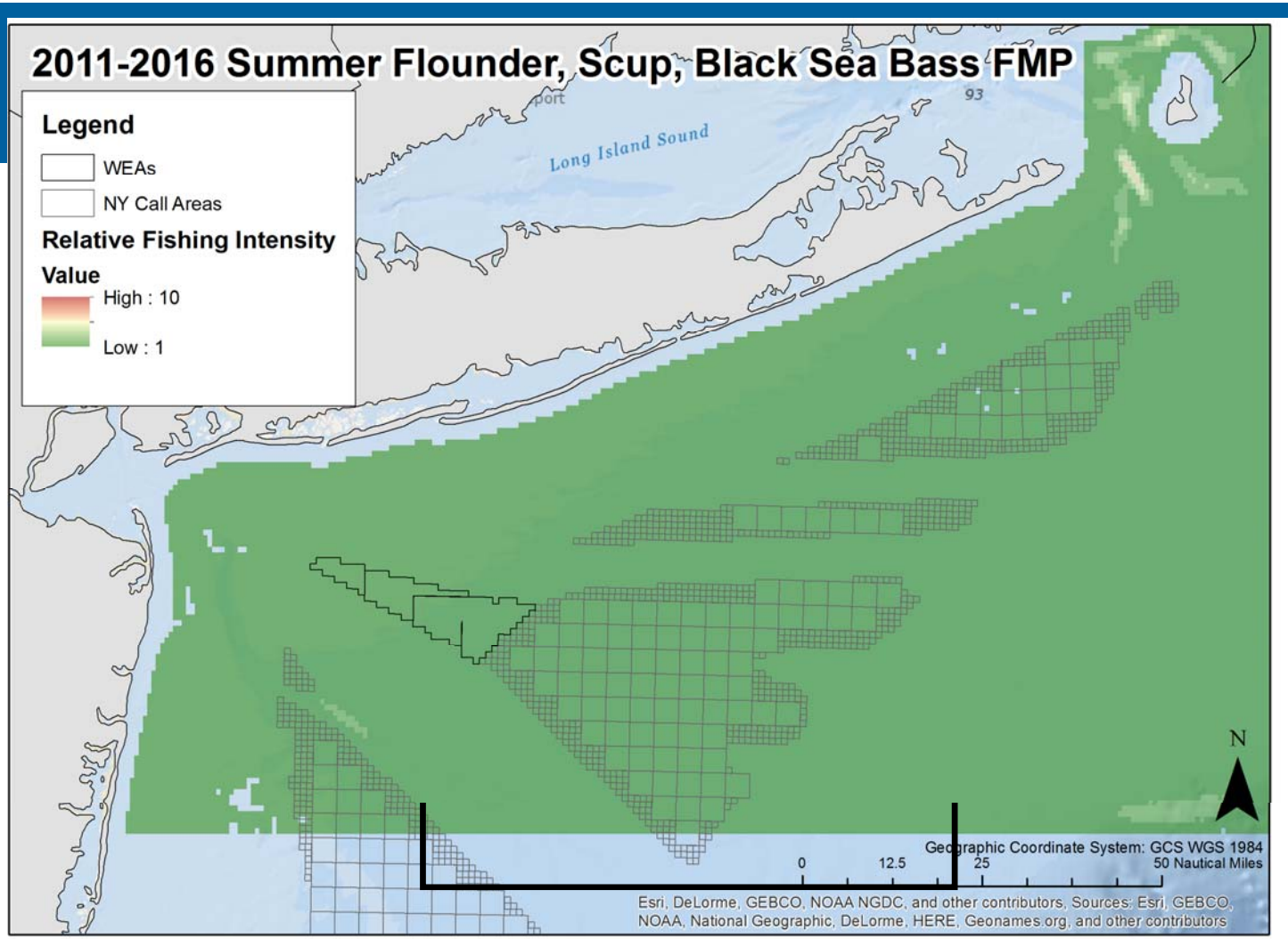

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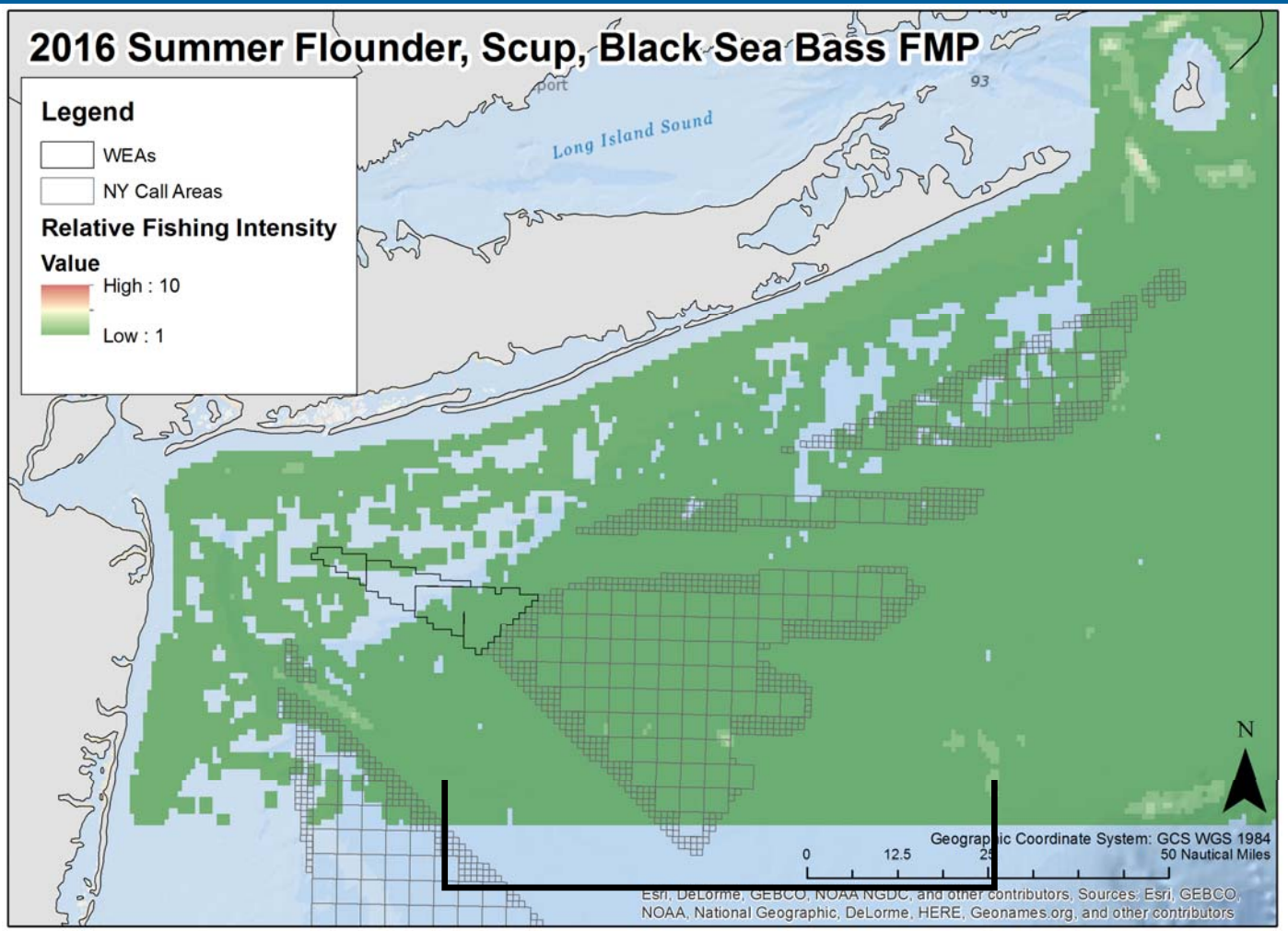
Landings by Species



# Findings

## Hudson North – Landings

### By gear

| Gear | % Landings over 6 Yrs |
|---|---|
| DREDGE, OCEAN QUAHOG/SURF CLAM | 0.54% |
| DREDGE, SCALLOP | 94.95% |
| GILL NET, SINK | 0.45% |
| OTTER TRAWL, BOTTOM,FISH | 3.01% |
| OTTER TRAWL, BOTTOM,SCALLOP | 0.40% |

### By port

| Port | % Landings over 6 Yrs |
|---|---|
| Barnegat Light, NJ | 6.13% |
| Cape May, NJ | 16.79% |
| Fairhaven, MA | 1.66% |
| New Bedford, MA | 57.95% |
| New London, CT | 1.05% |
| Point Judith, RI | 3.20% |
| Point Pleasant, NJ | 10.28% |
| Stonington, CT | 1.66% |

# Next Steps

- This analysis could be done on a coastwide scale, given access to larger datasets (coastwide VMS data and additional states' VTRs and landings).
- Still limitations to this approach
  - VMS is less common in the South Atlantic
  - VMS is relatively new and does not have 100% coverage yet
    - For example, squid fishery only required 2014 and later
    - No VMS or VTR for lobster fishery

# Next Steps

- Will be preparing a brief technical report on the findings shown here and will be posting it on the DEM DMF webpage (http://www.dem.ri.gov/programs/fish-wildlife/marine-fisheries/index.php) before the end of next week.
- Full report for other WEAs available on DEM DMF Website: http://www.dem.ri.gov/programs/bnatres/fishwild/pdf/RIDEM_VMS_Report_2017.pdf
- If anyone would like the raster layers of smoothed fishing density or map images, please email me and I will send the files to you.

