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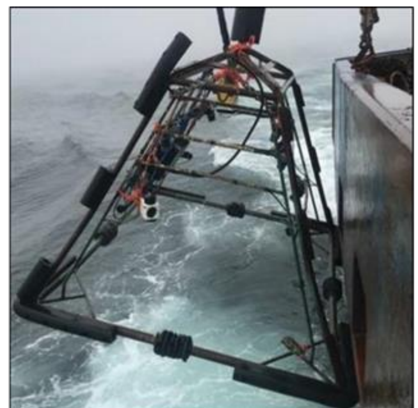
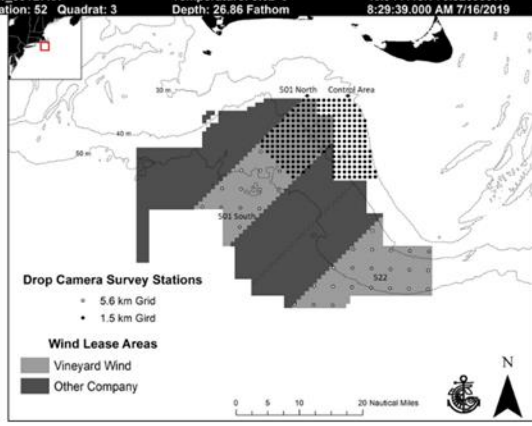
Final Report

2020 Drop Camera Survey of Benthic Communities and Substrate in the 522 Study Area





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

September 2022 **SMAST-CE-REP-2021-075**

Final Report

2020 Drop Camera Survey of Benthic Communities and Substrate in the 522 Study Area

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SMAST-CE-REP-2021-075

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 Vineyard Wind's Outer Continental Shelf (OCS) Lease Area OCS-A 0522 (522 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 the 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.

A centric systematic grid sampling design was used to sample 22 stations in the 522 Study Area. Stations were placed 5.6 kilometers (km) apart. A sampling pyramid mounted with a high-resolution camera was deployed at each station and used to take four quadrat (2.3 square meter [m^2] images) samples. The area was surveyed in August and October 2020 using a commercial scallop vessel to deploy the sampling pyramid. Eighteen different benthic animal groups were observed in the 522 Study Area. The most common groups were similar to the dominant groups in other Vineyard Wind OCS Study Areas, but sea stars, moon snails, and moon snail eggs cases were observed at higher frequencies in 522. Decreases in animal occurrence in October, except skates, were observed but wide confidence intervals were associated with most estimates. Sand was the only substrate observed during the August and October surveys.

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Introduction

In 2020, Vineyard Wind LLC (Vineyard Wind) leased a 516 square kilometer (km^2) area for renewable energy development on the Atlantic OCS (OCS) named Lease Area OCS-A 0522, which is located south of Nantucket, off the south coast of Massachusetts. Vineyard Wind is conducting fisheries surveys within the 522 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 (501N Study Area) where the Vineyard Wind 1 project will be located, and within the southern portion of Lease Area OCS-A 0501 (501S Study Area);[1] these studies are reported separately.

SMAST has developed an image-based drop camera survey that allows for sampling of the epibenthic community with minimum disturbance to the seafloor. The SMAST drop camera survey can be used to better understand benthic macrofaunal community characteristics, substrate habitats, 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 use 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 (NEFMC) to aid in annual scallop harvest allocation (NEFSC 2010; 2018).

[1] The Bureau of Ocean Energy Management segregated Lease Area OCS-A 0501 into two lease areas – OCS-A 0501 and OCS-A 0534 – in June 2021. The 501S Study Area is now located in the area designated as Lease Area OCS-A 0534 and is referred to as the 501S Study Area in SMAST fisheries survey reports published prior to January 2022.

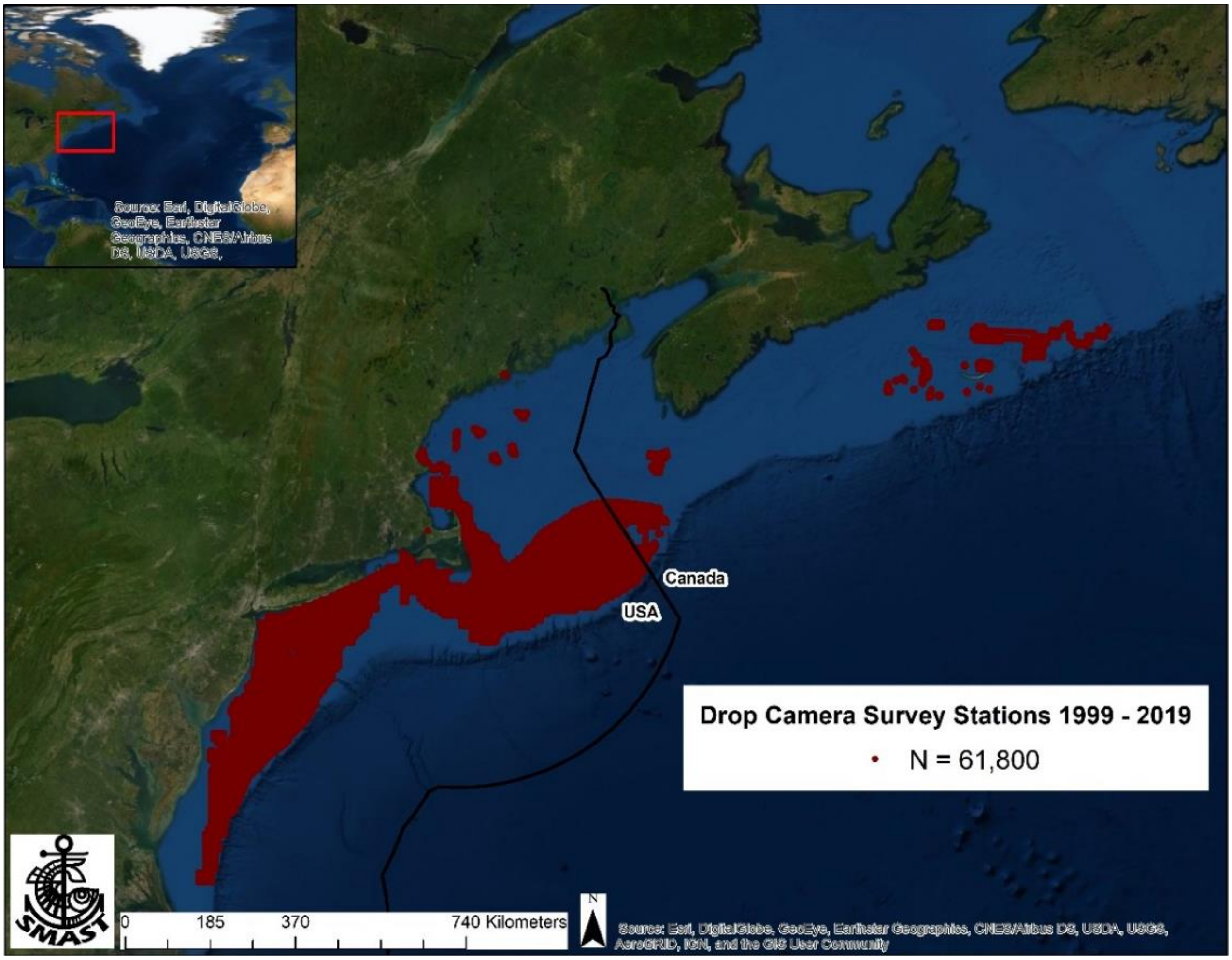

Figure 1. The spatial extent of SMAST drop camera surveys in the Northern Hemisphere. All stations surveyed since 1999 are displayed.

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 2020) 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 NEFMC 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).

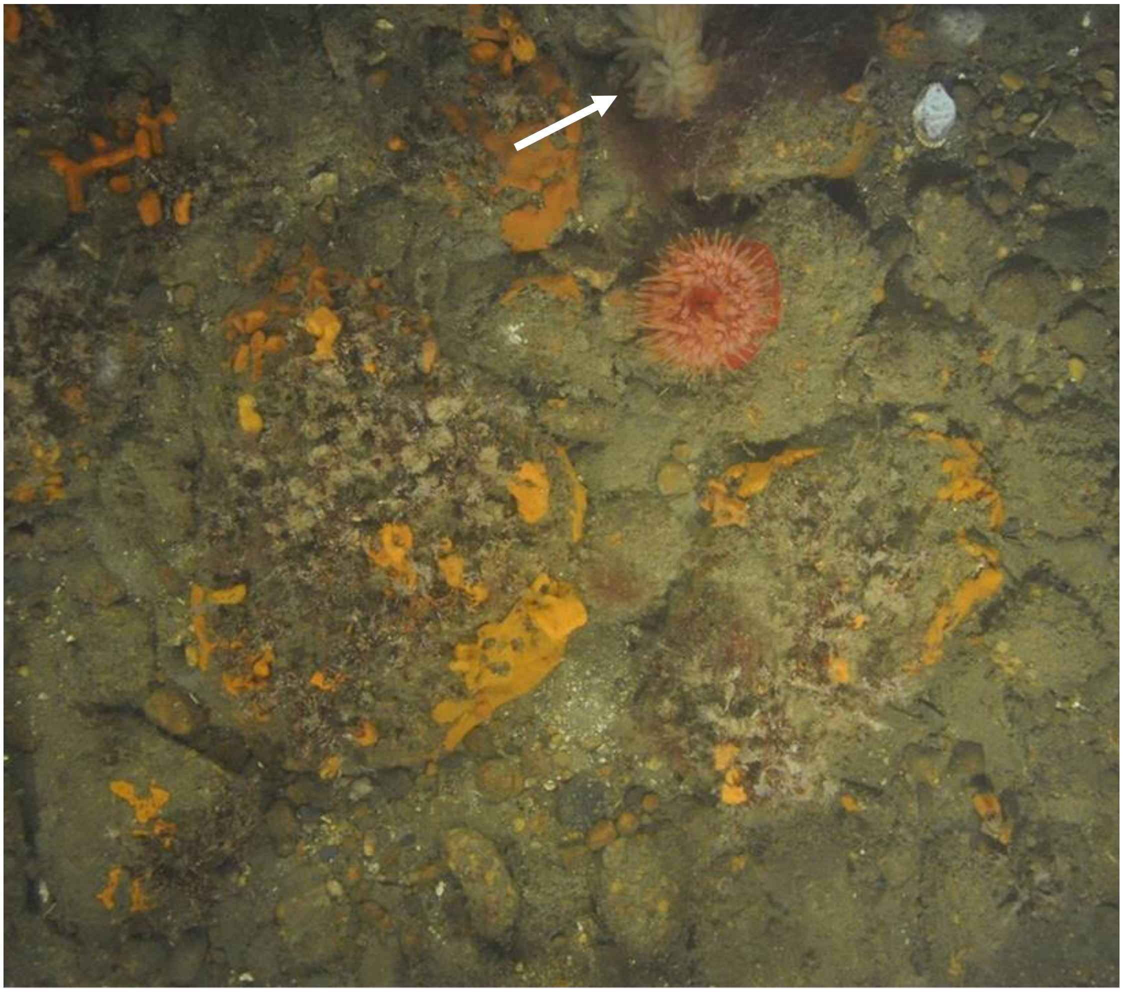

Figure 2. Example of a digital still image taken by the SMAST drop camera survey in complex habitat in the Rhode Island Wind Energy Lease Area on Cox's Ledge during a survey in 2013. A longfin squid *(Doryteuthis pealeii*) egg cluster is present (top, middle).

