

The Rhode Island Chapter of The Nature Conservancy
Annual Performance Report

Submitted to

The Rhode Island Department of Environmental Management
Division of Fish and Wildlife

Title: Block Island Seine Survey

Cooperative Agreement Award Number: 3425240

Award Term: January 15, 2020 to December 31, 2024

Reporting Period: January 1, 2022 to December 31, 2022

Prepared By

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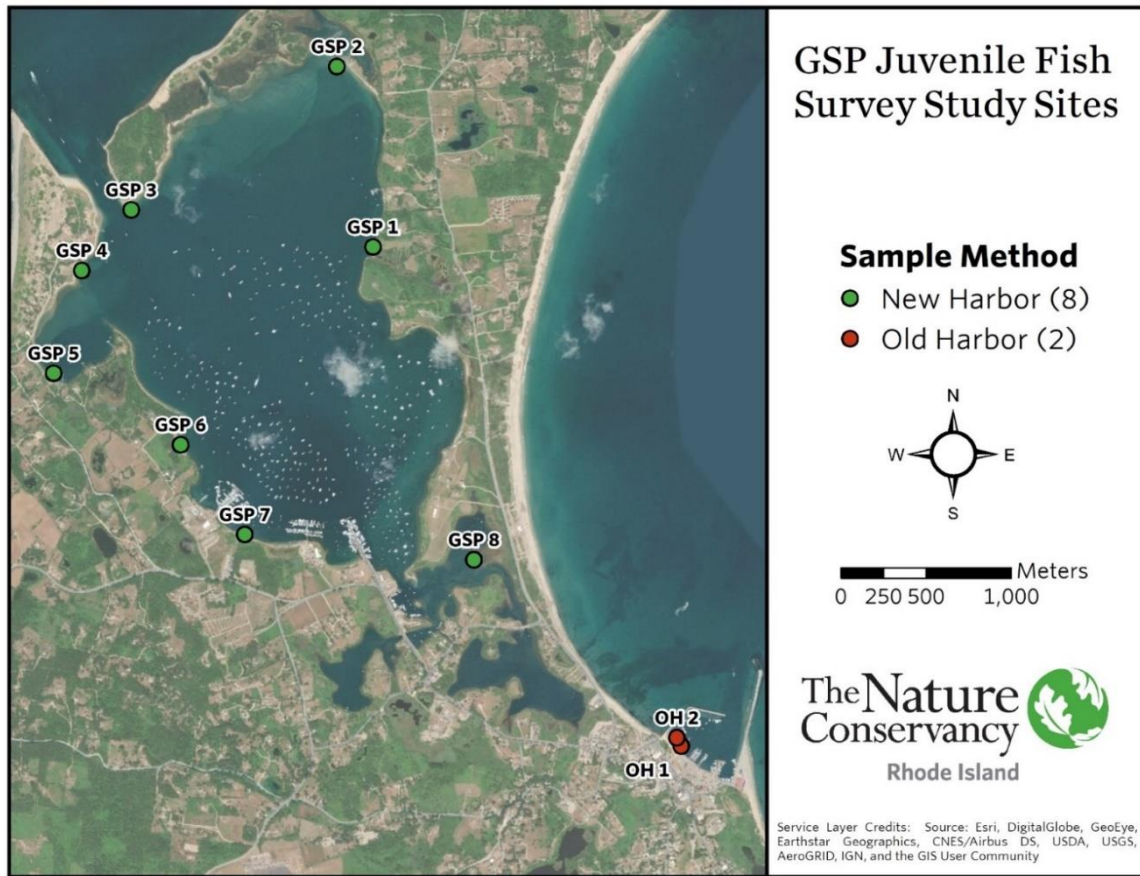
Approved By

Scott Comings, Associate State Director

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Map of study area and sampling locations.



SUMMARY:

During the 2022 season, a total of 60 seines were hauled across 10 sites in May through October resulting in the enumeration of 35,448 individuals. 34,842 of those individuals were finfish and 606 were other marine invertebrates. Of the animals caught, 3,750 individuals were measured, and 61 species were identified (see Table 1). Despite the additional considerations for safely working in the field during the COVID-19 pandemic, all scoped work was completed. All raw data have been shared with the appropriate staff of the Division of Marine Fisheries (DMF) and The Nature Conservancy (TNC) for incorporation into existing datasets.

For the entire time series (2014-2022), all individuals of the target species: winter flounder, summer flounder, tautog, scup, and black sea bass were enumerated and measured. The abundance indices for the target species only target young-of-the-year (YOY) individuals. Adults and juveniles of other species collected were not differentiated for data analysis or descriptive purposes. Presence and relative abundance of three forage species: silversides spp., common mummichog, and striped killifish were noted in this report. Presence and absence of bluefish and members of the Clupeidae family: Atlantic menhaden and river herring (alewife and blueback herring) were also included in this report. Since 2020 the gender and total carapace length of any blue crab, green crab, and horseshoe crab were measured and recorded. Data on weather, depth, water temperature, salinity, and dissolved oxygen were also recorded at each station since that start of the Block Island (BI) time series.

TARGET DATE:

December 31, 2022

NEXT STEPS:

Investigators intend to continue sampling with the same methodology for the 2023 field season. Additionally, the Great Salt Pond (GSP) project team will coordinate with the primary investigators of the Coastal Ponds (CP) and Providence River Estuary (PRE) juvenile fish surveys to evaluate variations in fish assemblages across study areas in Rhode Island (RI).

INTRODUCTION:

Estuaries provide essential nursery habitat for about two-thirds of the economically important fish species along the East Coast of the United States (Boesch and Turner 1984; Able 2005). In Rhode Island waters, more than 70% of commercially and recreationally important fish species are estimated to use estuaries for a portion of their life cycle, particularly early life stages (Meng and Powell 1999). While the linkage between habitat and fish production continues to be studied, it remains clear that many fisheries are concentrated on species that use estuaries as nurseries and identifying and valuing these ecosystems is a critical part of their conservation.

On Block Island, Rhode Island, the defining estuary is the Great Salt Pond. The Great Salt Pond is a 1,000-acre navigable estuary found in the center of the island. Having unique offshore features, the Great Salt Pond is generally known for its deeper depths, varied slopes, structure, and rich bottom communities (Hale 2000; Katz 2000). Although many studies have described the Great Salt Pond to be highly productive, there has been limited historic and empirical data to support these claims. In fact, a subsequent literature review revealed that one of the more recent finfish surveys documented in the Great Salt Pond was in 1992 as a part of a master's thesis (Neuman 1993). This gap in information

further supports the critical need to better understand the Great Salt Pond and its role in supporting fish populations.

In 2014, the Division of Marine Fisheries and The Nature Conservancy entered into a cooperative agreement and established the juvenile fish seine survey on Block Island. Through a holistic approach to monitoring, fish assemblages, water quality, and benthic habitat were evaluated in the Great Salt Pond and Old Harbor. Not only did the initial results show that the study area supported recreationally and commercially important juvenile finfish, but it also recognized that these areas could support habitat improvements aimed at increasing fish recruitment. As the habitat and water quality of the Great Salt Pond and Old Harbor continue to change, this seine survey will serve to document how these changes affect fish assemblage on Block Island over time. It also provides time series comparisons for other established seine surveys happening in the Providence River Estuary and Coastal Ponds of southern Rhode Island. Continuation of this survey has proven to be a valuable tool for the Division of Marine Fisheries and The Nature Conservancy for assessing fish populations across Rhode Island waters.

METHODS:

All 8 stations in the GSP and 2 stations in Old Harbor (OH) were sampled at monthly intervals from May through October. Sampling occurred on the incoming tide and in the rocky intertidal zone at depths shallower than 2m. At each site a 130' long, 5.5' deep, ¼" mesh net beach seine was used to collect species. This net was also outfitted with a midpoint pocket, weighted footrope, and a floated headrope, all consistent with the net used in the YOY Survey of Selected RI Coastal Ponds and Embayments (conducted as part of F-61-R-23, Job #3). For sampling in the GSP, the net was deployed by boat along the shoreline to create a semi-circle set for the seine haul. In OH, sampling required investigators to set and haul the net without a vessel. The average area swept of the net was calculated to be 2,112sq ft. The net was then hauled by hand from both ends toward the beach. Animals caught were transferred into a large water-filled tote. All collected animals were identified to genus or species and measured and enumerated to the nearest centimeter for total length (TL) (except for flounder species which were measured to the nearest millimeter). Additionally, the gender and total carapace length of any blue crabs, green crabs, or horseshoe crabs were recorded. When appropriate, species were subsampled by measuring the first 20 individuals identified and then counting the remainder. Upon completion, all animals were released back into the water at the collection site. At each sampling site, water temperature (°C), salinity (ppt), dissolved oxygen (mg/L), water depth, and transparency were recorded with a Professional Plus series handheld YSI multiparameter meter and Secchi disk. The YSI multiparameter meter was calibrated monthly throughout the sampling season according to manufacturer recommendations.