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# Supplemental Materials - Merging Landings to VTRs

- First step was addressing an issue with the VTR numbers
  - VTR numbers stored in two separate columns:
    - eVTR numbers (14 digits) stored in Supplier Trip ID column
    - Paper VTR numbers (8 digits) stored in the serial number column
    - All other numbers in these columns had incorrect numbers of digits and did not show up in the NOAA VTR database when we checked (possibly computer generated unique identifiers, not VTR numbers)
    - The correct numbers from the two columns were pulled into a new column and all others were dropped
- Used a lookup table to format the species names the same way in the VTR data and the landings data
- Merged (inner join) landings to VTRs on the Supplier Trip ID (i.e. VTR number) AND the species name to ensure that all landings match up correctly
  - Multiple species will be on a single VTR while landings data are stored by species landed

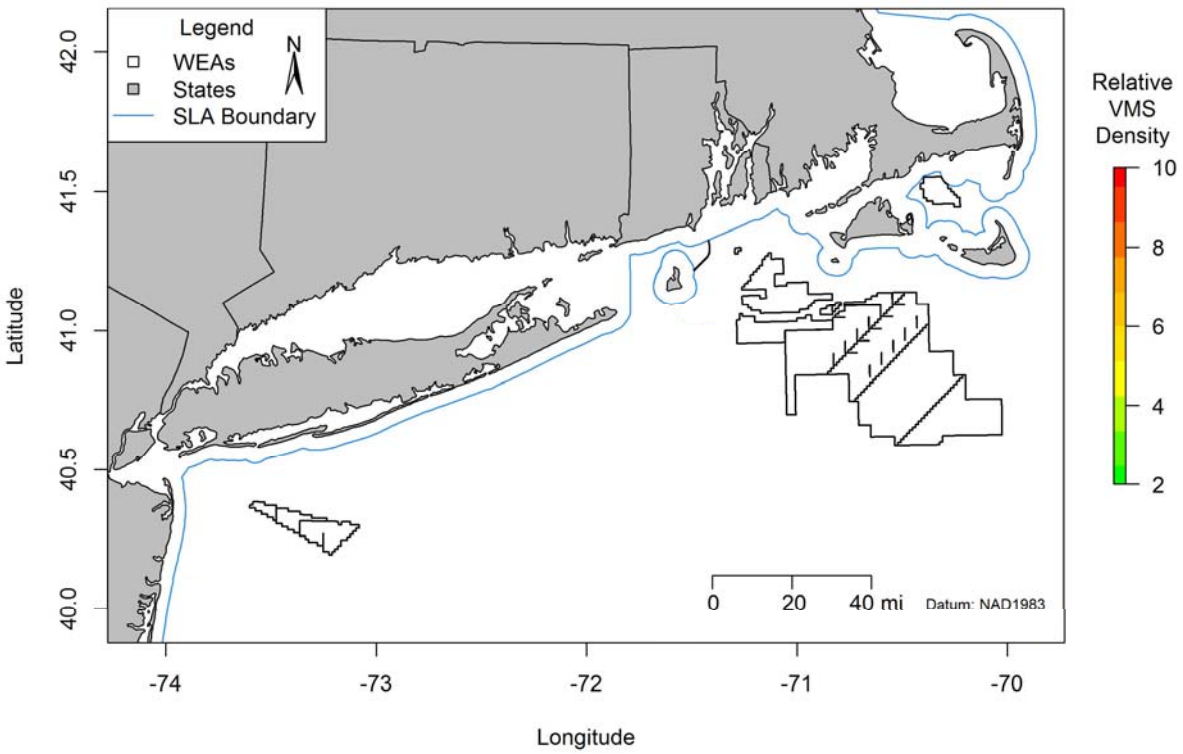
# Supplemental Materials - Merging Landings/VTRs to VMS Data

- VMS data came as 75 monthly files for the entire area
  - Formatted as html files readable in Excel
  - Each had 500,000 + entries
  - Total of over 37,500,000 data points
  - Could not merge all VMS into a single file in Excel or R
- Created a list of vessels in the merged landings/VTRs and looped through them one at a time
  - For each vessel, looped through each individual VMS file and merged matching entries on vessel federal permit number (from the VMS and VTR data)
  - Dropped all rows where VMS time did not match up with dates in VTR
  - Saved an individual output for each vessel containing all merged landings/VTRs/VMS

| Time (VMS) | Date (VMS) | Trip.Start.Date (VTR) | Trip.End.Date (VTR) |
|---|---|---|---|
| 13:27:56 | 2012-06-02 | 2012-06-01 | 2012-06-10 |
| ~~22:52:24~~ | ~~2009 10 15~~ | ~~2014 12 02~~ | ~~2014 12 14~~ |

