

A photograph of an offshore wind farm with several wind turbines visible against a blue sky with some clouds. The turbines are arranged in a line, receding into the distance. The water is a deep blue color.

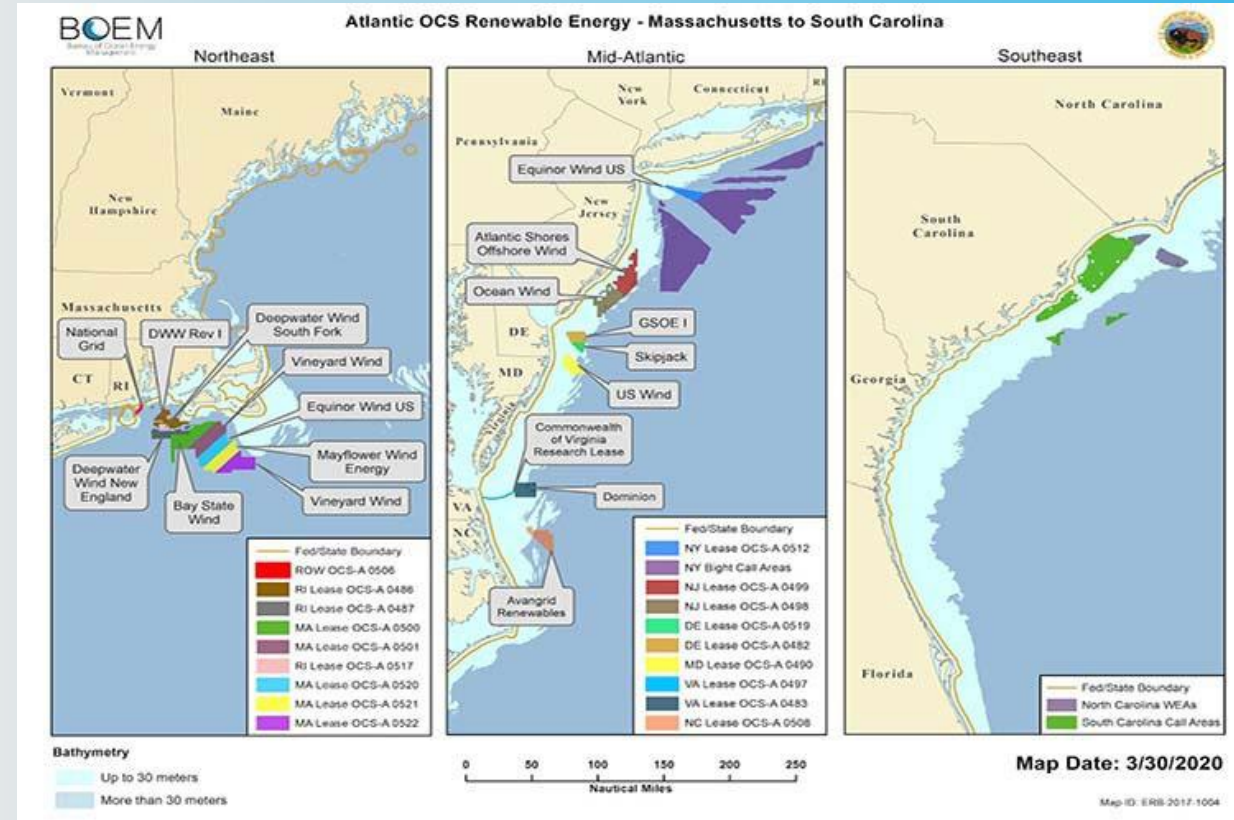
DEVELOPING A TRAWL SURVEY FOR OFFSHORE WIND DEVELOPMENT: EXPERIENCES AND CHALLENGES

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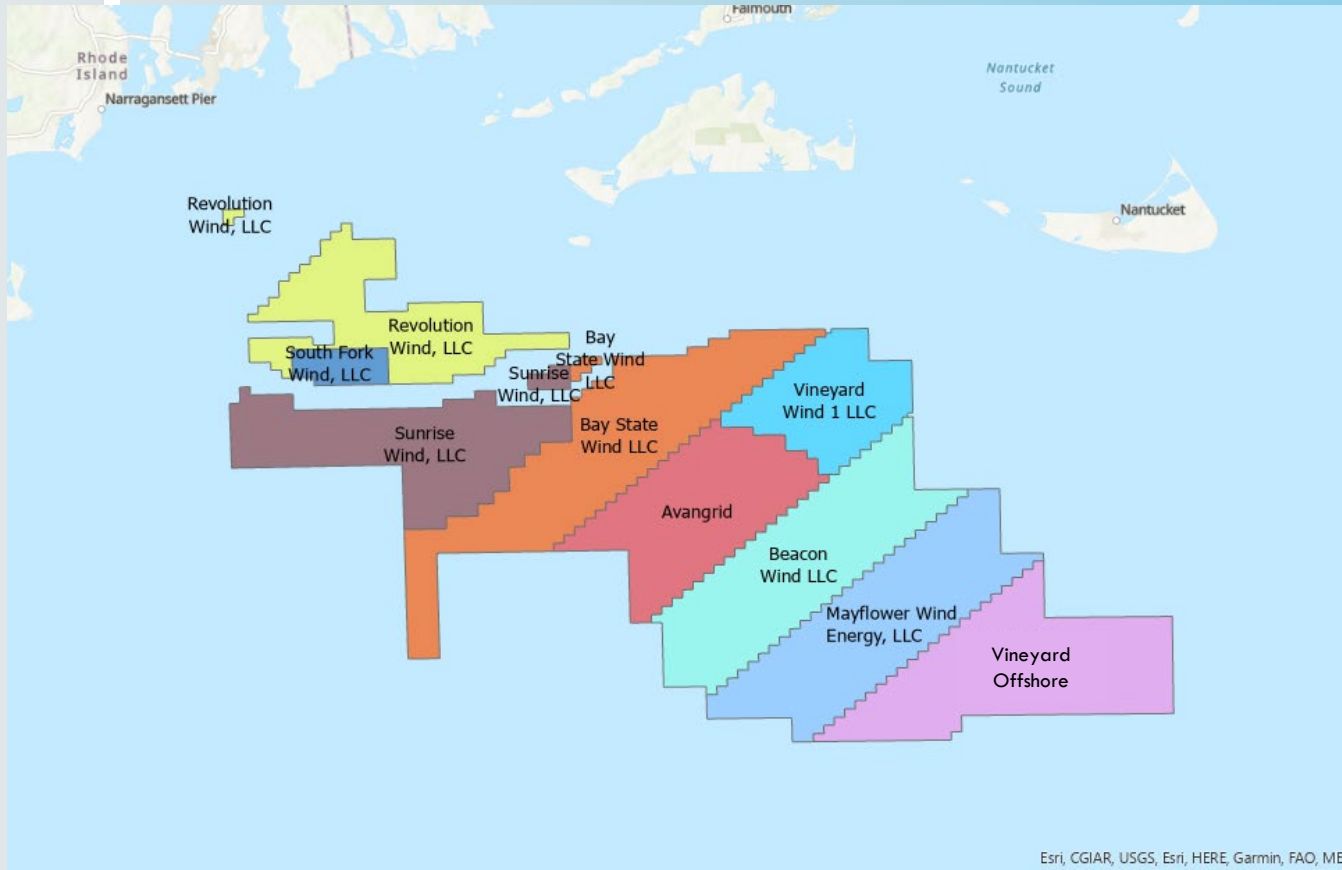
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² Vineyard Wind