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 benthic animals 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. 2020). 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 approach 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 drop camera survey data can be used to compare epibenthic faunal distributions between impact and control sites over time. The drop camera survey will aid in building a regional, standardized baseline dataset needed to address development impacts on epibenthic communities and habitats. From this study, the data collected can be used to provide preliminary estimates and enable the calculation of a power analysis detailing the number of samples required to detect significant changes with a specific level of precision. This will enable a precisely designed control-impact experiment prior to the development of the area.

Goal and Objectives

The primary goal of this project was to collect preliminary data on the benthic community and substrate in the 522 Study Area. These data could be used to help determine the sampling intensity needed to collect enough baseline data for environmental assessment of windfarm development impact in the 522 Study Area. To do this, we used information from drop camera surveys of the 522 Study Area during two periods to (Figure 3):

1) map the distribution and estimate the density of dominant benthic megafauna, and
2) classify substrate types.

These two objectives involved documenting the primary epibenthic animals and habitats within the 522 Study Area and this helped identify the sampling intensity needed for future statistical tests. They also documented seasonal changes in distribution and density.

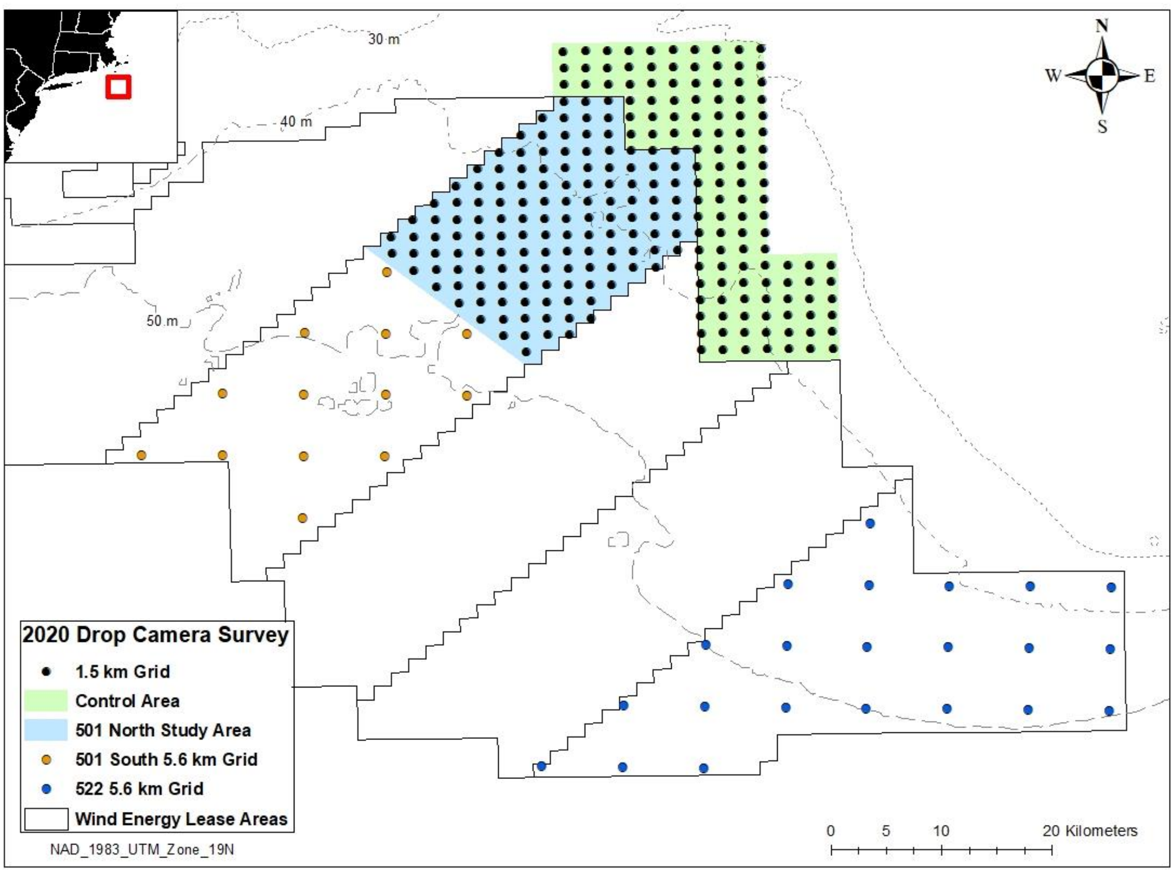

Figure 3. 2020 Drop camera survey station grids and Massachusetts Wind Energy Lease Areas.

Methods

A centric, systematic, grid design was used to sample stations in the 522 Study Area. Stations were placed 5.6 km apart (Figure 3). At each station, a sampling pyramid was deployed, and a high-resolution camera was used to 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 Areas. The information from these surveys was used to determine the 1.5 km station distance applied to the 501N Study Area and Control Area (Figure 3).

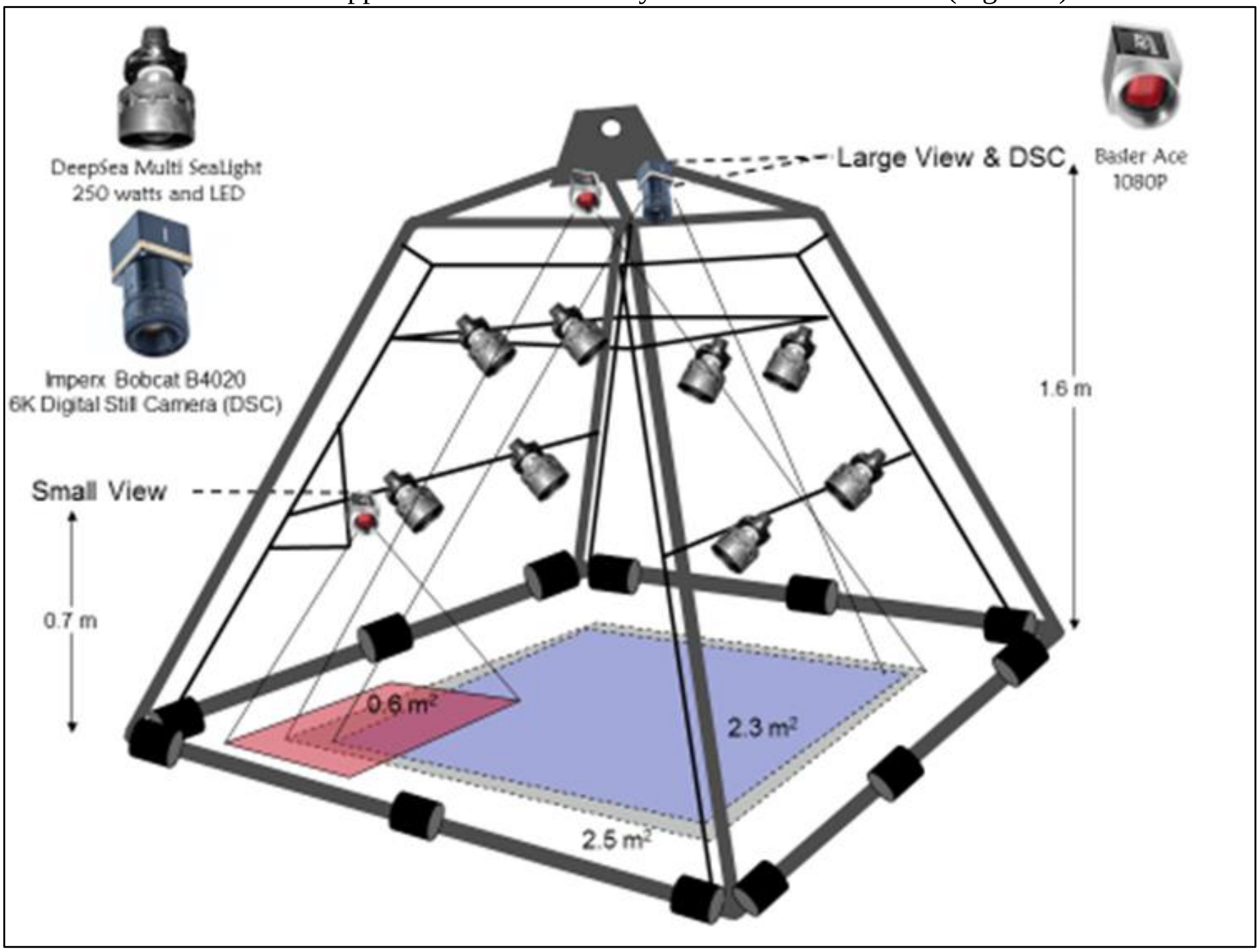

Figure 4. SMAST drop camera survey pyramid with cameras and lights used for data collection. The camera used for the small view was turned to the side to provide a view parallel to the seafloor for some stations.

A commercial scallop fishing vessel was used to transport and deploy the pyramid (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. Two downward-facing cameras mounted on the sampling pyramid provided 2.3 m^2 and 2.5 m^2 quadrat images of the seafloor 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 camera view of the first quadrat were saved and then the pyramid was raised, so that the seafloor could no longer be seen. The vessel was allowed to drift approximately 50 meters (m), and the pyramid was lowered to the seafloor again to sample a second quadrat; this was repeated a further two 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 an SQL Server Relational Database Management System.

After the survey, the images from the high-resolution digital still camera were used as the primary data source (Figure 2). Other images and video collected were used as aids. Within each quadrat, macrobenthos taxa were counted or noted as present, and the substrate was identified using the Wentworth scale (Stokesbury 2002; Stokesbury et al. 2004; Bethoney and Stokesbury 2018). Fifty taxa of macrobenthos can be identified if present in the sample (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 their presence or absence in 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 millimeter (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 four quadrats at station *i*. The SE of this two-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 two-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 of taxa and substrate within the 522 Study Area were mapped (Figures 8-21). The analysis was limited to the 12 most common benthic animal groups in the 522 Study Area to focus results on the groups detected at high enough rates for statistical analysis (Bethoney et al. 2017). Densities for each 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 522 Study Area were conducted on August 1 and October 24-25, 2020. All images and video collected were shared with Vineyard Wind. All 22 stations in the area were surveyed in both August and October. Eighteen different benthic animal groups were observed in the 522 Study Area. The most common groups were similar to the dominant groups in the 501N Study Area and Control Area, but sea stars, moon snails, and moon snail eggs cases were present and waved whelks, sponges, and skate egg cases were not (Table 1). In addition to these animals, several others were observed at lower frequencies. These animals included scallops (one in October) and flat fishes (two in August and one in October). Decreases in animal occurrence in October, except skates, were observed but wide confidence intervals are associated with most estimates (Figures 5-6). Sea stars were only found at one station in August and October at very high densities (Figures 5 & 8). Crabs also had a large confidence interval compared to the other animals, but high-density stations were spread through the survey area (Figures 9-10). All other animals had their highest densities at depths shallower than 50 m, except burrowing animals (Figures 11-19). Sand was the only substrate type present during the August (Figure 20) and October (Figure 21) surveys.

The October survey results are likely to have underestimated the density of all species due to a much greater proportion of images having poor visibility compared to the August survey (Figures I-1 & I-2). This inhibited the ability of this report to make reliable conclusions on changes in species distributions between the two months. This may mean that more data needs to be collected to accurately assess the area for the BACI. The cause could be due to local or seasonal hydrographical conditions and/or recent storms, which can affect turbidity and redistribute silt into the water column. Therefore, future surveys should be not conducted in October and another month should be chosen. In this area the weather window is the most ideal from May to September so to bypass the issue of low visibility surveys should be conducted in early May and late August or early September.

Table 1. The 12 most common benthic animal groups, in order of most to least quadrats present, during the 2020 SMAST drop camera survey of the 522 Study Area. Groups left blank in the "Counts" column are tracked as present or absent.