RESULTS & DISCUSSION:

For the 2022 field sampling season, a total of 60 seines were hauled across the 10 sampling sites. A total of 35,448 individuals were identified and enumerated, and 3,750 of those were measured. A total of 61 species were caught (Table 1). Of the species caught, only finfish were included in the results below (all crustaceans were excluded).

Excluding Atlantic menhaden from the analysis, a mean of 128.40 ± 101.46 SE finfish were caught per haul in 2022. Catch per haul across sites was greatest at the sand flat in OH (OH 2) at 1020.00 ± 931.13 SE and lowest at the Ball O'Brien site in the GSP (GSP 7) at 11.33 ± 10.35 SE (Figure 1). Catch per

haul across months was greatest in September at 731.50 ± 602.06 SE and lowest in October at 38.90 ± 25.17 SE (Figure 2).

TARGET SPECIES

Winter Flounder (*Pseudopleuronectes americanus*)

Of the total 185 winter flounder caught in 2022 seines, 172 individuals were YOY, and 13 individuals were age 1+ (max length = 220 mm; Able and Fahay 1998; Berry et al. 1965; Meng et al. 2000). Winter flounder were collected during all months and caught at all stations except for GSP 7 (Ball O'Brien site) in 2022 (Table 2). The most abundant site for winter flounder was the inner pond site in the GSP (GSP 8) at a catch per haul of 8.00 ± 3.21 SE (Figure 3a). The most abundant month for winter flounder was June at a catch per haul of 4.80 ± 2.28 SE fish/seine haul (Figure 3b). In past survey seasons, the sites in OH (OH 1-2) were recorded as sites of highest abundance for the BI time series. The 2022 juvenile winter flounder abundance index was 3.08 ± 0.60 SE fish/seine haul, which is lower than the 2021 index of 4.62 ± 1.02 SE. The BI survey's highest abundance index for juvenile winter flounder was recorded in 2016 at a catch per haul of 10.22 ± 3.59 SE fish/seine haul.

Summer Flounder (*Paralichthys dentatus*)

A total of 15 summer flounder were caught in 2022 beach seines ranging in size from 30mm to 120mm. Summer flounder were caught at 5 of the 10 stations: GSP 3 (Beane Point), GSP 4 (Coast Guard Station), GSP 8 (Inner Pond), OH 1 (eelgrass bed), and OH 2 (sand flat). Summer flounder were most abundant at the OH sites and had slight deviations between catch per hauls: 1.00 ± 0.41 SE at OH 1 (eelgrass bed) and 1.00 ± 0.75 SE at OH 2 (sand flat) (Figure 3a). In 2022, one individual was caught in May, three were caught in June, and the remaining nine were caught between August and October (Figure 3b). Since the start of the BI time series, summer flounder has been the least abundant catch for the interest group.

Tautog (*Tautoga onitis*)

During the 2022 survey 381 tautog were collected and ranged in size from 2cm to 35cm. This total number is an increase from the 2021 survey when 357 juveniles were collected. The 2022 abundance index was 6.35 ± 1.57 SE, an increase from the 2021 index 5.95 ± 1.37 SE. Juvenile tautog were caught at every station in 2022. The species was most abundant at OH 1 (eelgrass bed) with a catch per haul of 17.67 ± 8.10 SE (Figure 3a). Tautog were most abundant in September with a catch per haul of 13.70 ± 5.85 SE (Figure 3b). For the BI time series, all survey years except 2016 and 2019 recorded highest abundance of tautog in September.

Black Sea Bass (*Centropristis striata*)

One hundred and eighty-five black sea bass were caught in 2022, which is a slight decrease from the 195 individuals that were collected in 2021. The number of black sea bass has been highly variable from year-to-year during the time series survey, with 2015 and 2019 numbers standing out as significantly higher across survey years. In 2022, black sea bass individuals collected during sampling ranged in size between 2cm and 11cm. The highest mean monthly abundance for 2022 occurred in September at 8.90 ± 5.40 SE (Figure 3b). Black sea bass were caught at all stations apart from GSP 8

(Inner Pond). The Coast Guard Station (GSP 4) had the highest mean abundance of 17.67 ± 8.55 SE (Figure 3a).

The abundance index for black sea bass in 2022 was 3.08 ± 1.17 SE fish/seine haul. This is slightly lower than the 2021 index of 3.25 ± 1.19 SE fish/seine haul. While the 2022 index decreased from the previous season's index, the 2022 abundance was greater than past sampling years (2014 and 2017) when less than 25 individuals were collected during the season. The fall index dropped down from the high values in 2015 and 2016 but did show increase in abundance starting in 2018. This recruitment signal in recent years was also observed all along the Northern Atlantic coast (Tuckey and Fabrizio 2019). While investigators note that indices rise and fall, the presence of black sea bass has been increasingly prevalent across regional seine surveys (NEFSC 2017).

Scup (*Stenotomus chrysops*)

A total of 24 scup were caught in 2022 from June through October, a slight increase from 2021 when 17 scup were collected. The total survey abundance for 2022 was 0.40 ± 0.21 SE fish/seine haul. Scup were caught at 4 of the 10 sites: Harris Point (GSP 1), Cormorant Cove (GSP 5), and both sites in OH (OH 1-2). Scup were most abundant at the sand flat site in OH (OH 2) with a catch per haul of 2.83 ± 1.74 SE (Figure 3a). Most individuals were caught in October at a catch per haul of 1.20 ± 1.20 SE in 2022 (Figure 3b). Scup caught in 2022 ranged in size between 3cm and 28cm, representing ages-0-to-age-6 based on mean length-at-age data from a combination of studies based out of the Mid-Atlantic, southern New England, Georges Bank, Gulf of Maine, and Nova Scotia (Penttila et al. 1989).

OTHER SPECIES OF INTEREST

Bluefish (*Pomatomus saltatrix*)

A total of 79 bluefish were caught in 2022, which is an increase from the 33 individuals that were caught in 2021. The total mean abundance per haul was 1.32 ± 1.03 SE ranging in size from 6cm to 18cm. Bluefish were found from August through October at stations GSP 4 (Coast Guard Station), OH 1 (eelgrass bed), and OH 2 (sand flat). Bluefish were most abundant at the eelgrass site in OH (OH 1) with a catch per haul of 11.00 ± 9.33 SE. The most individuals were caught in September at a catch per haul of 7.10 ± 6.17 SE in 2022.

Family Clupeidae

In 2022, three species of clupeids were collected during the sampling season: alewife, Atlantic Menhaden, and blueback herring. While other species of clupeids have been collected in past BI surveys (Atlantic herring and hickory shad), they were not captured during the 2022 season. Due to the difficulty of separating juvenile alewives from juvenile blueback herring without sacrificing them, both species are collectively referred to as river herring. Investigators also acknowledge that although large schools of clupeid species were not encountered in the 2022 survey, they were most likely present in the system, particularly in large abundances, and may have been missed while sampling.

Atlantic Menhaden (*Brevoortia tyrannus*)

Atlantic menhaden was the most frequent clupeid species documented in 2022, with 7,704 individuals caught in the GSP and OH between September and October. This is an increase from the 2021 survey

when several schools of menhaden were caught from July through October, totaling 1,835 individuals. The total survey mean abundance index was 128.40 ± 101.46 SE in 2022. Menhaden were caught at 5 out of 10 sites in the GSP (GSP 1-3, 7-8), and both sites in OH (OH 1-2). The species was most abundant at the sand flat site in OH (OH 2) with a catch per haul of 1020.00 ± 931.13 SE. The highest number of individuals were caught in September at a catch per haul of 731.50 ± 602.06 SE. Menhaden TL measurements ranged from 3cm to 13cm in 2022.