ATLANTIC OFFSHORE WIND DEVELOPMENT



VINEYARD WIND 1



Leased in 2015

First Commercial Scale Offshore Wind Project in US

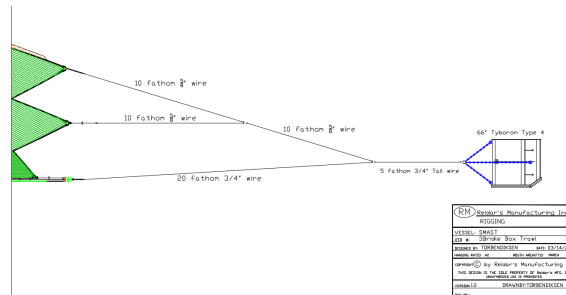
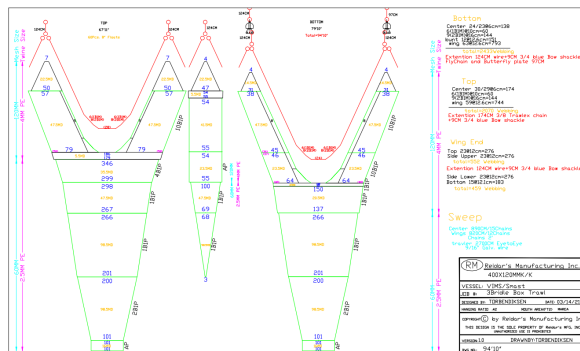
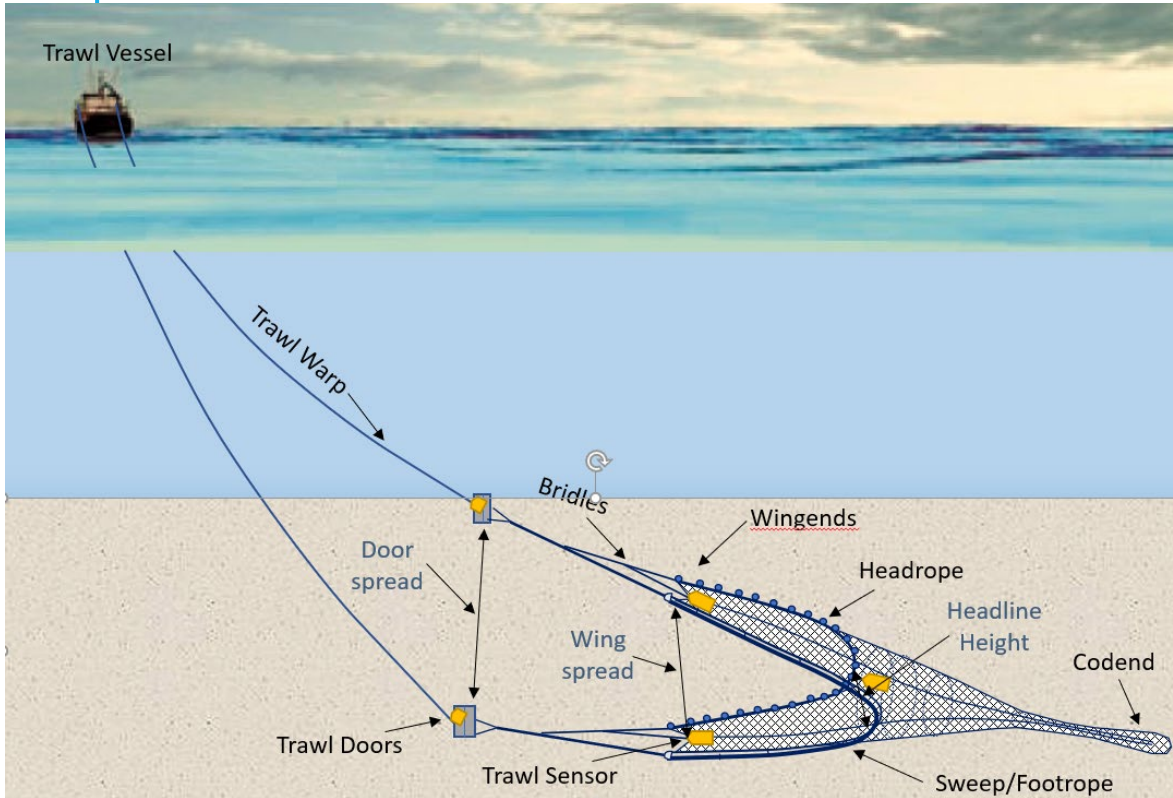
62 Turbines

800 MW Capacity

Construction to begin Spring 2023



ADOPTION OF NEAMAP TRAWL AND SURVEY PROTOCOL



Compliments NOAA and NEAMAP surveys Regional data integration

Provides consistency between regional surveys, and possible incorporation of high-resolution data for regional ecosystem assessments

NEAMAP trawl

- Three-bridle, four-seam bottom trawl developed by Northeast Trawl Advisory Panel and in use by NEAMAP surveys

NEAMAP survey protocol (Bonzek et al., 2008)

- Commercial fishing vessel
- Tow duration: 20 min
- Tow speed: 3.0 knots
- Daytime only: 30 min after sunrise – 30 min before sunset

BACI EXPERIMENTAL DESIGN



Four seasons

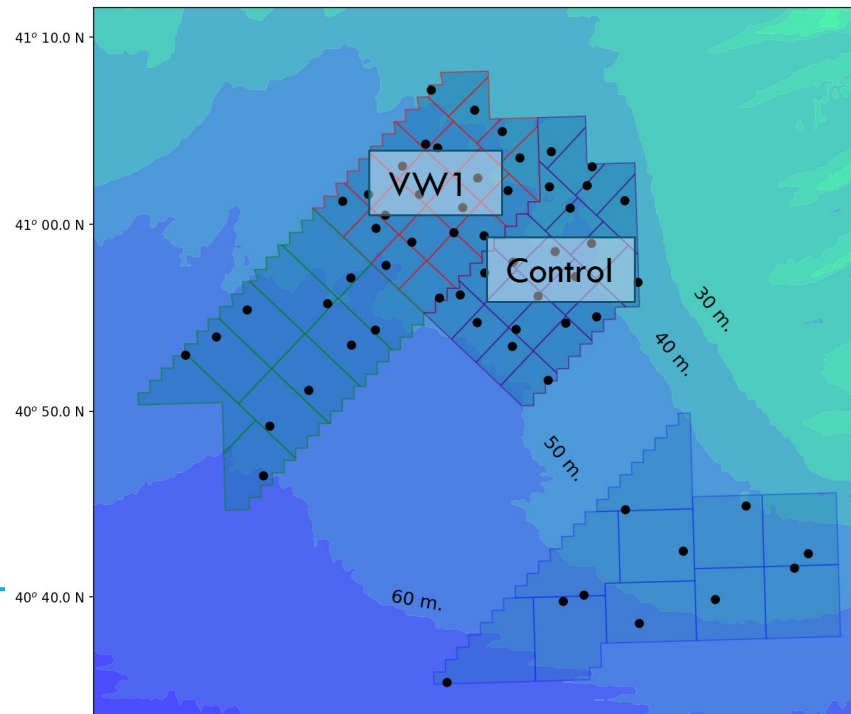
- Winter: January – March
- Spring: April – June
- Summer: July – September
- Fall: October – December