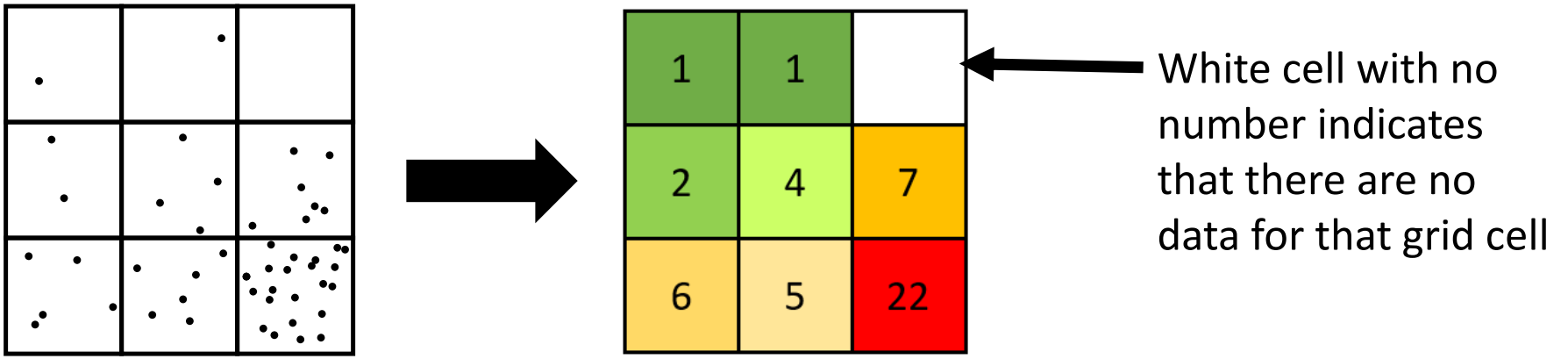
# Supplemental Materials - Spatial Subsetting and Mapping

- Subsetted data temporally (by year) and by fishery/grouping (i.e. species caught, gear used, port landed in, and state landed in)
  - Used another lookup table to group certain species together into FMP groupings since the initial maps for species in FMPs were very similar
- Dropped points with speeds > 5 knots for scallops and > 4 knots for all other species
- Dropped all state fishing data (within 3 nm of shoreline) since most speeds close to shore were slow while heading into port
  - Fishing densities were skewed heavily by port activity, where boats may be moving at fishing speeds but are not fishing
  - Port activity was eliminated by clipping point data close to shore



# Supplemental Materials - Spatial Subsetting and Mapping

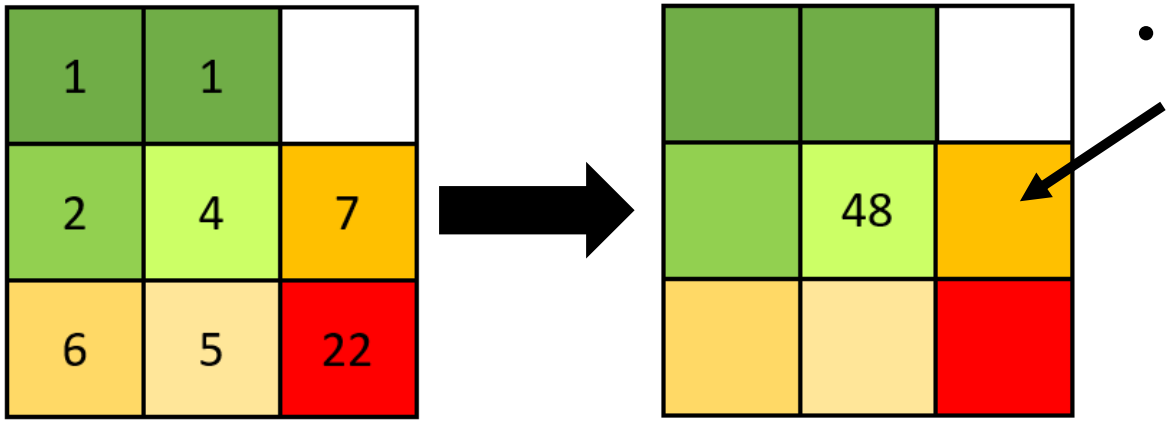
- Mapped the VMS point data as a density raster, where each cell corresponds to the number of VMS points that fell within that cell
  - Saved this density raster for later use




- Cells at a 0.01 degree resolution using the North American Datum 1983 and the reference ellipsoid GRS80

# Supplemental Materials - Spatial Subsetting and Mapping

- For non-confidential maps, each cell would be required to meet the Rule of 3 to comply with ACCSP confidentiality standards, so data were smoothed
  - Used a 3x3 focal window to calculate the sum of the cells in the focal window