Juvenile menhaden have been observed in very large schools on BI since 2015. This behavior often results in single large catches resulting in high abundance indices and large standard errors. It also contributes to the variability of their spatial and temporal abundance from year to year. In 2022, there were minimal instances in which more than 1,000 individuals were caught in a single haul. Because of these characteristics, it is difficult to develop an abundance index that will accurately reflect the number of juveniles observed in the field rather than the number represented in the samples.

River Herring (*Alosa pseudoharengus* & *Alosa aestivalis*)

A total of 45 river herring were caught in 2022. Both alewife and blueback herring are classified as river herring in this survey. River herring ranged in size from 1cm to 13cm and were found in August and September at both sites in OH (OH 1-2) with a total survey mean abundance of 0.75 ± 0.45 SE fish/seine haul in 2022.

Forage Fish Species

Forage fish species are commonly encountered across stations and months during the sampling season. In 2022, silversides, striped killifish, and common mummichog comprised more than 69.7% of the total catch, which is lower than percentages recorded for previous survey years. While other baitfish species such as sheepshead minnow were encountered this season in abundance, we selected the species below since their presence have been the most notable and reported on since the start of the time series.

Silversides spp. (*Menidia* spp.)

Silversides had the highest abundance of all finfish species caught during the 2022 survey. The species has been ranked as the most abundant finfish species since the start of the BI survey in 2014. For the purposes of this survey and streamlining report criteria, Atlantic silverside and inland silversides are collectively referred to as silversides (*Menidia* spp.).

A total of 18,478 silversides were caught in 2022. The total mean abundance was 307.97 ± 80.06 SE in 2022 and was higher than last year's index of 222.27 ± 70.15 SE, making it the second highest abundance index for the overall time series. The species was most abundant at the sand flat site in OH (OH 2) with a catch per haul of 1213.17 ± 551.47 SE in 2022. The highest number of silversides were caught in September at a catch per haul of 761.40 ± 298.22 SE in 2022, which is consistent with past survey records. Silversides ranged in size from 1cm to 15cm and were found in all months and stations.

Striped Killifish (*Fundulus majalis*)

A total of 5,738 striped killifish were collected in 2022 and ranged in size from 1cm to 13cm. The species ranked third in highest abundance this season, which is consistent with previous survey years when the species was ranked either second or third for all species caught. In 2022, striped killifish

occurred at all stations except OH 1-2 and during all months except for May. The total mean abundance was 95.63 ± 31.30 SE in 2022, which is higher than the 2021 index of 38.25 ± 12.27 SE. In 2022, the highest number of striped killifish were caught in September at a catch per haul of 272.10 ± 104.26 SE, and they were most abundant at Andy's Way (GSP 2) with a catch per haul of 500.83 ± 220.91 SE.

Common Mummichog (*Fundulus heteroclitus*)

Four hundred and ninety-eight mummichogs were caught during the 2022 survey. The individuals ranged in size from 3cm to 12cm in 2022. The species was caught at all stations this season except at OH 1. In 2022, mummichogs were most abundant in August at a catch per haul of 35.20 ± 30.06 SE and had the highest abundance at the Andy's Way (GSP 2), with a catch per haul of 57.33 ± 45.48 SE in 2022. The total mean abundance was 8.30 ± 5.09 SE in 2022. Catch frequencies of mummichogs have been variable across survey years for the BI time series.

WATER QUALITY DATA

Water quality data for the 2022 season can be found in Table 3. In the GSP, water temperature ranged from 13.9°C in May to 25.0°C in August. In OH, water temperature ranged from 13.7°C in May and 21.8°C in August. The mean salinity of the 8 sites in the GSP was $31.10\text{ppt} \pm 0.08$ SE, and the mean salinity of the 2 sites in OH were $31.89\text{ppt} \pm 0.08$ SE. The lowest dissolved oxygen value recorded across the GSP sites was 7.06mg/L in September at Andy's Way (GSP 2), while the mean was $8.68\text{mg/L} \pm 0.14$ SE. In 2022, the eelgrass site in OH (OH 1) recorded the lowest dissolved oxygen value at 8.14mg/L in August, with a mean of $8.98\text{mg/L} \pm 0.21$ SE between the OH sites.

SUMMARY:

In 2022, investigators caught 52 species of finfish representing 32 families. These numbers are fairly consistent with 2021 when 54 species from 30 families were collected. The number of finfish individuals caught in 2022 increased from the 2021 survey, with 34,842 collected in 2022, and 19,203 collected in 2021. This year also marked the highest number of individual species caught over the last 9 years of the BI juvenile fish survey. Frequency of all species caught by station during the 2022 BI survey can be found in the appendix. Additional data is available upon request.

REFERENCES:

- Able, K.W. 2005. A re-examination of fish estuarine dependence: Evidence for connectivity between estuarine and ocean habitats. *Estuarine, Coastal and Shelf Science*. 64(1):5-17.
- Able, K.W., and M.P. Fahay. 1998. The First Year in the Life of Estuarine Fishes in the Middle Atlantic Bight. *Rutgers University Press*. 342 pp.
- Berry, R.J., S.B. Saila, and D.B. Horton. 1965. Growth studies of winter flounder, *Pseudopleuronectes americanus* (Waldbaum), in Rhode Island. *Transactions American Fisheries Society*. 94:259-264.
- Boesch, D.F., and R.E. Turner. 1984. Dependence of fishery species on salt marshes: the role of food and refuge. *Estuaries* 7:460-468.
- Hale, S. 2000. Marine Bottom Communities of Block Island Waters. In P.W. Paton, L.L. Gould, P.V. August & A.O. Frost (Ed.), The Ecology of Block Island. *Rhode Island Natural History Survey*. 131-49.
- Katz, L.M. 2000. Designing a Protocol for Monitoring the Great Salt Pond and its Watershed, Block Island, Rhode Island (Doctoral Dissertation). Providence, RI: Brown University.
- Meng, L., and J.C Powell. 1999. Linking juvenile fish and their habitats: an example from Narragansett Bay, Rhode Island. *Estuaries*. 22(4): 860-71.
- Meng, L., C. Gray, B. Taplin, and E. Kupcha. 2000. Using Winter Flounder growth rates to assess habitat quality in Rhode Island's coastal lagoons. *Marine Ecology Progress Series*. 201:287-299.
- Neuman, M.J. 1993. Distribution, abundance, and diversity of shoreline fishes in the Great Salt Pond, Block Island, Rhode Island. Thesis (M.S.) *University of Rhode Island*. 33 pp.
- Northeast Fisheries Science Center (NEFSC). 2017. 62nd Northeast Regional Stock Assessment Workshop (62nd SAW) Assessment Summary Report. U.S. Department of Commerce, *Northeast Fisheries Science Center Reference Document*. 17-01; 37 pp.
- Penttila, J.A., G.A. Nelson, and J.M. Burnett, III. 1989. Guidelines for estimating lengths at age for 18 northwest Atlantic finfish and shellfish species. *NOAA Technical Memorandum NMFS-F/NEC-66*. 39 pp.
- Tuckey, T.D., and M.C. Fabrizio. 2019. Estimating Relative Juvenile Abundance of Ecologically Important Finfish in the Virginia Portion of the Chesapeake Bay. Project # F-104-R-23. Annual Report to the Virginia Marine Resources Commission. *Virginia Institute of Marine Science*. 157 pp.