Tow locations

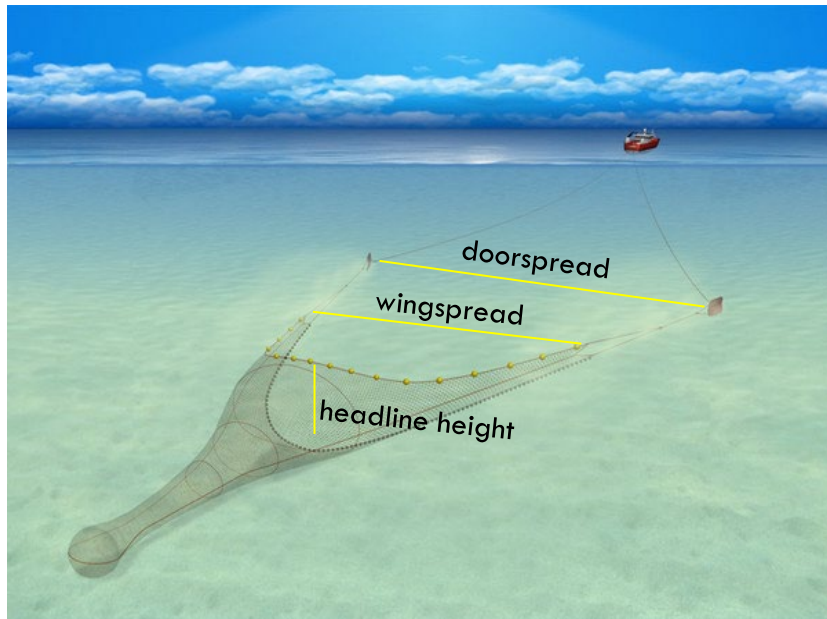
- Selected using spatially balanced sampling design.
- Areas are split into sub-sections. Tow locations are then randomly generated within the sub-section.
- Sampling resolution: 1 station every 3.6 – 4.5 sq. nautical miles (in Development and Control Areas)
 - NEAMAP sampling resolution: 1 tow every 30 sq. nautical miles
 - NMFS sampling resolution: 1 tow every ~100 sq. nautical miles

Number of tows

- 20 tows each in VW1 Study Area and Control Area.
- 10 tows each in 534 and 522 Study Areas



DATA COLLECTED



Trawl Geometry

- SIMRAD PX Trawl Monitoring System
- Wingspread – Horizontal opening of the net mouth
- Door Spread – Horizontal distance between the trawl doors
- Headline Height – Vertical opening of the net
- Pitch sensor in the net belly – Used to ensure the net on the bottom

Biological

- Total catch weight for each species per tow
- Individual length and weights

Environmental

- Sea state, Wind speed, Wind direction
- Bottom water temperature
- CTD profiles



2019 – 2022 SURVEY DATA

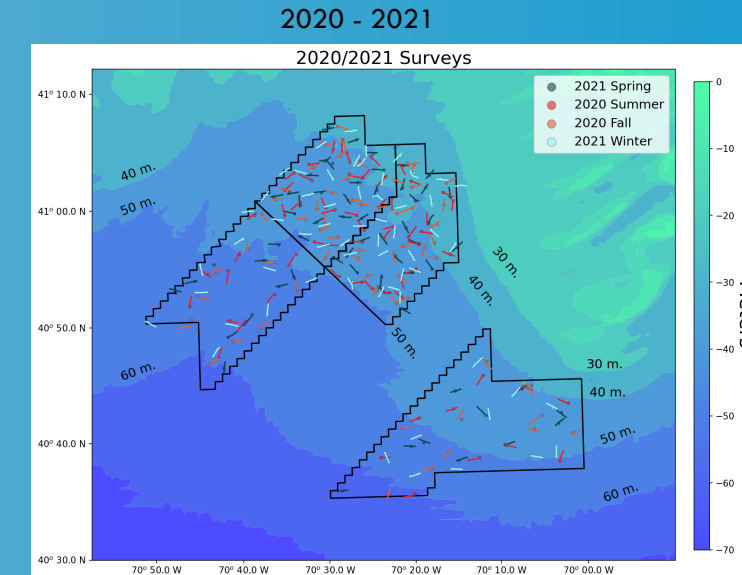
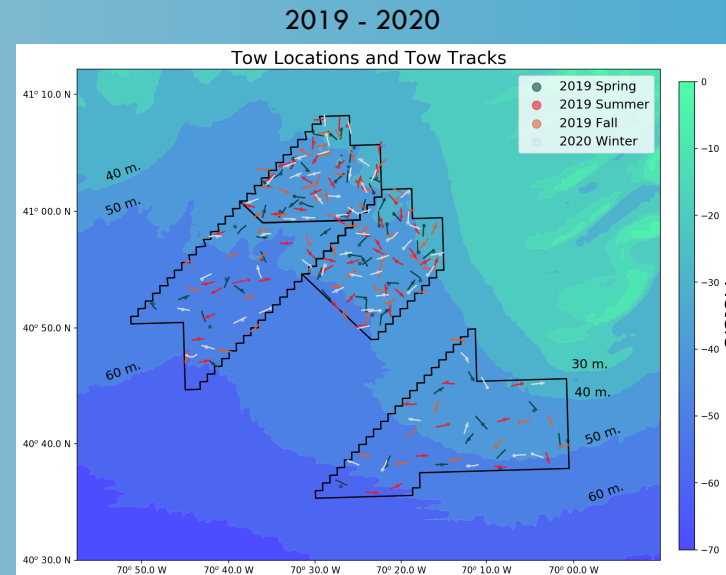


Surveys and tows:

- 11 seasonal surveys completed (June 2019 – August 2022)
- 3 Fishing vessels used for the surveys
 - F/V Heather Lynn – 9 surveys
 - F/V Guardian – 1 Survey
 - F/V Endurance – 1 Survey
- 640 tows made (440 in VW1/Control Area)

Species and measurements:

- 58 species
 - Smallest: 4 cm Whiting, Squid, Scup
 - Largest: 2.5 m Thresher Shark
- 136,356 individual fish length measurements.
- Including 68,621 individuals with length and weight measurements.



