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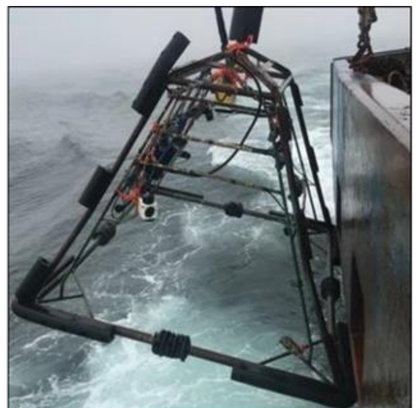
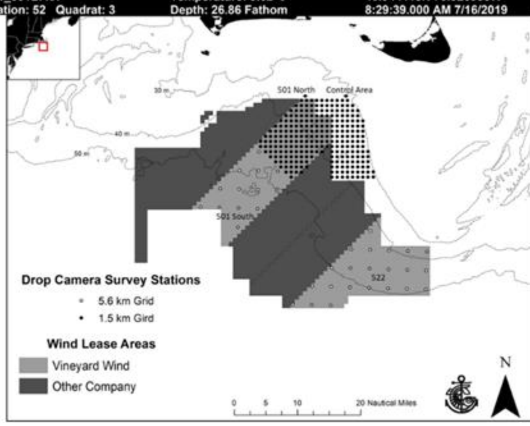
Final Report

2019 Drop Camera Survey of Benthic Communities and Substrate in Vineyard Wind Lease Area OCS-A 0501 South Study Area





Submitted to:
Vineyard Wind LLC
700 Pleasant Street
New Bedford, MA 02740

January 2020 **SMAST-CE-REP-2020-075**

Final Report

2019 Drop Camera Survey of Benthic Communities and Substrate in Vineyard Wind Lease Area OCS-A 0501 South Study Area

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SMAST-CE-REP-2020-075

Project Summary: The University of Massachusetts Dartmouth School for Marine Science and Technology (SMAST) conducted drop camera surveys to examine the benthic community and substrate in the southern portion of Vineyard Wind's Outer Continental Shelf (OCS) Lease Area OCS-A 0501 (501S Study Area). The primary goal of this project was to collect preliminary data to help determine the sampling intensity needed to collect enough baseline data for environmental assessment of windfarm development impact. Our objectives were to provide:

1) distribution and density estimates of dominant benthic megafauna, and
2) classify substrate across the survey domain.

We utilized a centric systematic sampling design to sample 13 stations in the 501S Study Area. Stations were placed 5.6 km apart following a grid design. At each station a sampling pyramid was deployed, and a high-resolution camera was used take four quadrats (2.3 m^2 images) samples. The area was surveyed in July and October 2019 using a commercial scallop vessel to deploy the sampling pyramid. Eleven different benthic animal groups were observed in the 501S Study Area. Decreases in animal occurrence in October, except skates, can be seen but wide confidence intervals were associated with most observations. The animals appeared randomly distributed in the area. Sand and silt were the only substrate types observed and were present at all stations.

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Introduction

In 2015, Vineyard Wind LLC leased a 675 km^2 area for renewable energy development on the Atlantic Outer Continental Shelf (OCS) named Lease Area OCS-A 0501, located approximately 14 miles south of Martha's Vineyard off the south coast of Massachusetts. Vineyard Wind is developing the southern portion of Lease Area OCS-A 0501 and fisheries surveys are occurring within the "501 South (501S) Study Area," which is the focus of this report. Vineyard Wind is also conducting fisheries studies within the northern portion of Lease Area OCS-A 0501 (the "501 North Impact Area"), considered the development area, and within Lease Area OCS-A 0522 (the "522 Study Area"); these studies are reported separately.

The University of Massachusetts Dartmouth School for Marine Science and Technology (SMAST) has developed a minimally invasive, image-based drop camera survey that allows for practical data collection of the epibenthic community without causing a disturbance to the seafloor. The SMAST drop camera survey can be used to better understand benthic macrofaunal community characteristics, substrate, and the spatial and temporal scales of potential impacts on these communities and habitats. The survey techniques were developed collaboratively with scallop (*Placopecten magellanicus*) fishermen and apply quadrat sampling methods based on diving studies (Stokesbury and Himmelman 1993, 1995). Initial surveys in the early 2000s focused on estimating the density of scallops within closed portions of the U.S Georges Bank fishery and the survey approach has since expanded to cover most of the scallop resource in U.S. and Canadian waters (≈100,000 km^2, Figure 1). Information from the survey has been incorporated into the scallop stock assessment through the Stock Assessment Workshop process and reliably provided to the New England Fisheries Management Council to aid in annual scallop harvest allocation (NEFSC 2010, 2018).

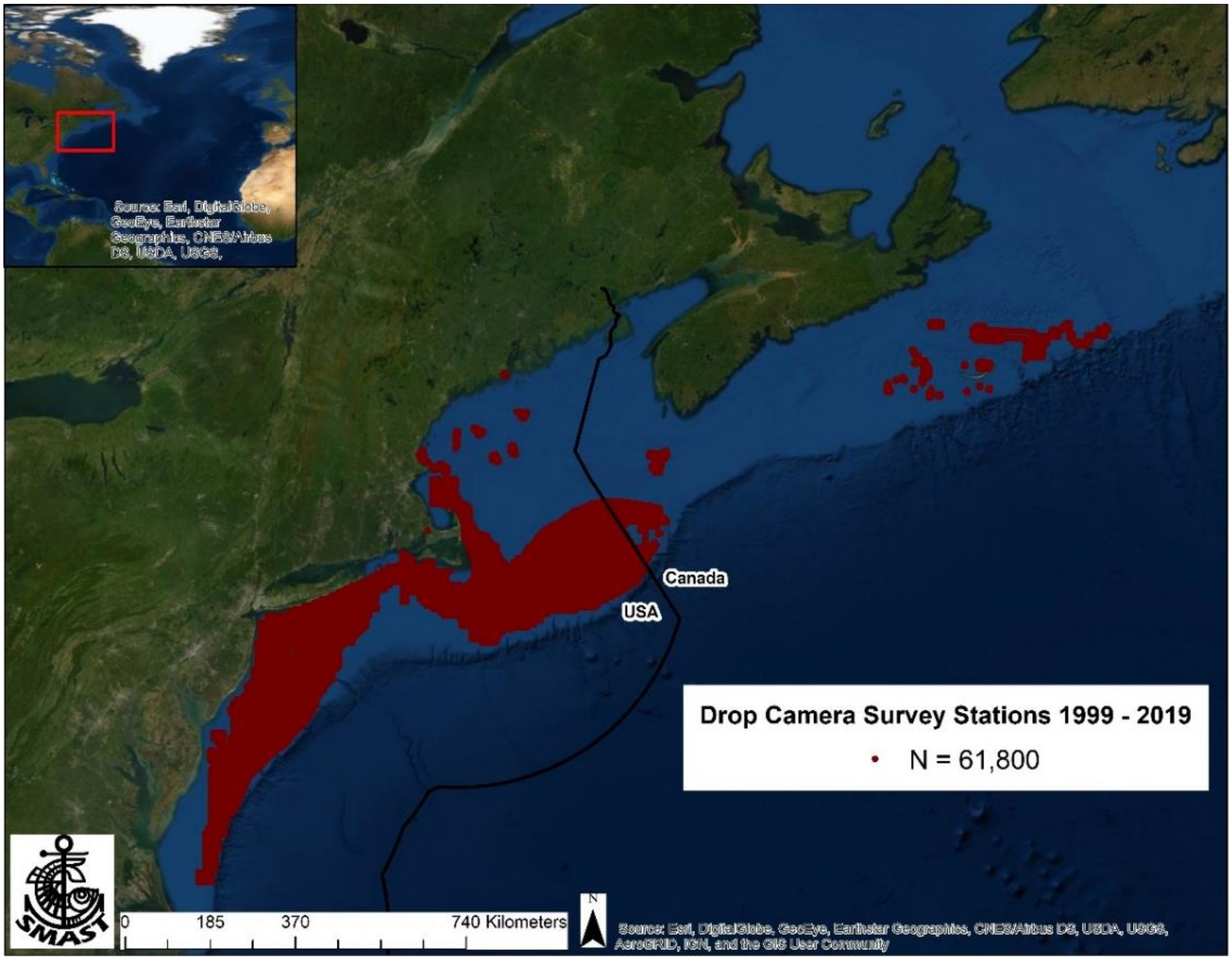

Figure 1. Spatial extent of SMAST drop camera surveys in the northern hemisphere. All stations surveyed since 1999 are displayed.

Data from the drop camera survey has contributed in numerous ways to understanding the ecology of non-scallop species (Marino et al. 2009, MacDonald et al. 2010, Bethoney et al 2017, Asci et al. 2018, Rosellon-Druker and Stokesbury 2019) and the characterization of benthic habitat (Stokesbury and Harris 2006, Harris and Stokesbury 2010, NEFMC 2011, Harris et al. 2012). This work contributed to several ecosystem-based management activities such as the New England Fisheries Management Council Swept Area Seabed Impact model (NEFMC 2011). Drop camera surveys have also been used to define habitat characteristics and spatial distribution of benthic marine invertebrates in potential wind energy areas off the coasts of Maryland and southern New England (Guida et al 2017). Ecologically and economically important species that would be difficult to sample with a net or dredge, such as longfin squid (*Doryteuthis pealeii*) egg clusters or habitat forming filamentous fauna (bryozoans or hydrozoans), can be counted using the drop camera survey (Figure 2).

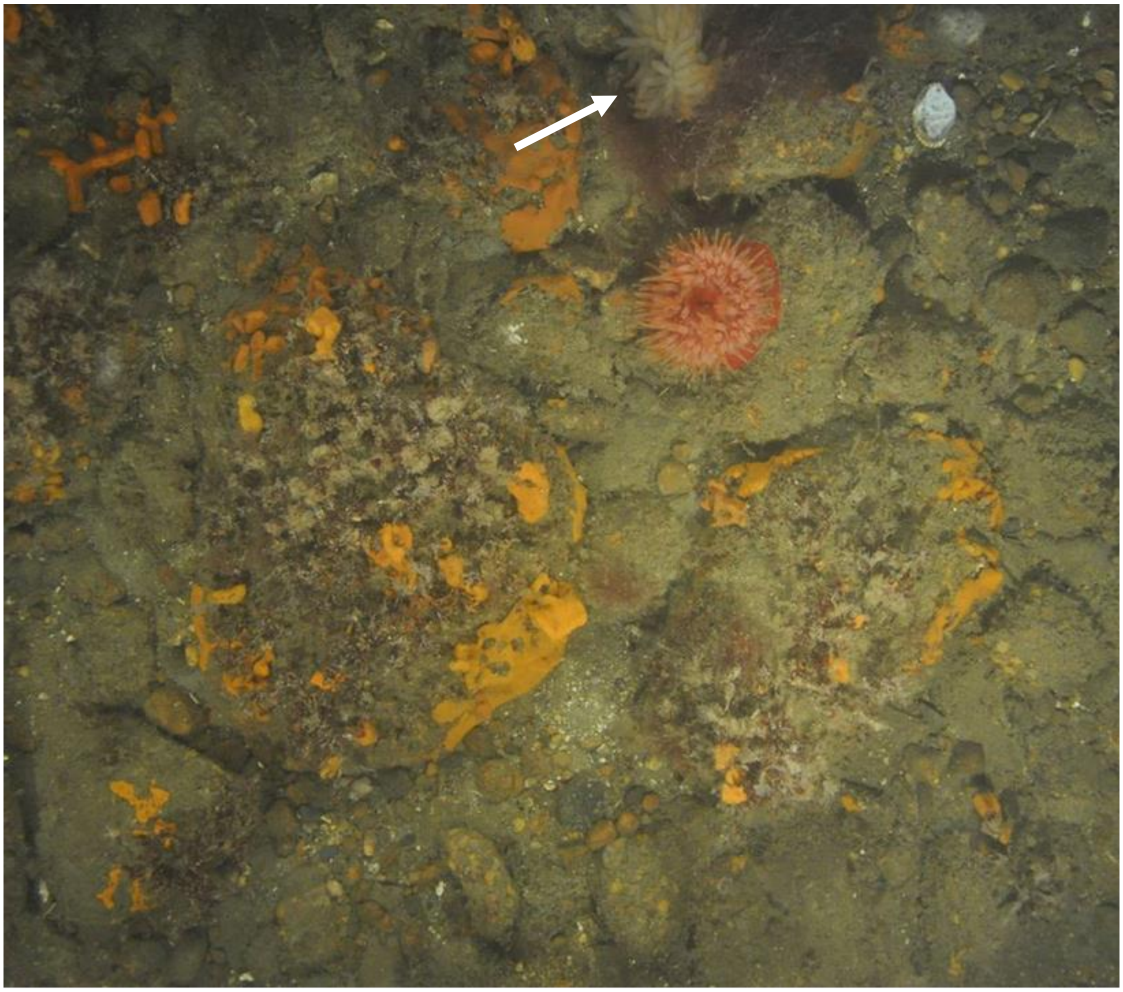

Figure 2. Example digital still image taken by the SMAST drop camera survey in complex habitat of the Rhode Island Wind Energy Lease Area, on Cox's Ledge during a survey in 2013. A longfin squid *(Doryteuthis pealeii*) egg cluster is present (top, middle).