FIGURES:

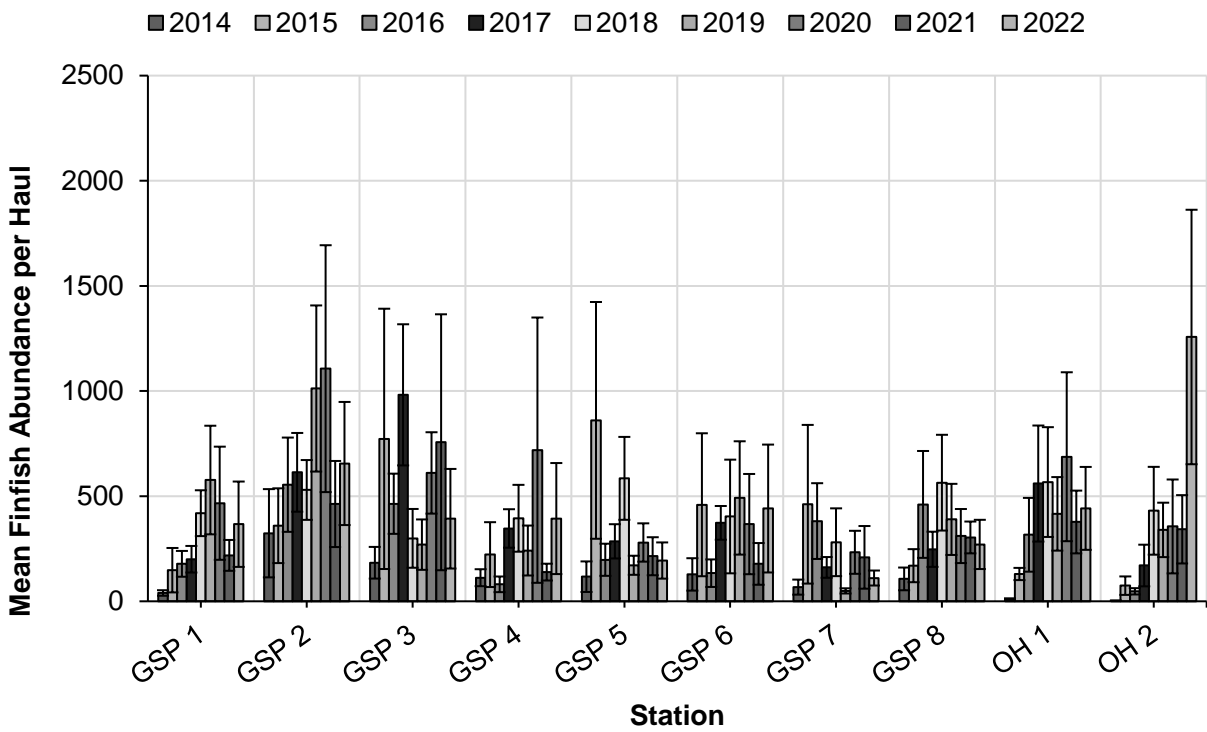


Figure 1. Mean abundance of finfish across stations (\pm SE) in 2014-2022 beach seines.

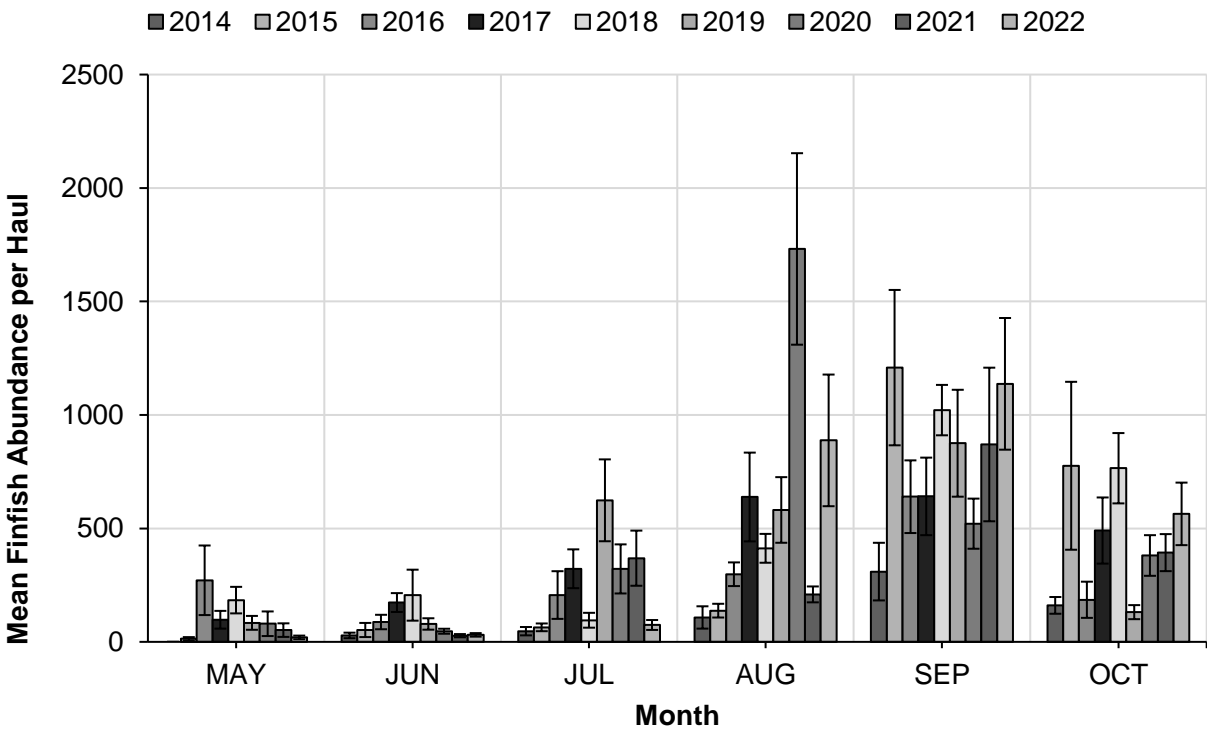


Figure 2. Mean abundance of finfish caught each month (\pm SE) in 2014-2022 beach seines.

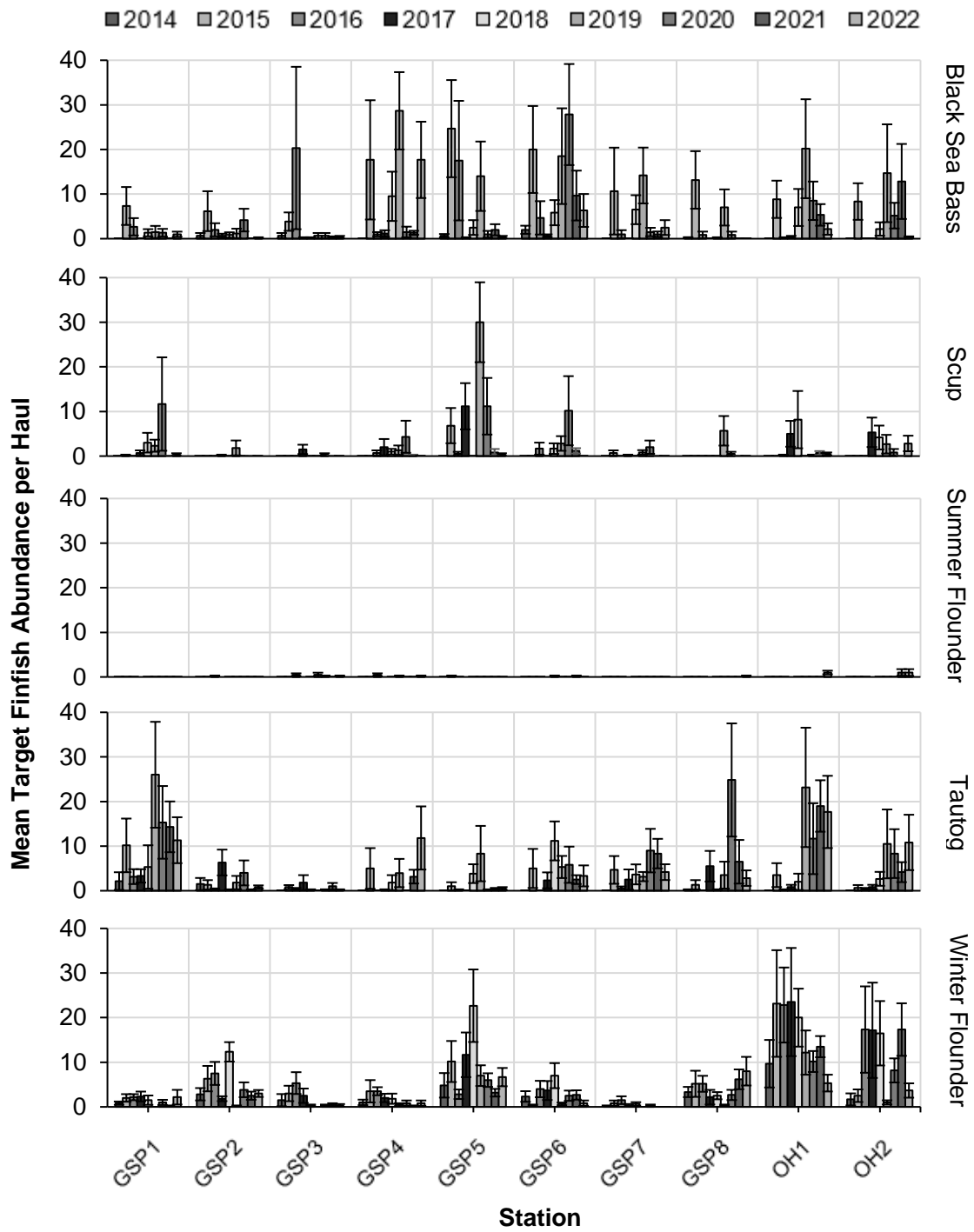


Figure 3a. Mean abundance of target finfish caught by site (\pm SE) in 2014-2022 beach seines.