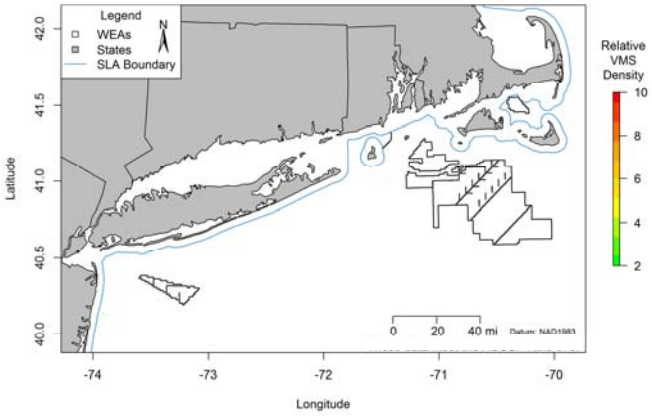

- All other cells here will depend on their additional neighboring cells not shown.

  - Results were scaled on as equal intervals from 1-10 to show differences in relative fishing density

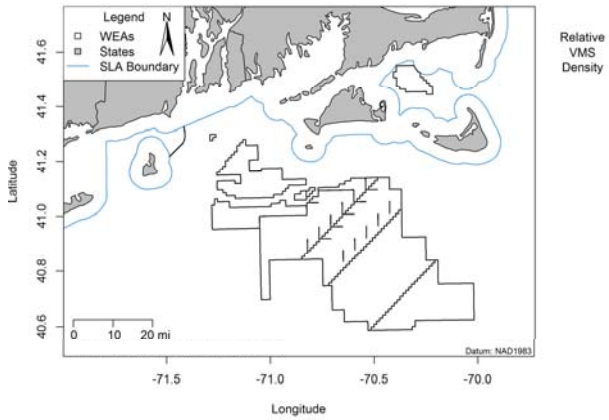
# Supplemental Materials - Spatial Subsetting and Mapping

- Maps for each grouping and time period were produced at three different scales, all with the same resolution and legend scale (1-10)