Animal Group	Quadrats Present	Counts
Crabs	26	73
Holes	26	
Detritus	20	
Sand Dollars	16	
Red hake	11	11
Silver hake	10	10
Skate	4	4
Hermit Crabs	2	2
Flat Fishes	1	1
Moonsnail	1	1
Scallop	1	1
Sea Stars	1	1
Quadrats Sampled	90	

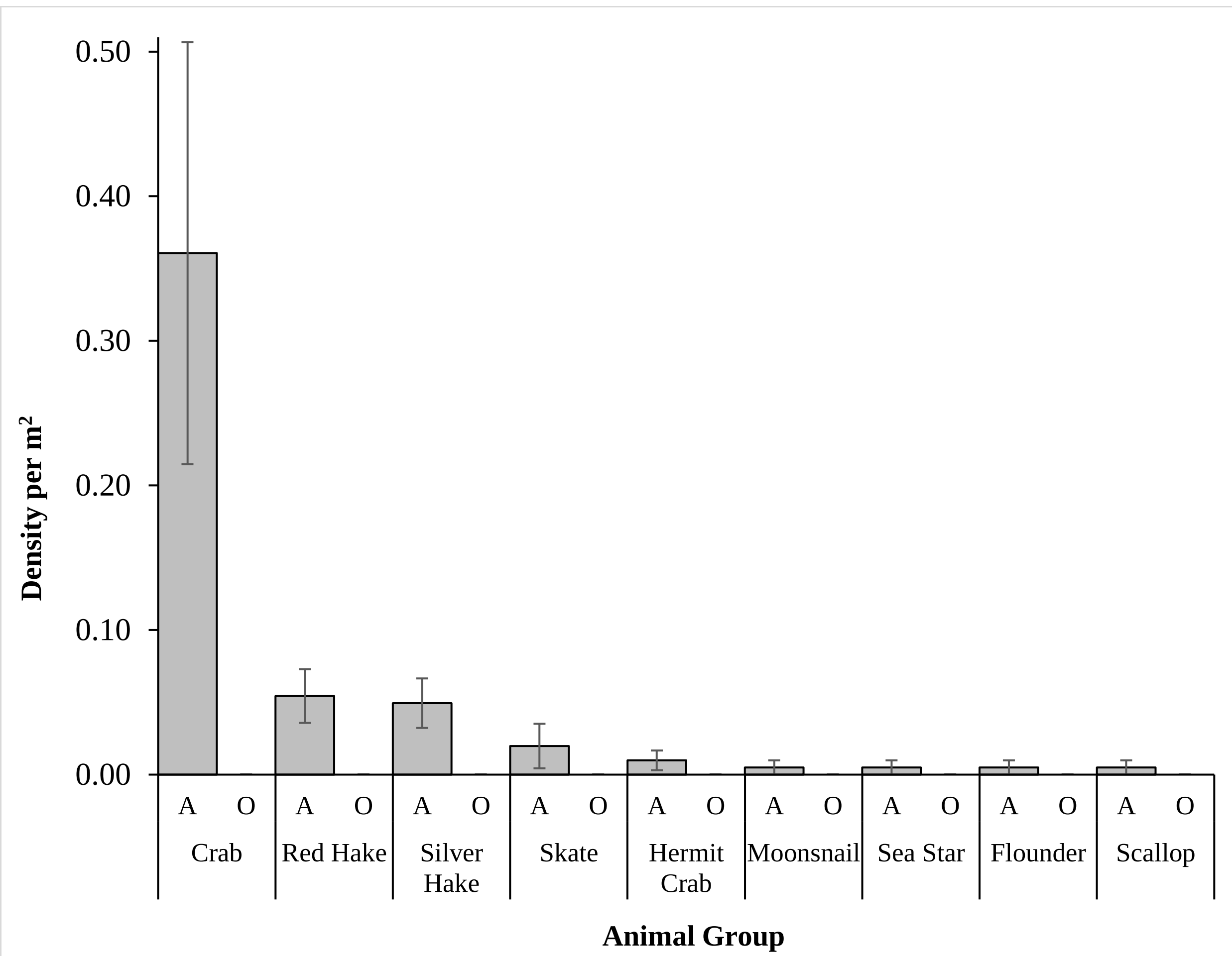

Figure 5. The density of common benthic animals found in August (A) and October (O) 2020 drop camera surveys of the 522 Study Area. Error bars are 95% confidence intervals.

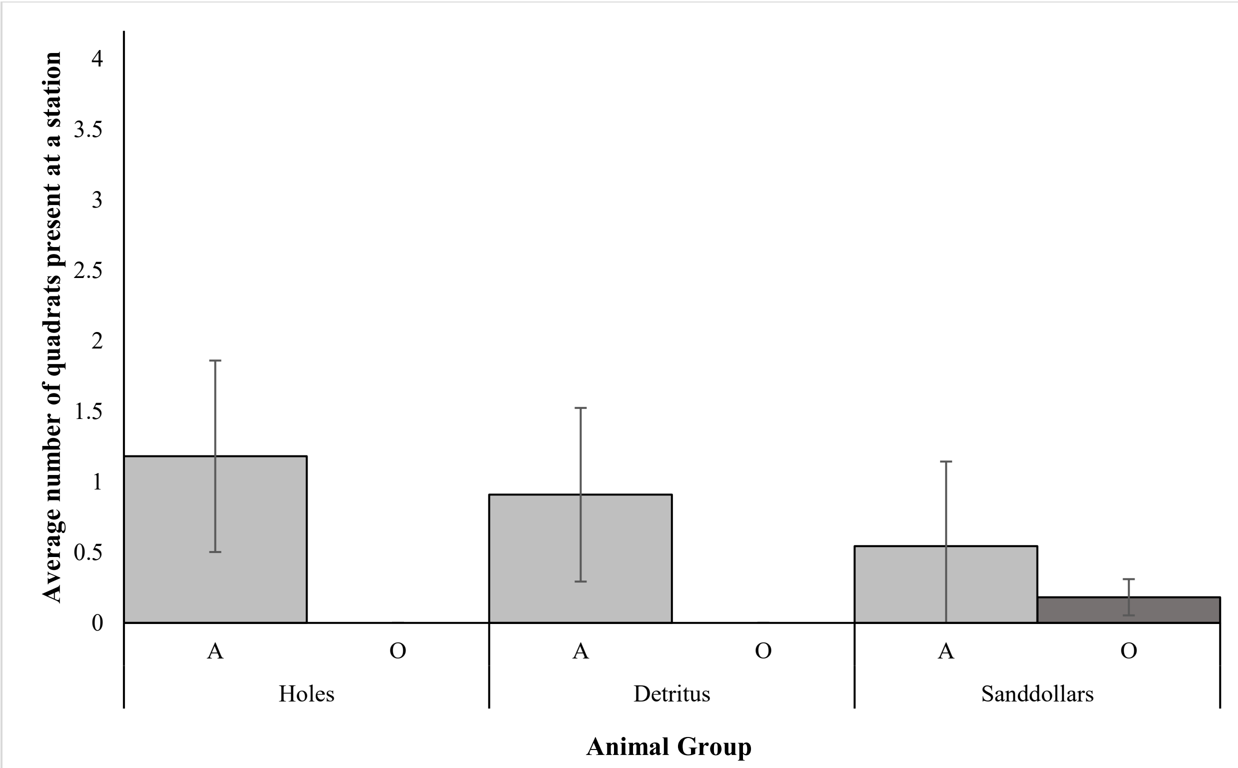

Figure 6. The average number of quadrats benthic animals present at each station during the August (A) and October (O) 2020 drop camera surveys of the 522 Study Area. Holes represent burrowing animals and detritus being marine snow (dead/decomposed animal matter). (Four quadrats (2.64 m^2 images in August, 2.44 m^2 images in October) were observed at each station.

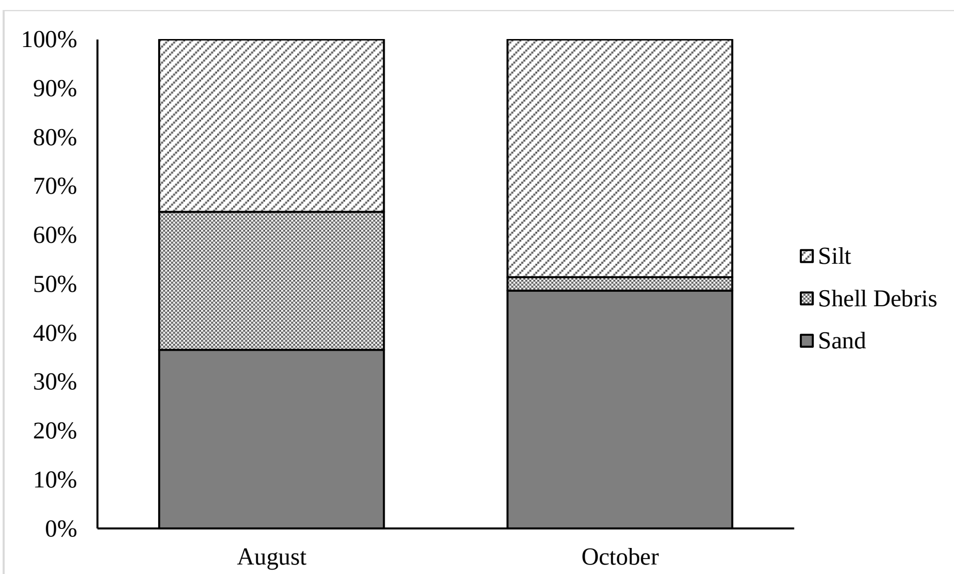

Figure 7. Substrate composition, defined by the most common substrate type observed at a station, during the August and October 2020 drop camera surveys of the 522 Study Area. Gravel, cobble, and rock were not observed at any station. Four quadrats were observed at each station.