The data collected by the drop camera survey can be used in an impact assessment to determine whether a change to the environment occurred due to a specific stressor, such as wind development, and to what extent the components are affected (Smith 2006). The Before-After Control-Impact (BACI) study is an experiment designed for assessing anthropogenic impacts on natural habitats and is particularly useful in large-scale anthropogenic disturbances or environmental management (Green 1979; Underwood 1991; Kerr et al. 2019). To account for naturally fluctuating characteristics, a designated area outside of the impact area, but containing similar environments and communities, is chosen to be the control site (Eberhardt 1976). The approached is strengthened with an asymmetrical design that uses multiple control sites at different distances from the impact site, incorporating the concepts of Beyond BACI (Underwood 1993) and Before After Gradient (Elllis and Scheider 1997). The standardized, systematic approach of the drop camera survey allows each survey the potential to become a dataset integrated into this design with the ultimate goal of comparing epibenthic faunal variance between impact and control sites over time. Based on the drop camera survey's history and this analytical approach, drop camera surveys within and near areas slated for offshore wind energy development will aid in building a regional, standardized baseline dataset needed to address development impacts on epibenthic communities and habitats.

Goal and Objectives

The primary goal of this project was to collect preliminary data on the benthic community and substrate in the southern portion of Vineyard Wind's OCS Lease Area OCS-A 0501 (501S Study Area). This data could be used to help determine the sampling intensity needed to collect enough baseline data for environmental assessment of wind energy development impact in the 501S Study Area. To do this we used information from drop camera surveys of the 501S Study Area during two different time periods to (Figure 3):

1) Map the distribution and estimate the density of dominant benthic megafauna

2) Classify substrate types

These two objectives documented the primary epibenthic animals and habitats within the 501S Study Area help identify the sampling intensity needed for future analysis of variance. They also document seasonal changes in distribution and density.

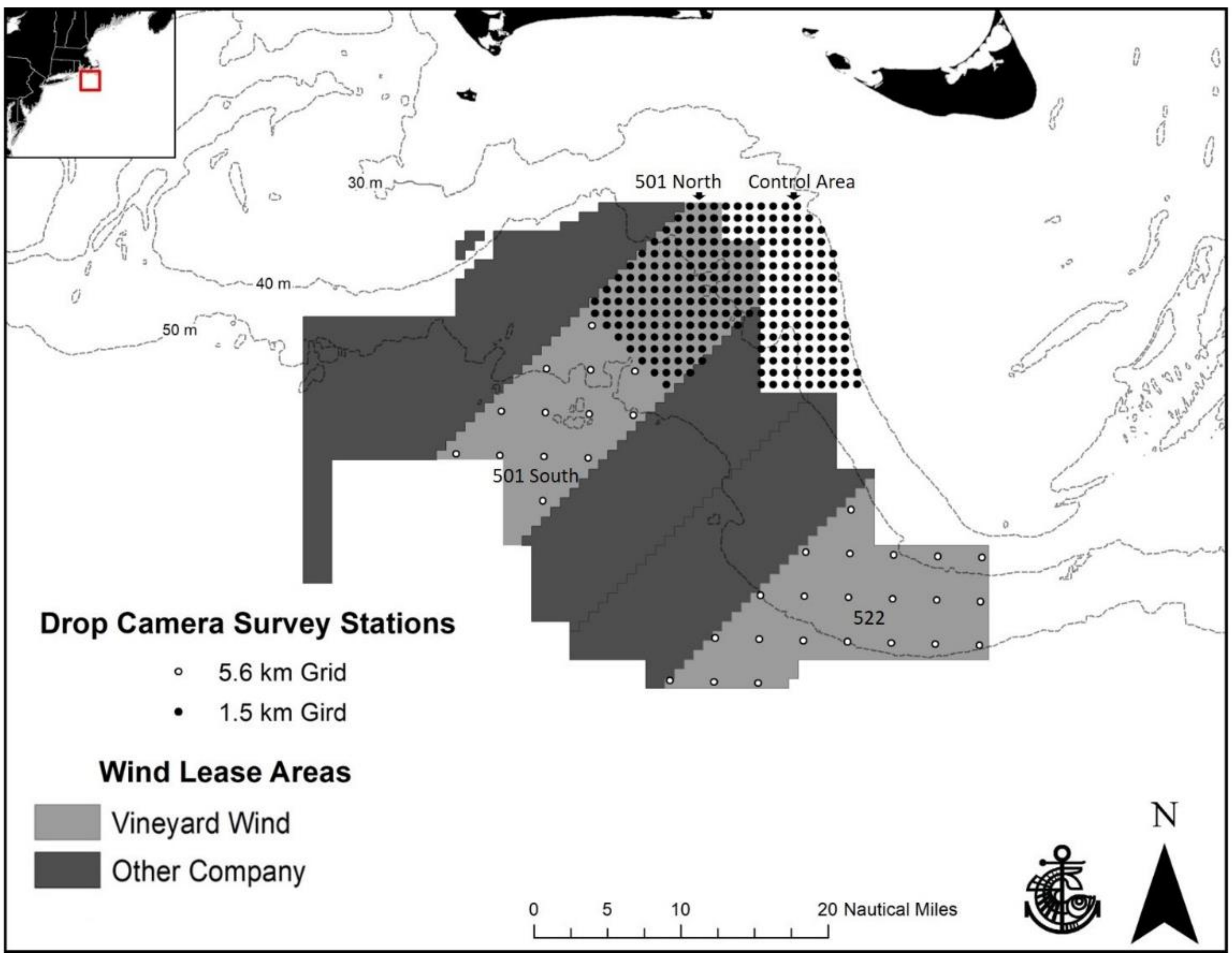

Figure 3. 2019 Drop camera survey station grids and Wind Energy Lease Areas.

Methods

We utilized a centric, systematic sampling design to sample survey stations in the 501S Study Area. Stations were placed 5.6 km apart following a grid design (Figure 3). At each station a sampling pyramid was deployed, and a high-resolution camera was used take four quadrat (2.3 m^2 images) samples (Figure 4). This provided the same sampling resolution as the 2012 and 2013 drop camera surveys of Massachusetts Wind Energy Area (Stokesbury 2012, 2014). The information from these surveys was used to determine the 1.5 km station distance applied to the 501 North Impact and Control Areas (Figure 3).

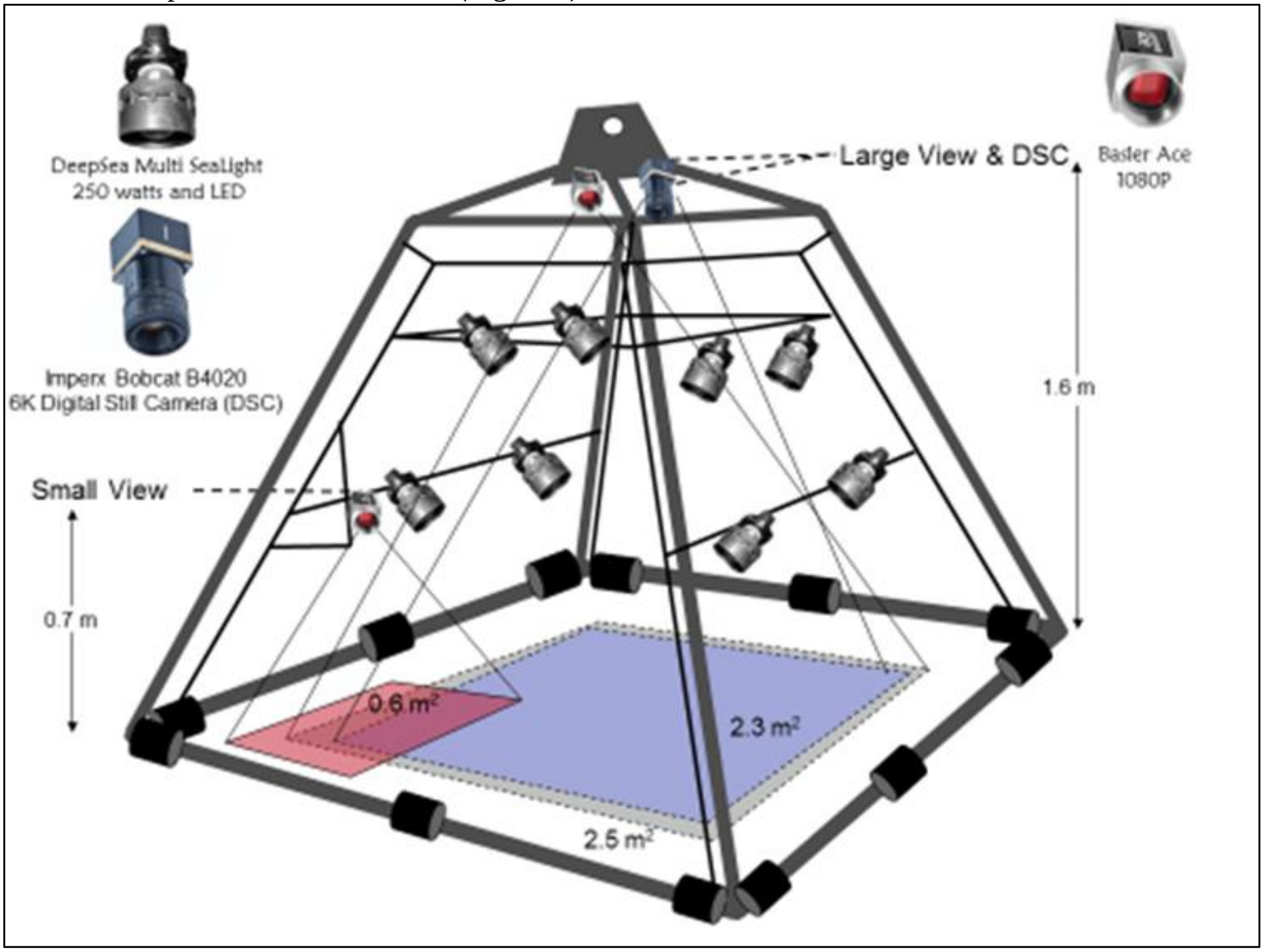

Figure 4. SMAST drop camera survey pyramid with cameras and lights used for data collection. The camera used for the small view was turned to the side to provide a view parallel to the seafloor for some stations.