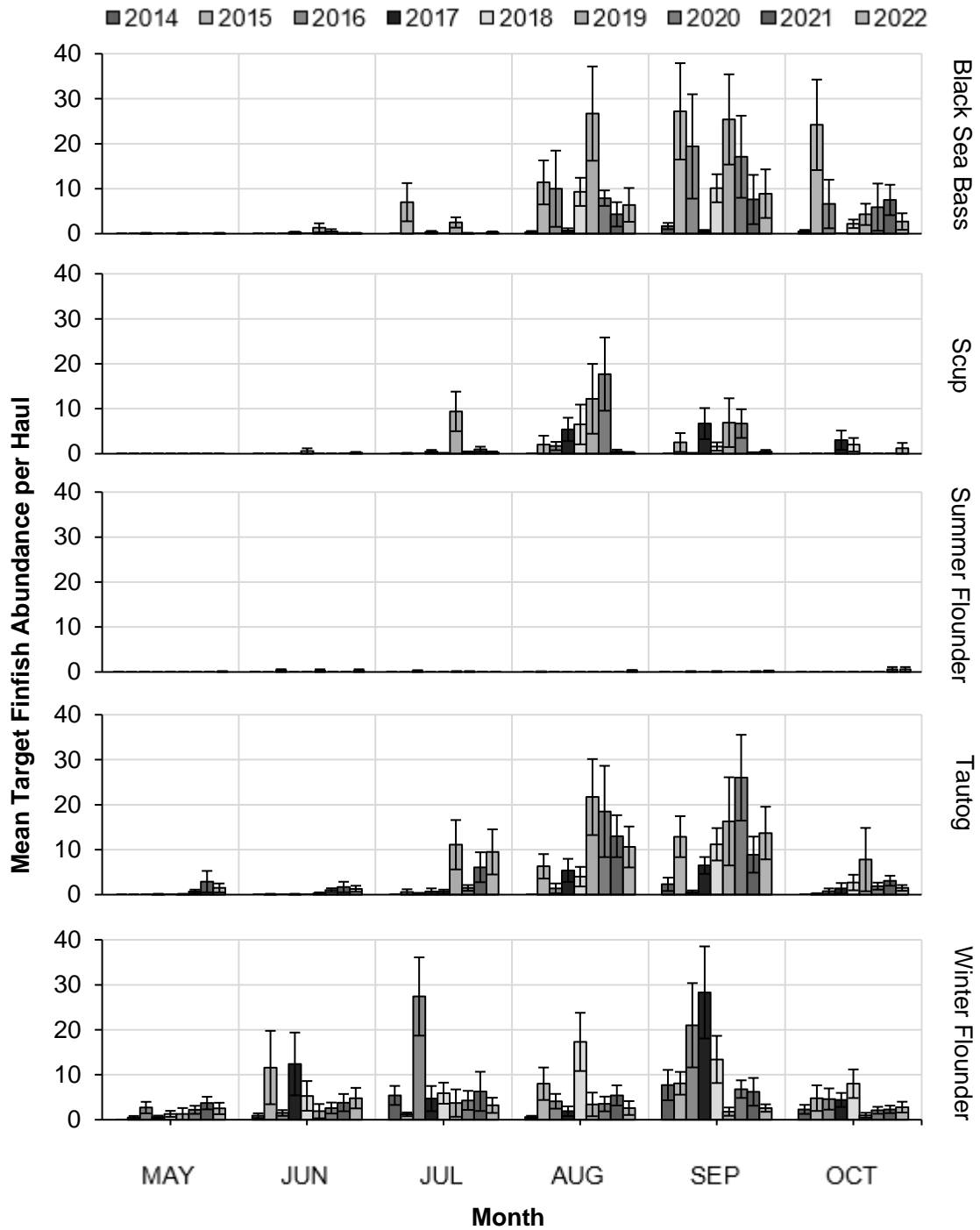


Figure 3b. Mean target finfish per seine haul (\pm SE) plotted for each month during the 2014-2022 field seasons.

TABLES:

Table 1. Common, scientific names, and total abundance of all species collected in beach seines during 2022.

Common Name	Scientific Name	Abundance
Silversides spp.	<i>Atherinopsidae spp.</i>	18478
Atlantic Menhaden	<i>Brevoortia tyrannus</i>	7704
Striped Killifish	<i>Fundulus majalis</i>	5738
Mummichog	<i>Fundulus heteroclitus</i>	498
Tautog	<i>Tautoga onitis</i>	381
Cunner	<i>Tautoglabrus adspersus</i>	380
American Sand Lance	<i>Ammodytes americanus</i>	366
Green Crab Male	<i>Carcinus maenas</i>	309
Green Crab Female	<i>Carcinus maenas</i>	207
Black Sea Bass	<i>Centropristis striata</i>	185
Winter Flounder	<i>Pseudopleuronectes americanus</i>	185
Sheepshead Minnow	<i>Archosargus probatocephalus</i>	182
Bay Anchovy	<i>Anchoa mitchilli</i>	94
Pollock	<i>Pollachius virens</i>	86
Northern Sennet	<i>Sphyraena borealis</i>	85
Bluefish	<i>Pomatomus saltatrix</i>	79
Grubby	<i>Myoxocephalus aeneus</i>	56
Rainwater Killifish	<i>Lucania parva</i>	45
River Herring (Alewife, Blueback Herring)	<i>Alosa pseudoharengus, Alosa aestivalis</i>	45
Northern Pipefish	<i>Syngnathus fuscus</i>	37
Blue Crab Male	<i>Calinectes sapidus</i>	34
Scup	<i>Stenotomus chrysops</i>	24
White Mullet	<i>Mugil curema</i>	24
Blue Crab Female	<i>Calinectes sapidus</i>	23
Oyster Toadfish	<i>Opsanus tau</i>	23
Crevalle Jack	<i>Caranx hippos</i>	19
Chain Pipefish	<i>Syngnathus louisianae</i>	16
Striped Searobin	<i>Prionotus evolans</i>	15
Summer Flounder	<i>Paralichthys dentatus</i>	15
Spider Crab Male	<i>Libinia emarginata</i>	13
Horse-eye Jack	<i>Caranx latus</i>	11
Northern Kingfish	<i>Menticirrhus saxatilis</i>	10
Pinfish	<i>Lagodon rhomboides</i>	8
Yellow Jack	<i>Caranx bartholomaei</i>	7

Table 1. (continued)

Common Name	Scientific Name	Abundance
Bay Scallop	<i>Argopecten irradians</i>	5
Longfin Squid	<i>Loligo pealei</i>	5
Striped Bass	<i>Morone saxatilis</i>	5
Atlantic Cod	<i>Gadus moruha</i>	4
Lady Crab Male	<i>Ovalipes ocellatus</i>	4
Bay Whiff	<i>Citharichthys spilopterus</i>	3
Fourspine Stickleback	<i>Apeltes quadracus</i>	3
Fourspot Flounder	<i>Paralichthys oblongus</i>	3
Northern Puffer	<i>Sphoeroides maculatus</i>	3
Northern Searobin	<i>Prionotus carolinus</i>	3
American Eel	<i>Anguilla rostrata</i>	2
Lined Seahorse	<i>Hippocampus erectus</i>	2
Mantis Shrimp	<i>Squilla empusa</i>	2
Pigfish	<i>Orthopristis chrysoptera</i>	2
Rock Gunnel	<i>Pholis gunnellus</i>	2
Smallmouth Flounder	<i>Etropus microstomus</i>	2
Spot	<i>Leiostomus xanthurus</i>	2
Threespine Stickleback	<i>Gasterosteus aculeatus</i>	2
Atlantic Tomcod	<i>Microgadus tomcod</i>	1
Flame Box Crab Male	<i>Calappa flammea</i>	1
Horseshoe Crab Male	<i>Limulus polyphemus</i>	1
Lady Crab Female	<i>Ovalipes ocellatus</i>	1
Leopard Searobin	<i>Prionotus scitulus</i>	1
Naked Goby	<i>Gobiosoma bosc</i>	1
Round Scad	<i>Decapterus punctatus</i>	1
Snakefish	<i>Trachinocephalus myops</i>	1
Spider Crab Female	<i>Libinia emarginata</i>	1
Spotfin Morraja	<i>Eucinostomus argenteus</i>	1
Twospot Flounder	<i>Bothus robinisi</i>	1
Windowpane	<i>Scophthalmus aquosus</i>	1

Table 2. Abundances of winter flounder in 2022 beach seines.