CATCH COMPOSITION – VINEYARD WIND 1

2019 - 2020

Species Name	Scientific Name	Total Weight (Kg)	Catch/Tow (Kg)		% of Total Catch	Tows with Species Present
			Mean	SEM*		
Dogfish, Spiny	Squalus acanthias	18392.5	260.8	91.0	43.9	55
Skate, Little	Leucoraja erinacea	6326.4	81.0	8.2	15.1	78
Hake, Silver	Merluccius bilinearis	4512.5	56.0	6.8	10.8	80
Hake, Red	Urophycis chuss	3574.1	43.8	8.4	8.5	74
Skate, Winter	Leucoraja ocellata	2257.9	28.0	4.4	5.4	50
Scup	Stenotomus chrysops	1559.6	20.9	5.0	3.7	31
Butterfish	Peprilus triacanthus	1487.0	18.5	4.1	3.6	72
Alewife	Alosa pseudoharengus	1035.6	12.4	5.7	2.5	51
Skate, Barndoor	Dipturus laevis	376.8	4.5	1.1	0.9	40
Squid, Atlantic Longfin	Doryteuthis pealei	337.2	4.2	0.5	0.8	63
Dogfish, Smooth	Mustelus canis	323.5	3.8	1.6	0.8	20
Monkfish	Lophius americanus	296.3	3.6	0.7	0.7	47
Mackerel, Atlantic	Scomber scombrus	197.0	2.5	2.0	0.5	16
Flounder, Fourspot	Paralichthys oblongus	195.5	2.5	0.3	0.5	60
Herring, Atlantic	Clupea harengus	194.3	2.4	0.9	0.5	25
Crab, Cancer	Cancer irroratus	121.3	1.5	0.3	0.3	57
Flounder, Winter	Pleuronectes americanus	104.1	1.3	0.3	0.2	45
Sea Robin, Northern	Prionotus carolinus	79.5	1.1	0.3	0.2	26
Haddock	Melanogrammus aeglefinus	77.3	0.9	0.9	0.2	1
Flounder, Summer (Fluke)	Paralichthys dentatus	71.8	0.9	0.2	0.2	32
Flounder, Windowpane	Scopthalmus aquosus	61.1	0.8	0.2	0.1	47
Herring, Blueback	Alosa aestivalis	38.2	0.5	0.2	0.1	17
Menhaden, Atlantic	Brevoortia tyrannus	32.3	0.4	0.3	0.1	2
Shad, American	Alosa sapidissima	29.8	0.4	0.1	0.1	29

Yellowtail flounder, Bluefish, Atlantic cod, Weakfish, Black sea bass, American Plaice, Northern Kingfish, Thresher shark

Top 5 Species: 83.8%
Top 10 Species: 95.2%

2020 - 2021

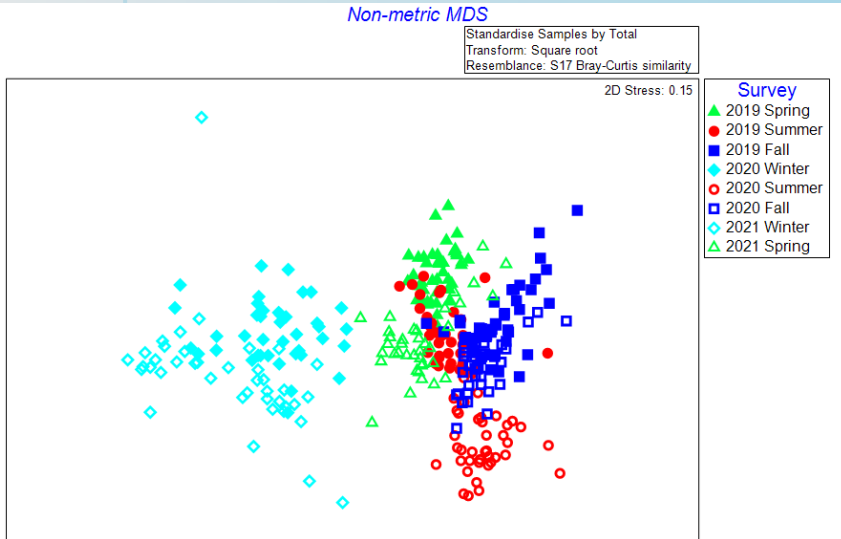
Species Name	Scientific Name	Total Weight (Kg)	Catch/Tow (Kg)		% of Total Catch	Tows with Species Present
			Mean	SEM*		
Skate, Little	Leucoraja erinacea	5215.1	64.9	8.4	27.4	75
Scup	Stenotomus chrysops	3754.2	46.6	10.9	19.7	50
Dogfish, Spiny	Squalus acanthias	3677.2	44.6	20.7	19.3	31
Skate, Winter	Leucoraja ocellata	1030.1	12.7	2.0	5.4	46
Hake, Silver (Whiting)	Merluccius bilinearis	1015.8	12.6	2.7	5.3	69
Butterfish	Peprilus triacanthus	878.2	11.0	2.0	4.6	58
Squid, Atlantic Longfin	Doryteuthis pealei	686.3	8.6	1.2	3.6	56
Herring, Atlantic	Clupea harengus	575.7	7.2	2.3	3.0	40
Hake, Red	Urophycis chuss	472.8	5.9	1.1	2.5	50
Dogfish, Smooth	Mustelus canis	275.2	3.4	1.1	1.4	20
Flounder, Summer (Fluke)	Paralichthys dentatus	223.8	2.8	0.6	1.2	46
Black Sea bass	Centropristis striata	177.5	2.2	0.3	0.9	45
Northern Sea Robin	Prionotus carolinus	152.6	1.9	0.4	0.8	50
Flounder, Winter	Pleuronectes americanus	148.0	1.9	0.4	0.8	43
Shark, Thresher	Alopias vulpinus	100.0	1.2	1.2	0.5	1
Flounder, Fourspot	Paralichthys oblongus	99.3	1.2	0.2	0.5	57
Flounder, Windowpane	Scopthalmus aquosus	82.3	1.0	0.2	0.4	48
Crab, Rock	Cancer irroratus	66.6	0.8	0.2	0.4	42
Monkfish	Lophius americanus	59.3	0.7	0.2	0.3	19
Sculpin, Longhorn	Myoxocephalus octodecimspinosus	56.7	0.7	0.4	0.3	34
Hake, Spotted	Urophycis regia	54.4	0.7	0.2	0.3	20
Herring, Blueback	Alosa aestivalis	47.6	0.6	0.3	0.3	17
Skate, Barndoor	Dipturus laevis	37.5	0.5	0.1	0.2	36
Alewife	Alosa pseudoharengus	32.3	0.4	0.1	0.2	35

Bluefish, Atlantic cod, Yellowtail flounder, Weakfish, Haddock, Thresher shark

Top 5 Species: 77.3%
Top 10 Species: 92.4%

COMMUNITY COMPOSITION ANALYSIS

Non-metric MDS



Winter – Atlantic herring, silver hake, little skate, alewife and longhorn sculpin
2020 average tow: 32.1 kg/tow (VW1) & 45.8 kg/tow (Control)
2021 average tow: 29.9 kg/tow (VW1) & 45.5 kg/tow (Control)

Spring – Silver hake, winter skate, red hake, little skate, squid and black sea bass
2019 average tow: 556.0 kg/tow (VW1) & 862.8 kg/tow (Control)
2021 average tow: 106.0 kg/tow (VW1) & 205.9 kg/tow (Control)