At each station, we deployed the drop camera pyramid (Figure 4) affixed with cameras and lights to the seafloor from a commercial fishing vessel (Stokesbury 2002, Stokesbury et al. 2004, Bethoney and Stokesbury 2018). A mobile studio including monitors, computers for image capturing and data entry, and survey navigation (software integrated with the differential global positioning system) was assembled in the vessel's wheelhouse. The two downward facing cameras mounted on the sampling pyramid provided 2.3 m^2 and 2.5 m^2 quadrat images of the sea floor for all stations. Additionally, a third camera providing a 0.6 m^2 view or view parallel to the seafloor was also deployed. Images from all cameras and video footage from the 2.5 m^2 quadrat view of the first quadrat was saved and then the pyramid was raised, so the seafloor could no longer be seen. The vessel was allowed to drift approximately 50 m and the pyramid was lowered to the seafloor again to obtain a second quadrat; this was repeated four times, so that each station had four images from each camera. Onboard the survey vessel, scallop counts, station location, and depth were recorded and saved through a specialized field application for entry into a SQL Server Relational Database Management System.

After the survey, the high resolution digital still images were used as the primary data source (Figure 2). Other images and video collected were used as aids. Within each quadrat, macrobenthos were counted or noted as present, and the substrate was identified (Stokesbury 2002, Stokesbury et al. 2004, Bethoney and Stokesbury 2018). Fifty taxa of macrobenthos are identified if present in the sample, counted or noted as present or absent (Appendix I). For animals noted as present, the percent of a quadrat they were present within was calculated by portioning the quadrat into equal sized cells and recording presence or absence for each cell. In addition, longfin squid egg clusters *(Doryteuthis pealeii*), which are not typically enumerated, were counted. Sediments were visually identified following the Wentworth particle grade scale from images, where the sediment particle size categories (in grain diameters) are based on a doubling or halving of the fixed reference point of 1 mm; sand = 0.0625 to 2.0 mm, gravel = 2.0 to 256.0 mm and boulders > 256.0 mm (Lincoln et al. 1992). Gravel was divided into two categories, granule/pebble = 2.0 to 64.0 mm and cobble = 64.0 to 256.0 mm (Lincoln et al. 1992). The presence of each sediment category was noted for each image. Maps and analysis focused on classifying stations by the largest sediment particle size observed in a digital still image from that station (Harris and Stokesbury 2010). Shell debris was also identified. After the images were digitized, a quality assurance check was performed on each image to ensure accuracy of counted and identified species and sediments.

Mean densities and standard errors of animals counted were calculated using equations for a two-stage sampling design where the mean of the total sample is (Cochran 1977):

$$\bar{\bar{x}} = \sum_{i=1}^{n} \left(\frac{\bar{x}_i}{n} \right)$$

where *n* is the number of stations and $\bar{x}_i$ is the mean of the 4 quadrats at station *i*. The SE of this 2-stage mean was calculated as:

$$S.E.(\bar{x}) = \sqrt{\frac{1}{n}(s^2)}$$

where:

$$s^2 = \sum^{n} (\bar{x}_i - \bar{\bar{x}})^2 / (n-1)$$

According to Cochran (1977) and Krebs (1989) this simplified version of the 2-stage variance is appropriate when the ratio of sample area to survey area (*n*/*N*) is small. In this case, thousands of square meters (*n*) are sampled compared with millions of square meters (*N*) in the study area. A similar multi-stage approach was used to calculate mean presence values. Mean density or quadrats present per station within the 501S Study Area were mapped (Figures 7-20). The analysis was limited to the most common benthic animal groups in the 501S Study Area, to focus results on the groups detected at high enough rates for future analysis of variance (Bethoney et al. 2017). Densities for animal group were compared by graphing mean estimates with their associated 95% confidence intervals (Sokal and Rohlf 2012).

Results and Discussion

The two drop camera surveys of the 501S Study Area were conducted on July 15th-16th and October 18th-19th 2019. All images and video collected were shared with Vineyard Wind. All 13 stations in the area were surveyed in July and October. Eleven different benthic animal groups were observed in the 501S Study Area (Table 1). These groups were similar to the dominant groups in the 501N Impact Area with the addition of sea stars and flat fishes. Decreases in animal occurrence in October, except skates, can be seen but wide confidence intervals are associated with most observations (Figures 5 & 6). The animals appear randomly distributed in the area, though waved whelks waved whelks (*Buccinum undatum*, not the commercially harvested channeled whelk, *Busycotypus canaliculatus*), sea stars, crabs (caner spp.), and skates may have been observed more in stations deeper than 50 meters (Figures 7-20). Sand was the largest substrate type at all stations in both July and October. Sand and silt were the only substrate types observed and were present at all stations.

Table 1. Benthic animal groups, in order of most to least quadrats present, during the 2019 SMAST drop camera survey of the 501S Study Area. Groups left blank in the “Counts” column are tracked as present or absent.

Animal Group	Quadrats Present	Counts
Bryozoans/Hydrozoans	52	
Holes (burrowing animals)	50	
Hermit Crabs	12	14
Anemones	10	
Common Whelk	10	12
Sea Stars	7	8
Flat Fishes	5	6
Red hake	4	4
Crabs (cancer spp.)	4	4
Skates	3	3
Silver hake	3	3

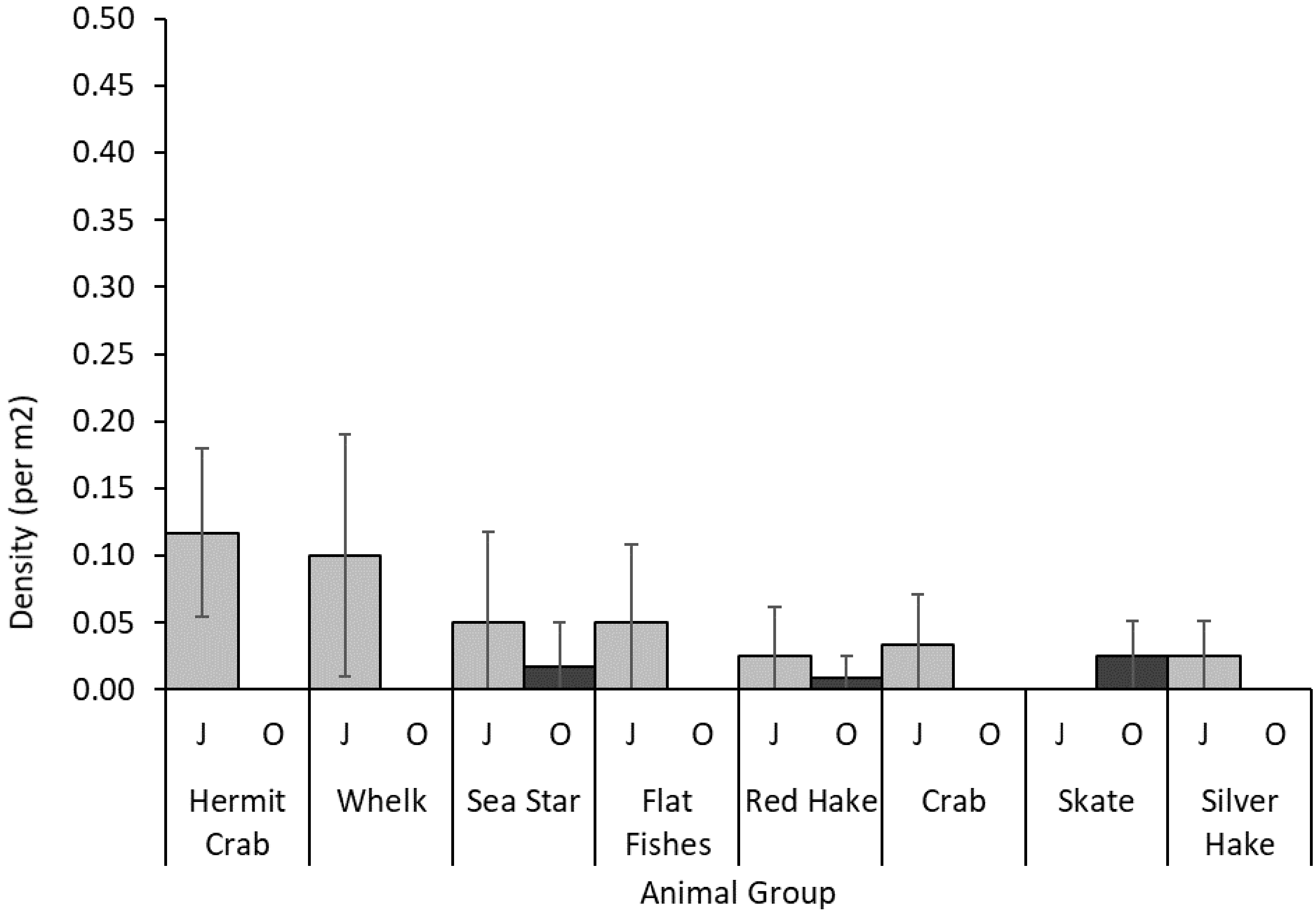

Figure 5. Density of benthic animals found in the July (J) and October (O) 2019 drop camera surveys of the OCS 501S Study Area. Error bars are 95% confidence intervals.

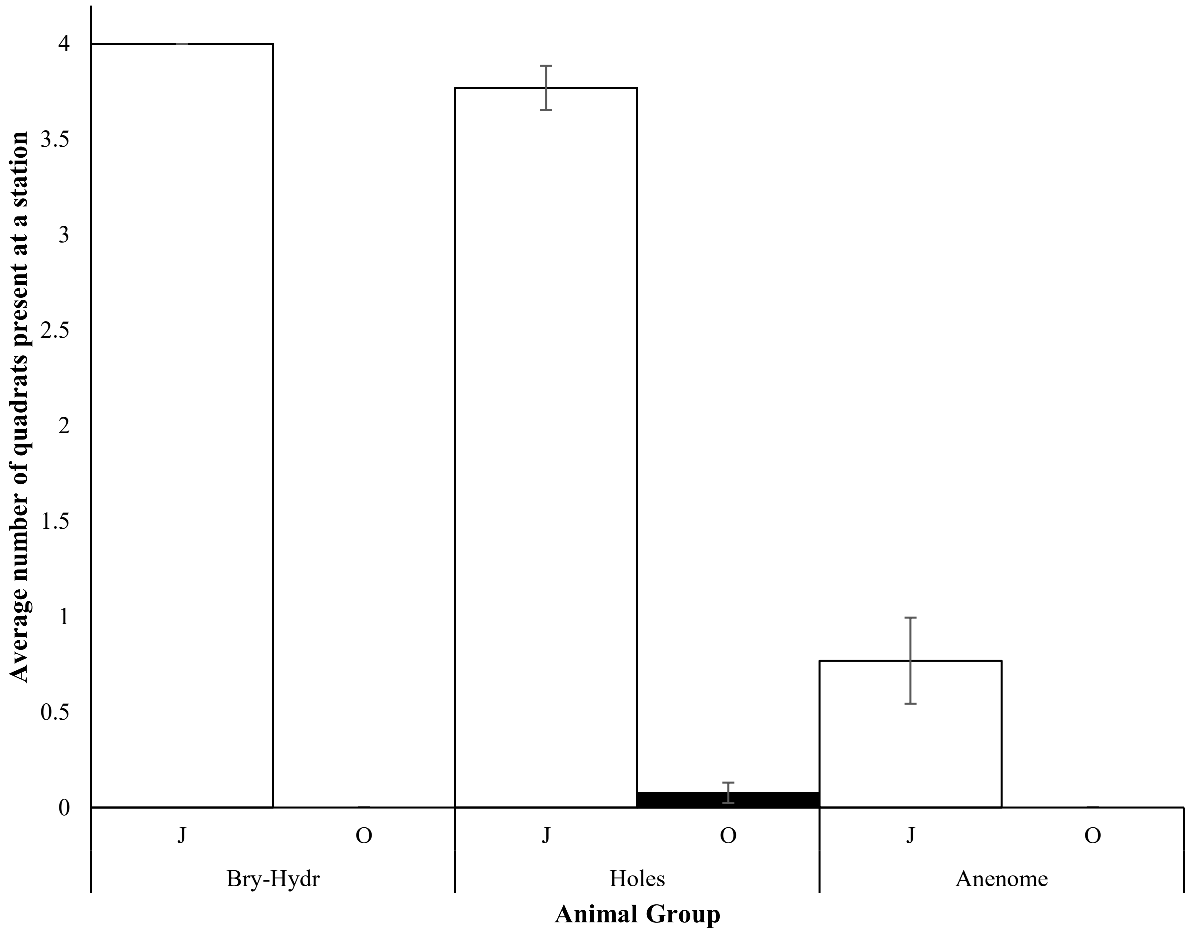

Figure 6. The average number of quadrats benthic animals were present in at each station during the July (J) and October (O) 2019 drop camera surveys of the OCS 501S Study Area. Holes represent burrowing animals and Bry-Hydr indicates bryozoans and hydrozoans. Four quadrats (2.3m^2 images) were observed at each station.