Month	Station										Mean	SD	SE
	GSP 1	GSP 2	GSP 3	GSP 4	GSP 5	GSP 6	GSP 7	GSP 8	OH1	OH2			
MAY	0	4	2	0	13	1	0	0	4	1	2.50	4.01	1.27
JUN	0	6	0	0	14	0	0	21	4	3	4.80	7.21	2.28
JUL	11	0	0	0	2	0	0	2	15	2	3.20	5.33	1.69
AUG	0	2	0	1	2	4	0	16	1	0	2.60	4.88	1.54
SEP	0	2	0	4	3	0	0	7	6	4	2.60	2.63	0.83
OCT	2	4	0	0	6	0	0	2	2	12	2.80	3.79	1.20
Mean	2.17	3.00	0.33	0.83	6.67	0.83	0.00	8.00	5.33	3.67			
SD	4.02	1.91	0.75	1.46	5.02	1.46	0.00	7.85	4.61	3.94			
SE	1.64	0.78	0.30	0.60	2.05	0.60	0.00	3.21	1.88	1.61			
Total	13	18	2	5	40	5	0	48	32	22			
													Total Fish
													185

Table 3. Temperature, salinity, and dissolved oxygen by station and month during 2022 beach seines.

Site	Month	Temp. (°C)	Sal. (ppt)	DO (mg/L)	Site	Month	Temp. (°C)	Sal. (ppt)	DO (mg/L)
GSP 1 (Harris Point)	MAY	13.9	30.71	10.12	GSP 5 (Cormorant Cove)	MAY	15.7	30.75	10.06
	JUN	21.8	30.92	9.15		JUN	18.9	31.05	9.11
	JUL	22.0	31.22	8.16		JUL	21.1	30.24	9.06
	AUG	22.3	31.66	7.79		AUG	22.9	32.09	8.08
	SEP	22.2	31.04	7.38		SEP	21.0	31.82	7.60
	OCT	16.4	30.14	8.36		OCT	16.4	30.90	9.16
GSP 2 (Andy's Way)	MAY	14.1	31.03	9.99	GSP 6 (Bonnell Beach)	MAY	16.2	30.66	10.10
	JUN	21.1	30.83	9.44		JUN	19.5	31.14	9.81
	JUL	22.5	30.99	9.08		JUL	21.5	31.05	9.12
	AUG	23.4	31.48	7.54		AUG	22.4	31.72	8.12
	SEP	23.1	32.09	7.06		SEP	22.1	31.44	7.11
	OCT	17.1	30.69	8.37		OCT	16.6	30.23	9.09
GSP 3 (Beane Point)	MAY	15.6	31.08	10.01	GSP 7 (Ball O'Brien)	MAY	15.9	30.51	9.64
	JUN	19.5	30.91	9.59		JUN	19.5	30.82	9.90
	JUL	21.2	31.03	8.83		JUL	21.8	31.11	8.57
	AUG	23.7	31.80	8.06		AUG	22.9	31.35	7.91
	SEP	22.2	32.15	7.64		SEP	22.2	31.25	7.29
	OCT	16.6	31.44	8.39		OCT	16.6	30.75	9.24
GSP 4 (Coast Guard Station)	MAY	15.4	30.88	9.94	GSP 8 (Inner Pond)	MAY	18.0	30.28	10.00
	JUN	19.5	30.90	9.68		JUN	20.1	30.73	9.25
	JUL	20.9	30.78	9.00		JUL	21.6	30.66	9.21
	AUG	25.0	32.03	8.10		AUG	24.4	30.27	7.77
	SEP	21.7	32.04	7.39		SEP	22.6	30.84	8.06
	OCT	17.0	31.50	8.01		OCT	16.9	31.67	7.41
OH 1 (Eelgrass Bed)	MAY	13.7	31.59	9.61	OH 2 (Sand Flat)	MAY	13.7	31.63	9.47
	JUN	19.1	31.98	10.02		JUN	19.2	31.92	10.06
	JUL	21.2	31.47	9.18		JUL	21.2	31.50	9.07
	AUG	21.5	32.22	8.14		AUG	21.8	32.26	8.18
	SEP	21.0	32.04	8.16		SEP	21.7	32.05	8.20
	OCT	16.1	32.01	8.84		OCT	16.1	8.18	8.85

APPENDIX

Catch frequency of all species by station for 2022 BI seine survey.

Species	GSP1 (Harris Point)	GSP2 (Anby's Way)	GSP3 (Beane Point)	GSP4 (Coast Guard)	GSP5 (Cannonment Cove)	GSP6 (Bonnet Beach)	GSP7 (Ball O'Brien)	GSP8 (Inner Pond)	OH1 (Eelgrass Bed)	OH2 (Sand Flat)
American Eel										2
American Sand Lance		2	24	32	124	6			178	
Atlantic Cod		3							1	
Atlantic Menhaden	71	295	333				68	250	567	6120
Atlantic Tomcod									1	
Bay Anchovy			83			11				
Bay Scallop				2	3					
Bay Whiff			2	1						
Black Sea Bass	6	1	2	106	2	38	15		13	2
Bluefish				4					66	9
Blue Crab Male	3				1		1	3	8	18
Blue Crab Female	3				1		1	1	2	15
Chain Pipefish	1	1		1		1	2	1	5	4
Crevalle Jack									16	3
Cunner	85	1	1	112	7	30	8	6	67	63
Flame Box Crab Male								1		
Fourspine Stickleback								3		
Fourspot Flounder				2						1
Green Crab Female	5	17	4	26	6	20	48	6	48	27
Green Crab Male	14	21	7	32	14	36	51	14	54	66
Grubby	2	1		4	8	9	7		8	17
Horse-eye Jack									10	1
Horseshoe Crab Male	1									
Lady Crab Female							1			
Lady Crab Male		1	1		1		1			
Leopard Searobin				1						
Lined Seahorse						1				1
Longfin Squid					3	2				
Mantis Shrimp										2
Mummichog	26	344	5	17	7	9	44	45	1	
Naked Goby								1		
Northern Kingfish							1			9
Northern Pipefish	1		2	2		1			26	5
Northern Puffer				1		2				
Northern Searobin					1					2
Northern Sennet	39	3	36		3	2	2			
Oyster Toadfish								23		
Pigfish								2		
Pinfish									7	1
Pollock							13		66	7
Rainwater Killifish	3	18	1			2	13	8		
River Herring (Alewife & Blueback Herring)		9							21	15
Rock Gunnel						1		1		
Round Scad				1						
Scup	2				2				3	17
Sheepshead Minnow	41	99	20	2	10	9		1		
Silversides spp.	1676	418	1290	1502	524	2100	459	1245	1985	7279
Smallmouth Flounder				1	1					
Snakefish			1							
Spider Crab Female		1								
Spider Crab Male	4	1	1				1	5		1
Spot									2	
Spotfin Morraja				1						
Striped Bass	2						1		2	
Striped Killifish	234	3005	883	495	431	397	74	219		
Striped Searobin		3				3				9
Summer Flounder			1	1				1	6	6
Tautog	68	5	2	70	3	20	25	17	106	65
Threespine Stickleback								2		
Twospot Flounder		1								
White Mullet									22	2
Windowpane			1							
Winter Flounder	13	18	2	5	40	5		48	32	22
Yellow Jack									7	

APPENDIX

Species presence by station for May 2022 beach seines.