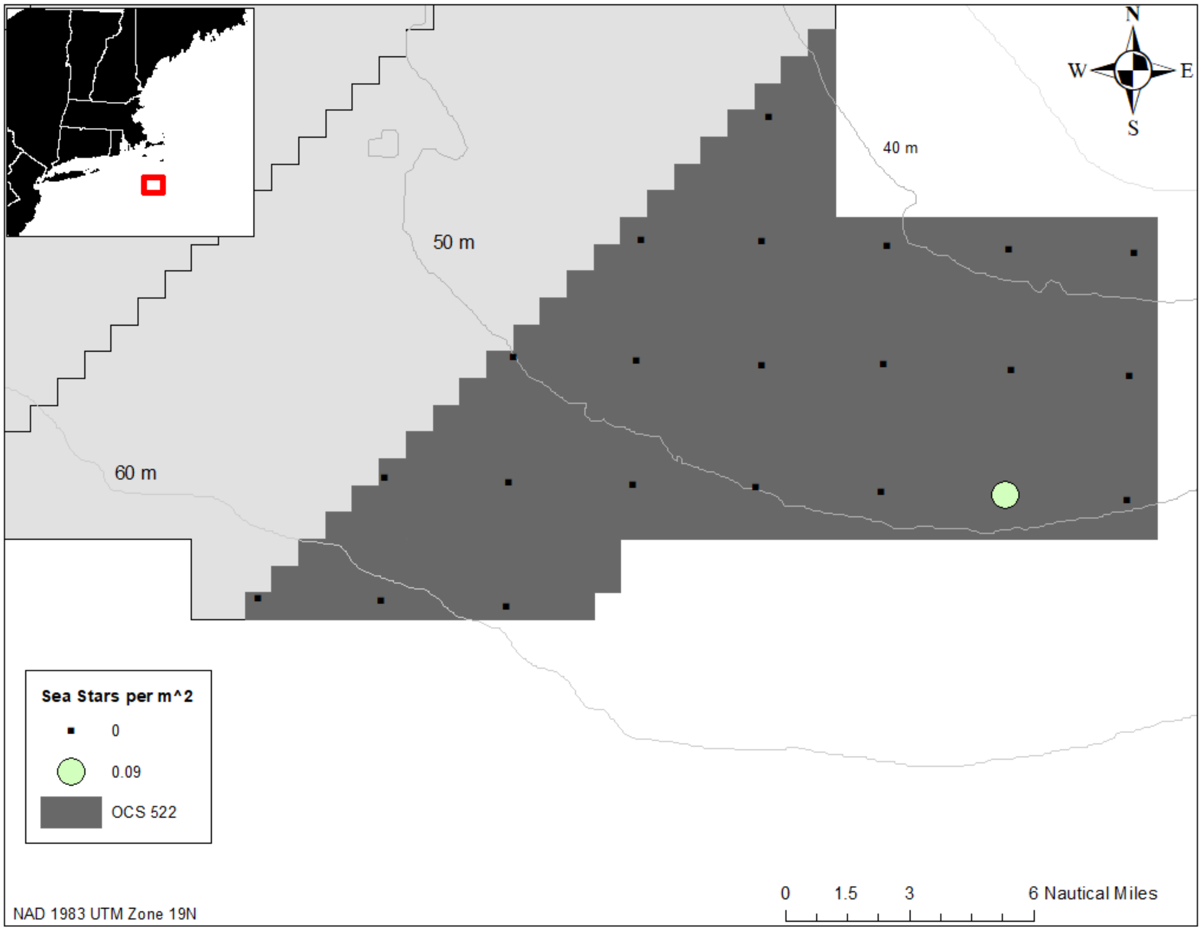

Figure 8. The distribution of sea stars in the August 2020 drop camera survey of the 522 Study Area. No sea stars were observed in the October 2020 survey of the same area. Density categories represent zero or one sea stars observed at a station.

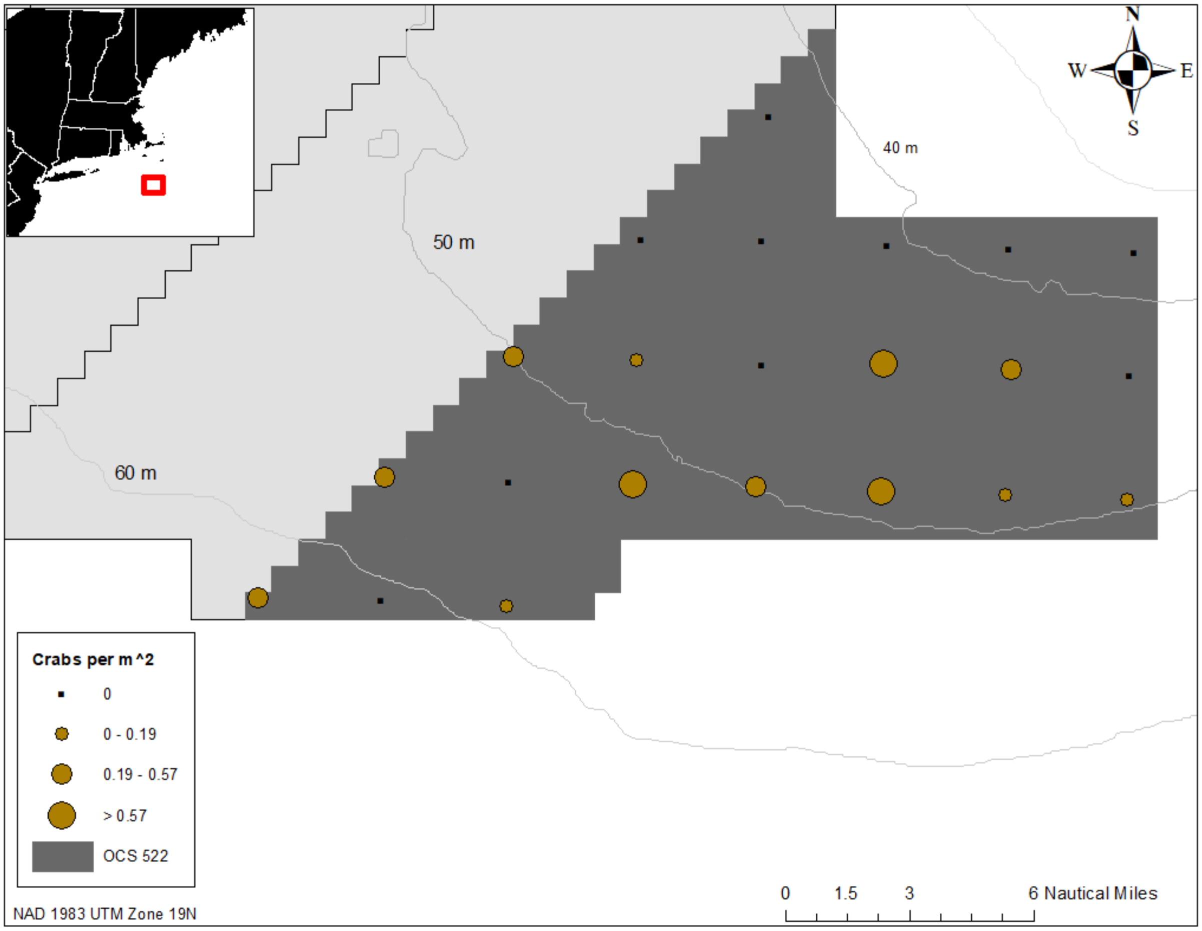

Figure 9. The distribution of crabs in the August 2020 drop camera survey of the 522 Study Area. No crabs were observed in the October 2020 survey of the same area. Density categories equally divide the data above zero based on observations in August.

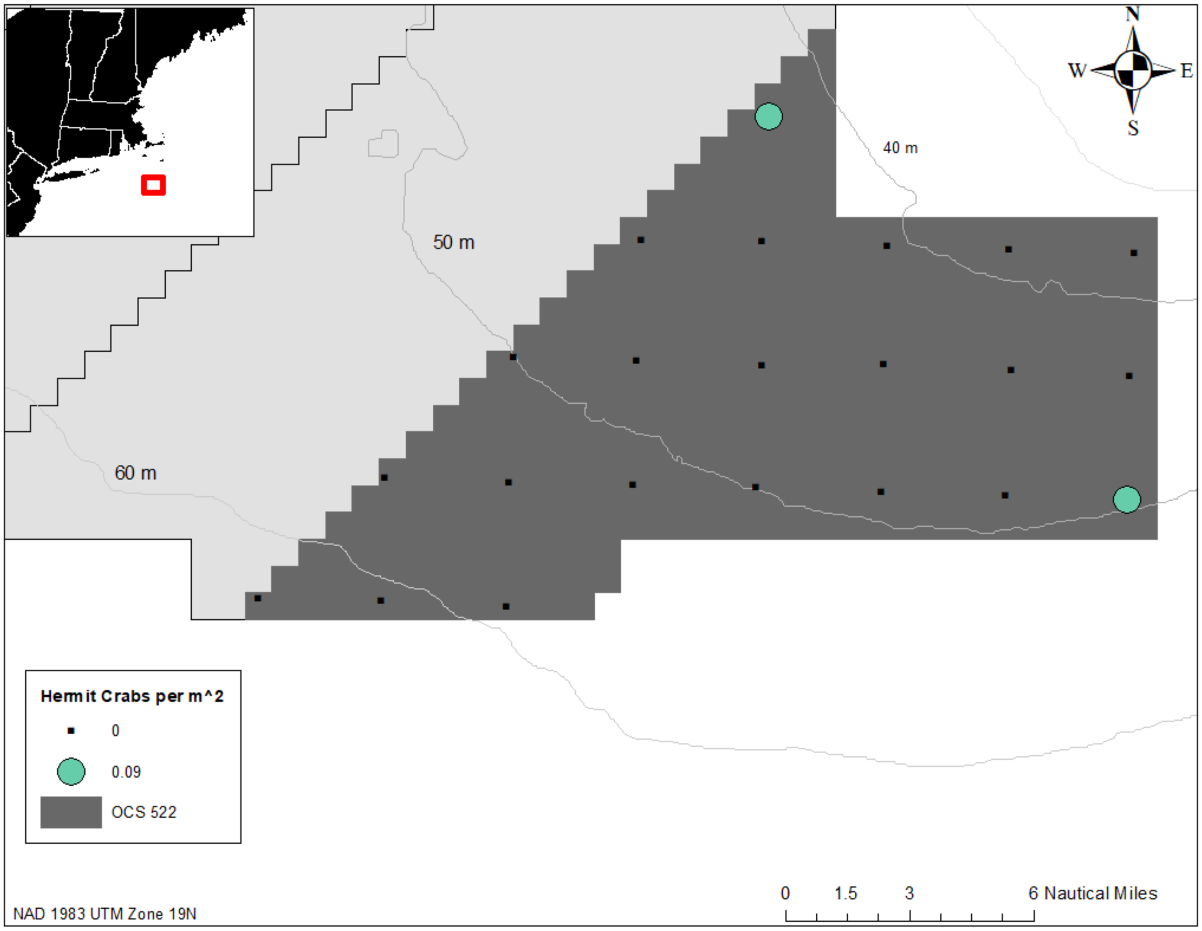

Figure 10. The distribution of hermit crabs in the August 2020 drop camera survey of the 522 Study Area. No hermit crabs were observed in the October 2020 survey of the same area. Density categories represent zero or one hermit crab observed at a station.

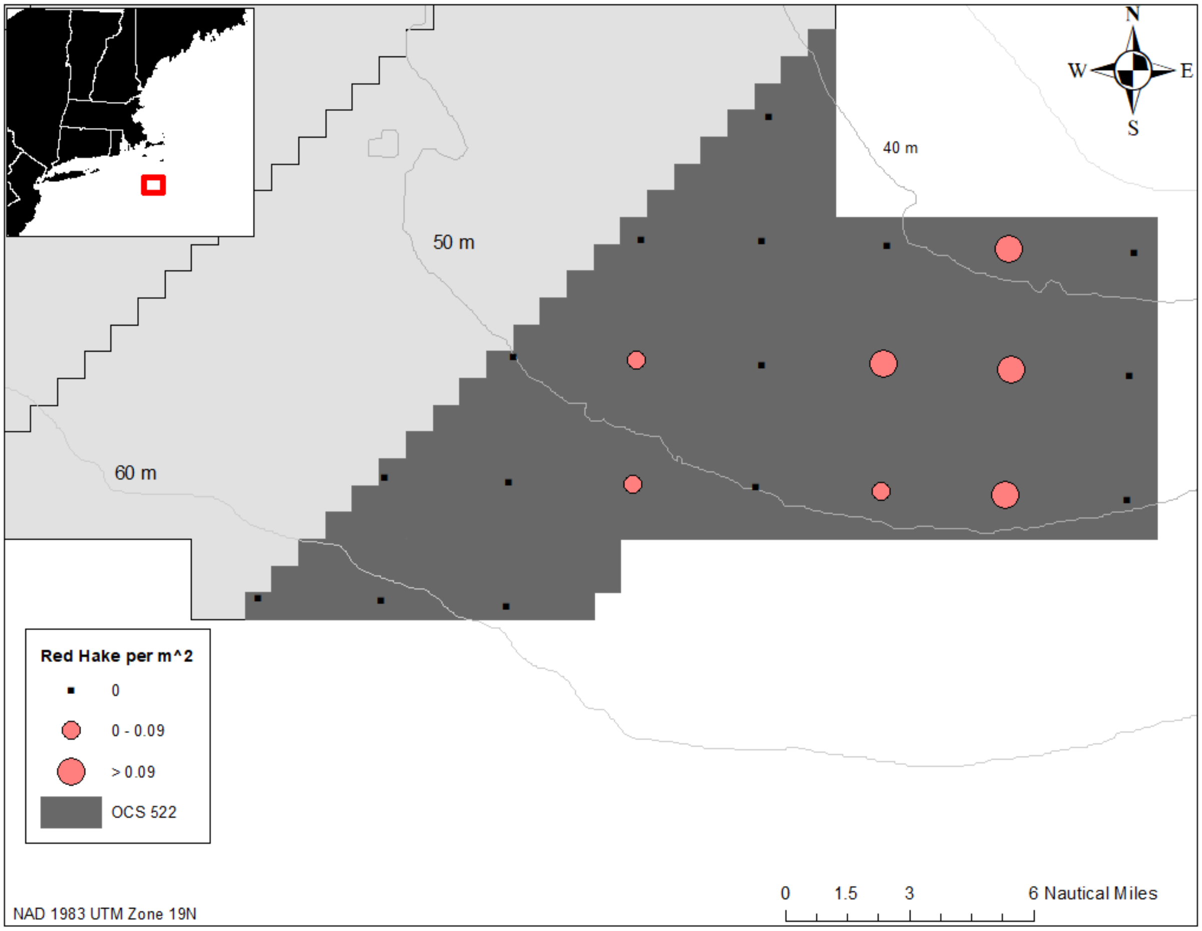

Figure 11. The distribution of red hake in the August 2020 drop camera survey of the 522 Study Area. No red hake were observed in the October 2020 survey of the same area. Density categories equally divide the data above zero based on observations in August.