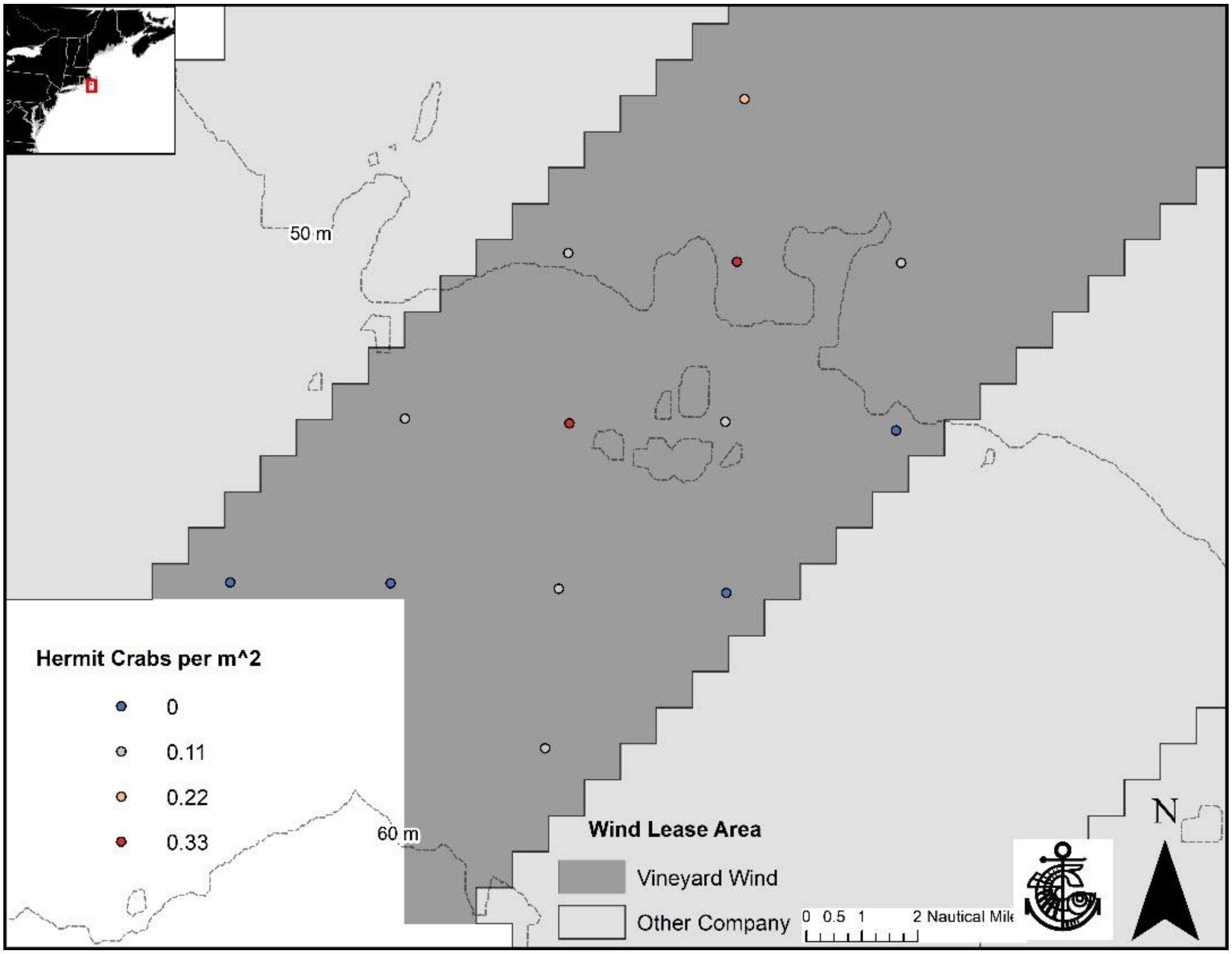

Figure 7. The distribution of hermit crabs in the 2019 July drop camera survey of OCS 501S Study Area. No hermit crabs were observed in an October survey of the same area. Density categories represent zero, one, two, or three hermit crabs observed at a station.

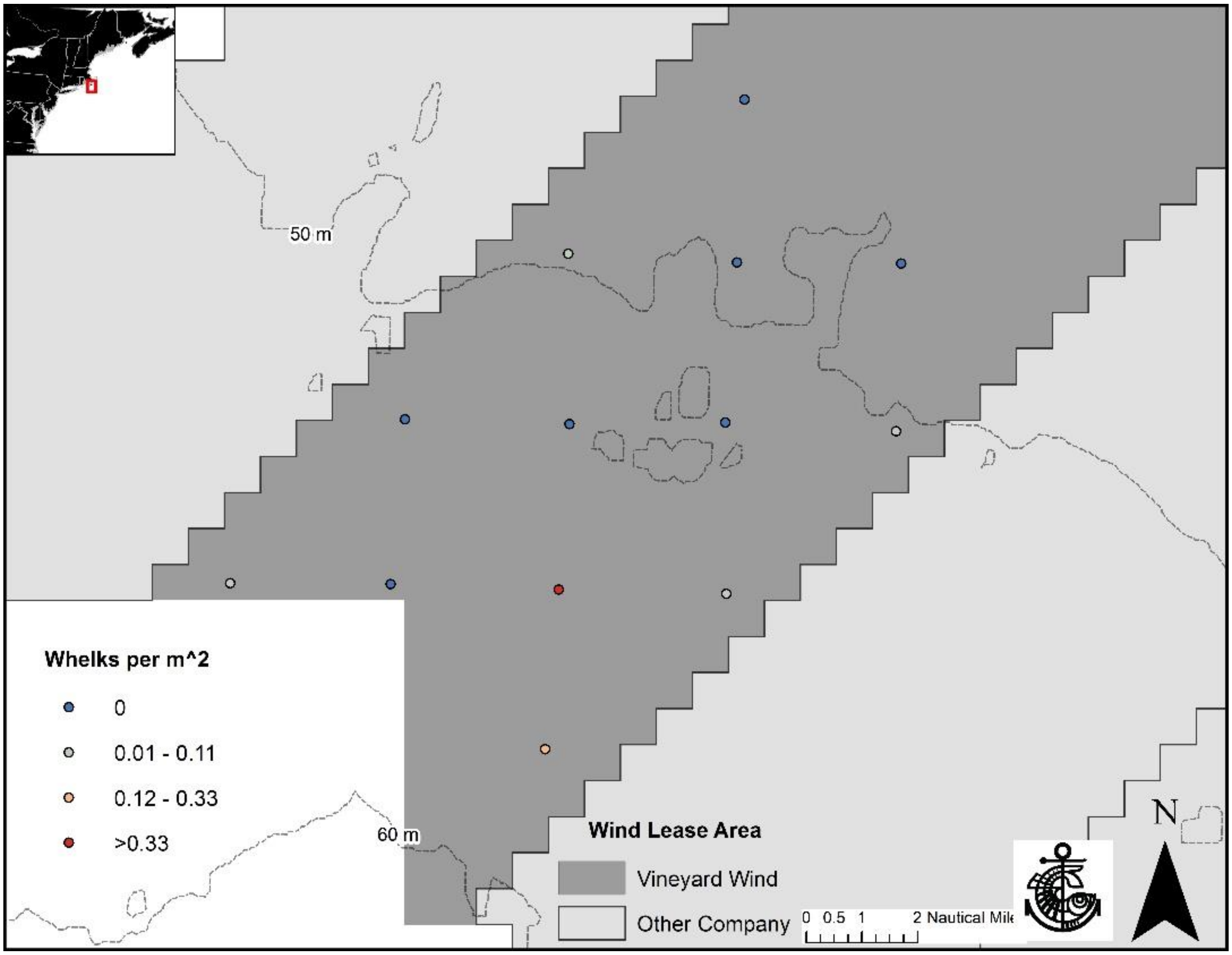

Figure 8. The distribution of waved whelks in the 2019 July drop camera survey of OCS 501S Study Area. No whelks were observed in an October survey of the same area. Density categories equally divide the data above zero.

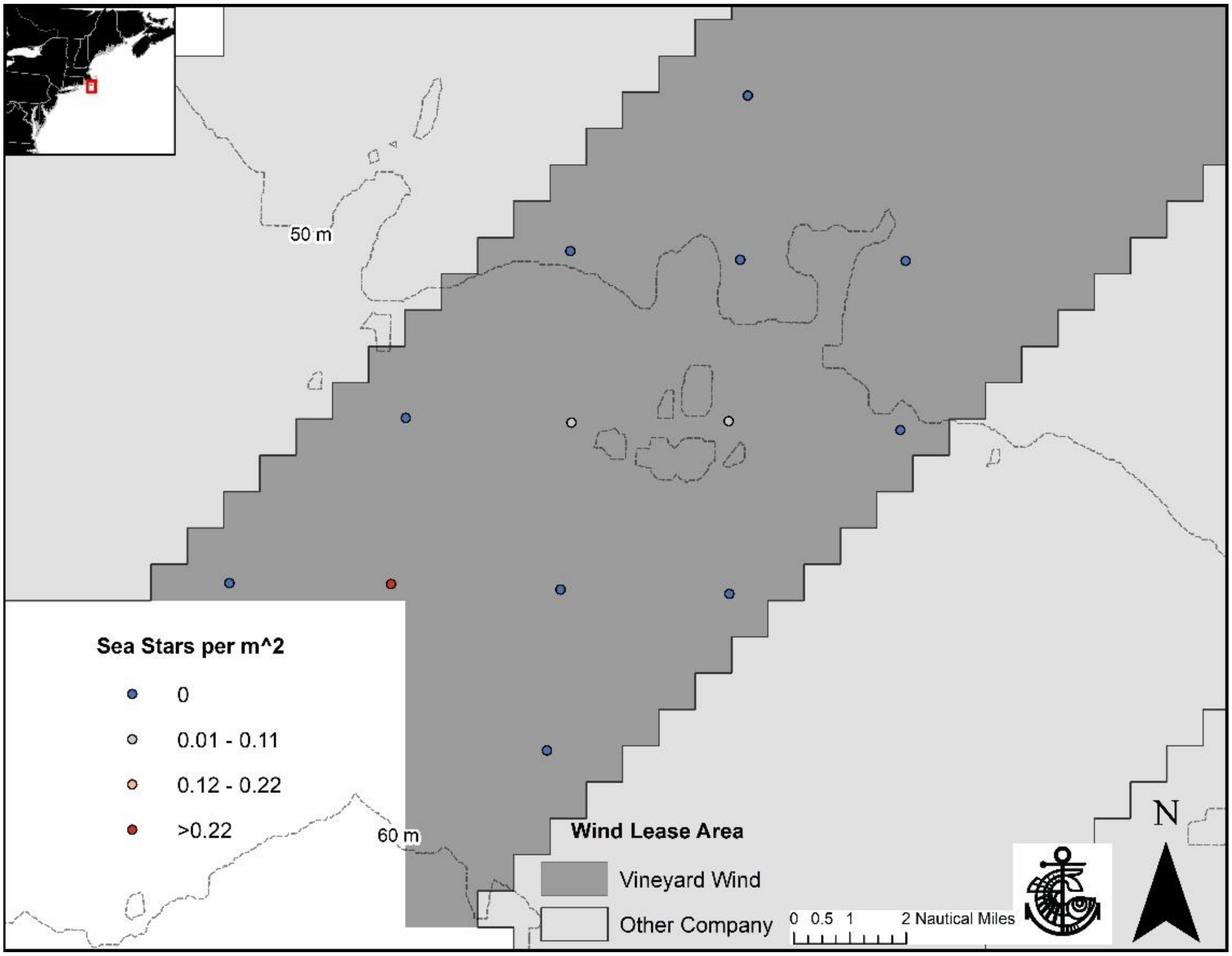

Figure 9. The distribution of sea stars in the 2019 July drop camera survey of OCS 501S Study Area. Density categories equally divide the data above zero based on observations in July and October.

