Leveraging data from a private recreational fishing application to begin to understand potential impacts from offshore wind development

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Increasing competition for offshore resources

- Wind

- Aquaculture

- Oil

- Other...

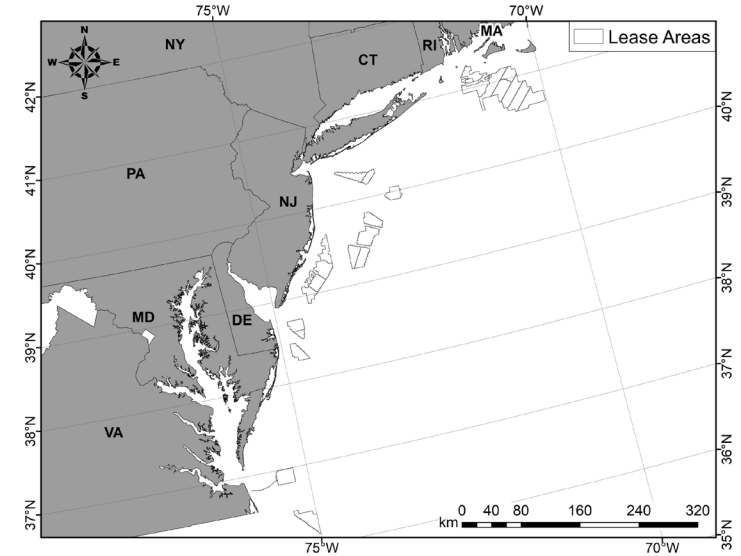- Necessitates an understanding of current usage

Figure 1: The location of the 26 wind lease areas anticipated to be developed within the Greater Atlantic Region, as they were defined in December 2022.

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Private Recreational Fishing:
A Glaring Data Gap

- 2020 – 49.1 million trips in Mid-Atlantic
  - 37% from private boats
  - 62% from shore

- $1.8 billion in expenses
  - 55% from private boats
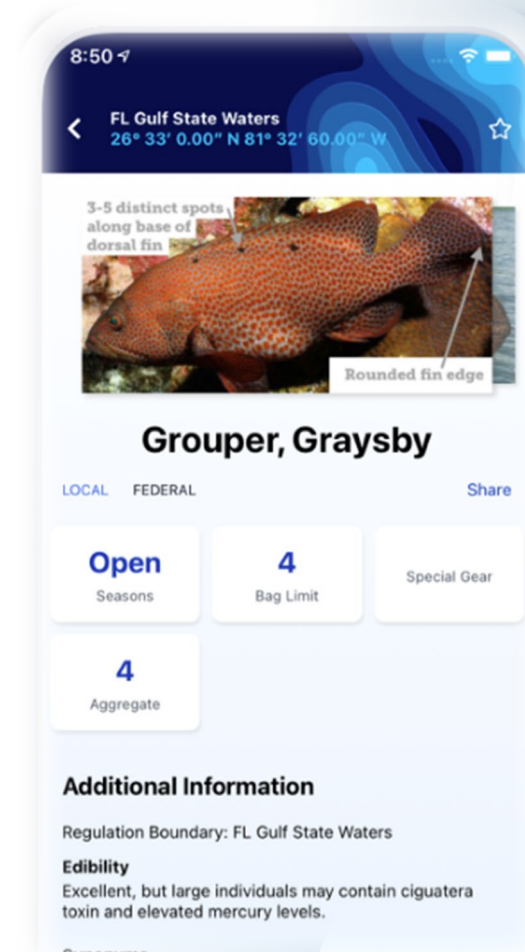 - 20% from shore

- MRIP - only generic fishing locations
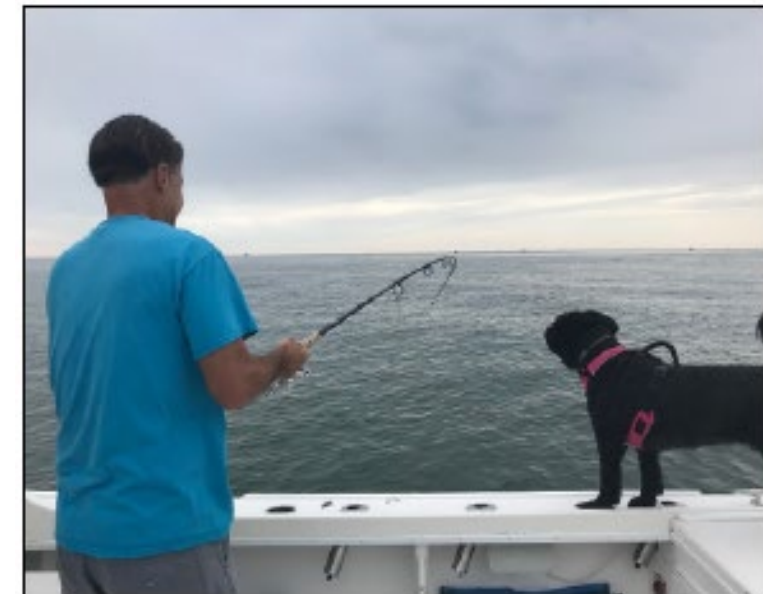
Filling this gap means getting creative…

- Proliferation of geolocated datasets

- Satellite

- Phones

- Computers

- Opportunistic

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Fish Rules

- Georeferenced Recreational Fishing Regulations
  - Species-level information

- Is it fishing information?
  1. Search for clusters
  2. Validate fishing locations
  3. Practical Management Example: Offshore Wind

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Fish Rules Data: 2020-21

Table 1: Descriptive statistics of daily view data generated by users on the Fish Rules application for the thirteen species assessed within this research.

Species Name	Total	Average	Median	Max	Min	SD
Black Sea Bass	747	2.8	2	14	1	2.33
Striped Bass	638	2.9	1	20	1	3.39
Summer Flounder	574	2.7	2	15	1	2.38
Tautog	452	2.4	2	13	1	1.99
Bluefish	386	2.1	1	11	1	1.74
Atlantic Cod	351	1.9	1	8	1	1.44
Winter Flounder	305	2.1	1	10	1	1.69
Scup	249	1.7	1	6	1	1.07
Red Drum	211	1.8	1	6	1	1.22
Haddock	207	1.7	1	8	1	1.22
Weakfish	180	1.6	1	5	1	0.92
Yellowtail Flounder	156	1.4	1	6	1	0.83
Windowpane Flounder	139	1.4	1	4	1	0.74

Step 1: Search for clusters

- Restricted likelihood spatial scan statistic
  - Tango (2008), Tango and Takahashi (2005), Kulldorf (1997)
- Bernoulli Likelihood Ratio Test
- Restriction = filter
  - Data aggregated to 10 minute square
  - One-tailed Binomial
    - All subregions mid p-value $\leq \alpha_m = 0.4$

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Step 1: Search for clusters

- 24 clusters across 11 species
  - 144 km^2 – 7,100 km^2

Table 3: Flexible restricted likelihood spatial scan statistic significance levels and cluster area for species presenting significant results. p-values corrected for multiple tests using the Holm-Bonferroni method.

Species Name	Corrected p-value	Cluster Area (km^2)
Bluefish	0.0322	2316.49
Red Drum	0.0001	3571.61
Red Drum	0.0001	143.78
Scup	0.0016	3434.56
Scup	0.0026	4467.60
Atlantic Cod	0.0003	4933.51
Atlantic Cod	0.0003	2553.29
Atlantic Cod	0.0956	2709.88
Haddock	0.0003	2786.77
Haddock	0.0092	2606.49
Haddock	0.0386	3355.76
Summer Flounder	0.0003	7134.04
Summer Flounder	0.0120	2908.31
Summer Flounder	0.0414	2863.58
Tautog	0.0002	3554.69
Tautog	0.0477	1257.73
Windowpane Flounder	0.0115	2953.90
Winter Flounder	0.0004	3851.82
Black Sea Bass	0.0004	4087.79
Black Sea Bass	0.0004	4938.24
Black Sea Bass	0.0004	2862.97
Black Sea Bass	0.0004	5797.10
Striped Bass	0.0002	2504.76
Striped Bass	0.0072	799.85

Note: Yellowtail Flounder and Weakfish were found to have no significant clusters in the data.
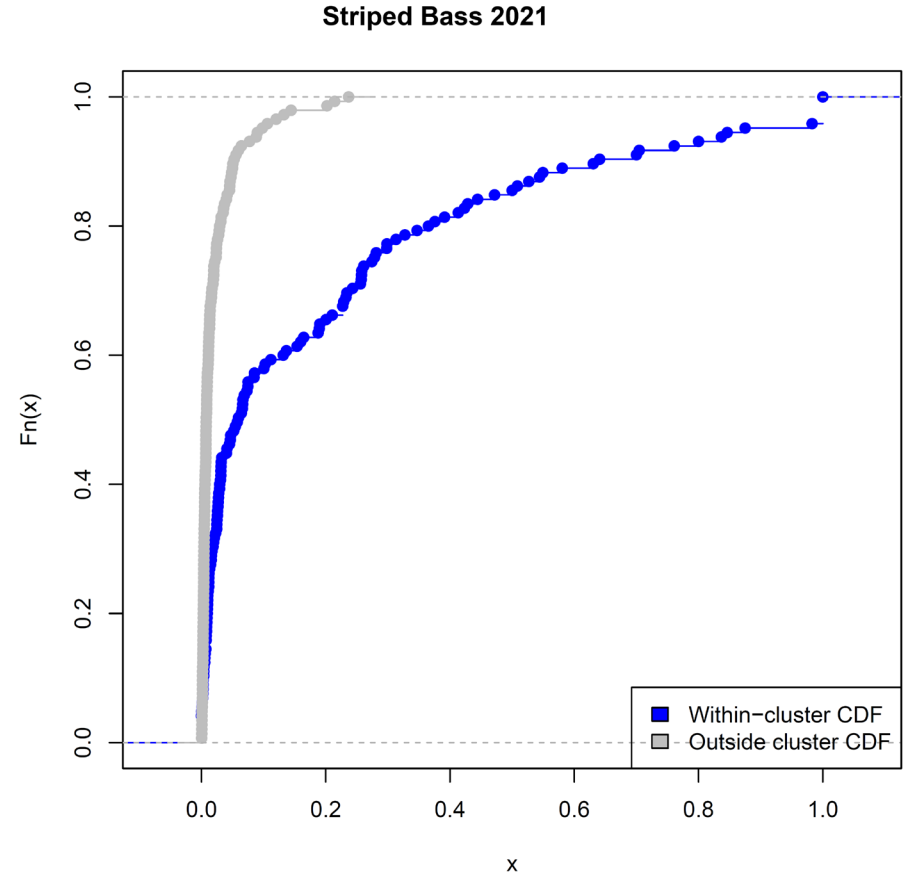
Step 2: Validate fishing locations

Table 2: Descriptive statistics of recreational harvest as reported by federally permitted party and charter vessels in vessel trip reports. Data are presented in daily numbers of fish harvested.

Species Name	Total	Average	Median	Max	Min	SD
Scup	1,552,596	3,346.10	3,126	14,937	0	2,448.14
Black Sea Bass	899,505	1,694.00	1,590	8,357	0	1,417.93
Haddock	455,347	975.00	848	4,274	1	710.70
Bluefish	131,725	287.60	220	1,508	0	280.92
Summer Flounder	110,937	292.70	222	1,111	0	293.02
Tautog	67,102	141.90	25	2,617	0	254.16
Striped Bass	33,764	69.00	53	389	0	63.18
Atlantic Cod	24,888	43.90	18	461	0	67.41
Winter Flounder	3,108	11.00	6	93	0	13.66
Weakfish	888	5.60	3	39	0	7.17
Windowpane Flounder	288	6.10	0	48	0	10.15
Red Drum	126	1.40	0	12	0	2.47
Yellowtail Flounder	125	3.80	2	40	1	6.83