MAY	Station										
Species	GSP1	GSP2	GSP3	GSP4	GSP5	GSP6	GSP7	GSP8	OH1	OH2	Total
Atlantic Cod									1		1
Black Sea Bass									1		1
Blue Crab Male				1					1	1	3
Chain Pipefish									1	1	2
Cunner	1		1				1				3
Green Crab Female	1	1	1	1	1	1	1	1	1	1	10
Green Crab Male	1	1	1	1	1	1	1	1	1	1	10
Grubby				1							1
Northern Pipefish									1		1
Pollock						1			1	1	3
Rock Gunnel						1					1
Silversides spp.	1	1		1	1			1			5
Spider Crab Male							1				1
Summer Flounder									1		1
Tautog	1	1					1		1		4
Winter Flounder		1	1		1	1			1	1	6

APPENDIX

Species presence by station for June 2022 beach seines.

JUN	Station										
Species	GSP1	GSP2	GSP3	GSP4	GSP5	GSP6	GSP7	GSP8	OHI	OII	Total
American Eel									1		1
American Sand Lance		1	1								2
Bay Scallop				1	1						2
Black Sea Bass								1			1
Blue Crab Male							1		1		2
Chain Pipefish		1									1
Cunner								1			1
Fourspot Flounder									1		1
Green Crab Female	1	1	1	1	1	1	1	1	1	1	10
Green Crab Male	1	1	1	1	1	1	1	1	1	1	10
Grubby						1			1	1	3
Horseshoe Crab Male	1										1
Longfin Squid						1					1
Mummichog								1			1
Naked Goby								1			1
Northern Pipefish									1		1
Rainwater Killifish								1			1
Scup										1	1
Silversides spp.	1	1	1	1		1	1	1	1	1	9
Spider Crab Male		1	1					1			3
Spider Crab Female		1									1
Striped Killifish	1							1			2
Summer Flounder									1		1
Tautog	1			1	1				1	1	5
Winter Flounder		1			1			1	1	1	5

APPENDIX

Species presence by station for July 2022 beach seines

JUL	Station										
Species	GSP1	GSP2	GSP3	GSP4	GSP5	GSP6	GSP7	GSP8	OHI	OII	Total
Black Sea Bass									1	1	2
Blue Crab Female				1						1	2
Blue Crab Male	1									1	2
Chain Pipefish						1		1	1	1	3
Cunner	1							1	1	1	3
Green Crab Female	1	1		1	1	1	1	1	1	1	9
Green Crab Male		1		1	1	1	1	1	1	1	8
Grubby				1	1				1	1	4
Lady Crab Male		1									1
Mantis Shrimp										1	1
Mummichog	1	1	1			1					4
Northern Pipefish				1					1	1	3
Northern Puffer				1							1
Northern Sennet	1	1									2
Pinfish									1	1	2
Rainwater Killifish	1										1
Scup	1								1		2
Silversides spp.	1	1	1	1	1	1	1	1	1	1	10
Spider Crab Male								1			1
Striped Bass	1								1		2
Striped Killifish	1	1	1	1	1			1			6
Striped Searobin		1				1					2
Tautog	1			1					1	1	4
Winter Flounder	1				1			1	1	1	5

APPENDIX

Species presence by station for August 2022 beach seines.

AUG	Station										
Species	GSP1	GSP2	GSP3	GSP4	GSP5	GSP6	GSP7	GSP8	OHI	OII	Total
Atlantic Cod		1									1
Bay Scallop				1	1						2
Bay Whiff			1	1							2
Black Sea Bass	1	1	1	1	1	1					6
Bluefish				1							1
Blue Crab Male								1	1	1	3
Chain Pipefish				1		1	1	1			4
Crevalle Jack									1	1	2
Cunner	1			1	1	1	1	1	1		7
Fourspine Stickleback								1			1
Green Crab Female		1		1	1	1	1	1	1	1	8
Green Crab Male	1	1	1	1	1	1	1	1	1		9
Grubby	1			1	1	1	1		1	1	7
Horse-eye Jack									1	1	2
Lady Crab Male					1						1
Leopard Searobin				1							1
Lined Seahorse						1					1
Longfin Squid					1						1
Mummichog	1	1	1		1	1	1				6
Northern Kingfish							1				1
Northern Pipefish	1			1					1	1	4
Northern Puffer						1					1
Northern Sennet			1		1	1	1				4
Oyster Toadfish								1			1
Rainwater Killifish	1	1	1				1	1			5
River Herring		1							1	1	3
Rock Gunnel								1			1
Round Scad				1							1
Scup					1						1
Sheepshead Minnow		1	1								2
Silversides spp.	1	1	1	1	1	1	1	1	1	1	10
Smallmouth Flounder				1							1
Snakefish			1								1
Spider Crab Male	1										1
Spotfin Morraja				1							1
Striped Killifish	1	1	1	1	1	1	1	1			8
Striped Searobin		1				1					2
Summer Flounder			1						1	1	3
Tautog	1	1		1	1	1	1	1	1	1	9
Threespine Stickleback								1			1
White Mullet									1	1	2
Windowpane			1								1
Winter Flounder		1		1	1	1		1	1		6

APPENDIX

Species presence by station for September 2022 beach seines.

SEP	Station										
Species	GSP1	GSP2	GSP3	GSP4	GSP5	GSP6	GSP7	GSP8	OHI	OHI2	Total
American Sand Lance			1						1		2
Atlantic Menhaden		1	1						1	1	4
Bay Anchovy			1								1
Black Sea Bass	1			1		1	1		1	1	6
Bluefish									1	1	2
Blue Crab Female	1								1	1	3
Blue Crab Male	1								1	1	3
Chain Pipefish	1										1
Crevalle Jack									1		1
Cunner	1			1			1		1	1	5
Flame Box Crab Male								1			1
Fourspot Flounder				1							1
Green Crab Female	1			1		1			1		4
Green Crab Male	1	1		1	1	1	1		1	1	8
Grubby	1			1		1	1		1	1	6
Horse-eye Jack									1		1
Lady Crab Male			1								1
Lined Seahorse										1	1
Mummichog	1	1		1			1	1			5
Northern Kingfish										1	1
Northern Pipefish			1			1			1	1	4
Northern Searobin										1	1
Oyster Toadfish								1			1
Rainwater Killifish	1	1				1	1	1			5
River Herring										1	1
Scup									1	1	2
Sheepshead Minnow	1	1			1			1			4
Silversides spp.	1	1	1	1	1	1	1	1	1	1	10
Spider Crab Male	1										1
Spot									1		1
Striped Killifish	1	1	1	1	1	1	1	1			8
Summer Flounder				1					1		2
Tautog	1	1		1		1		1	1	1	7
Twospot Flounder		1									1
Winter Flounder		1		1	1			1	1	1	6
Yellow Jack									1		1

APPENDIX

Species presence by station for October 2022 beach seines.

OCT	Station										
Species	GSP1	GSP2	GSP3	GSP4	GSP5	GSP6	GSP7	GSP8	OHI	OII	Total
American Sand Lance				1	1	1					3
Atlantic Menhaden	1						1	1			3
Atlantic Tomcod									1		1
Bay Anchovy						1					1
Bay Scallop					1						1
Black Sea Bass				1			1				2
Bluefish									1		1
Blue Crab Female							1	1			2
Blue Crab Male							1	1		1	3
Cunner		1		1		1					3
Green Crab Female				1		1	1		1		4
Green Crab Male		1		1		1	1		1	1	6
Grubby		1							1	1	3
Lady Crab Female							1				1
Lady Crab Male										1	1
Mummichog	1	1	1	1	1	1			1		7
Northern Kingfish										1	1
Northern Pipefish									1		1
Northern Searobin					1						1
Pigfish								1			1
Pollock							1				1
Scup										1	1
Sheepshead Minnow	1	1	1	1	1	1					6
Silversides spp.	1	1	1	1	1	1	1	1	1	1	10
Smallmouth Flounder					1						1
Spider Crab Male										1	1
Striped Bass							1				1
Striped Killifish	1	1	1	1	1	1	1				7
Striped Searobin										1	1
Summer Flounder								1		1	2
Tautog	1		1	1		1	1		1		6
Winter Flounder	1	1			1			1	1	1	6

APPENDIX

Abundances of summer flounder in 2022 beach seines.

	Station										Mean	SD	SE
	GSP 1	GSP 2	GSP 3	GSP 4	GSP 5	GSP 6	GSP 7	GSP 8	OH1	OH2			
Summer Flounder													
MAY	0	0	0	0	0	0	0	0	1	0	0.10	0.32	0.10
JUN	0	0	0	0	0	0	0	0	3	0	0.30	0.95	0.30
JUL	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
AUG	0	0	1	0	0	0	0	0	1	1	0.30	0.48	0.15
SEP	0	0	0	1	0	0	0	0	1	0	0.20	0.42	0.13
OCT	0	0	0	0	0	0	0	1	0	5	0.60	1.58	0.50
Mean	0.00	0.00	0.17	0.17	0.00	0.00	0.00	0.17	1.00	1.00			
SD	0.00	0.00	0.37	0.37	0.00	0.00	0.00	0.37	1.00	1.83			
SE	0.00	0.00	0.15	0.15	0.00	0.00	0.00	0.15	0.41	0.75			
Total	0	0	1	1	0	0	0	1	6	6			
											Total Fish		
											15		

APPENDIX

Abundances of tautog in 2022 beach seines.

		Station										Mean	SD	SE
		GSP 1	GSP 2	GSP 3	GSP 4	GSP 5	GSP 6	GSP 7	GSP 8	OH1	OH2			
Tautog	Month													
	MAY	1	1	0	0	0	0	10	0	3	0	1.50	3.14	0.99
	JUN	1	0	0	2	2	0	0	0	7	1	1.30	2.16	0.68
	JUL	16	0	0	3	0	0	0	0	35	41	9.50	15.88	5.02
	AUG	9	2	0	49	1	16	9	11	6	3	10.60	14.40	4.55
	SEP	37	2	0	15	0	3	0	6	54	20	13.70	18.51	5.85
	OCT	4	0	1	2	0	1	6	0	1	0	1.50	2.01	0.64
	Mean	11.33	0.83	0.17	11.83	0.50	3.33	4.17	2.83	17.67	10.83			
	SD	12.61	0.90	0.37	17.33	0.76	5.76	4.34	4.26	19.85	15.20	Total Fish		
	SE	5.15	0.37	0.15	7.08	0.31	2.35	1.77	1.74	8.10	6.21	381		
Total	68	5	1	71	3	20	25	17	106	65				

APPENDIX

Abundances of black sea bass in 2022 beach seines.

	Station										Mean	SD	SE	
	GSP 1	GSP 2	GSP 3	GSP 4	GSP 5	GSP 6	GSP 7	GSP 8	OH1	OH2				
Black Sea Bass														
Month														
MAY	0	0	0	0	0	0	0	0	1	0	0.10	0.32	0.10	
JUN	0	0	0	0	0	0	0	0	1	0	0.10	0.32	0.10	
JUL	0	0	0	0	0	0	0	0	2	1	0.30	0.67	0.21	
AUG	3	1	2	35	2	21	0	0	0	0	6.40	11.90	3.76	
SEP	3	0	0	55	0	17	4	0	9	1	8.90	17.09	5.40	
OCT	0	0	0	16	0	0	11	0	0	0	2.70	5.81	1.84	
Mean	1.00	0.17	0.33	17.67	0.33	6.33	2.50	0.00	2.17	0.33				
SD	1.41	0.37	0.75	20.95	0.75	9.03	4.07	0.00	3.13	0.47				
SE	0.58	0.15	0.30	8.55	0.30	3.69	1.66	0.00	1.28	0.19				
Total	6	1	2	106	2	38	15	0	13	2				
											Total Fish	185		

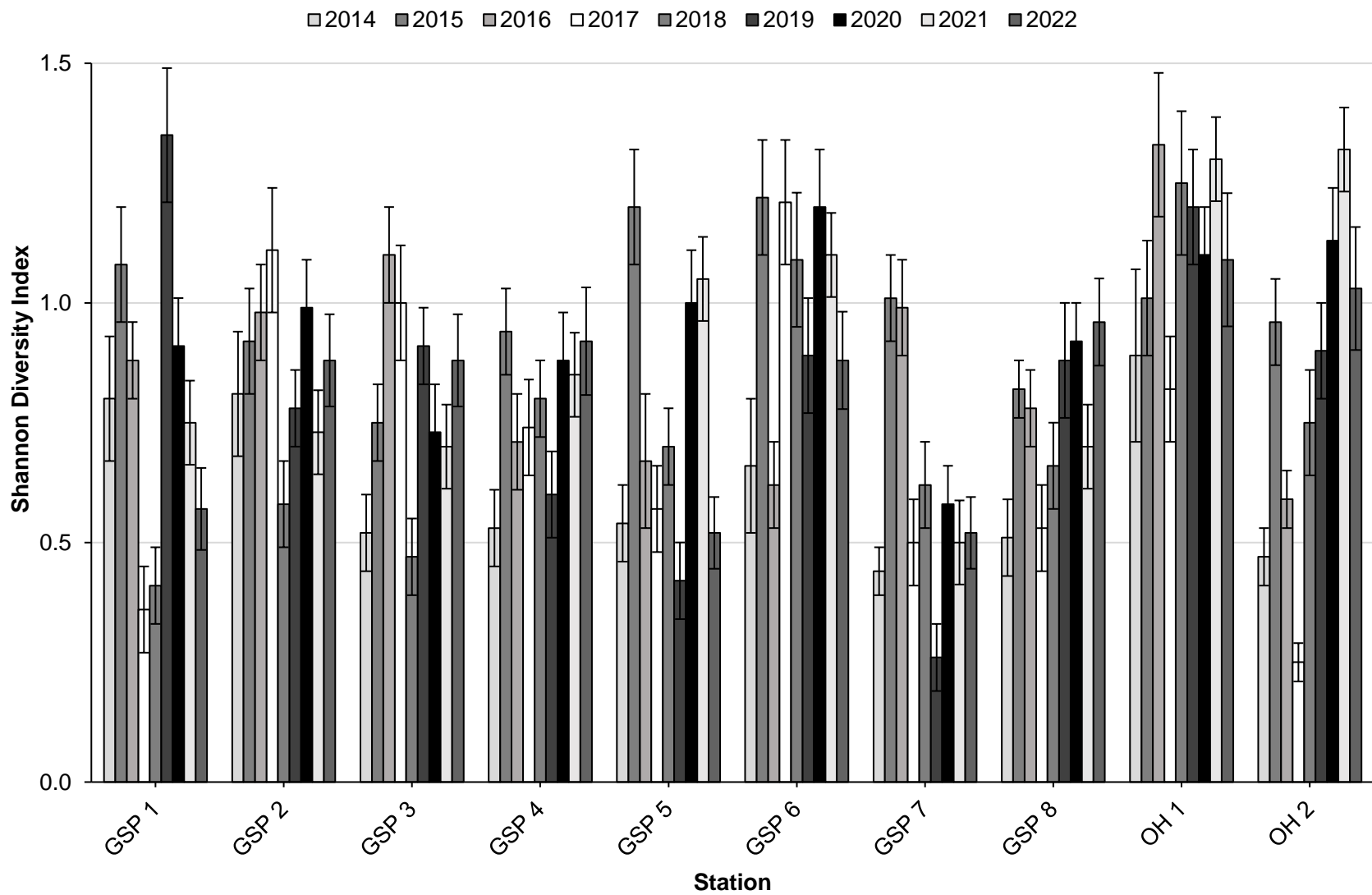
APPENDIX

Abundances of scup in 2022 beach seines.

		Station										Mean	SD	SE
		GSP 1	GSP 2	GSP 3	GSP 4	GSP 5	GSP 6	GSP 7	GSP 8	OH1	OH2			
Scup	Month													
	MAY	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
	JUN	0	0	0	0	0	0	0	0	0	2	0.20	0.63	0.20
	JUL	2	0	0	0	0	0	0	0	1	0	0.30	0.67	0.21
	AUG	0	0	0	0	2	0	0	0	0	0	0.20	0.63	0.20
	SEP	0	0	0	0	0	0	0	0	2	3	0.50	1.08	0.34
	OCT	0	0	0	0	0	0	0	0	0	12	1.20	3.79	1.20
Mean	0.33	0.00	0.00	0.00	0.33	0.00	0.00	0.00	0.50	2.83				
SD	0.75	0.00	0.00	0.00	0.75	0.00	0.00	0.00	0.76	4.26	Total Fish			
SE	0.30	0.00	0.00	0.00	0.30	0.00	0.00	0.00	0.31	1.74	24			
Total	2	0	0	0	2	0	0	0	3	17				

APPENDIX

Mean Shannon diversity across stations in 2014-2022 beach seines.



APPENDIX

Cumulative number of finfish species by station in 2014-2022 beach seines.