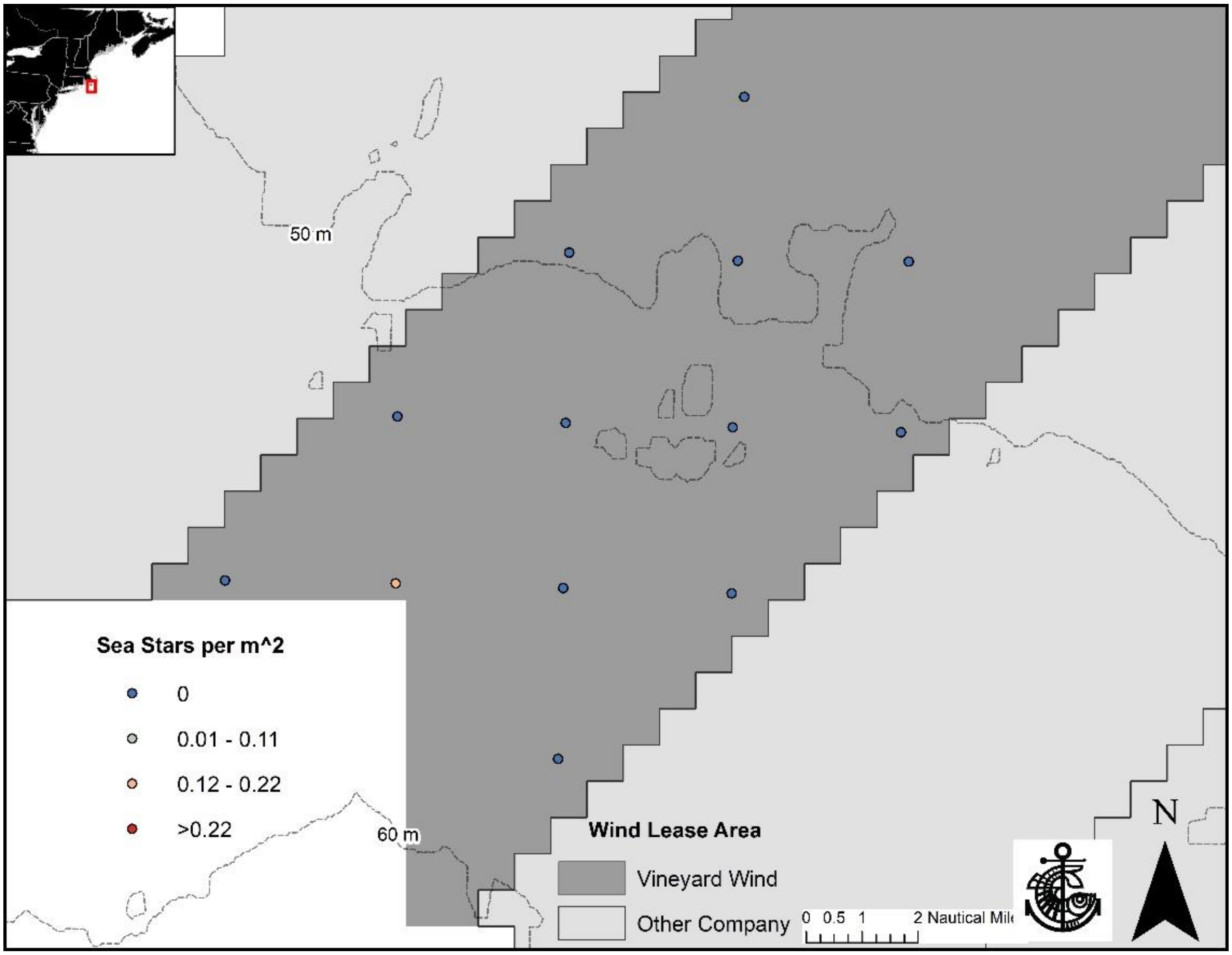

Figure 10. The distribution of sea stars in the 2019 October drop camera survey of OCS 501S Study Area. Density categories equally divide the data above zero based on observations in July and October.

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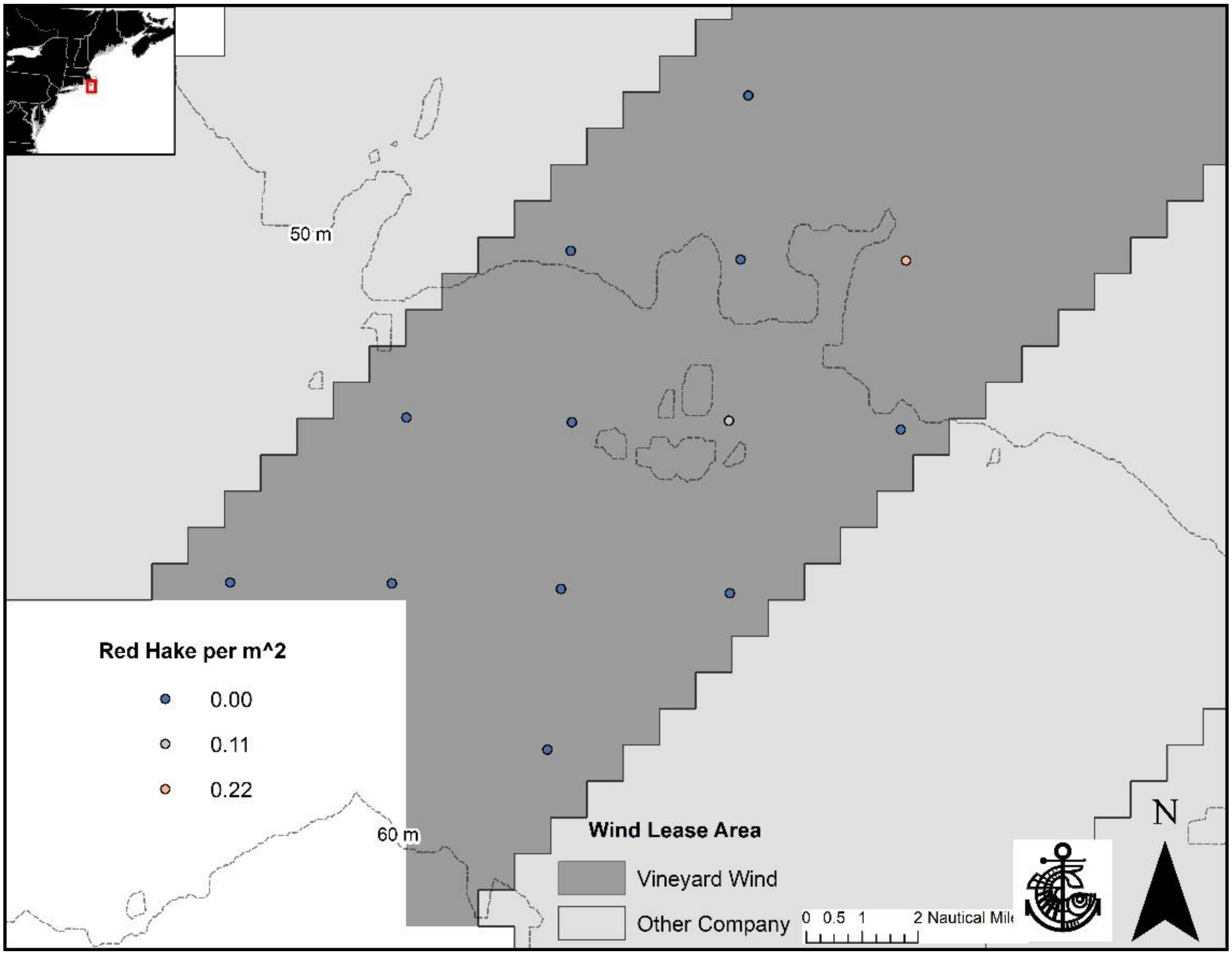

Figure 11. The distribution of red hake in the 2019 July drop camera survey of OCS 501S Study Area. Density categories represent zero, one, or two red hake at a station.

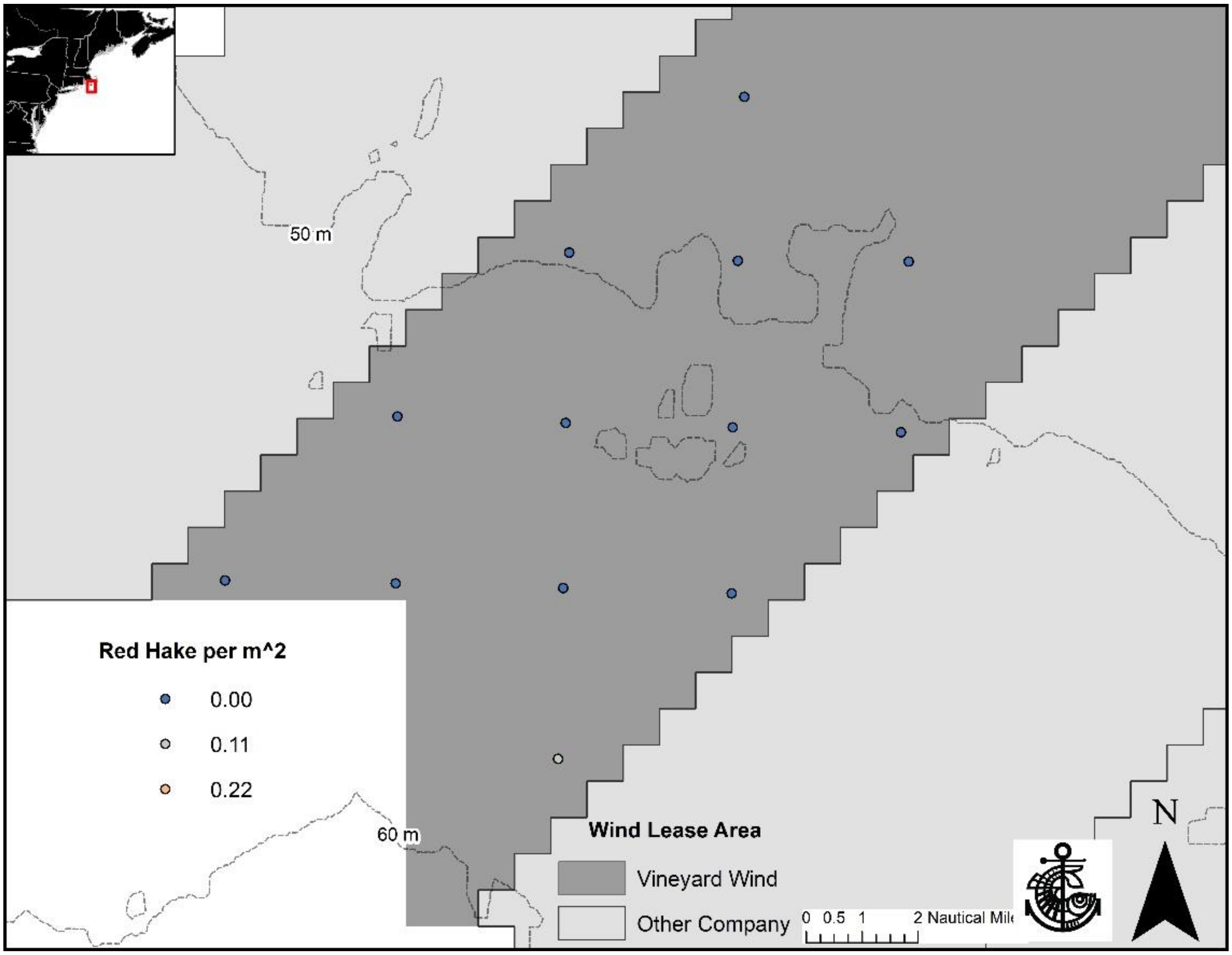

Figure 12. The distribution of red hake in the 2019 October drop camera survey of OCS 501S Study Area. Density categories represent zero, one, or two red hake at a station.

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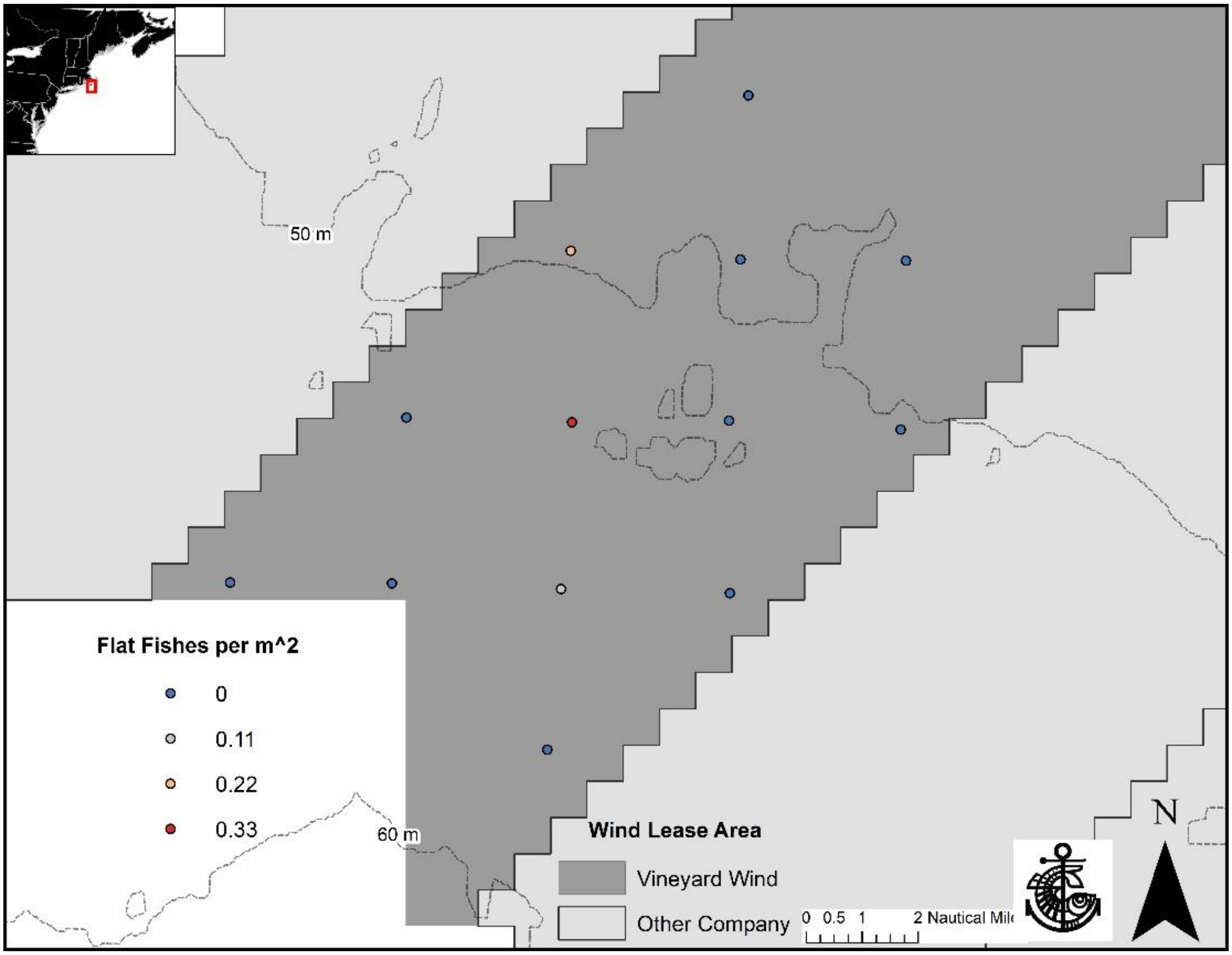

Figure 13. The distribution of flat fishes in the 2019 July drop camera survey of OCS 501S Study Area. No flat fishes were observed in an October survey of the same areas. Density categories represent zero, one, two, or three flat fishes observed at a station.

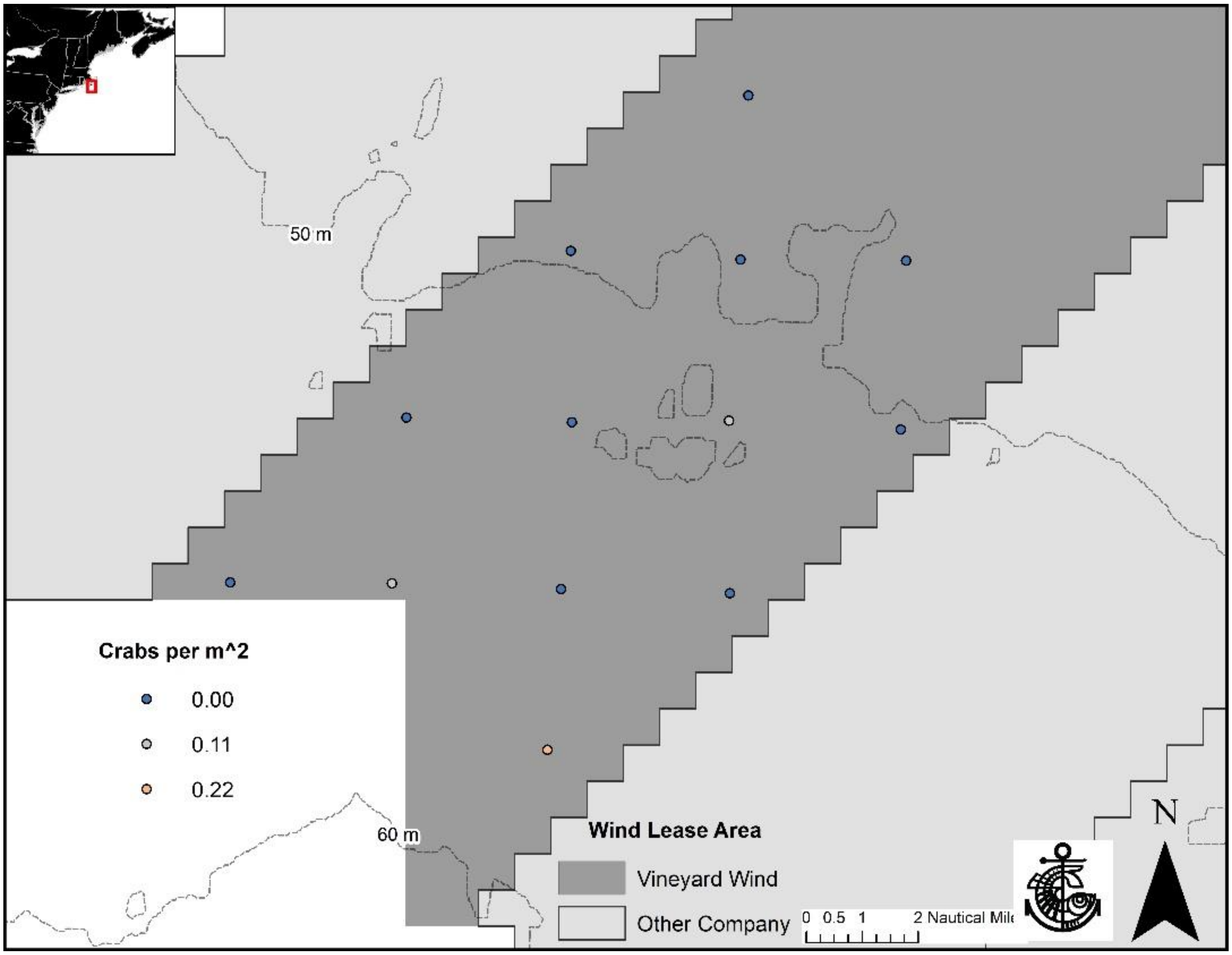

Figure 14. The distribution of crabs in the 2019 July drop camera survey of OCS 501S Study Area. No crabs were observed in an October survey of the same area. Density categories represent zero, one, or two crabs observed at a station.

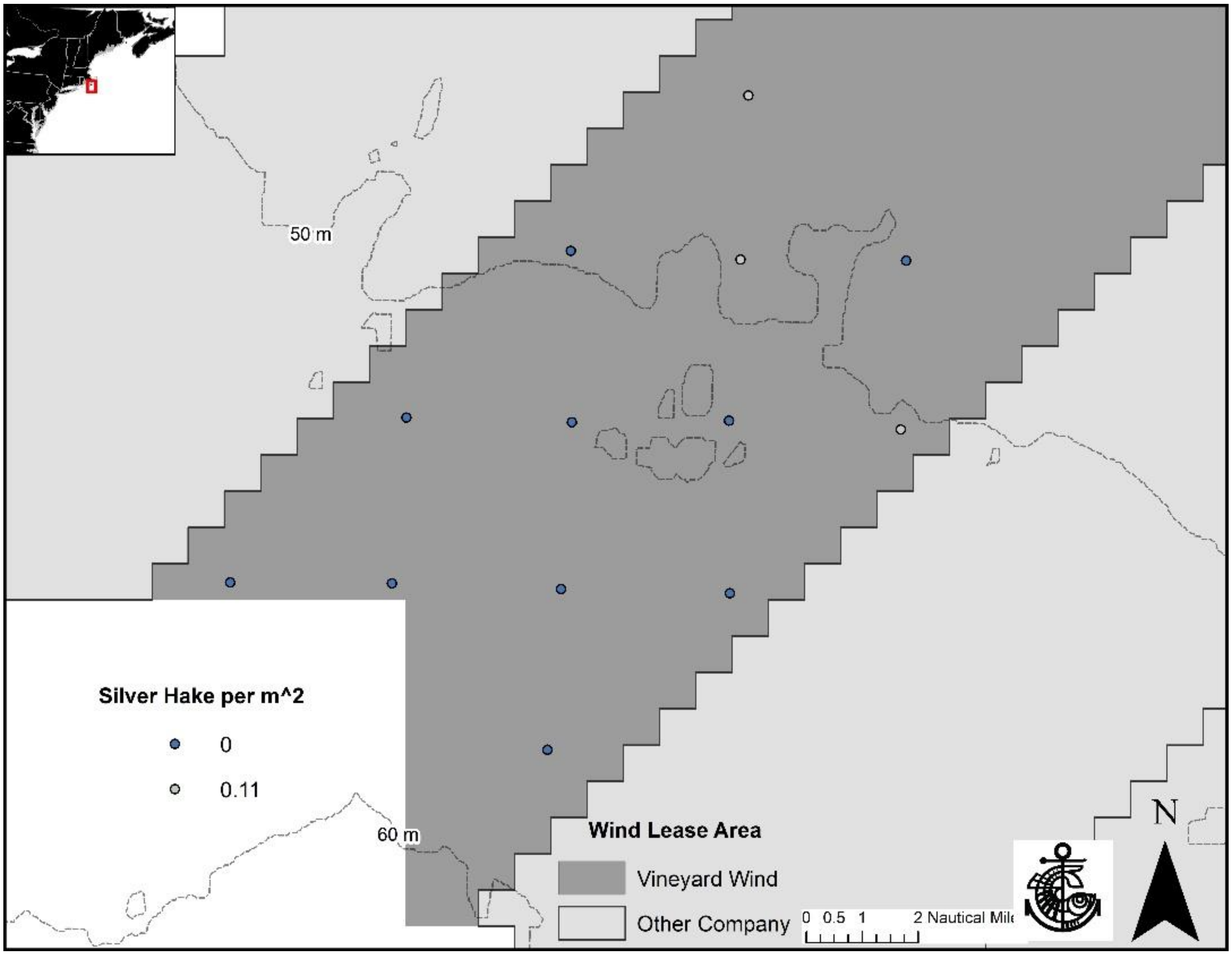

Figure 15. The distribution of silver hake in the 2019 July drop camera survey of OCS 501S Study Area. No silver hake were observed in an October survey of the same area. Density categories represent zero or one silver hake observed at a station.