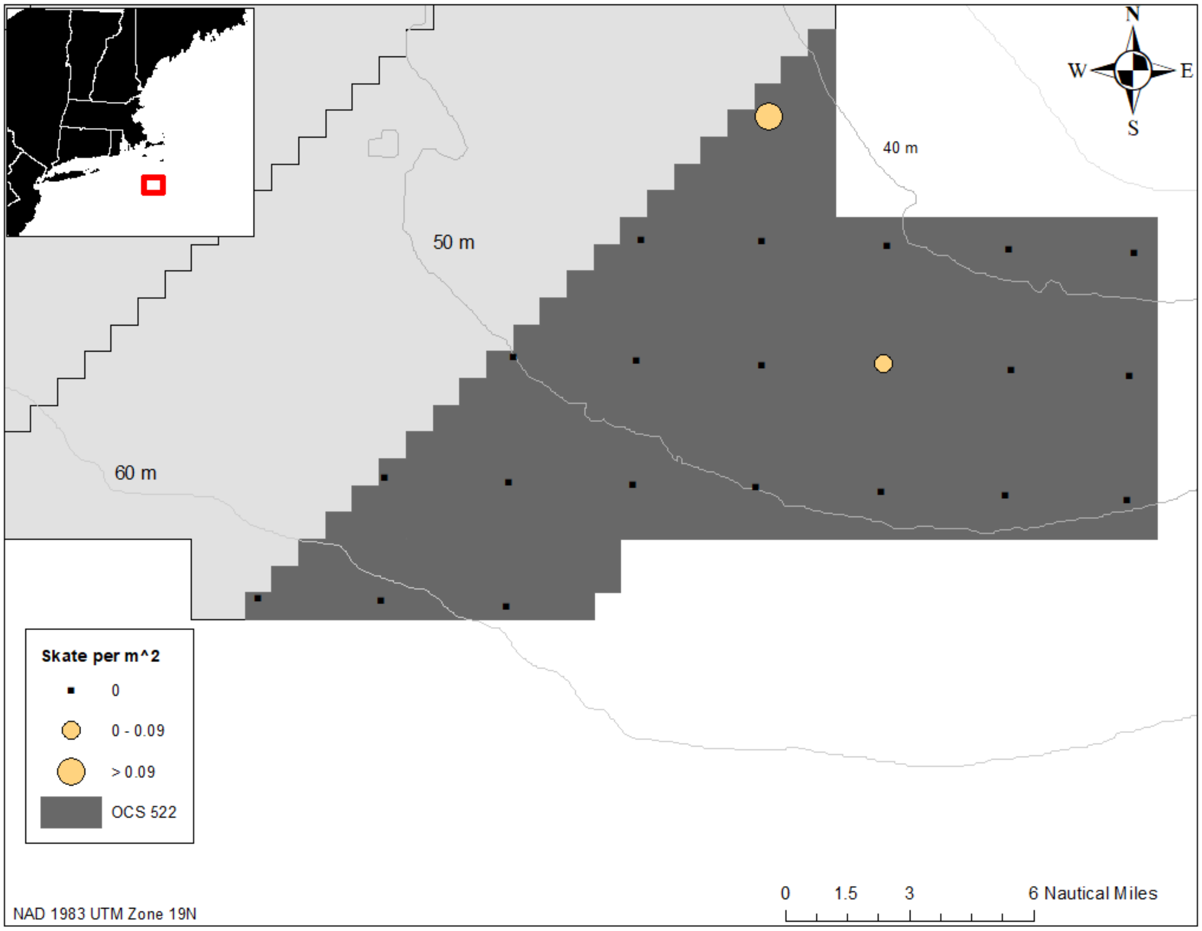

Figure 12. The distribution of skates in the August 2020 drop camera survey of the 522 Study Area. No skates were observed in the October 2020 survey of the same area. Density categories equally divide the data above zero based on observations in August.

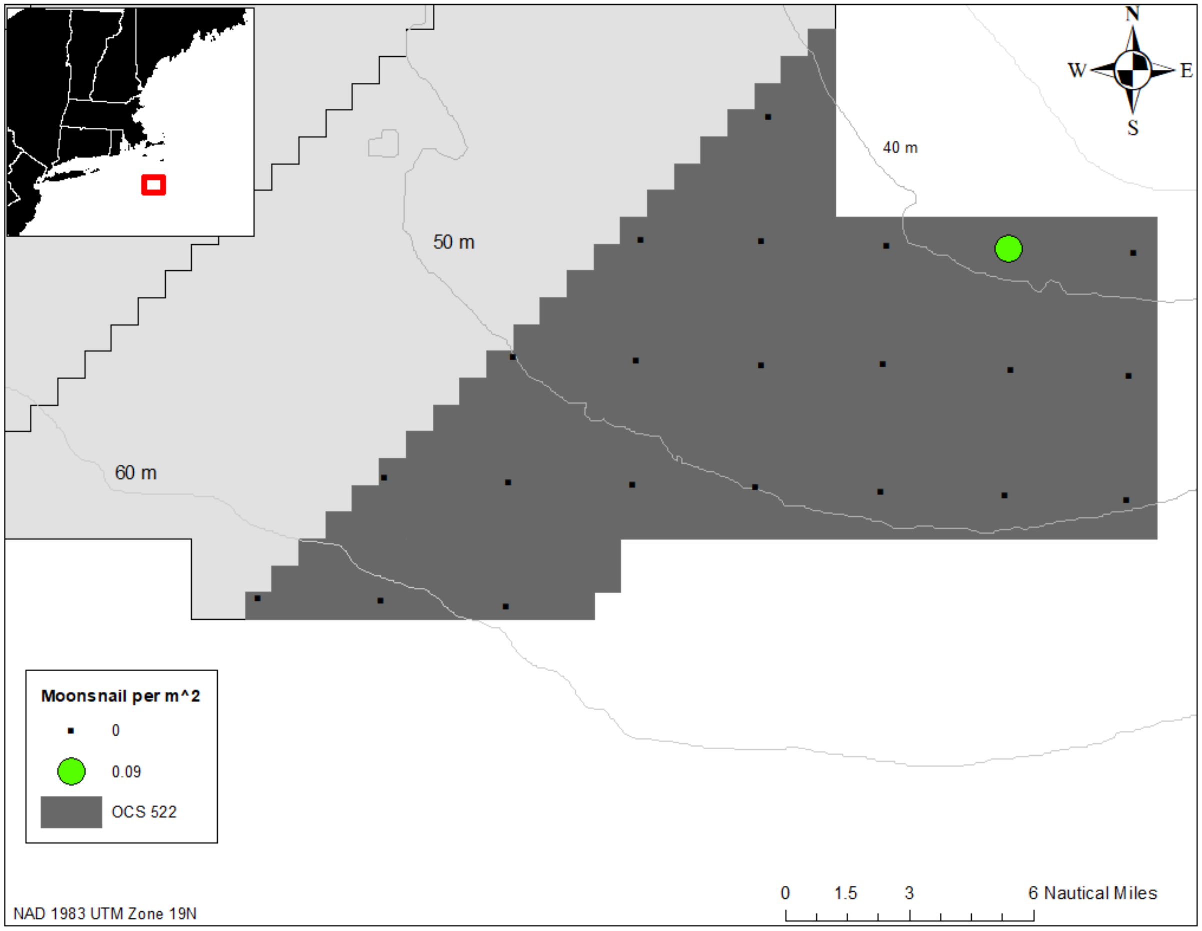

Figure 13. The distribution of moon snails in the August 2020 drop camera survey of the 522 Study Area. No moon snails were observed in the October 2020 survey of the same area. Density categories represent zero or one moon snail observed at a station.

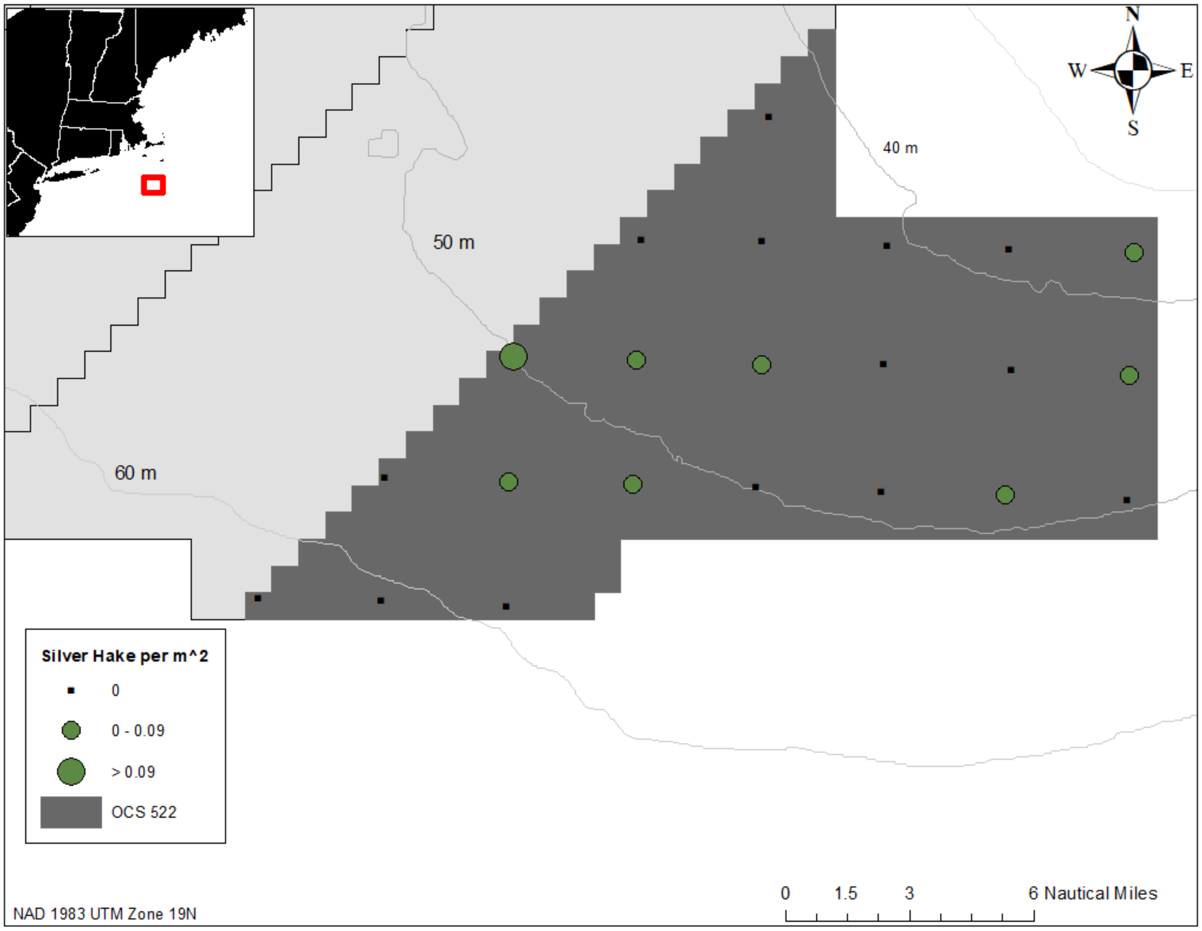

Figure 14. The distribution of silver hake in the August 2020 drop camera survey of the OCS 522 Study Area. No silver hake were observed in the October 2020 survey of the same area. Density categories equally divide the data above zero based on observations in August.