Step 2: Validate fishing locations

- Test harvest rates for species inside vs. outside Fish Rules Clusters
  - First Order Stochastic Dominance
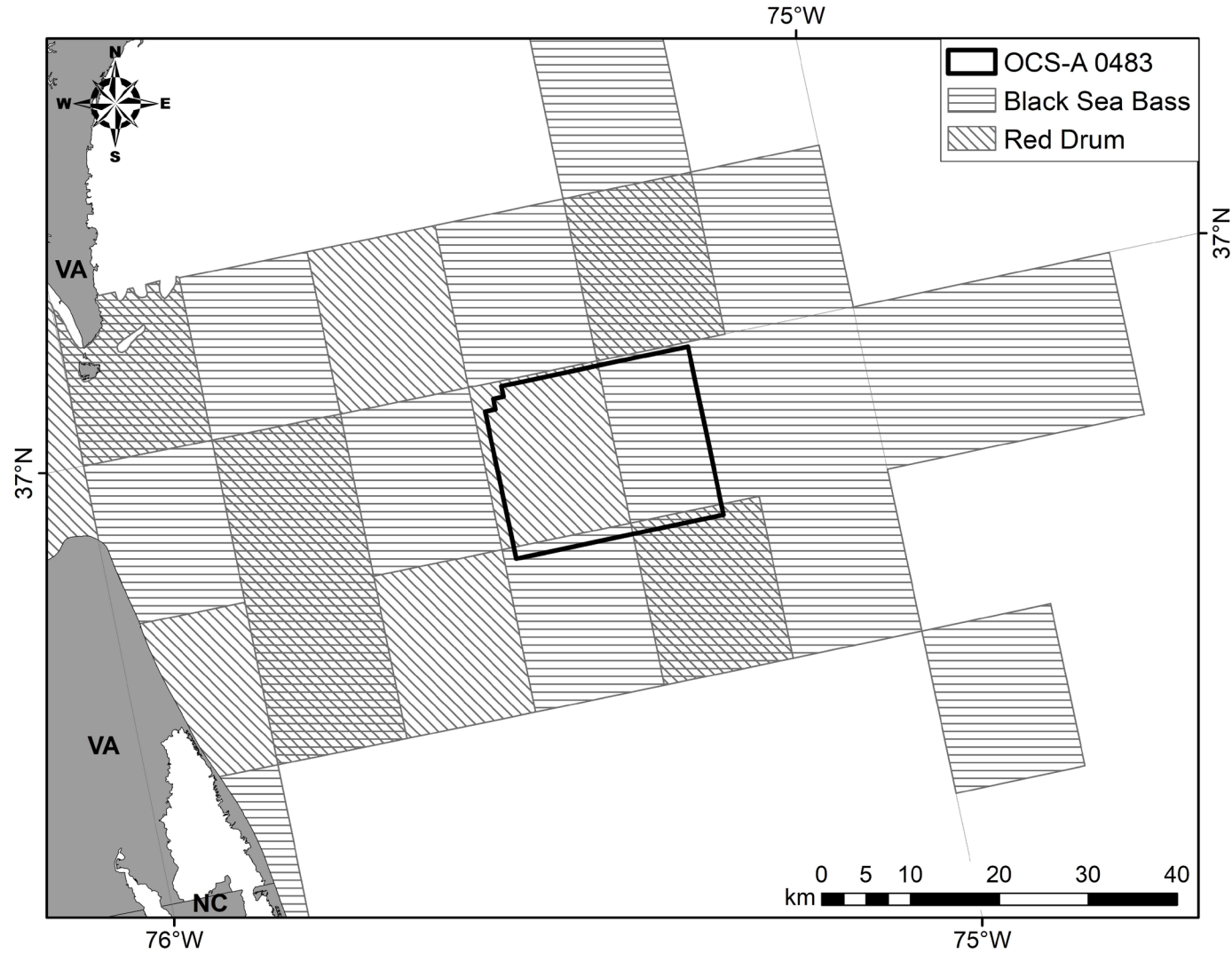   - (Barrett and Donaldson 2003), Whang (2019)

Striped Bass 2021

Step 2: Validate fishing locations

Table 4: Tests for First Order Stochastic Dominance for species harvested inside vs. outside of their relevant clusters. Variable tested is the ratio of species harvested vs. all species harvested daily. Failure to reject the null hypothesis indicates harvest rates within the cluster are higher than outside of the cluster.

Species Name	Year	p-value	Daily Observations
Striped Bass	2020	0.0125	111
Striped Bass	2021	0.7468	145
Cod	2020	0.8566	146
Cod	2021	0.9290	140
Summer Flounder	2020	0.9336	165
Summer Flounder	2021	0.8252	183
Haddock	2020	0.5381	100
Haddock	2021	0.0359	100
Scup	2020	0.9018	178
Scup	2021	0.8951	220
Red Drum	2020	0.7792	16
Red Drum	2021	0.6923	9
Black Sea Bass	2020	0.9403	218
Black Sea Bass	2021	0.4979	256
Tautog	2020	0.8449	82
Tautog	2021	0.4942	112
Bluefish	2020	0.7671	72
Bluefish	2021	0.0990	55
Winter Flounder	2020	0.9799	79
Winter Flounder	2021	0.9898	115

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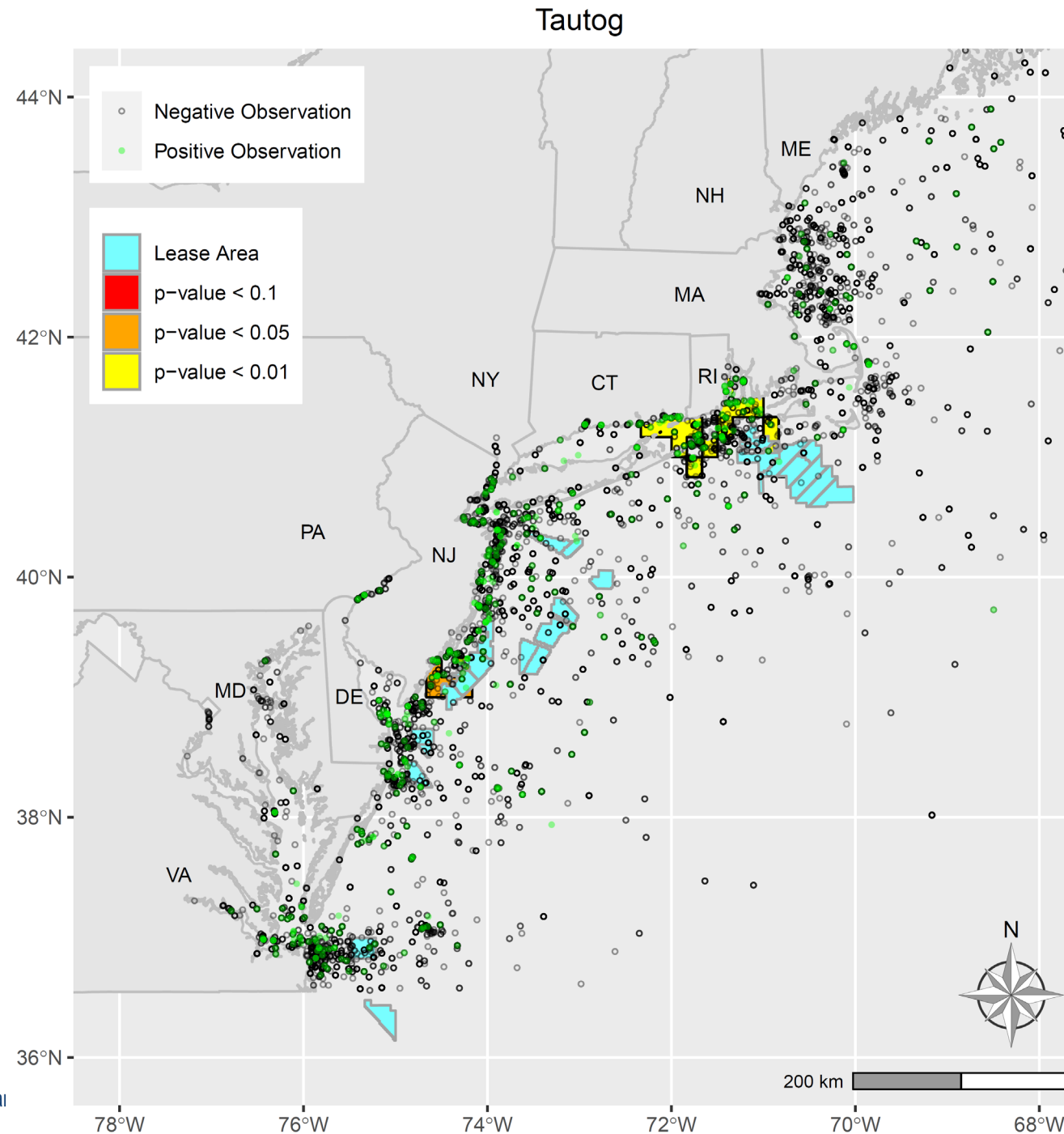
Step 3: Wind Lease Example

Figure 2: The overlap of black sea bass and red drum clusters with offshore wind lease area OCS-A 0483.

Step 3:
Wind Lease Example

- Six wind lease areas overlap 5 or more Fish Rules clusters
  - OCS-A 0517 100% within cod and haddock clusters
- 44% of tautog cluster 2 falls within wind energy areas
  - 559 km²

Tautog

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Key Takeaways

- Fish Rules Data can be used to assess likely private anger fishing locations
  - Significant Clusters
  - Harvest inside clusters First Order Stochastic Dominate harvest outside
  - Clusters usefully inform impact assessments from wind

- Future behavioral modeling work

NOAA
FISHERIES