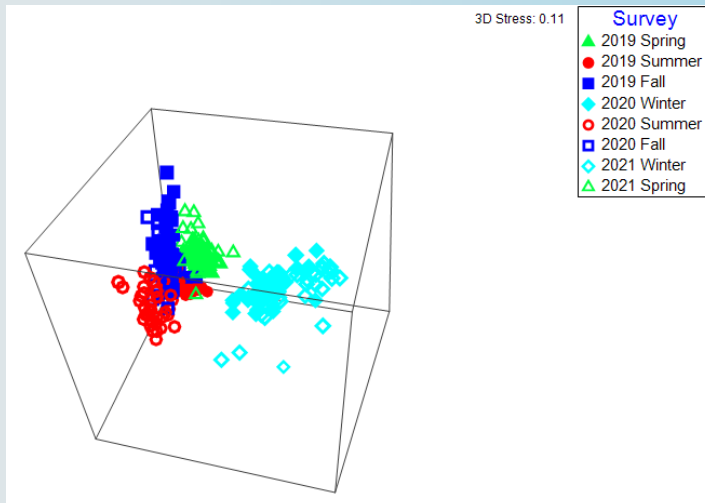
Summer – Little skate, longfin squid, butterfish, scup and summer flounder
2019 average tow: 351.3 kg/tow (VW1) & 526.1 kg/tow (Control)
2020 average tow: 305.5 kg/tow (VW1) & 354.2 kg/tow (Control)

Fall – Little skate, spiny dogfish, scup, silver hake and red hake
2019 average tow: 1171.5 kg/tow (VW1) & 955.2 kg/tow (Control)
2020 average tow: 529.5 kg/tow (VW1) & 477.5 kg/tow (Control)

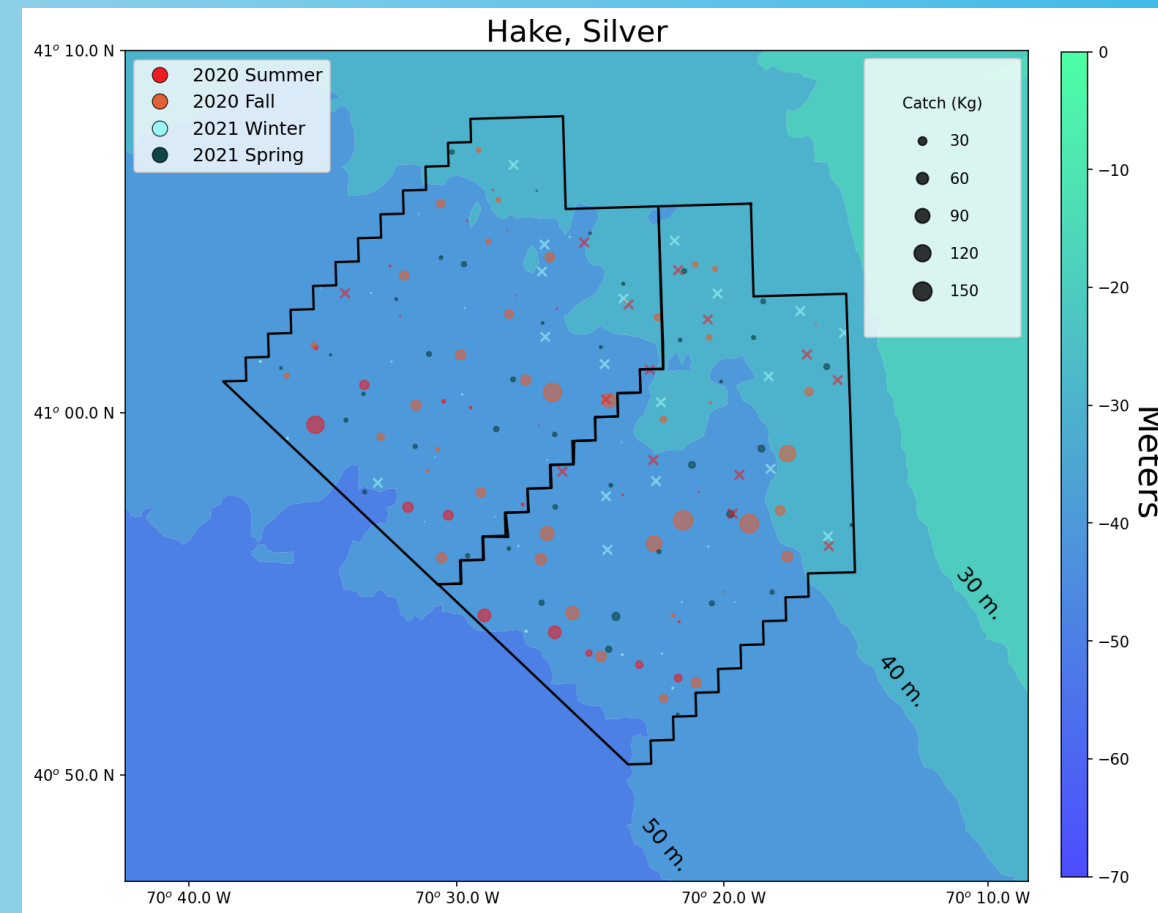
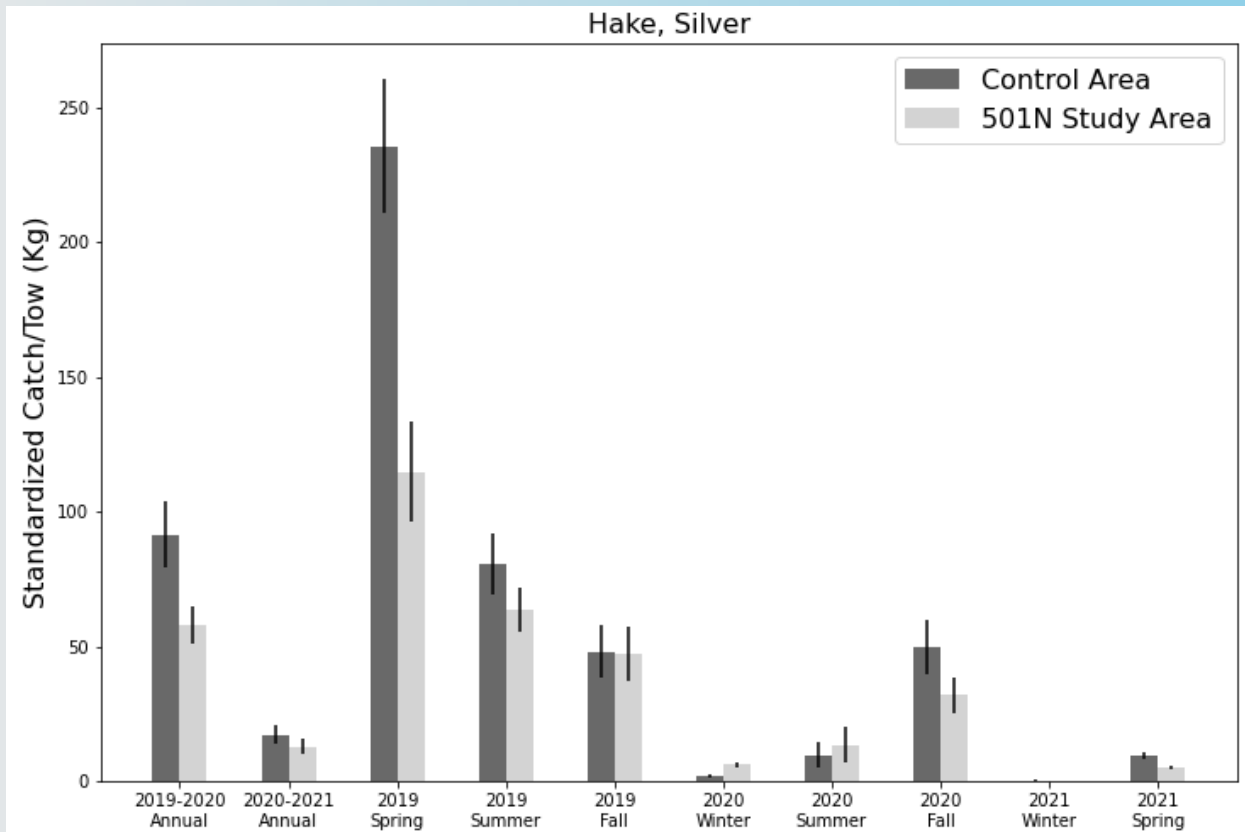
ANOSIM Analysis