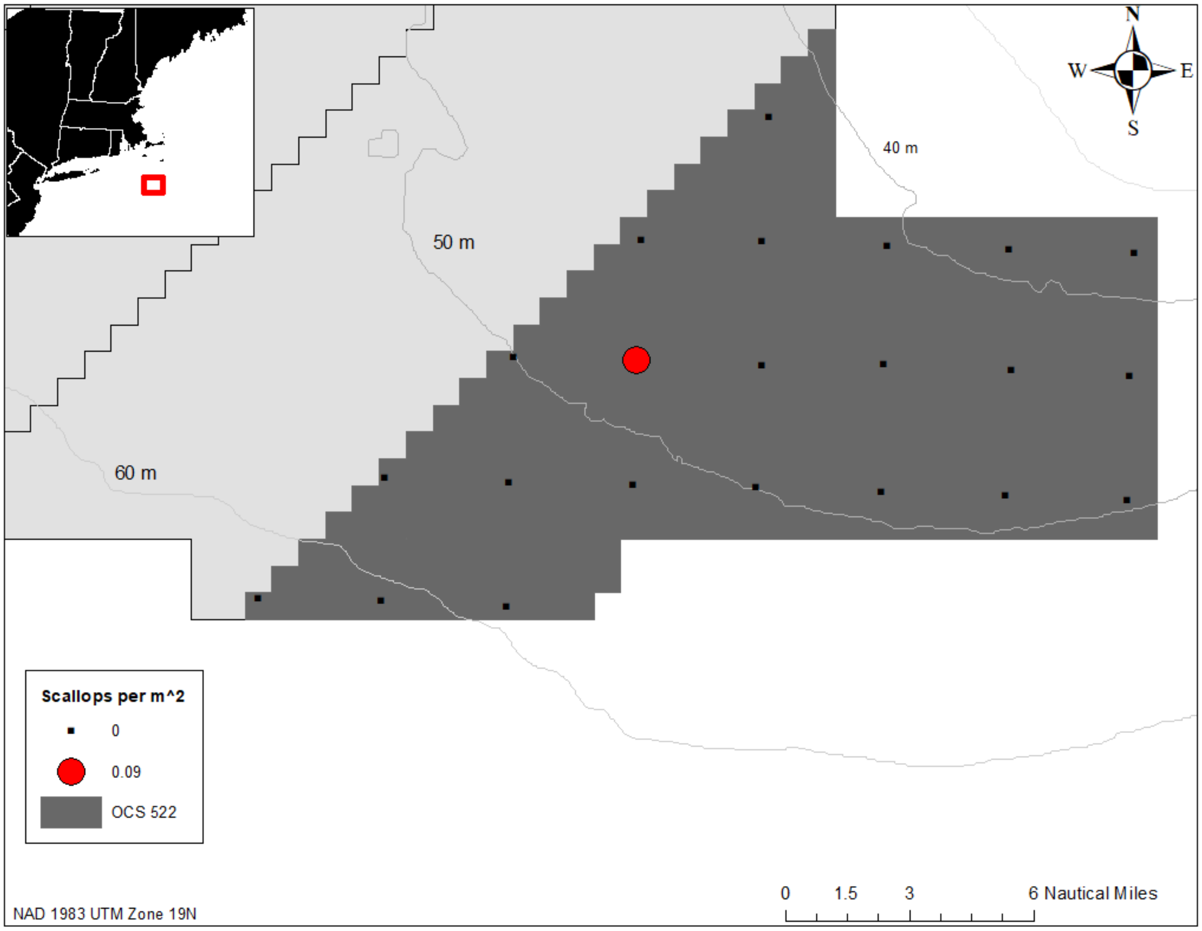

Figure 15. The distribution of scallops in the August 2020 drop camera survey of the 522 Study Area. No scallops were observed in the October 2020 survey of the same area. Density categories represent zero or one scallop observed at a station.

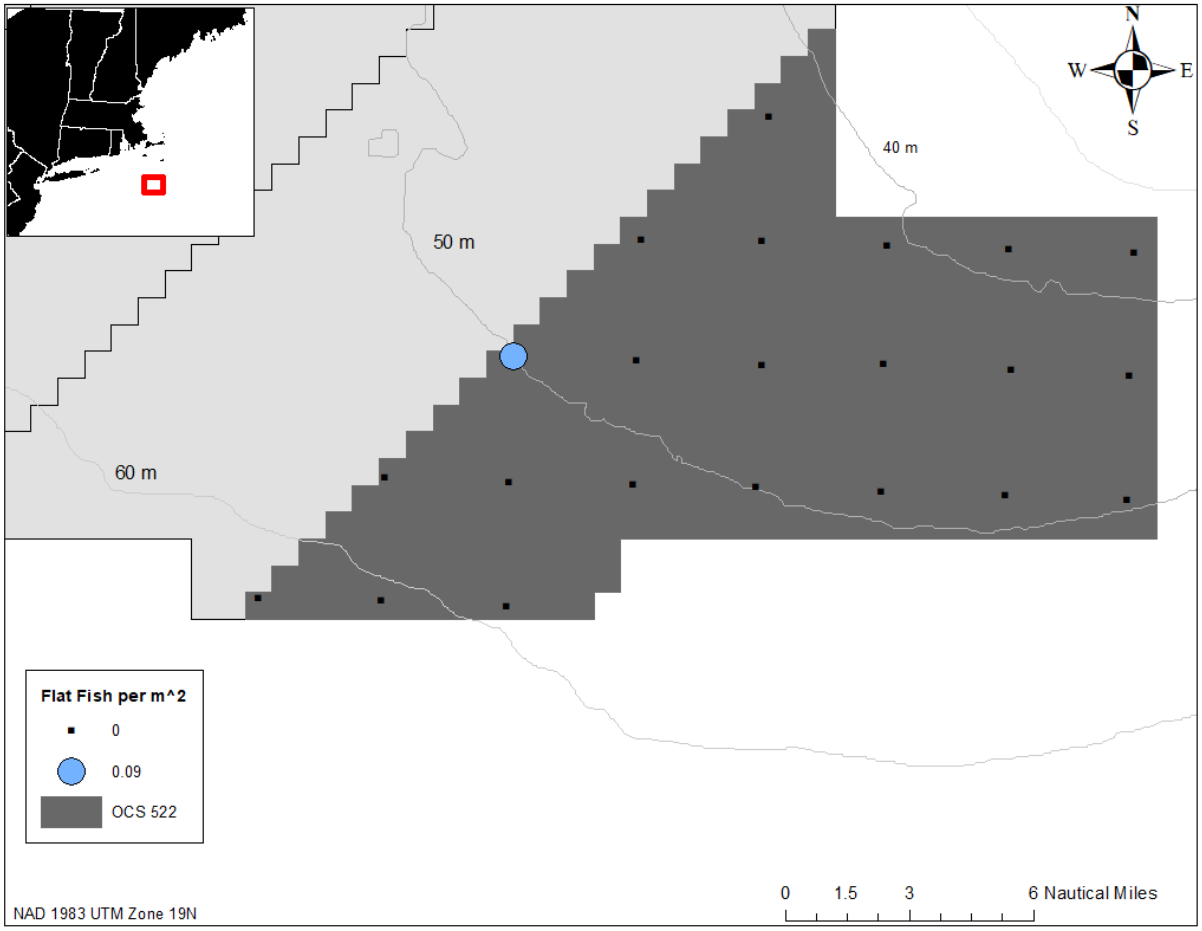

Figure 16. The distribution of flat fish in the August 2020 drop camera survey of the 522 Study Area. No flat fish were observed in the October 2020 survey of the same area. Density categories represent zero or one flat fish observed at a station.

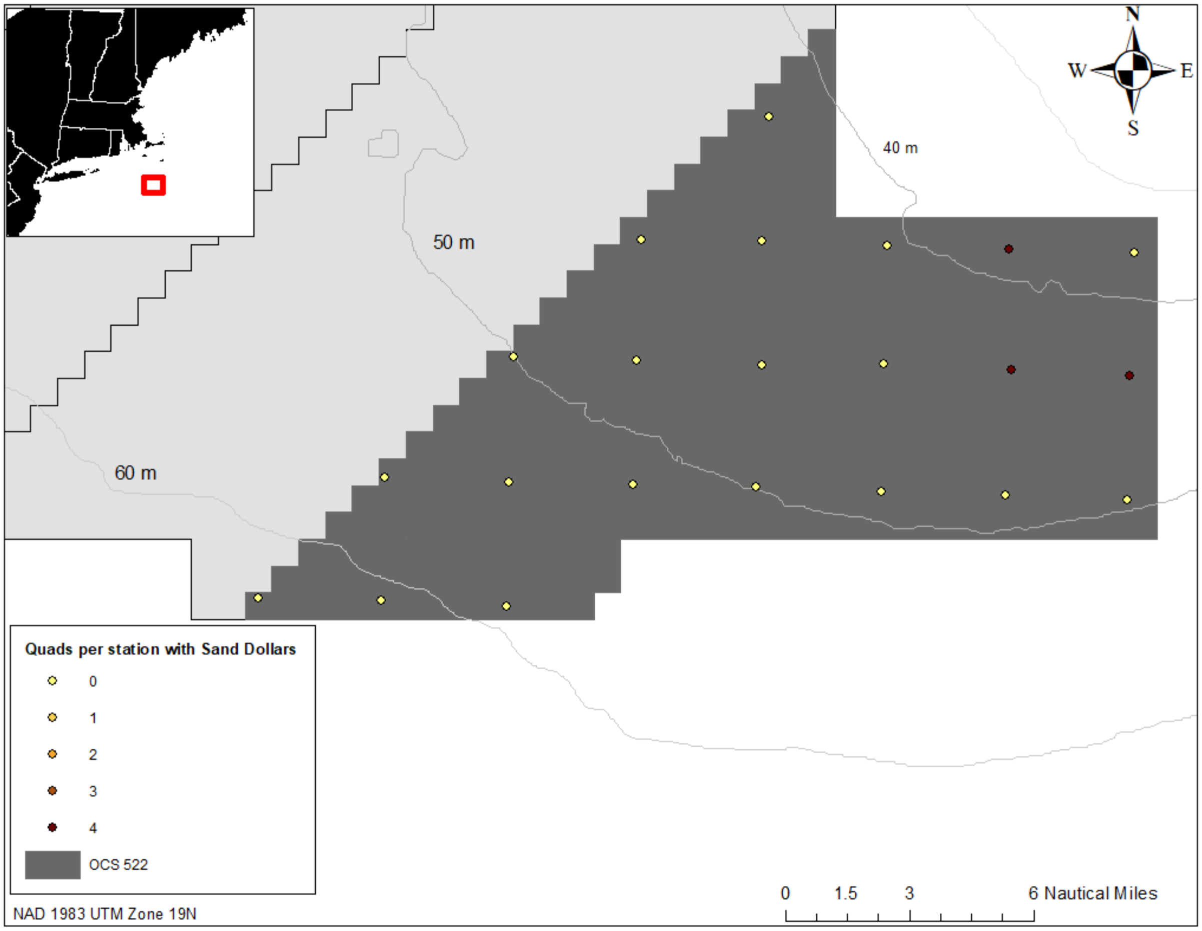

Figure 17. The distribution of sand dollars in the August 2020 drop camera survey of the 522 Study Area. Four quadrats (2.64 m^2 images) were observed at each station.