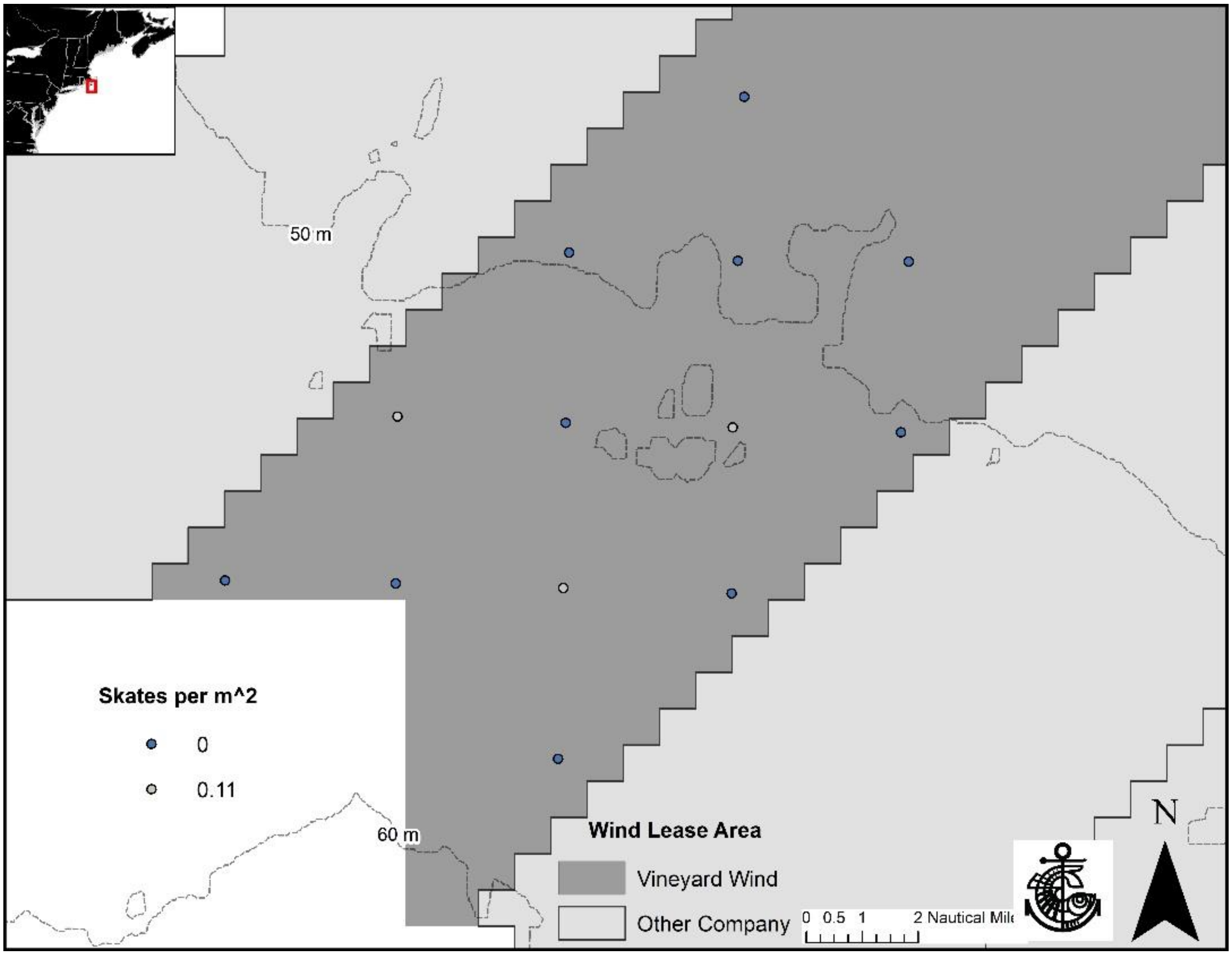

Figure 16. The distribution of skates in the 2019 October drop camera survey of OCS 501S Study Area. No skates were observed in a July survey of the same area. Density categories represent zero or one skate observed at a station.

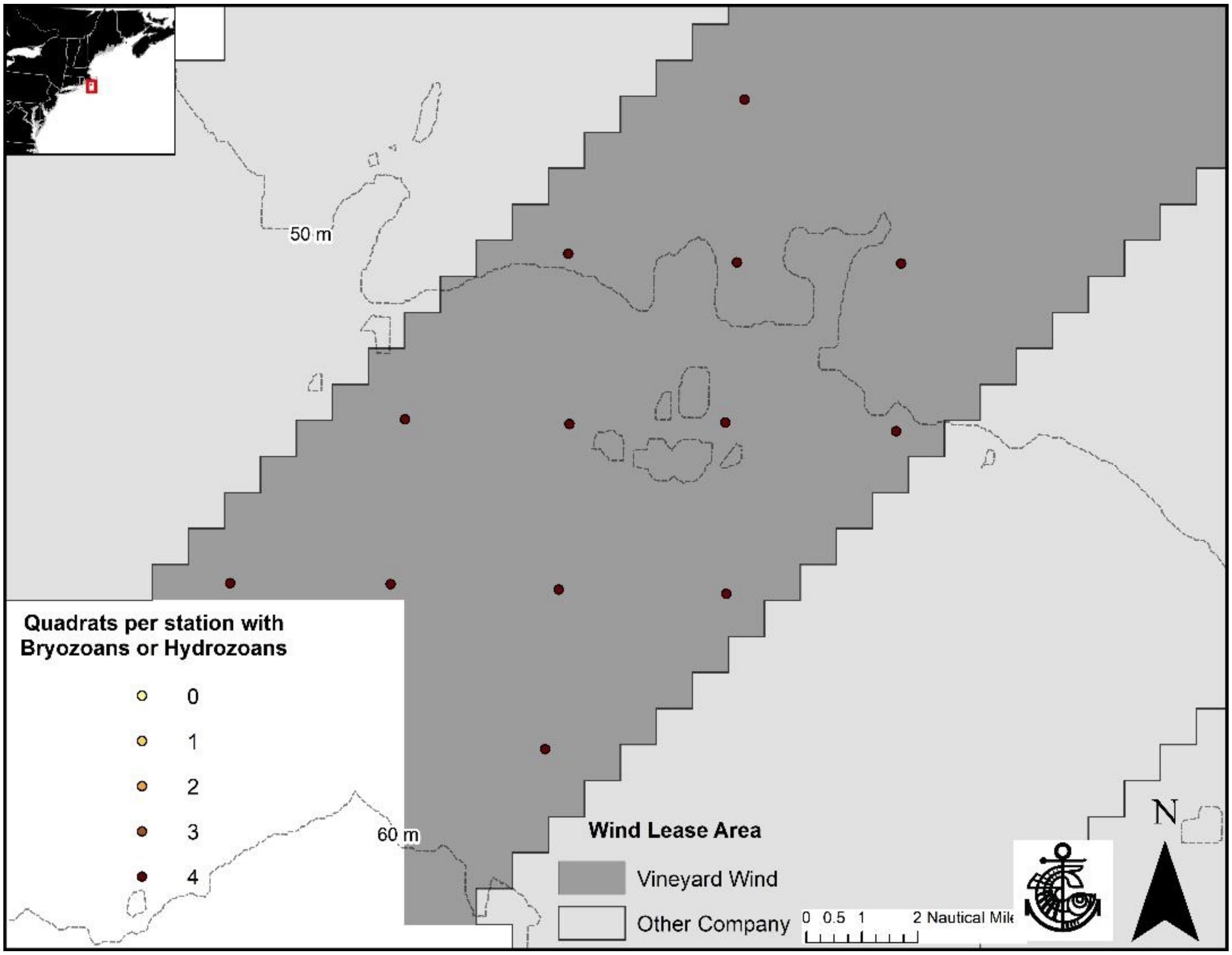

Figure 17. The distribution of bryozoans and hydrozoans in the 2019 July drop camera survey of OCS 501S Study Area. No bryozoans and hydrozoans were observed in an October survey of the same area. Four quadrats (2.3m^2 images) were observed at each station.

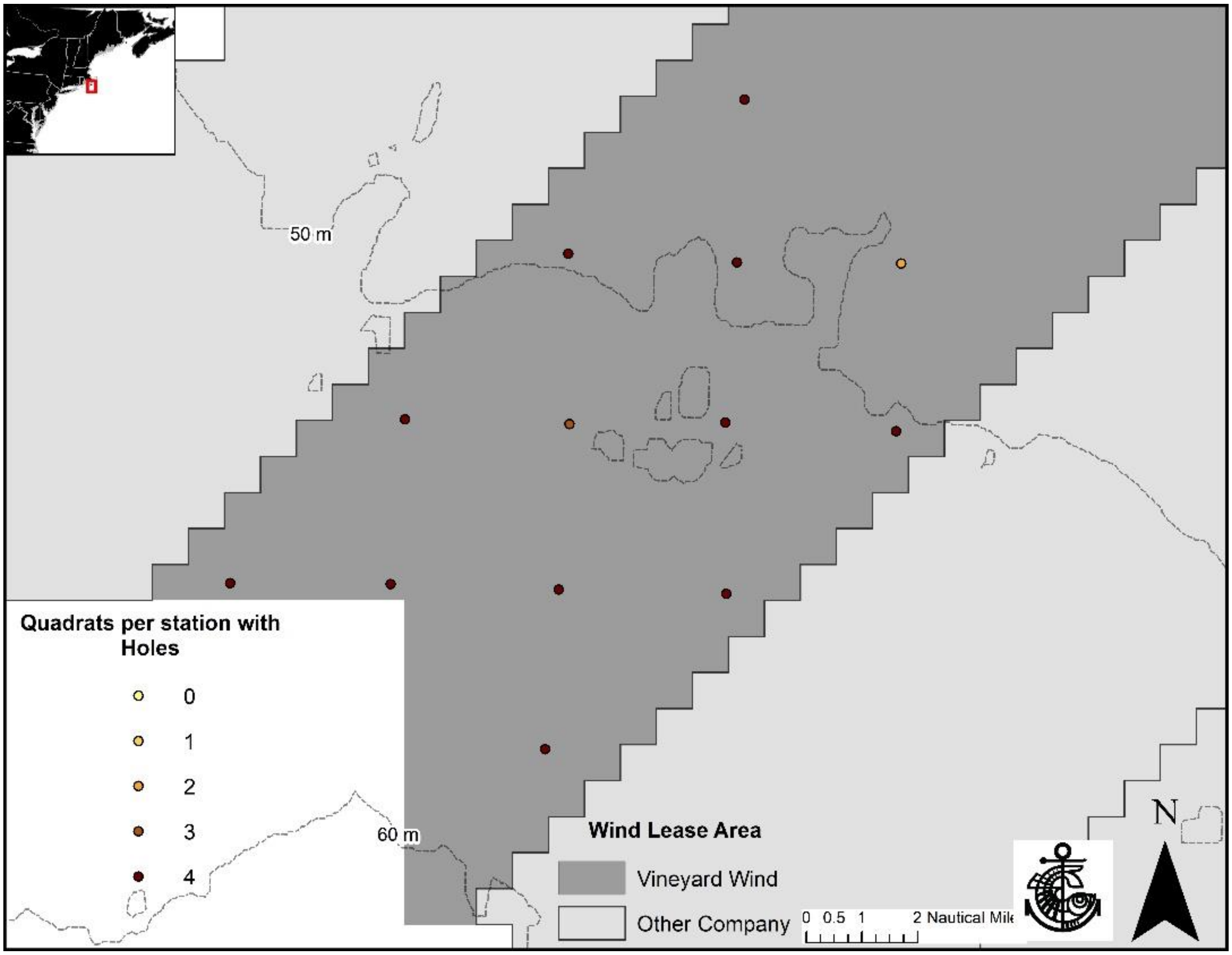

Figure 18. The distribution of holes (burrowing animals) in the 2019 July drop camera survey of OCS 501S Study Area. Four quadrats (2.3m^2 images) were observed at each station.

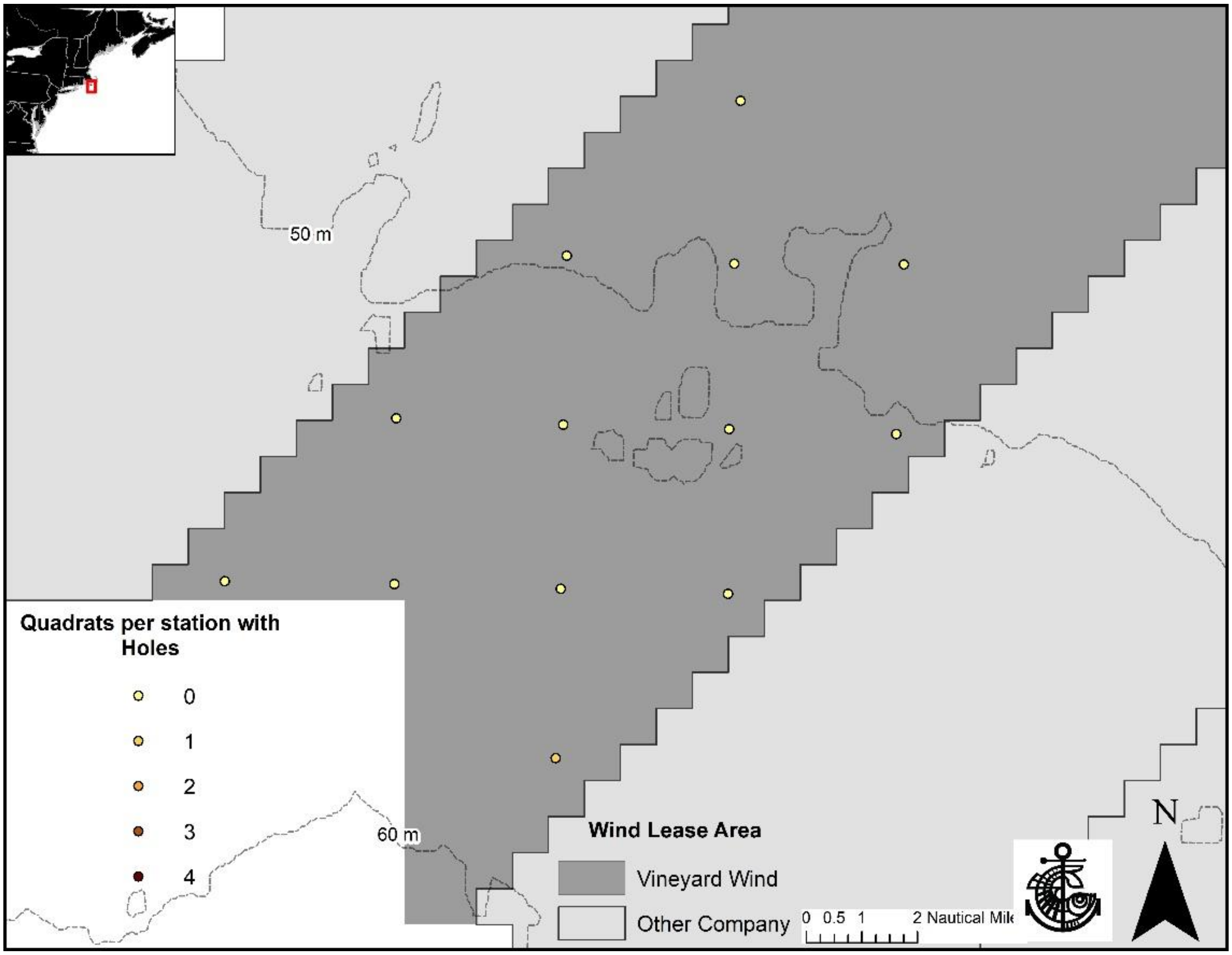

Figure 19. The distribution of holes (burrowing animals) in the 2019 October drop camera survey of OCS 501S Study Area. Four quadrats (2.3m^2 images) were observed at each station.

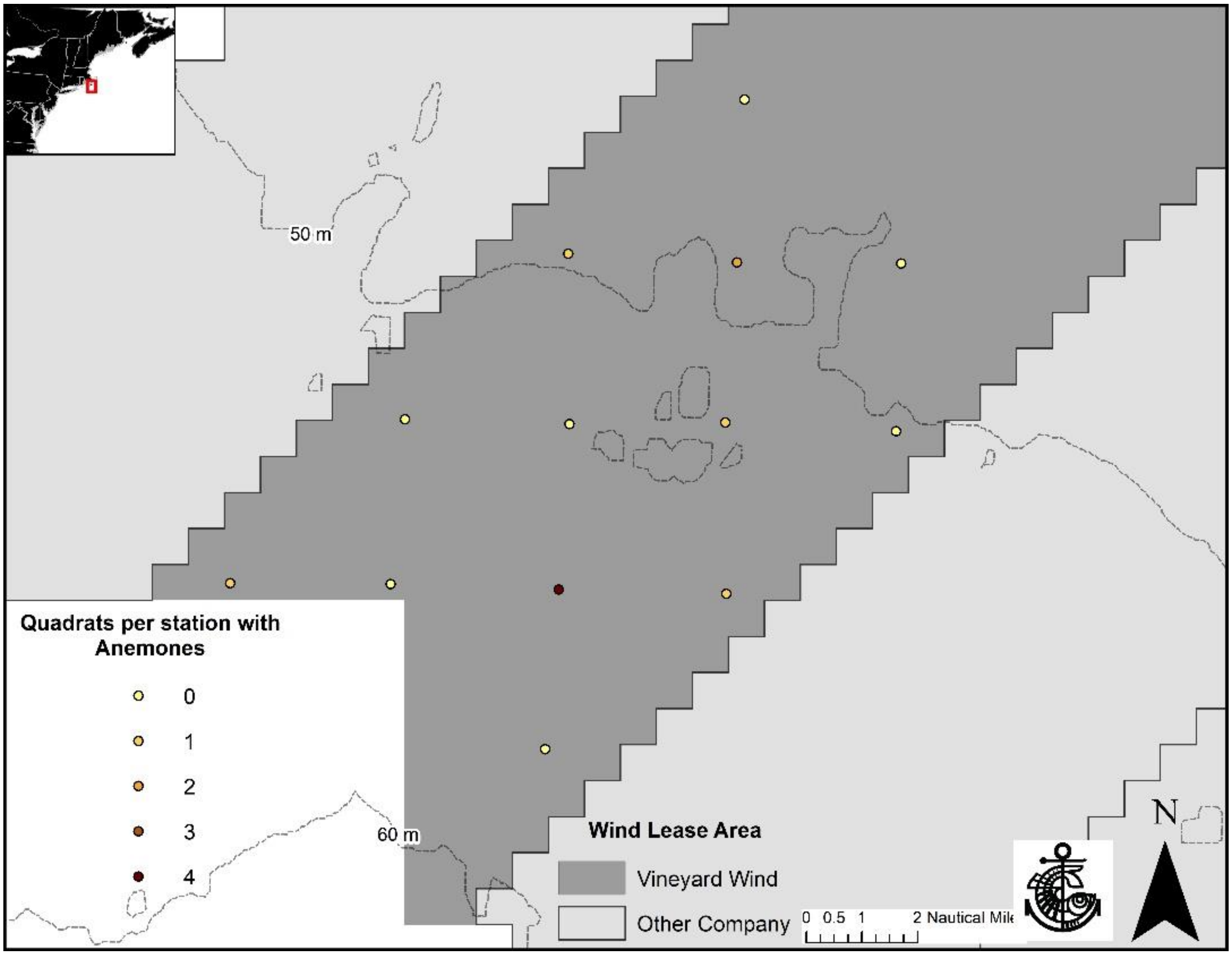

Figure 20. The distribution of anemones in the 2019 July drop camera survey of OCS 501S Study Area. No anemones were observed in an October survey of the same area. Four quadrats ($2.3 m^2$ images) were observed at each station.

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<u>Appendix I:</u> Georges Bank species are grouped into taxonomic categories (Stokesbury and Harris, 2006).

Category	Scientific name	Common name
Scallop	*Placopecten magellanicus*	Sea scallop
Starfishes	*Solaster endeca*	Purple sunstar
	Crossaster papposus	Spiny sunstar
	Leptasterias Polaris	Polar sea star
	Asterias spp.	Sea stars
	Henricia spp	Blood star
Sand dollars	*Echinarachnius parma*	Sand dollar
Bryozoans/hydrozoans	*Flustra foliacea*	Bryozoans
	Callopora aurita	Bryozoans
	Electra monostachys	Bryozoans
	Cribrilina punctate	Bryozoans
	Eucratea loricate	Bryozoans
	Tricellaria ternate	Bryozoans
	Eudendrium capillare	Hydrozoans
	Sertularia cupressina	Sea cypress hydroid
	Sertularia argentea	Squirrel's tail hydroid
	Diphasia fallax	Hydrozoans
	Filograna implexa	Lacy tube worm
Sponges	*Suberites ficus*	Fig sponge
	Haliclona oculata	Finger sponge
	Halichondria panacea	Crumb of bread sponge
	Cliona celata Grant	Boring sponge
	Polymastia robusta	Encrusting sponge
	Isodictya palmate	Palmate sponge
	Microciona prolifera	Red beard sponge
Lobster	*Homarus americanus*	American lobster
Crabs	*Cancer irroratus Say*	Atlantic rock crab
	Cancer borealis Stimpson	Jonah crab
Hermit crabs	*Diogenidae*	Left-handed hermit crabs
	Paguridae	Right-handed hermit crabs
	Parapaguridae	Deep water hermit crabs
Eel pout	*Zoarces americanus*	Ocean pout
Flounder	*Paralichthys dentatus*	Summer flounder
	Paralichthys oblongus	Fourspot flounder
	Scophthalmus aquosus	Windowpane flounder
	Pseudopleuronectes americanus	Winter flounder
	Limanda ferruginea	Yellowtail flounder
	Glyptocephalus cynoglossus	Witch flounder
	Trinectes maculatus	Hogchoaker
Haddock	*Melanogrammus aeglefinus*	Haddock
Hake	*Merluccius bilinearis*	Silver hake
	Urophycis spp.	Red and white hake
Sculpins	*Myoxocephalus octodecemspinosus*	Longhorn sculpin
	Prionotus carolinus	Northern sea robin
Skates	*Leucoraja erinacea*	Little skate
	Leucoraja ocellata	Winter skate
	Dipturus laevis	Barndoor skate
Other fish	*Myxine glutinosa*	Atlantic hagfish
	Scyliorhinus rotifer	Chain dogfish
	Squalus acanthias	Spiny dogfish
	Anguilla rostrate	American eel
	Conger oceanicus	Conger eel
	Clupea harengus	Atlantic herring
	Brosme brosme	Cusk
	Gadus morhua	Atlantic cod
	Lophius americanus	Goosefish
	Ammodytes dubius	Northern sand lance
	Scomber scombrus	Atlantic mackerel
	Sebastes fasciatus	Acadian refish
	Anarhichas lupus	Atlantic wolfish
Shell debris	*Buccinum undatum*	Waved whelk
	Euspira heros	Northern moonsnail
	Mercenaria mercenaria	Northern quahog
	Modiolus modiolus	Northern horse mussel
	Ensis directus	Atlantic jackknife
	Placopecten magellanicus	Sea scallops