Seasonal differences ($R = 0.801$)

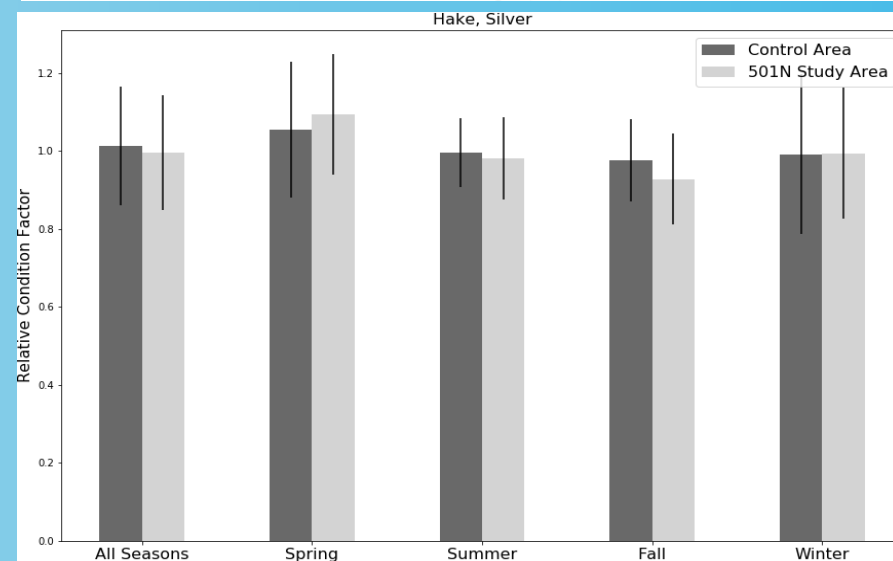
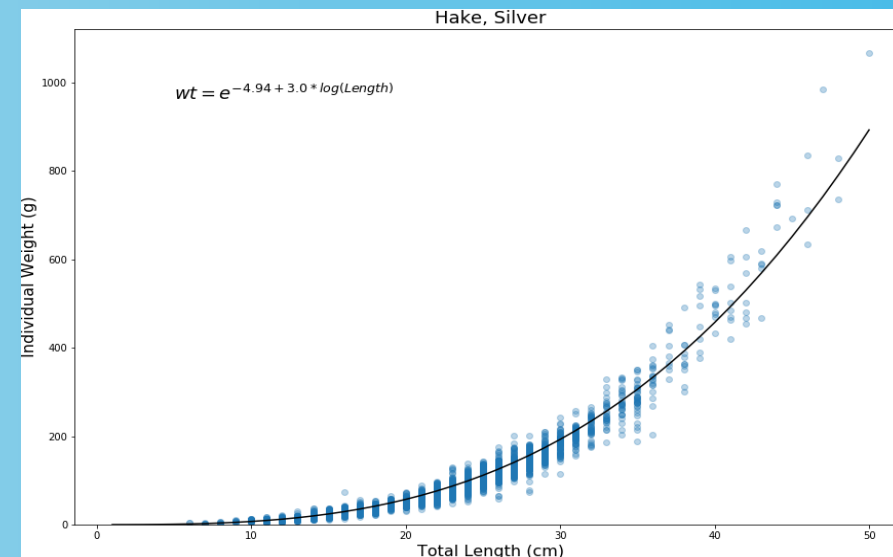
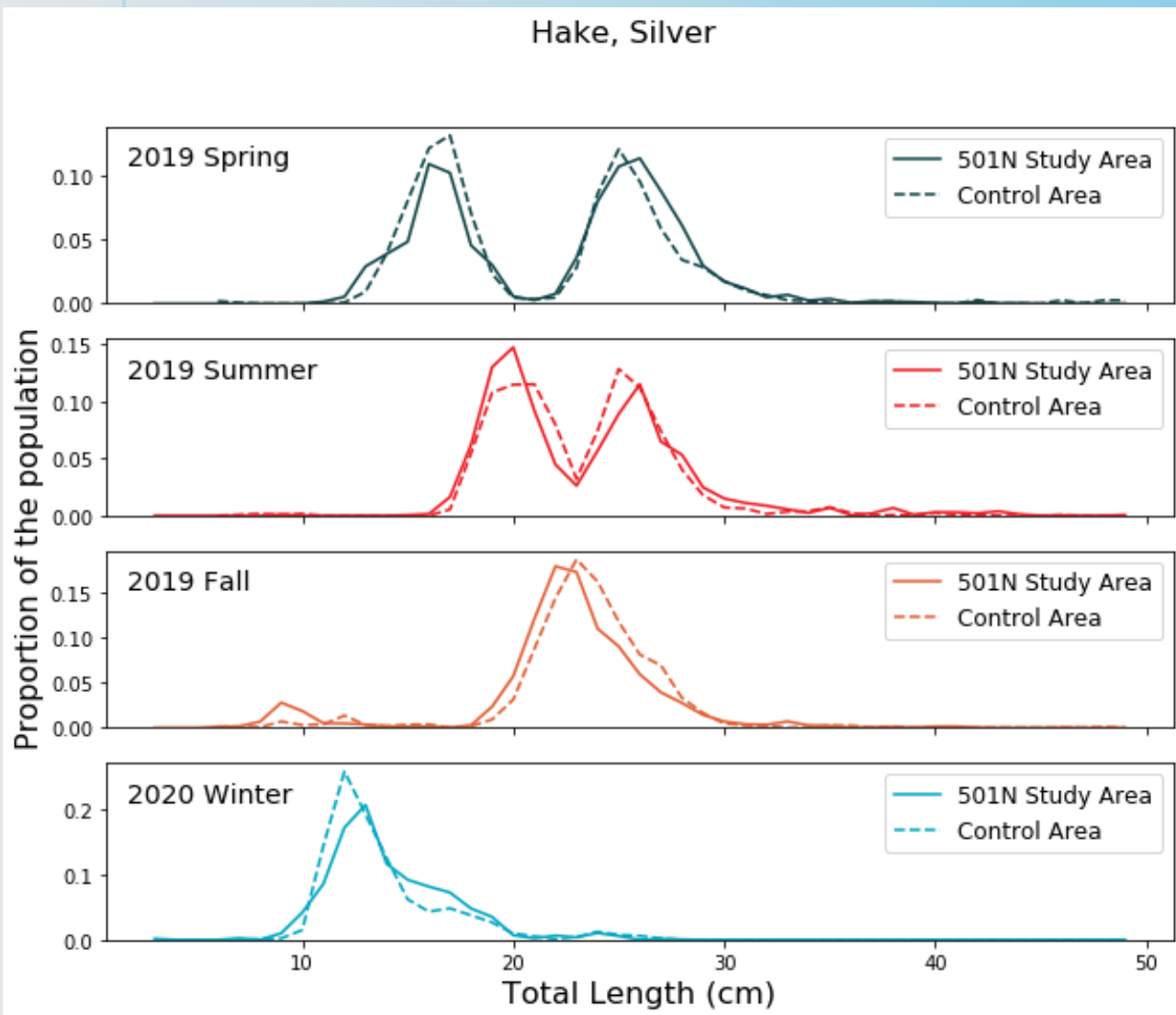
Strong seasonal differences in community structure/species composition