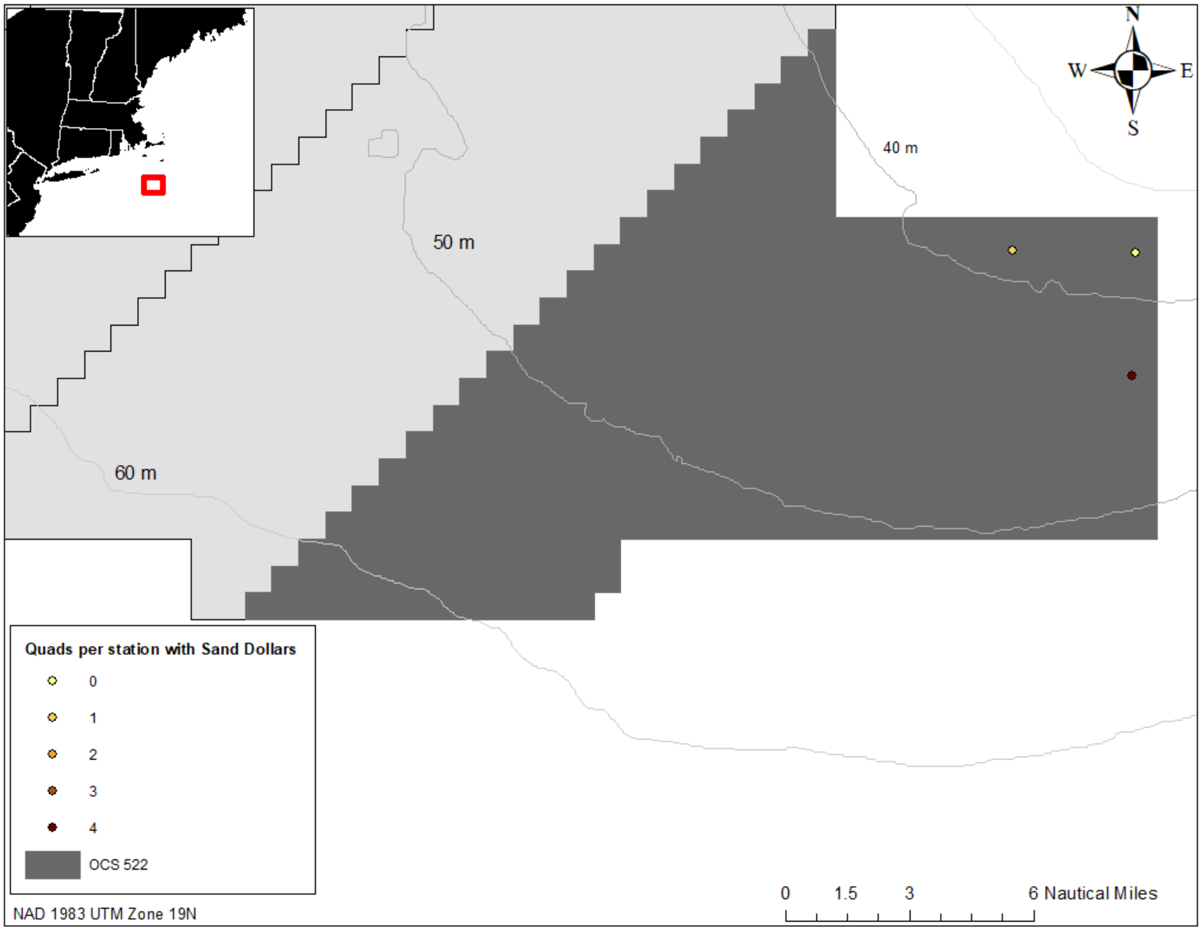

Figure 18. The distribution of sand dollars in the October 2020 drop camera survey of the 522 Study Area. Four quadrats (2.44 m^2 images) were observed at each station.

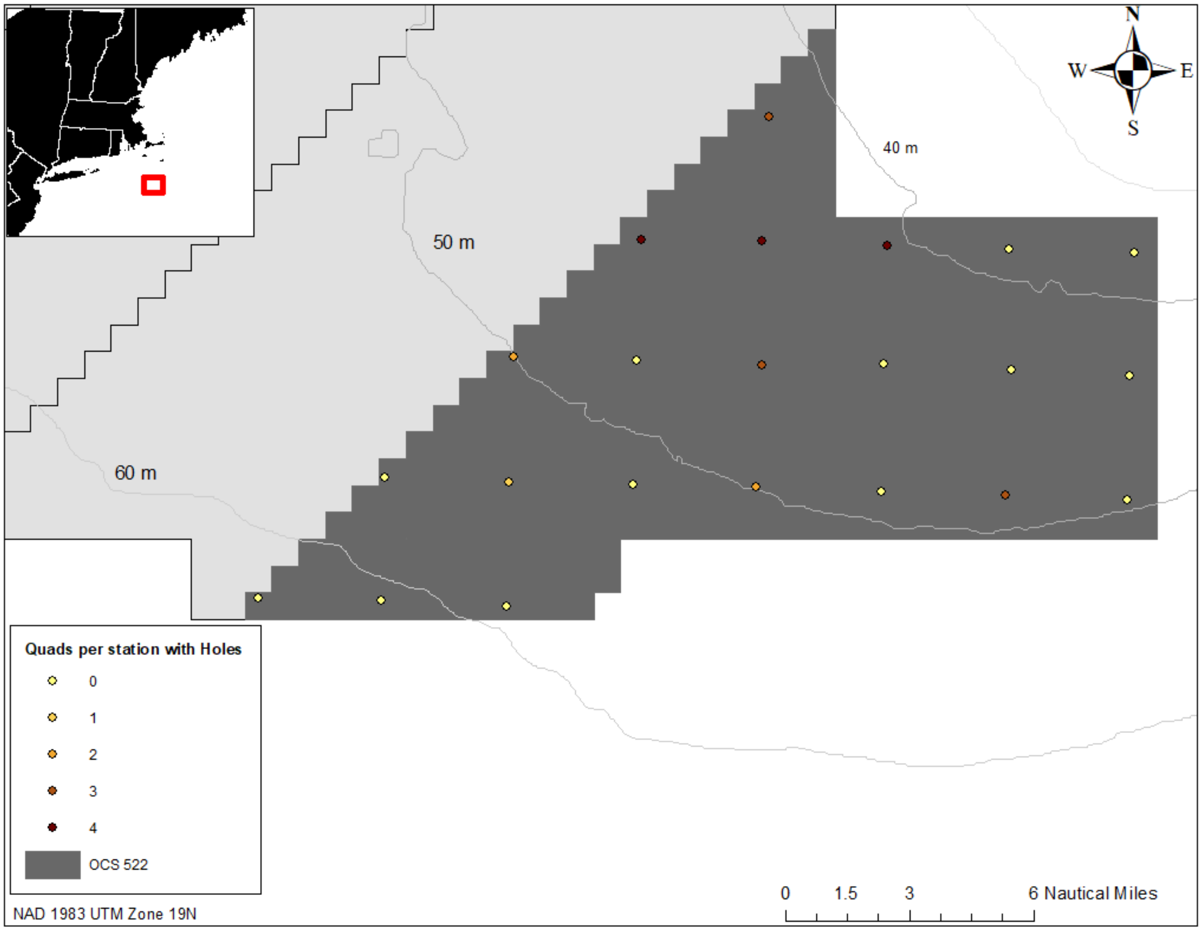

Figure 19. The distribution of holes (burrowing animals) in the August 2020 drop camera survey of the 522 Study Area. No holes (burrowing animals) were observed in the October 2020 survey of the same area. Four quadrats (2.64 m^2 images) were observed at each station.

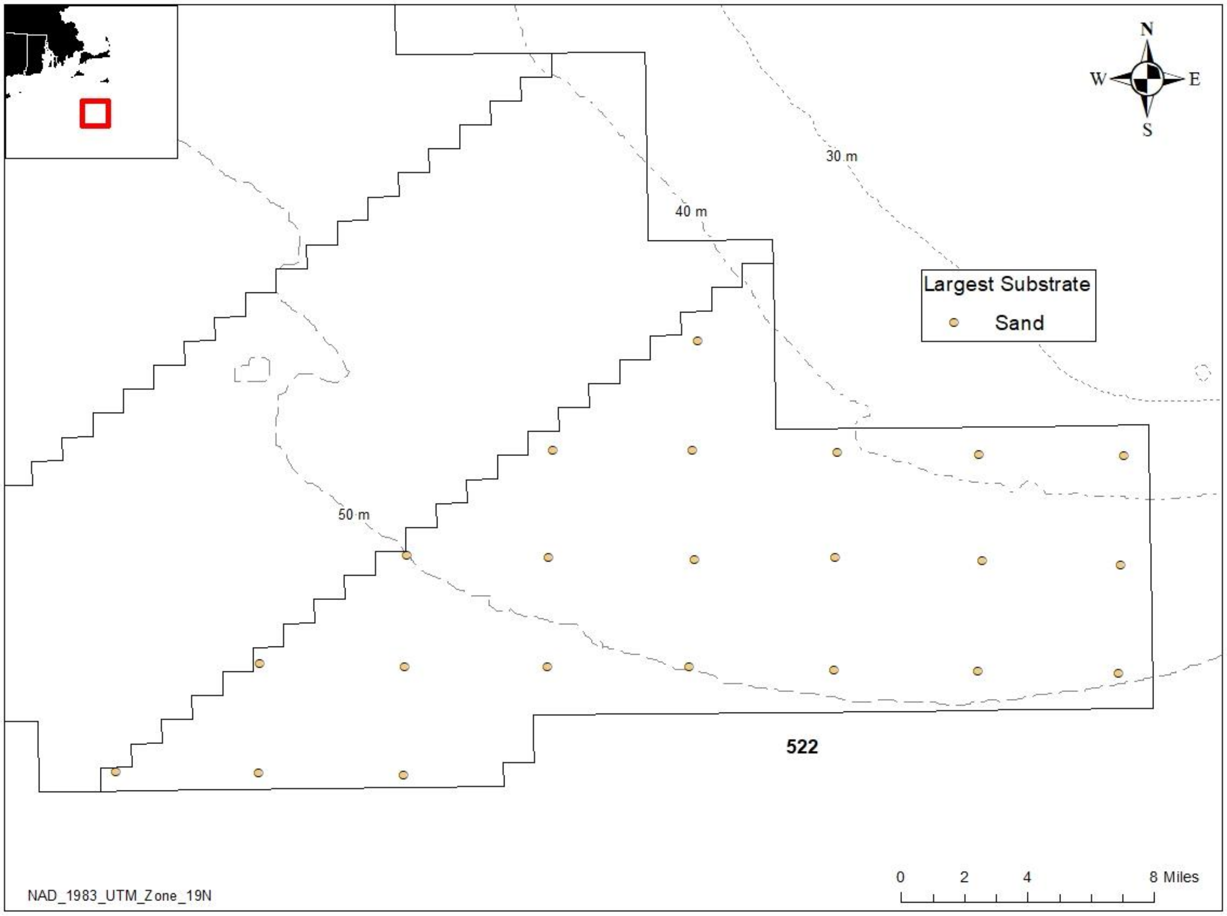

Figure 20. The distribution of substrate types in the August 2020 drop camera survey of the 522 Study Area. Four quadrats (2.64 m^2 images) were observed at each station.