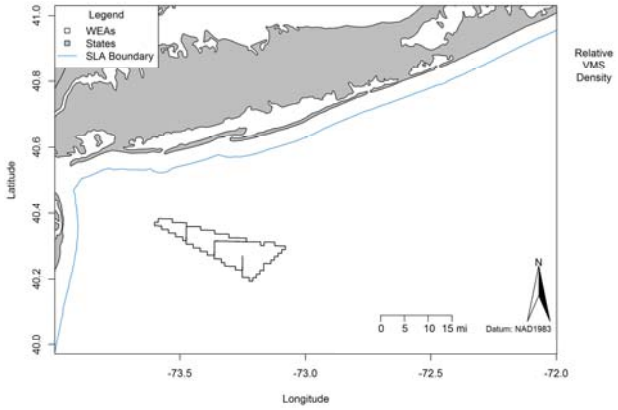
Total study area




South of MA/RI

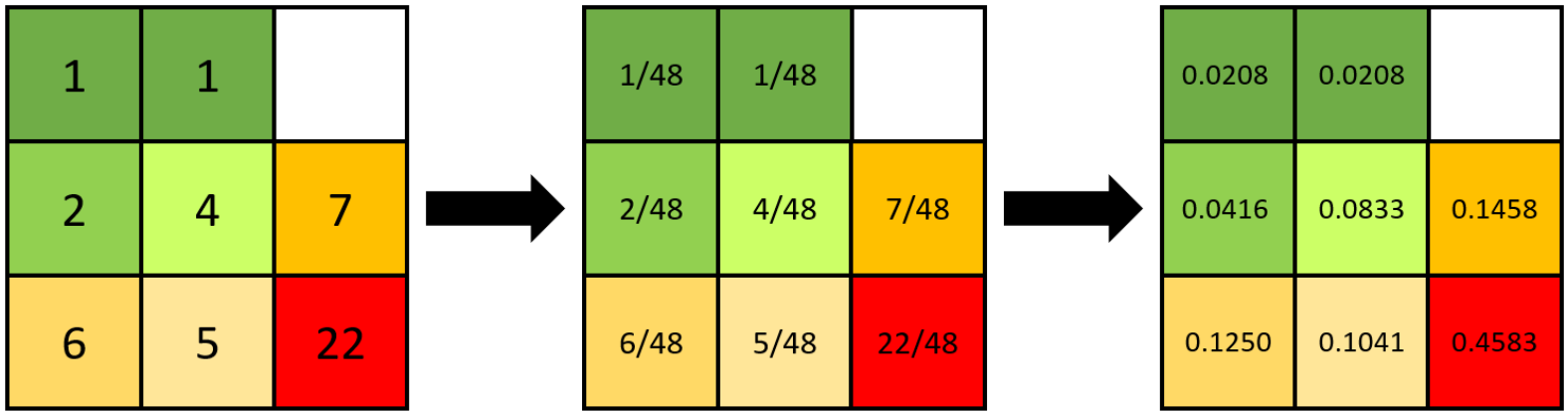



South of Long Island



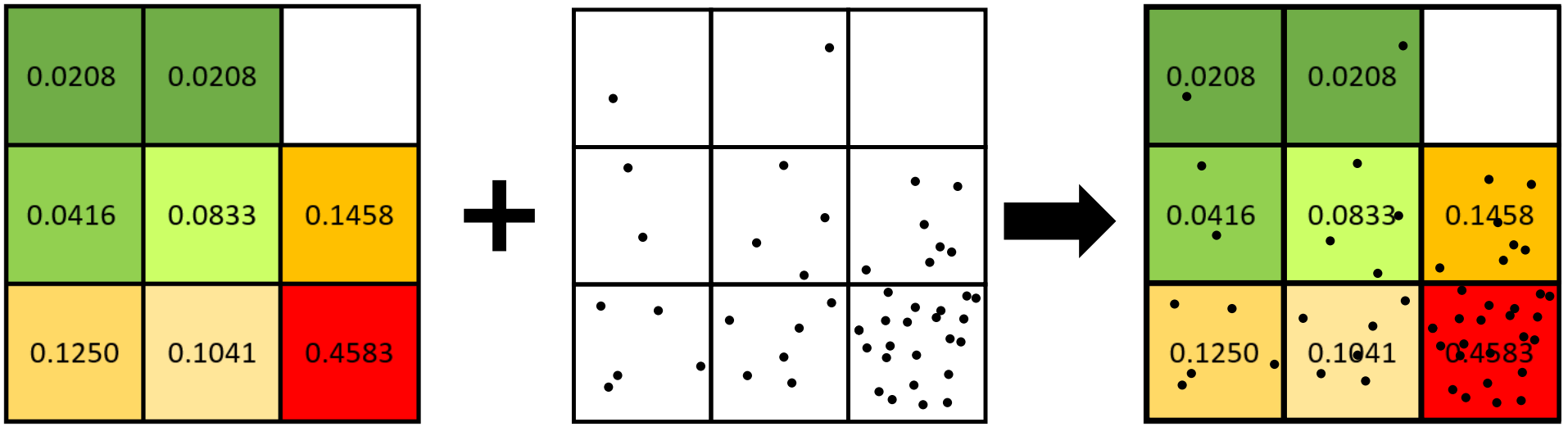
# Supplemental Materials - Economic Calculations

- Read in all point data and subsetted by species caught
- For all species other than scallops, any points with VMS speeds > 4 knots were dropped based on NROC cutoffs
- Added a column containing a weighted fishing value based on the total trip value for that species
  - Subsetted each species by year (since fishing corresponds to where the fish are)
  - Read in the raster of raw fishing density data for that species that year and created a weight raster of fishing density
    - Each cell's value/the sum of all cell values



# Supplemental Materials - Economic Calculations

- Fishing point data were overlaid on top of weight raster and the extract function pulled the raster values into the points' data frame in a new column



# Supplemental Materials - Economic Calculations

| Year | Species | Dollar.Value | Supplier Trip ID | VMS.Lat | VMS.Long | VMS.Date | VMS.Time | Raster.Weight |
|---|---|---|---|---|---|---|---|---|
| 2011 | Squid | 4062.59 | 99999999 | 41.265745 | -71.597465 | 8/25/2011 | 5:02:00 | 0.0000059 |
| 2011 | Squid | 4062.59 | 99999999 | 41.265745 | -71.597465 | 8/25/2011 | 6:02:00 | 0.0000056 |
| 2011 | Squid | 4062.59 | 99999999 | 41.26576 | -71.597466 | 8/25/2011 | 7:02:00 | 0.0000102 |
| 2011 | Squid | 4062.59 | 99999999 | 41.265746 | -71.597471 | 8/25/2011 | 8:02:00 | 0.0000002 |
| 2011 | Squid | 4062.59 | 99999999 | 41.265744 | -71.597472 | 8/25/2011 | 9:02:00 | 0.0000141 |
| 2011 | Squid | 4062.59 | 99999999 | 41.26575 | -71.597472 | 8/25/2011 | 10:02:00 | 0.0000956 |
| 2011 | Squid | 4062.59 | 99999999 | 41.26575 | -71.597471 | 8/25/2011 | 11:02:00 | 0.0000003 |
| 2011 | Squid | 25.56 | 11111111 | 41.378914 | -71.159876 | 9/2/2011 | 15:29:00 | 0.0000048 |
| 2011 | Squid | 25.56 | 11111111 | 41.378914 | -71.159881 | 9/2/2011 | 16:29:00 | 0.0000098 |
| 2011 | Squid | 25.56 | 11111111 | 41.378914 | -71.159885 | 9/2/2011 | 17:29:00 | 0.0000042 |
| 2011 | Squid | 25.56 | 11111111 | 41.378914 | -71.159881 | 9/2/2011 | 18:29:00 | 0.0000035 |
| 2011 | Squid | 78.94 | 55555555 | 40.506489 | -73.597685 | 8/12/2011 | 4:13:00 | 0.0000073 |

Not real data. Only for example.

# Supplemental Materials - Economic Calculations

- For each trip, the aggregate function was used to sum all the extracted weight values (by Supplier Trip ID)

Not real data. Only for example.

| Year | Species | Dollar.Value | Supplier Trip ID | VMS.Lat | VMS.Long | VMS.Date | VMS.Time | Raster.Weight | Trip.Wt |
|---|---|---|---|---|---|---|---|---|---|
| 2011 | Squid | 4062.59 | 99999999 | 41.265745 | -71.597465 | 8/25/2011 | 5:02:00 | 0.0000059 | 0.0001319 |
| 2011 | Squid | 4062.59 | 99999999 | 41.265745 | -71.597465 | 8/25/2011 | 6:02:00 | 0.0000056 | 0.0001319 |
| 2011 | Squid | 4062.59 | 99999999 | 41.26576 | -71.597466 | 8/25/2011 | 7:02:00 | 0.0000102 | 0.0001319 |
| 2011 | Squid | 4062.59 | 99999999 | 41.265746 | -71.597471 | 8/25/2011 | 8:02:00 | 0.0000002 | 0.0001319 |
| 2011 | Squid | 4062.59 | 99999999 | 41.265744 | -71.597472 | 8/25/2011 | 9:02:00 | 0.0000141 | 0.0001319 |
| 2011 | Squid | 4062.59 | 99999999 | 41.26575 | -71.597472 | 8/25/2011 | 10:02:00 | 0.0000956 | 0.0001319 |
| 2011 | Squid | 4062.59 | 99999999 | 41.26575 | -71.597471 | 8/25/2011 | 11:02:00 | 0.0000003 | 0.0001319 |
| 2011 | Squid | 25.56 | 11111111 | 41.378914 | -71.159876 | 9/2/2011 | 15:29:00 | 0.0000048 | 0.0000223 |
| 2011 | Squid | 25.56 | 11111111 | 41.378914 | -71.159881 | 9/2/2011 | 16:29:00 | 0.0000098 | 0.0000223 |
| 2011 | Squid | 25.56 | 11111111 | 41.378914 | -71.159885 | 9/2/2011 | 17:29:00 | 0.0000042 | 0.0000223 |
| 2011 | Squid | 25.56 | 11111111 | 41.378914 | -71.159881 | 9/2/2011 | 18:29:00 | 0.0000035 | 0.0000223 |
| 2011 | Squid | 78.94 | 55555555 | 40.506489 | -73.597685 | 8/12/2011 | 4:13:00 | 0.0000073 | 0.0000073 |

# Supplemental Materials - Economic Calculations

- For each trip, the aggregate function was used to sum all the extracted weight values (by Supplier Trip ID)
- Then the individual extracted weight values were divided by the summed extracted weight for that trip

Not real data. Only for example.

| Year | Species | Dollar.Value | Supplier Trip ID | VMS.Lat | VMS.Long | VMS.Date | VMS.Time | Raster.Weight | Trip.Wt | Pt.Weight |
|---|---|---|---|---|---|---|---|---|---|---|
| 2011 | Squid | 4062.59 | 99999999 | 41.265745 | -71.597465 | 8/25/2011 | 5:02:00 | 0.0000059 | 0.0001319 | 0.04473086 |
| 2011 | Squid | 4062.59 | 99999999 | 41.265745 | -71.597465 | 8/25/2011 | 6:02:00 | 0.0000056 | 0.0001319 | 0.04245641 |
| 2011 | Squid | 4062.59 | 99999999 | 41.26576 | -71.597466 | 8/25/2011 | 7:02:00 | 0.0000102 | 0.0001319 | 0.07733131 |
| 2011 | Squid | 4062.59 | 99999999 | 41.265746 | -71.597471 | 8/25/2011 | 8:02:00 | 0.0000002 | 0.0001319 | 0.00151630 |
| 2011 | Squid | 4062.59 | 99999999 | 41.265744 | -71.597472 | 8/25/2011 | 9:02:00 | 0.0000141 | 0.0001319 | 0.10689917 |
| 2011 | Squid | 4062.59 | 99999999 | 41.26575 | -71.597472 | 8/25/2011 | 10:02:00 | 0.0000956 | 0.0001319 | 0.72479151 |
| 2011 | Squid | 4062.59 | 99999999 | 41.26575 | -71.597471 | 8/25/2011 | 11:02:00 | 0.0000003 | 0.0001319 | 0.00227445 |
| 2011 | Squid | 25.56 | 11111111 | 41.378914 | -71.159876 | 9/2/2011 | 15:29:00 | 0.0000048 | 0.0000223 | 0.21524664 |
| 2011 | Squid | 25.56 | 11111111 | 41.378914 | -71.159881 | 9/2/2011 | 16:29:00 | 0.0000098 | 0.0000223 | 0.43946188 |
| 2011 | Squid | 25.56 | 11111111 | 41.378914 | -71.159885 | 9/2/2011 | 17:29:00 | 0.0000042 | 0.0000223 | 0.18834081 |
| 2011 | Squid | 25.56 | 11111111 | 41.378914 | -71.159881 | 9/2/2011 | 18:29:00 | 0.0000035 | 0.0000223 | 0.15695067 |
| 2011 | Squid | 78.94 | 55555555 | 40.506489 | -73.597685 | 8/12/2011 | 4:13:00 | 0.0000073 | 0.0000073 | 1.00000000 |

# Supplemental Materials - Economic Calculations

- Then the trip weight was multiplied by the total trip value column to create the final weighted point value

| Year | Species | Dollar.Value | Supplier Trip ID | VMS.Lat | VMS.Long | VMS.Date | VMS.Time | Raster.Weight | Trip.Wt | Pt.Weight | Pt.Dollar.Val |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2011 | Squid | 4062.59 | 99999999 | 41.265745 | -71.597465 | 8/25/2011 | 5:02:00 | 0.0000059 | 0.0001319 | 0.04473086 | 181.7231312 |
| 2011 | Squid | 4062.59 | 99999999 | 41.265745 | -71.597465 | 8/25/2011 | 6:02:00 | 0.0000056 | 0.0001319 | 0.04245641 | 172.4829719 |
| 2011 | Squid | 4062.59 | 99999999 | 41.26576 | -71.597466 | 8/25/2011 | 7:02:00 | 0.0000102 | 0.0001319 | 0.07733131 | 314.1654132 |
| 2011 | Squid | 4062.59 | 99999999 | 41.265746 | -71.597471 | 8/25/2011 | 8:02:00 | 0.0000002 | 0.0001319 | 0.00151630 | 6.160106141 |
| 2011 | Squid | 4062.59 | 99999999 | 41.265744 | -71.597472 | 8/25/2011 | 9:02:00 | 0.0000141 | 0.0001319 | 0.10689917 | 434.2874829 |
| 2011 | Squid | 4062.59 | 99999999 | 41.26575 | -71.597472 | 8/25/2011 | 10:02:00 | 0.0000956 | 0.0001319 | 0.72479151 | 2944.530735 |
| 2011 | Squid | 4062.59 | 99999999 | 41.26575 | -71.597471 | 8/25/2011 | 11:02:00 | 0.0000003 | 0.0001319 | 0.00227445 | 9.240159212 |
| 2011 | Squid | 25.56 | 11111111 | 41.378914 | -71.159876 | 9/2/2011 | 15:29:00 | 0.0000048 | 0.0000223 | 0.21524664 | 5.501704036 |
| 2011 | Squid | 25.56 | 11111111 | 41.378914 | -71.159881 | 9/2/2011 | 16:29:00 | 0.0000098 | 0.0000223 | 0.43946188 | 11.23264574 |
| 2011 | Squid | 25.56 | 11111111 | 41.378914 | -71.159885 | 9/2/2011 | 17:29:00 | 0.0000042 | 0.0000223 | 0.18834081 | 4.813991031 |
| 2011 | Squid | 25.56 | 11111111 | 41.378914 | -71.159881 | 9/2/2011 | 18:29:00 | 0.0000035 | 0.0000223 | 0.15695067 | 4.011659193 |
| 2011 | Squid | 78.94 | 55555555 | 40.506489 | -73.597685 | 8/12/2011 | 4:13:00 | 0.0000073 | 0.0000073 | 1.00000000 | 78.94 |

Not real data. Only for example.

Dollar.Value * Pt.Weight = Pt.Dollar.Val

# Supplemental Materials - Economic Calculations

- Subsetted data temporally (by year) and by fishery/grouping (i.e. species caught, gear used, port landed in, and state landed in)
- For each WEA, pulled the points that fell within the WEA
  - Used the aggregate function in R to sum the weighted fishing values of the points within each WEA
    - Since weighted fishing values are being used, the landings have been scaled to reflect the amount of fishing that occurred within each WEA