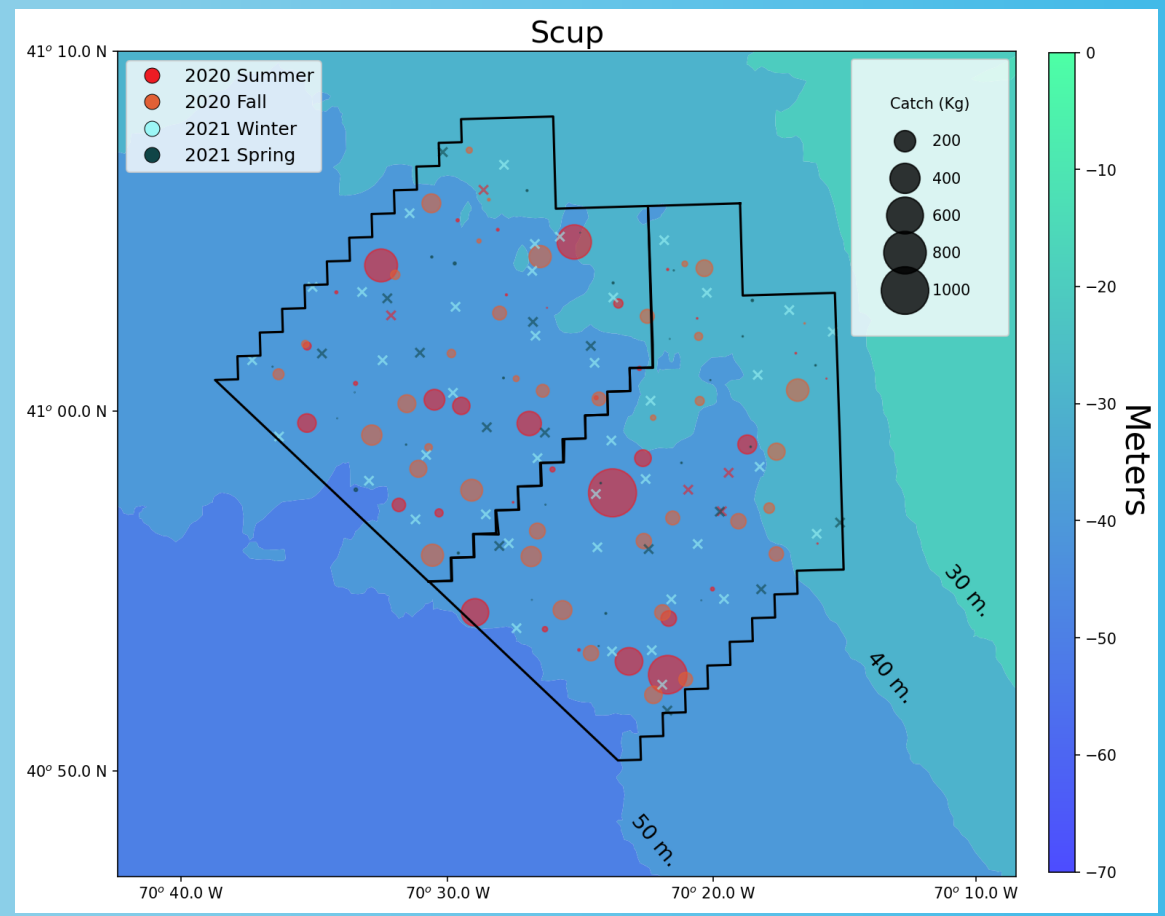
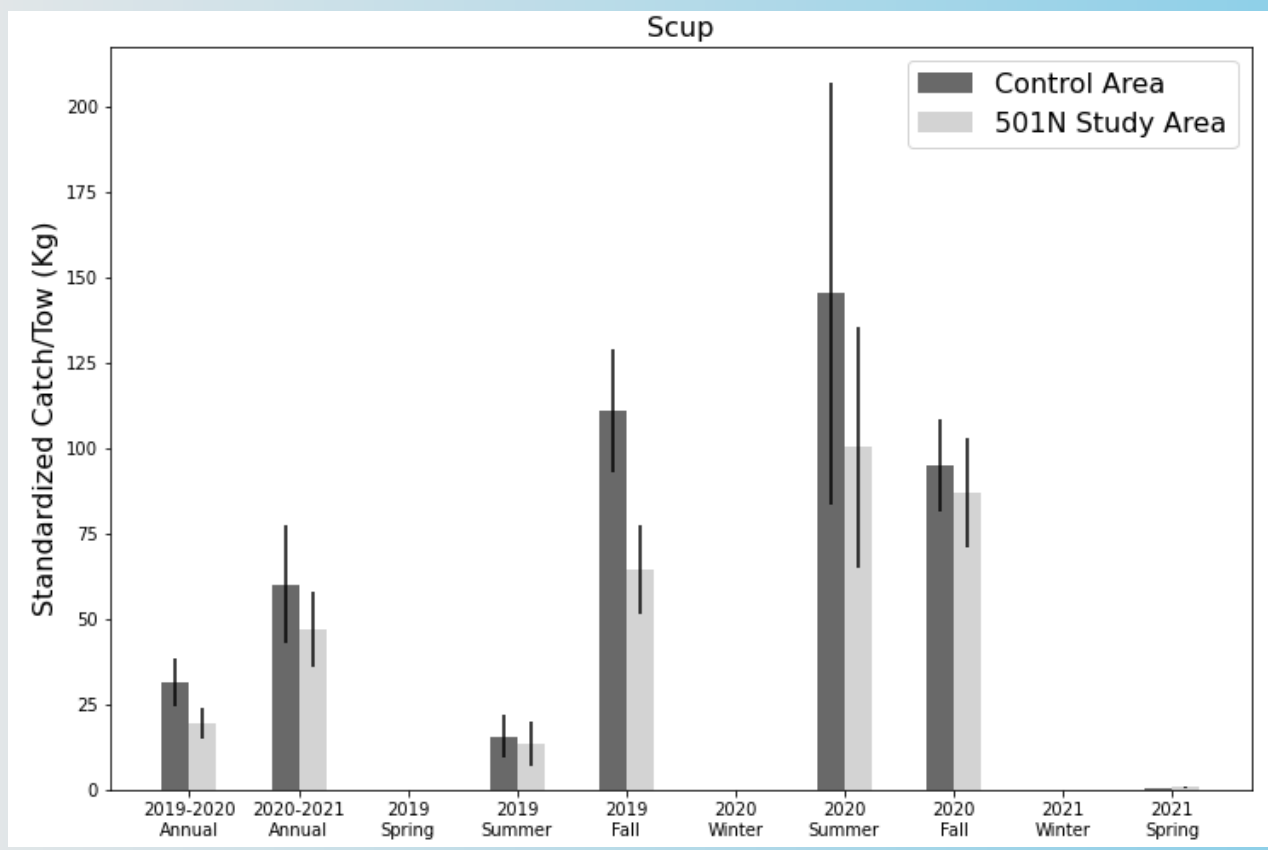
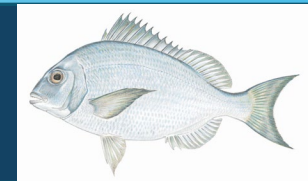
EXAMPLE – SILVER HAKE (*Merluccius bilinearis*)