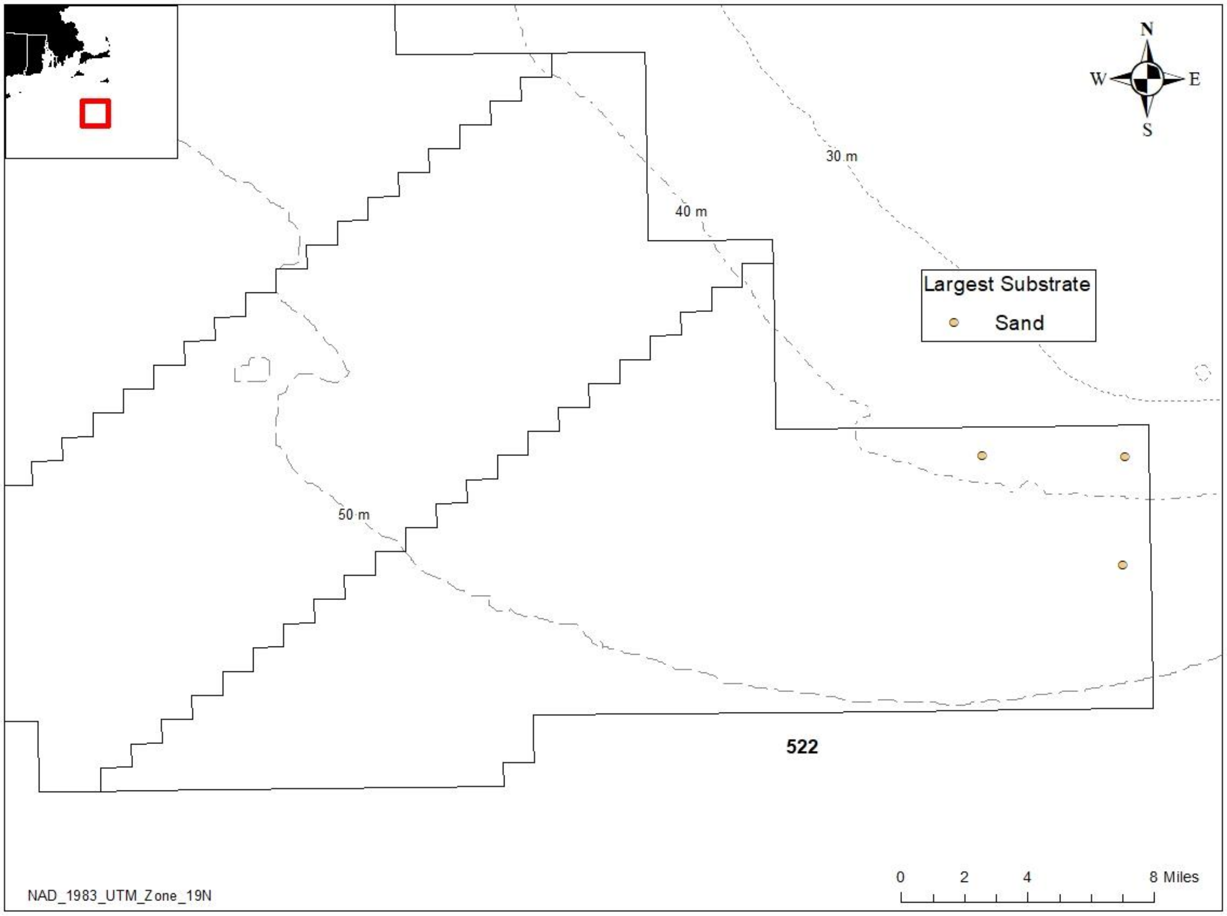

Figure 21. The distribution of substrate types in the October 2020 drop camera survey of the 522 Study Area. Four quadrats (2.44 m^2 images) were observed at each station.

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<u>Appendix I:</u> Species list and visibility information.

Table I-1. 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

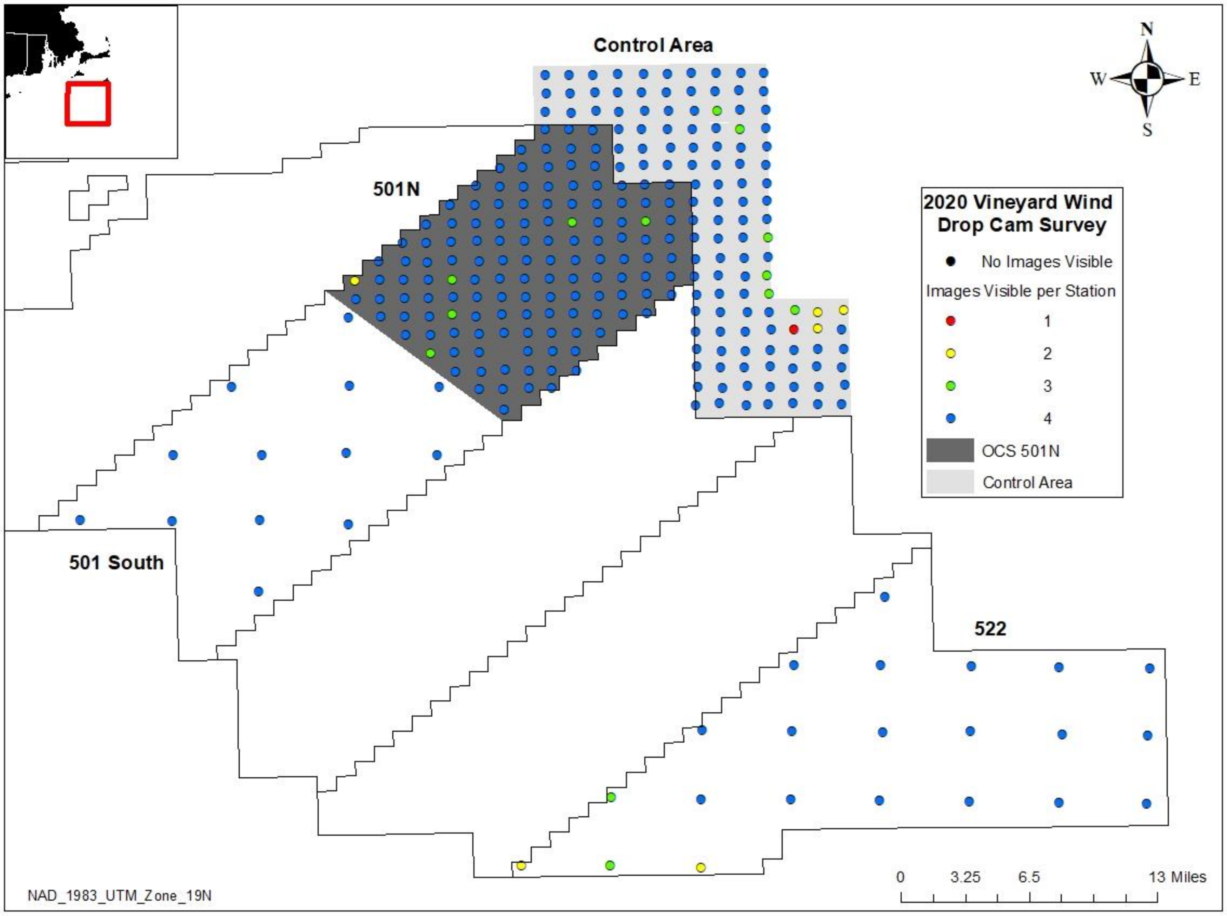

Figure I-1. The distribution of image visibility per station for the August 2020 drop camera survey.

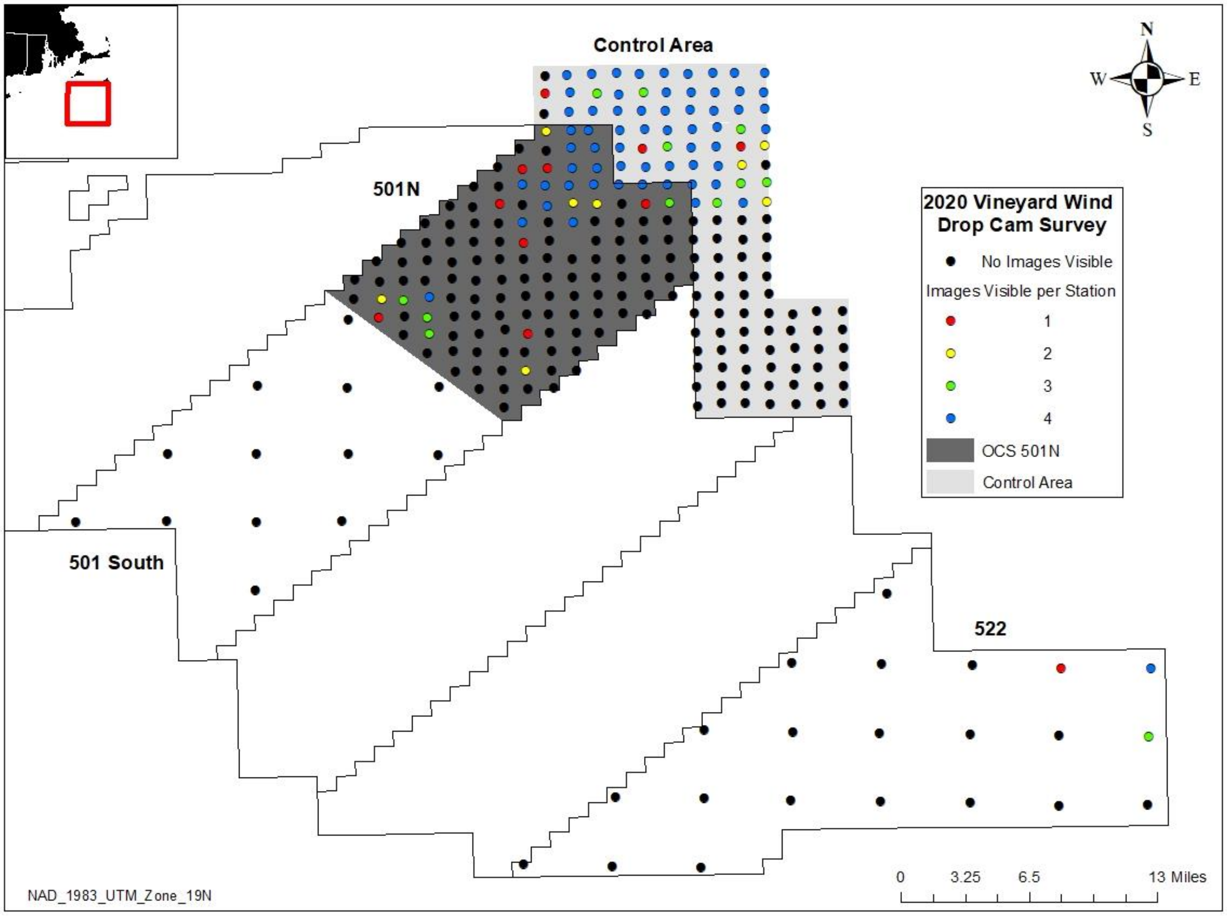

Figure I-2. The distribution of image visibility per station for the October 2020 drop camera survey.