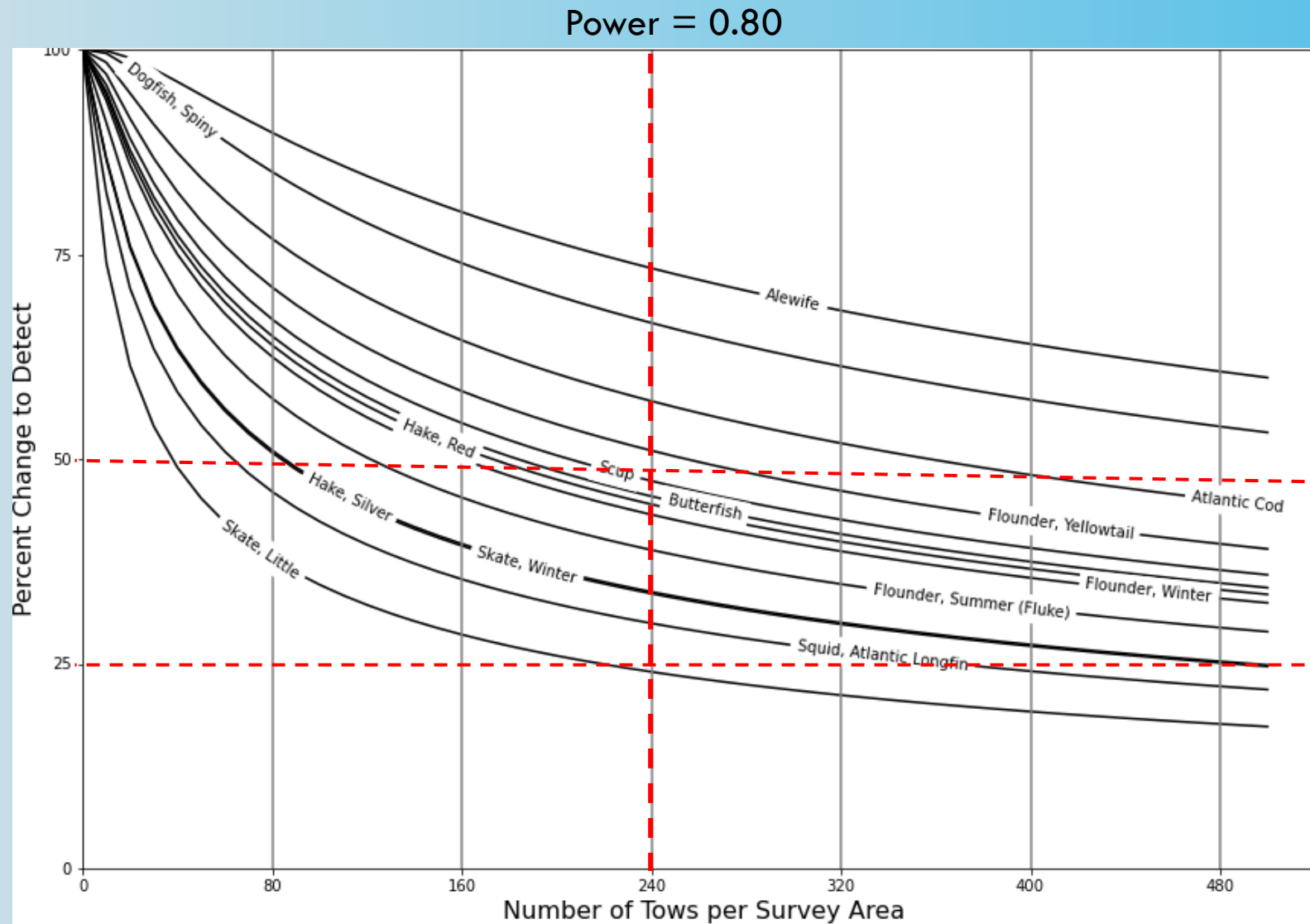
EXAMPLE – SILVER HAKE (*Merluccius bilinearis*)



EXAMPLE – SCUP (*Stenotomus chrysops*)

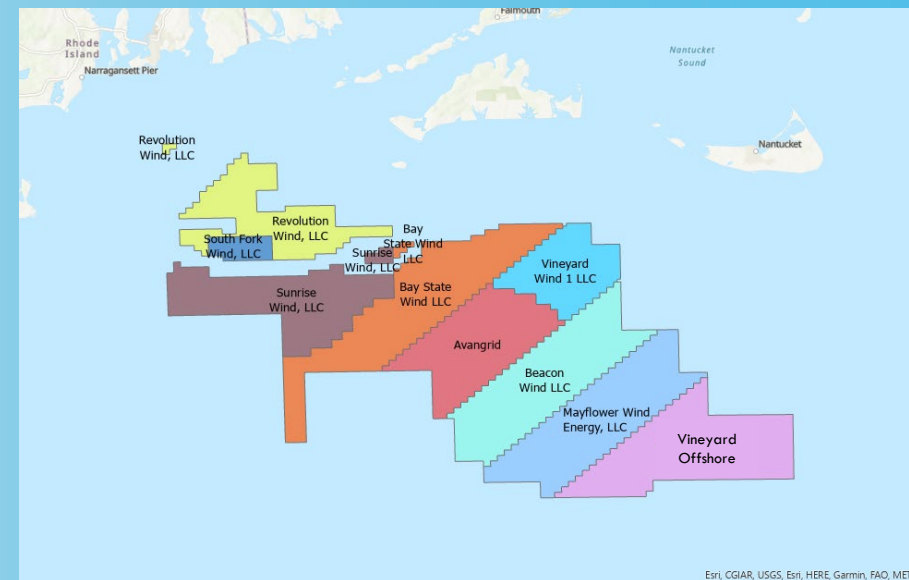


POWER ANALYSIS



SUMMARY

- Experiences:
 - Offshore wind energy areas are highly dynamic exhibiting seasonal and annual variability in community composition, species abundances and population structure.
 - NEAMAP protocol and survey gear serves as a good model for monitoring species composition and density in these area.
 - Based on our results, the projected 240 tows before development would provide sufficient statistical power (0.80) to detect a moderate change (50%) for most important commercial species.
- Challenges
 - Defining Control Areas.
 - Data sharing
 - Permitting and ESA compliance
 - Data Quantity



MORE INFORMATION CAN BE FOUND AT:

<https://www.vineyardwind.com/fisheries-science>
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Funding provided by:

