

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, 2021 to December 31, 2021

Prepared By

Diandra Verbeyst (Great Salt Pond Scientist)

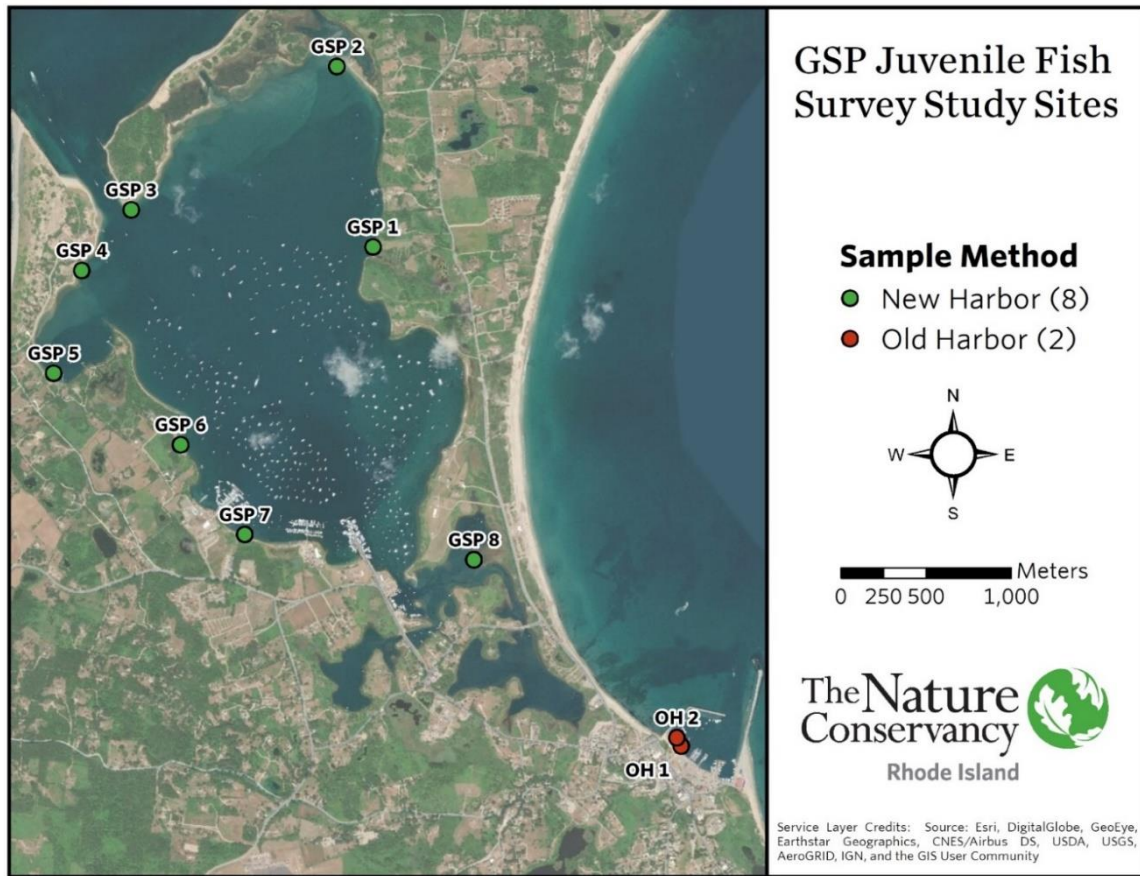
Approved By

Scott Comings, Associate State Director

The Nature Conservancy Rhode Island Chapter
159 Waterman Street
Providence, RI 02906



Map of study area and sampling locations.



SUMMARY:

During the 2021 season, a total of 60 seines were hauled across 10 sites in May through October resulting in the enumeration of 19,918 individuals. 19,203 of those individuals were finfish and 715 were other marine invertebrates. Of the total catch, 2,837 finfish were measured, and 54 out of the 60 species identified were finfish (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) for incorporation into existing datasets.

TARGET DATE:

December 31, 2021

NEXT STEPS:

Investigators intend to continue sampling with the same methodology for the 2022 field season. Additionally, the project team will coordinate with the primary investigators of the Coastal Ponds (CPS) and Providence River Estuary (PRE) juvenile fish surveys to evaluate variations in fish assemblages across study areas and regional waters.

INTRODUCTION:

Estuaries are dynamic environments known for their unique habitat features and ecosystem services. They also provide critical habitat for many marine species, particularly those in early stages of life (Able & Fahay 1998). In the context of an island environment, estuaries serve as offshore spawning grounds and nursery areas for juvenile species that otherwise could not survive on the continental shelf (Beck et al. 2001). On BI, the GSP is the defining offshore estuary, and it is generally known for its deeper depths, varied slopes, and rich bottom communities (Hale 2000). Although many studies have described the GSP to be highly productive, there has been limited empirical data in the literature to support this notion (Katz 2000; Neumann 1993).

In 2014, the DMF and TNC entered into a cooperative agreement to begin evaluating the GSP and its role in supporting juvenile finfish populations. This monitoring revealed that the GSP supported recreationally and commercially important juvenile finfish. It also recognized that the study area could support additional opportunities for enhancing and protecting essential fish habitat. Since the inception of the cooperative project, the statistical catch at age models for five species of interest: winter flounder, summer flounder, scup, tautog, and black sea bass have been generated as an important component of this project. In addition to the direct usage of the data in fisheries models, the other data points collected in the survey, water quality and benthic habitat, also serve as useful information. As these physical properties continue to change, this dataset will document how such changes may affect fish assemblage within the study areas. The collection of results from the PRE, GSP, and CP seine surveys will continue to provide useful data for the DMF in managing fish populations.

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 2 m. 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 Young of the Year (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 following 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 2,112 sq ft. The net was then hauled by hand from both ends toward the beach and all 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 winter flounder 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 immediately back into the water at the collection site. Water quality parameters including, water temperature (°C), salinity (ppt), dissolved oxygen (mg/L), water depth, and transparency were also recorded at each sampling site. A Professional Plus series handheld YSI multiparameter meter and Secchi disk were used during the time of seine as point measurements. The YSI unit was calibrated monthly throughout the sampling season according to manufacturer recommendations.

RESULTS & DISCUSSION:

For the 2021 field sampling season, a total of 60 seines were hauled across the 10 sampling sites. Of the total catch for the year (n=19,918), 19,203 finfish were identified and enumerated, and 2,837 of those individuals measured. The remaining 715 invertebrates were identified, counted, and measured during sampling because they were a species of recreational or commercial importance such as blue crab or horseshoe crab, or another common species encountered while sampling such as green crab, lady crab, spider crab, or mantis shrimp. Out of 60 species caught, 54 of those were finfish (Table 1).

A mean of 320.05 ± 69.18 SE finfish were caught per haul. Catch per haul across sites was greatest at Beane Point (GSP 3) at 756.33 ± 608.67 SE and lowest at the Coast Guard Station (GSP 4) at 138.83 ± 39.99 SE (Figure 1). Catch per haul across months was greatest in September at 869.90 ± 338.42 SE and lowest in June at 27.30 ± 7.02 SE (Figure 2).

Winter Flounder (*Pseudopleuronectes americanus*)

Of the total 277 winter flounder caught in 2021 seines, 266 individuals were YOY, and 11 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 2021 (see table in Appendix). July had the highest mean monthly abundance of 6.30 ± 4.36 SE fish/seine haul (Figure 3b). The sand flat site in OH (OH 2), which is adjacent to the eelgrass bed station (OH1), had the highest mean station abundance of 17.33 ± 5.89 SE across all sites in the study area in 2021 (Figure 3a). In the GSP study extent, the Inner Pond site (GSP 8) had the highest mean abundance of winter flounder with a catch per haul of 6.17 ± 2.22 SE fish/seine haul in 2021. In past survey seasons, GSP 5 (Cormorant Cove site) was the most abundant site in the GSP. For the BI time series, the two stations in OH have consistently had higher mean abundances when comparing all stations across the study area on BI.

The 2021 juvenile winter flounder abundance index was 4.62 ± 1.02 SE fish/seine haul. This is greater than the 2020 index of 3.58 ± 1.63 SE. Figure 3a shows the 2021 abundance index continues to be lower than most years since 2016, the BI survey high. In 2020, the DMF beach seine survey data also saw a decrease in winter flounder since their peak abundance over the last grant cycle in 2014.

Summer Flounder (*Paralichthys dentatus*)

A total of seven individuals were caught in 2021 at GSP 6 (Bonnell Beach), GSP 7 (Ball O'Brien) and OH 2 (sand flat) towards the end of the sampling season at varying sizes ranging between 67- and 145-mm TL, indicating YOY (Penttila et al.1989). Summer flounder were the least abundant catch for target species in 2021 with a catch per haul of 0.12 ± 0.09 SE (Figure 3b). In 2021, one individual was caught in September at OH 2 and six were caught in October: one individual at Bonnell Beach and the remaining five at OH 2 (Figure 3a). Summer flounder has been the least abundant catch for the interest group of the BI time series.

Tautog (*Tautoga onitis*)

During the 2021 survey 357 juvenile tautog were collected and ranged in size from 2 cm to 35 cm. This total number is a decrease from the 2020 survey when 596 juveniles were collected. The 2021 abundance index was 5.95 ± 1.37 SE, a decrease from the 2020 index 9.93 ± 3.29 SE. Juvenile tautog were caught at every station in 2021. The species was most abundant at OH 1 (eelgrass site) with a catch per haul of 19.00 ± 5.77 SE (Figure 3a). Tautog were most abundant in August with a catch per haul of 13.00 ± 4.67 SE (Figure 3b). For the BI time series, survey years 2016 and 2019 also marked highest abundance of tautog during August, whereas all other survey years recorded highest abundance for the species in September.

Black Sea Bass (*Centropristis striata*)

One-hundred and ninety-five black sea bass were caught in 2021, which is a decrease from the 315 individuals that were collected in 2020. The number of black sea bass has been highly variable from year-to-year during the time series survey, with 2015 and 2019 totals standing out as unique. In 2021, black sea bass individuals collected during sampling ranged in size between 4 cm and 15 cm. The highest mean monthly abundance for 2021 occurred during September at 7.60 ± 5.48 SE (Figure 3b). Black sea bass were caught at all stations apart from GSP 1 (Harris Point), GSP 2 (Andy's Way), and GSP 8 (Inner Pond) in 2021. The sand flat site in Old Harbor (OH 2) had the highest mean abundance of 12.83 ± 8.41 SE (Figure 3a). The most individuals were caught in September at a catch per haul of 7.60 ± 5.48 SE (Figure 3b).

The abundance index for 2021 was 3.25 ± 1.19 SE fish/seine haul. This was lower than the 2020 index 5.25 ± 1.98 SE. While the 2021 index decreased from the previous season's index, the 2021 abundance was still greater than past sampling years; specifically, 2014 and 2017 when less than 25 individuals were collected per 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 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 is increasingly prevalent across regional seine and multi-gear surveys (NEFSC 2017).

Scup (*Stenotomus chrysops*)

A total of 17 scup were collected in 2021 from July through September, a decrease from 2020 year when 247 scup were collected. The total survey abundance for 2021 was 0.28 ± 0.13 SE. Scup were caught at 4 of the 10 sites: Coast Guard Station (GSP 4), Cormorant Cove (GSP 5), Bonnell Beach (GSP 6), and the eelgrass bed site in OH (OH 1). Scup were most abundant at Bonnell Beach (GSP 6) with a catch per haul of 1.17 ± 0.60 SE (Figure 3a). The most individuals were caught in July at a catch per haul of 1.00 ± 0.56 SE in 2021 (Figure 3b). Scup caught in 2021 ranged in size between 4 cm and 27 cm, 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).

Family Clupeidae

In 2021, two species of clupeids were collected during the sampling season: alewife and Atlantic Menhaden. While other species of clupeids have been collected during the time series, namely, Atlantic herring, bay anchovy, blueback herring, and hickory shad, their presence was not captured during the 2021 survey. Investigators also acknowledge that although large schools of clupeid species were not encountered this season, they were most likely present in the system, particularly in large abundances, and may have been missed during sampling.

Alewife (*Alosa pseudoharengus*)

In 2021, a total of 66 alewives were caught in the beach seines. Individuals ranged in size between 5 cm and 7 cm and were found in August and September. The total survey mean abundance for 2021 was 1.10 fish/seine haul.

Atlantic Menhaden (*Brevoortia tyrannus*)

Atlantic menhaden was the most frequent clupeid species documented in 2021, with 1,835 individuals caught in both the GSP and OH from July through October. This is a decrease from the 2020 survey when several schools of menhaden were caught between August and October, totaling 6,896 individuals. The total survey mean abundance index was 30.58 ± 12.89 SE in 2021. Menhaden were caught at Cormorant Cove, Bonnell Beach, Ball O'Brien, and Inner Pond sites (GSP 5-8) in the GSP, and both sites in OH (OH 1-2). The species was most abundant at GSP 7 (Ball O'Brien) with a catch per haul of 88.67 ± 80.94 SE. The highest number of individuals were caught in October at a catch per haul of 90.60 ± 60.49 SE. Menhaden TL measurements ranged from 3 cm to 8 cm in 2021.

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 2021, there were minimal instances in which more than 500 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.

Baitfish Species

Baitfish species are commonly encountered across stations and months during the sampling season. In 2021, silversides, striped killifish, and common mummichog comprised more than 82.9 percent of the

total catch, which is also consistent with percentages recorded for previous survey years. While other baitfish species such as sheepshead minnow were encountered this season in abundance, we selected the species noted below since their presence and numbers have been the most notable and abundant, as well as reported on in past performance reports.

Silversides spp. (*Menidia spp.*)

Silversides had the highest abundance of all finfish species caught during the 2021 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 silversides (sp.) and inland silversides (sp.) are categorized as silversides (*Menidia spp.*).

A total of 13,336 silversides were caught in 2021. The total mean abundance was 222.27 ± 70.15 SE in 2021 and fell from last year's index at 312.17 ± 72.53 SE, making it the third lowest abundance index for the overall time series. The species was most abundant at the Beane Point site (GSP 3) with a catch per haul of 692.17 ± 519.80 SE in 2021. This is different than previous survey years when the species was documented as most abundant at Andy's Way (GSP 2). In comparison, the highest number of silversides were caught in September at a catch per haul of 678.40 ± 328.93 SE in 2021, which is consistent with past survey records.

Silversides ranged in size from 2 cm to 14 cm and were found in all months and stations. This range in size suggests multiple year classes. The larger individuals with TL greater than 14 cm were caught at multiple stations this season: GSP 1, 2, and 8, as well as at both sites in OH. According to the literature, individuals recorded at, or more than 13 cm are indicative of living longer than their two-year lifespan, which is noted to be unusual since mortality is high and few individuals can survive a second year and reach 13 cm TL, and they are infrequently observed or captured in the field (Fay et al. 1983; Conand 1993). The occurrence of age-2 silversides has been observed on several occasions in the BI time series, suggesting localized adaptation for a resident GSP sub-population based on growing empirical evidence from Therkildsen and Baumann (2018 and 2020). In past survey years (2018 and 2019), individuals with TL greater than 14 cm were collected, preserved, and sent to Dr. Hannes Baumann, Marine Science Professor at the University of Connecticut, for the purpose of conducting otolith analyses.

Striped Killifish (*Fundulus majalis*)

A total of 2,295 striped killifish were collected in 2021 and ranged in size from 2 cm to 13 cm. The species ranked second in abundance this season, which is consistent with previous survey years when the species was ranked either second or third for all species caught. In 2021, striped killifish occurred in all stations and months in the GSP but did not occur at the OH stations. The total mean abundance was 38.25 ± 12.27 SE in 2021, which is slightly higher, yet very similar to the 2020 index of 37.48 ± 16.39 SE. In 2021, the highest number of striped killifish were caught in September at a catch per haul of 113.30 ± 55.77 SE, and they were most abundant at GSP 2 (Andy's Way) with a catch per haul of 170.33 ± 83.42 SE. Their presence became more prevalent as the season progressed in 2021.

Common Mummichog (*Fundulus heteroclitus*)

Two hundred and eighty-nine mummichogs were caught during the 2021 survey. The individuals ranged in size from 3 cm to 11 cm in 2021, which is a wider range of TL sizes recorded in past survey

seasons. The species occurred at each station in the GSP study area this season but did not occur at the OH stations except for one individual caught at OH 1 in August. In 2021, mummichogs were most abundant in August at a catch per haul of 15.20 ± 4.82 SE and had the highest abundance at the Ball O'Brien (GSP 7), with a catch per haul of 10.50 ± 3.96 SE in 2021. The total mean abundance was 4.82 ± 1.35 SE in 2021. Overall, the catch frequencies of mummichogs across the time series has been highly variable for the BI seine survey.

Physical and Chemical Data

Water quality data for the 2021 season can be found in Table 2. In the GSP, water temperature ranged from 12.7°C in May to 27.1°C in August. In OH, water temperature ranged from 12.3°C in May and 23.1°C in August. The mean salinity of the eight sites within the GSP was 31.07 ppt ± 0.12 SE, and the mean salinity of the two sites within OH were 32.05 ppt ± 0.12 SE. The lowest dissolved oxygen value recorded across the GSP sites was 6.08 mg/L in August at Bonnell Beach site (GSP 6), while the mean was 8.62 mg/L ± 0.25 SE. In, OH, the eelgrass site (OH 1) recorded the lowest dissolved oxygen value at 6.82 mg/L in August, with a mean of 8.90 mg/L ± 0.38 SE between the two sites.

SUMMARY:

In 2021, investigators caught 54 species of finfish representing 30 families. These numbers are not consistent with 2020, where 45 species from 28 families were collected. The number of individuals caught in 2021 decreased from the 2020 survey, with 19,203 collected in 2021, and 30,813 collected in 2020. This year also marked the highest number of different species caught over the last 8 years of the BI juvenile fish survey.

REFERENCES:

- 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.
- Beck, M.W., K.L. Heck Jr., K.W. Able, D., Childers, D. Eggleston, B.M. Gillanders, B. Halpern, C. Hays, K. Hoshino, T. Minello, R. Orth, P. Sheridan, and M. Weinstein. 2001. The identification, conservation, and management of estuarine and marine nurseries for fish and invertebrates. *Bioscience*. 51:633-641.
- 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.
- Conand, F. 1993. Life history of the silverside *Atherinomorus lacunosus* (Atherinidae) in New Caledonia. *Journal of Fish Biology*. 42: 851-863.
- Fay, C.W., R.J. Neves, and G.B. Pardue. 1983. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (Mid-Atlantic)—Atlantic silverside. *U.S. Fish and Wildlife Service Biological Report*. 82(11.10).
- 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*. (pp. 131-149).
- 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., 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.
- Neumann, J.T. 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.
- Therkildsen, N.O., and H. Baumann. 2018. Collaborative research: The genomic underpinnings of local adaptation despite gene flow along a coastal environmental cline. *Marine Ecology Progress Series*. 632:1-12.
- Therkildsen, N.O., and H. Baumann. 2020. A comprehensive non-redundant reference transcriptome for the Atlantic silverside *Menidia menidia*. *Marine Genomics*. 100738
- 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:

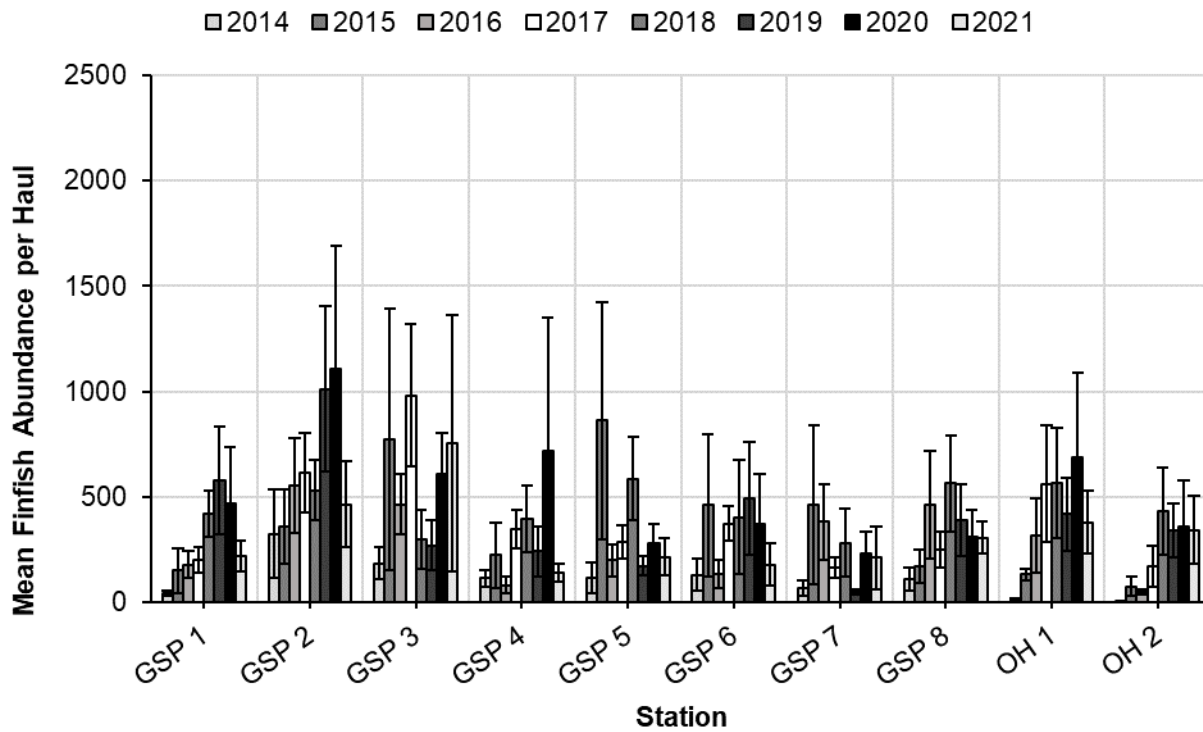


Figure 1. Mean abundance of finfish across stations (\pm SE) in 2014-2021 beach seines.

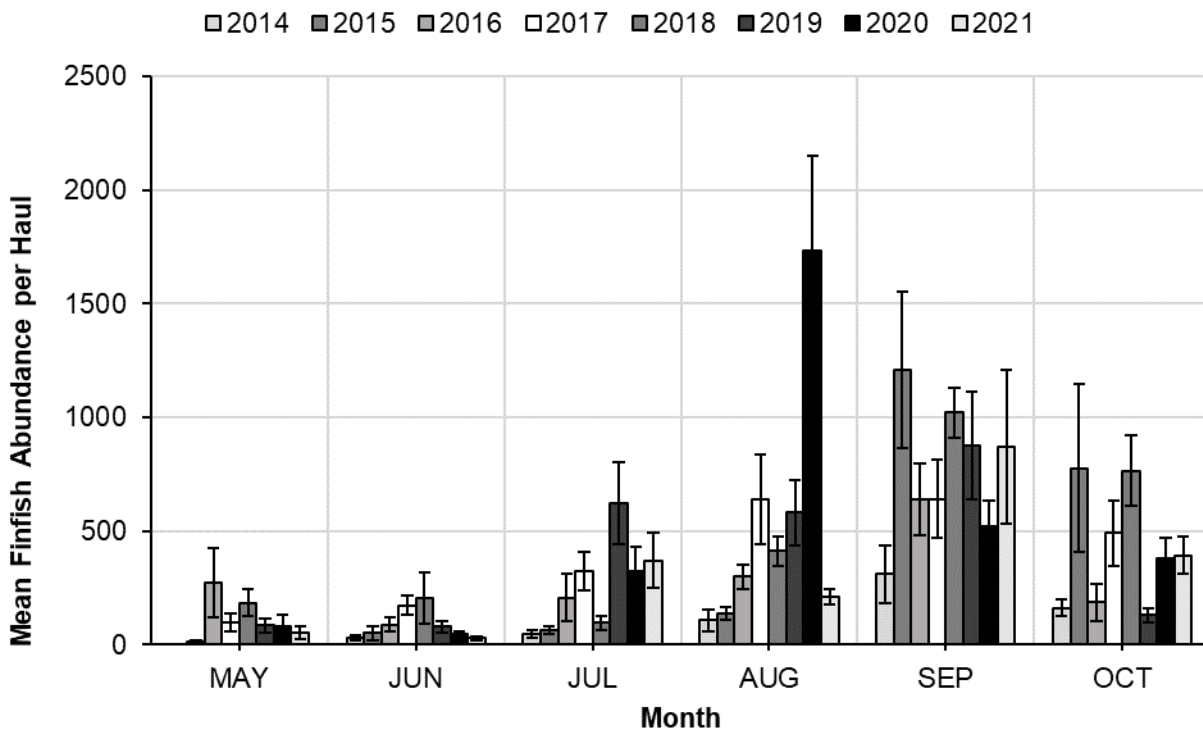


Figure 2. Mean abundance of finfish caught each month (\pm SE) in 2014-2021 beach seines.

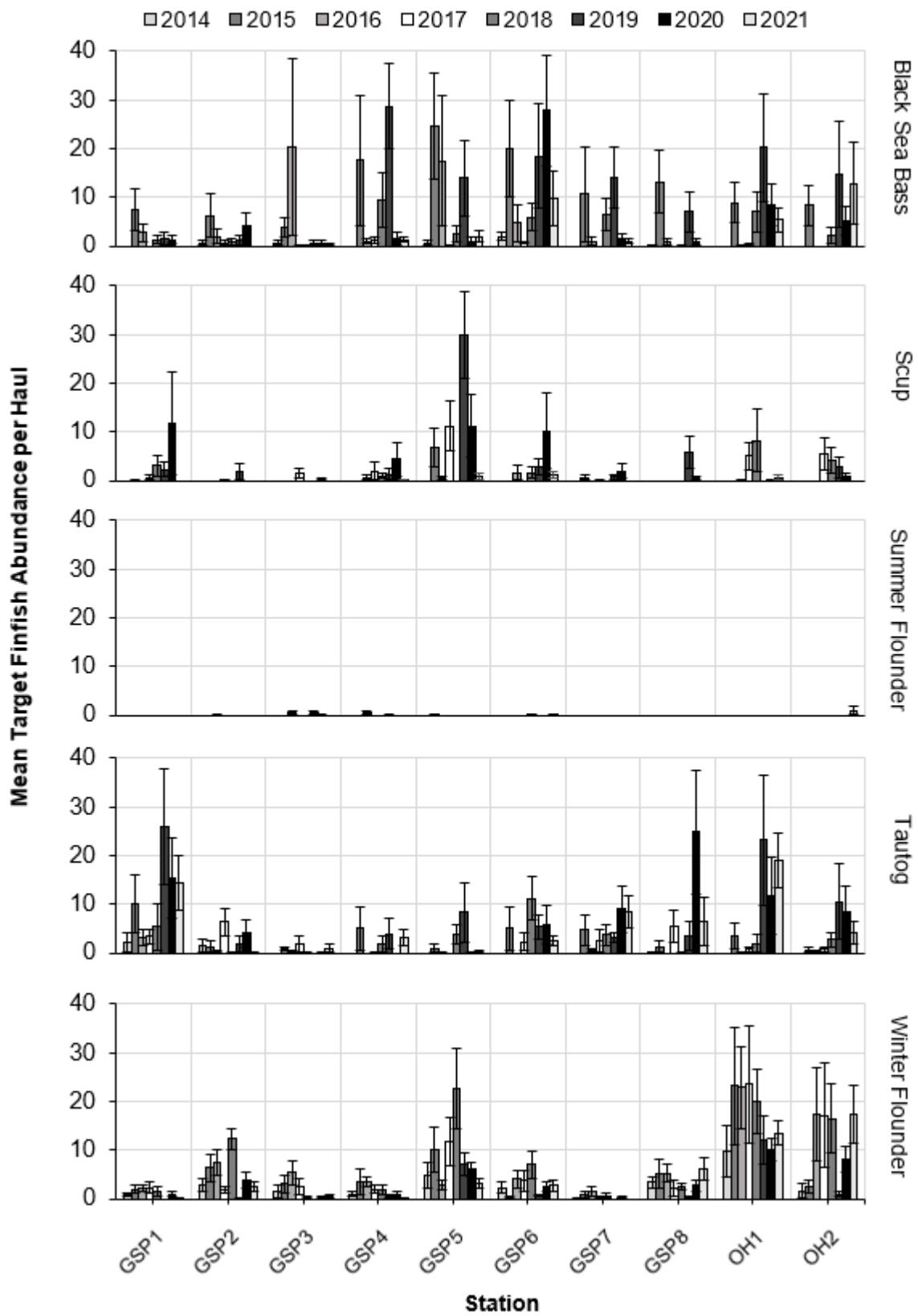


Figure 3a. Mean abundance of target finfish caught by site (\pm SE) in 2014-2021 beach seines.

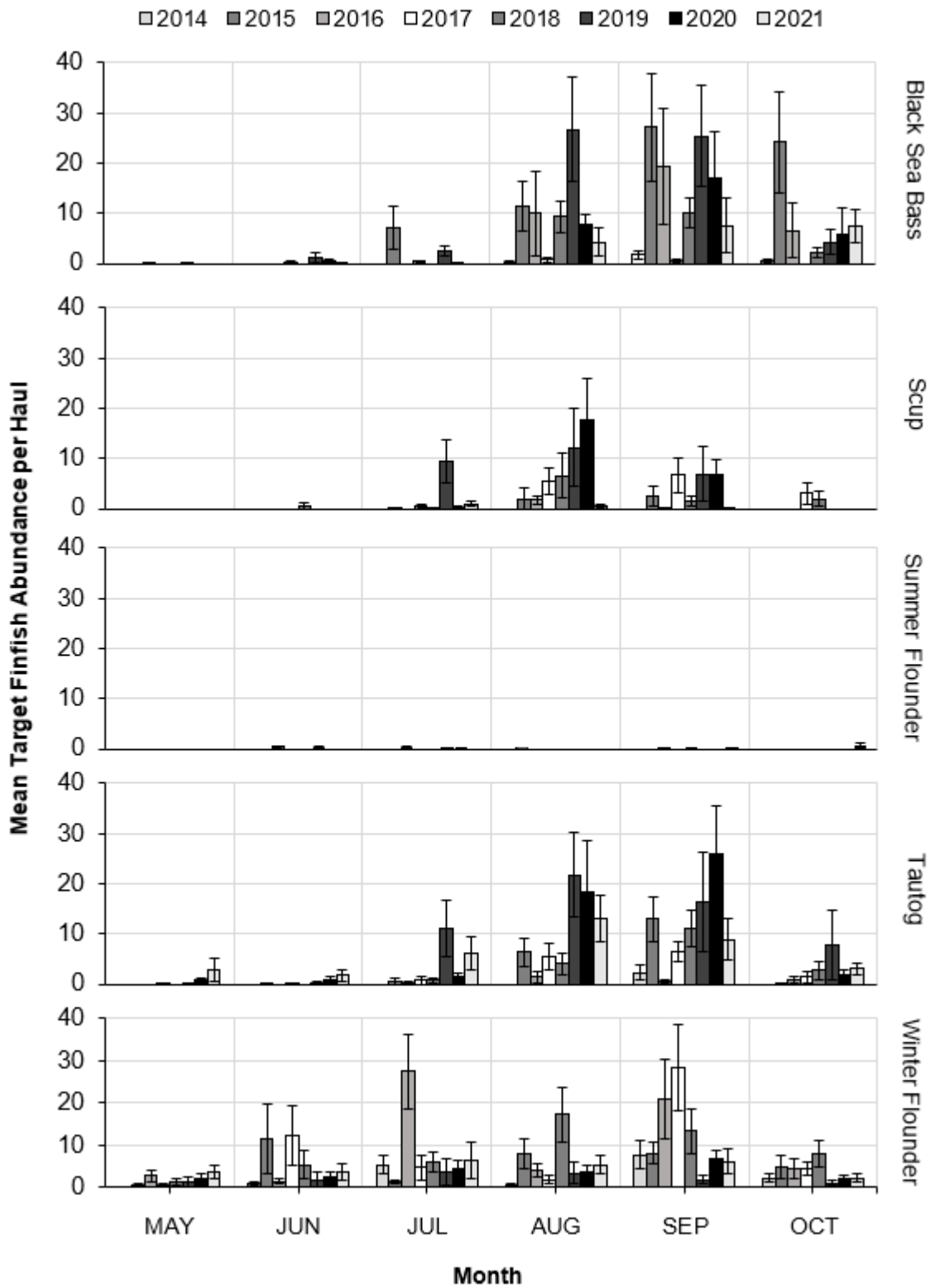


Figure 3b. Mean target finfish per seine haul (\pm SE) plotted for each month sampled during the 2014-2021 field seasons.

TABLES:

Table 1. Scientific, common names, and total abundance of all species caught in beach seines during 2021.

Scientific Name	Common Name	Total Caught
<i>Atherinopsidae spp.</i>	Silversides spp.	13336
<i>Fundulus majalis</i>	Striped Killifish	2295
<i>Brevoortia tyrannus</i>	Atlantic Menhaden	1835
<i>Carcinus maenas</i>	Green Crab	489
<i>Tautoga onitis</i>	Tautog	357
<i>Fundulus heteroclitus</i>	Mummichog	322
<i>Pseudopleuronectes americanus</i>	Winter Flounder	277
<i>Centropristis striata</i>	Black Sea Bass	195
<i>Calinectes sapidus</i>	Blue Crab	189
<i>Archosargus probatocephalus</i>	Sheepshead Minnow	152
<i>Tautogolabrus adspersus</i>	Cunner	80
<i>Alosa pseudoharengus</i>	Alewife	66
<i>Mugil curema</i>	White Mullet	51
<i>Pomatomus saltatrix</i>	Bluefish	33
<i>Sphyrna borealis</i>	Northern Sennet	20
<i>Myoxocephalus aeneus</i>	Grubby	19
<i>Gerreidae spp.</i>	Mojarras spp.	17
<i>Stenotomus chrysops</i>	Scup	17
<i>Squilla empusa</i>	Mantis Shrimp	14
<i>Sphoeroides maculatus</i>	Northern Puffer	13
<i>Decapterus punctatus</i>	Round Scad	13
<i>Ovalipes ocellatus</i>	Lady Crab	10
<i>Syngnathus fuscus</i>	Northern Pipefish	10
<i>Apeltes quadracus</i>	Fourspine Stickleback	9
<i>Prionotus evolans</i>	Striped Searobin	9
<i>Syngnathus louisianae</i>	Chain Pipefish	8
<i>Loligo pealei</i>	Longfin Squid	8
<i>Eucinostomus argenteus</i>	Spotfin Morraja	8
<i>Ammodytes americanus</i>	American Sand Lance	7
<i>Paralichthys dentatus</i>	Summer Flounder	7
<i>Microgadus tomcod</i>	Atlantic Tomcod	6
<i>Prionotus scitulus</i>	Leopard Searobin	6
<i>Gadus moruha</i>	Atlantic Cod	5
<i>Fistularia tabacaria</i>	Bluespotted Cornetfish	5
<i>Selene vomer</i>	Lookdown	5
<i>Menticirrhus saxatilis</i>	Northern Kingfish	5
<i>Opsanus tau</i>	Oyster Toadfish	5
<i>Trachinocephalus myops</i>	Snakefish	5

Table 1. (continued)

Scientific Name	Common Name	Total Caught
<i>Caranx latus</i>	Horse-eye Jack	4
<i>Pholis gunnellus</i>	Rock Gunnel	4
<i>Lactophrys triqueter</i>	Smooth Trunkfish	4
<i>Paralichthys oblongus</i>	Fourspot Flounder	3
<i>Limulus polyphemus</i>	Horseshoe Crab	3
<i>Scophthalmus aquosus</i>	Windowpane	3
<i>Anchoa mitchilli</i>	Bay Anchovy	2
<i>Lactophrys polygonia</i>	Honeycomb Cowfish	2
<i>Hippocampus erectus</i>	Lined Seahorse	2
<i>Libinia emarginata</i>	Spider Crab	2
<i>Urophycis regia</i>	Spotted Hake	2
<i>Caranx latus</i>	Bar Jack	1
<i>Citharichthys spilopterus</i>	Bay Whiff	1
<i>Prionotus tribulus</i>	Bighead Searobin	1
<i>Lactophrys trigonus</i>	Buffalo Trunkfish	1
<i>Syngnathus floridae</i>	Dusky Pipefish	1
<i>Decapterus macarellus</i>	Mackerel Scad	1
<i>Prionotus carolinus</i>	Northern Searobin	1
<i>Pollachius virens</i>	Pollock	1
<i>Lucania parva</i>	Rainwater Killifish	1
<i>Eucinostomus gula</i>	Silver Jenny	1
<i>Morone saxatilis</i>	Striped Bass	1
<i>Caranx bartholomaei</i>	Yellow Jack	1

Table 2. Temperature, salinity, and dissolved oxygen by station and month during 2021 beach seines.

Station	Water Quality Parameters	Month						Total Average
		MAY	JUN	JUL	AUG	SEP	OCT	
GSP 1	Temperature (°C)	13.7	21.6	22.3	25.9	19.9	16.7	20.0
	Salinity (ppt)	30.85	31.99	30.91	32.13	30.54	30.20	31.10
	Dissolved Oxygen (mg/L)	10.02	8.68	7.94	6.34	8.12	10.02	8.52
GSP 2	Temperature (°C)	13.7	21.6	22.3	27.1	20.1	17.3	20.4
	Salinity (ppt)	29.98	31.91	31.06	32.24	30.01	30.96	31.03
	Dissolved Oxygen (mg/L)	10.50	8.78	7.16	6.15	8.25	10.13	8.50
GSP 3	Temperature (°C)	12.9	20.9	22.2	24.1	20.2	16.8	19.5
	Salinity (ppt)	30.87	31.54	31.13	32.11	30.06	31.37	31.18
	Dissolved Oxygen (mg/L)	10.13	8.99	7.58	6.94	8.30	10.00	8.66
GSP 4	Temperature (°C)	12.7	20.1	22.8	22.7	20.7	17.8	19.5
	Salinity (ppt)	30.99	31.30	31.08	32.45	31.95	31.26	31.51
	Dissolved Oxygen (mg/L)	10.25	9.24	7.02	6.13	8.98	10.04	8.61
GSP 5	Temperature (°C)	13.1	18.4	23.4	22.5	20.1	16.3	19.0
	Salinity (ppt)	29.17	31.25	31.01	31.98	31.40	31.27	31.01
	Dissolved Oxygen (mg/L)	9.47	9.02	7.26	7.01	8.46	10.02	8.54
GSP 6	Temperature (°C)	12.7	18.4	23.5	23.0	20.6	16.2	19.1
	Salinity (ppt)	30.66	31.33	31.40	32.02	31.27	31.15	31.31
	Dissolved Oxygen (mg/L)	10.76	9.16	7.01	6.08	8.94	10.06	8.67
GSP 7	Temperature (°C)	13.1	18.3	21.0	23.7	20.6	16.6	18.9
	Salinity (ppt)	29.62	31.28	30.09	32.03	31.94	31.39	31.06
	Dissolved Oxygen (mg/L)	10.14	9.06	7.74	6.14	8.99	9.92	8.67
GSP 8	Temperature (°C)	14.7	20.6	22.2	23.6	19.7	17.3	19.7
	Salinity (ppt)	29.17	30.92	30.19	30.98	30.73	30.26	30.38
	Dissolved Oxygen (mg/L)	10.01	8.88	7.42	7.15	9.23	10.04	8.79
OH 1	Temperature (°C)	12.3	19.0	21.0	23.0	20.7	18.1	19.0
	Salinity (ppt)	31.92	32.14	32.50	32.41	31.95	31.34	32.04
	Dissolved Oxygen (mg/L)	10.80	8.91	8.03	6.86	8.98	10.10	8.95
OH 2	Temperature (°C)	12.7	19.1	21.2	23.1	20.8	18.1	19.2
	Salinity (ppt)	32.19	32.22	32.50	32.38	31.62	31.38	32.05
	Dissolved Oxygen (mg/L)	10.56	8.77	8.10	6.82	8.74	10.08	8.85

APPENDIX

Species presence by station for May 2021 beach seines.

MAY	Station										
Species	G-SP1	G-SP2	G-SP3	G-SP4	G-SP5	G-SP6	G-SP7	G-SP8	OHI1	OHI2	Total
Grubby									1		1
Northern Pipefish						1			1	1	3
Pollock										1	1
Rock Gunnel					1						1
Silversides spp.	1	1	1	1				1		1	6
Spotted Hake									1	1	2
Striped Killifish		1					1	1			3
Tautog		1				1	1				3
Winter Flounder		1	1		1	1		1	1	1	7

APPENDIX

Species presence by station for June 2021 beach seines.

JUN	Station										
Species	GSP1	GSP2	GSP3	GSP4	GSP5	GSP6	GSP7	GSP8	OH1	OH2	Total
American Sand Lance					1	1					2
Bay Anchovy				1							1
Black Sea Bass				1							1
Cunner									1		1
Grubby									1		1
Mummichog							1				1
Northern Pipefish					1						1
Rock Gunnel									1		1
Silversides spp.	1	1	1	1		1	1	1			7
Striped Killifish				1							1
Tautog	1						1		1	1	4
Winter Flounder	1	1		1	1				1	1	6

APPENDIX

Species presence by station for July 2021 beach seines.

JUL	Station										
Species	GSP1	GSP2	GSP3	GSP4	GSP5	GSP6	GSP7	GSP8	OHI	OHI2	Total
Atlantic Cod									1		1
Atlantic Menhaden								1	1	1	3
Bar Jack										1	1
Bay Whiff				1							1
Bighead Searobin		1									1
Chain Pipefish				1		1					2
Cunner	1	1				1		1	1		5
Dusky Pipefish						1					1
Lookdown									1		1
Mackerel Scad									1		1
Mummichog	1	1				1	1				4
Northern Pipefish						1					1
Northern Sennet	1						1	1	1		4
Round Scad										1	1
Scup				1	1			1			3
Sheepshead Minnow		1									1
Silversides spp.	1	1	1	1	1	1	1	1	1	1	10
Striped Killifish	1	1	1					1			4
Tautog	1			1		1		1	1		5
Winter Flounder		1			1	1		1	1	1	6

APPENDIX

Species presence by station for August 2021 beach seines.

AUG	Station										
Species	GSP1	GSP2	GSP3	GSP4	GSP5	GSP6	GSP7	GSP8	OH1	OH2	Total
Atlantic Menhaden					1	1					2
Atlantic Tomcod									1		1
Black Sea Bass			1	1		1	1		1	1	6
Bluefish									1	1	2
Chain Pipefish				1		1					2
Cunner	1			1		1	1		1	1	6
Fourspine Stickleback								1			1
Fourspot Flounder						1					1
Grubby						1	1		1	1	4
Horse-eye Jack									1	1	2
Lined Seahorse							1				1
Lookdown									1		1
Mojarras spp.										1	1
Mummichog	1	1	1	1		1	1	1	1		8
Northern Kingfish						1					1
Northern Pipefish				1		1					2
Northern Puffer						1			1		2
Northern Sennet						1					1
Oyster Toadfish								1			1
Rock Gunnel								1			1
Scup				1		1					2
Sheepshead Minnow		1	1								2
Silversides spp.	1	1	1	1	1	1	1	1	1	1	10
Snakefish			1								1
Striped Killifish	1	1	1		1	1	1	1			7
Striped Searobin									1	1	2
Tautog	1		1	1		1	1	1	1		7
White Mullet		1								1	2
Windowpane						1					1
Winter Flounder			1		1	1		1	1	1	6
Yellow Jack									1		1

APPENDIX

Species presence by station for September 2021 beach seines.

SEP	Station										
Species	GSP1	GSP2	GSP3	GSP4	GSP5	GSP6	GSP7	GSP8	OH1	OH2	Total
Alewife							1				1
Atlantic Menhaden									1		1
Black Sea Bass		1	1	1		1		1	1		6
Bluefish			1								1
Bluespotted Cornetfish				1					1		2
Chain Pipefish							1				1
Cunner	1								1	1	3
Fourspot Flounder									1		1
Grubby	1					1	1		1		4
Honeycomb Cowfish									1		1
Horse-eye Jack									1		1
Leopard Searobin				1					1		2
Lined Seahorse						1					1
Lookdown									1		1
Mojarras spp.	1		1								2
Mummichog	1	1	1	1	1	1	1	1			8
Northern Kingfish									1		1
Northern Puffer								1			1
Rainwater Killifish							1				1
Scup					1			1			2
Sheepshead Minnow	1	1						1			3
Silversides spp.	1	1	1	1	1	1	1	1	1	1	10
Smooth Trunkfish									1		1
Snakefish		1									1
Striped Bass			1								1
Striped Killifish	1	1	1	1	1	1		1			7
Striped Searobin									1		1
Summer Flounder									1		1
Tautog	1		1	1		1	1	1	1	1	8
Windowpane			1								1
Winter Flounder		1						1	1	1	4

APPENDIX

Species presence by station for October 2021 beach seines.

OCT	Station										
Species	GSP1	GSP2	GSP3	GSP4	GSP5	GSP6	GSP7	GSP8	OH1	OH2	Total
Atlantic Menhaden						1	1	1			3
Bay Anchovy					1						1
Black Sea Bass				1	1	1			1	1	5
Bluespotted Cornetfish									1	1	2
Buffalo Trunkfish									1		1
Chain Pipefish									1		1
Cunner									1		1
Fourspine Stickleback								1			1
Grubby					1				1		2
Honeycomb Cowfish		1									1
Leopard Searobin									1		1
Mummichog				1	1						2
Northern Pipefish					1					1	2
Northern Searobin										1	1
Sheepshead Minnow		1									1
Silver Jenny				1							1
Silversides spp.	1	1	1	1	1	1	1	1	1	1	10
Smooth Trunkfish									1	1	2
Spotfin Morraja	1								1		2
Striped Killifish	1	1	1	1	1	1	1	1			8
Striped Searobin						1					1
Summer Flounder						1				1	2
Tautog	1				1	1	1	1	1	1	7
Windowpane					1						1
Winter Flounder					1	1		1	1	1	5

APPENDIX

Abundances of winter flounder in 2021 beach seines.

Month	Station										Mean	SD	SE
	GSP 1	GSP 2	GSP 3	GSP 4	GSP 5	GSP 6	GSP 7	GSP 8	OH 1	OH 2			
MAY	0	1	2	0	6	6	0	2	14	6	3.70	4.42	1.40
JUN	1	4	0	1	4	0	0	0	19	9	3.80	6.07	1.92
JUL	0	5	0	0	3	1	0	3	6	45	6.30	13.78	4.36
AUG	0	0	1	0	1	6	0	16	15	15	5.40	7.09	2.24
SEP	0	5	0	0	0	0	0	10	21	26	6.20	9.76	3.09
OCT	0	0	0	0	5	3	0	6	6	3	2.30	2.63	0.83
Mean	0.17	2.50	0.50	0.17	3.17	2.67	0.00	6.17	13.50	17.33			
SD	0.37	2.22	0.76	0.37	2.11	2.56	0.00	5.43	5.80	14.43			
SE	0.15	0.91	0.31	0.15	0.86	1.05	0.00	2.22	2.37	5.89			
Total	1	15	3	1	19	16	0	37	81	104			
													Total Fish 277

APPENDIX

Abundances of summer flounder in 2021 beach seines.

Month	Station										Mean	SD	SE
	GSP 1	GSP 2	GSP 3	GSP 4	GSP 5	GSP 6	GSP 7	GSP 8	OH 1	OH 2			
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	0	0.00	0.00	0.00
JUL	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
AUG	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
SEP	0	0	0	0	0	0	0	0	0	1	0.10	0.32	0.10
OCT	0	0	0	0	0	1	0	0	0	5	0.60	1.58	0.50
Mean	0.00	0.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	1.00			
SD	0.00	0.00	0.00	0.00	0.00	0.37	0.00	0.00	0.00	1.83			
SE	0.00	0.00	0.00	0.00	0.00	0.15	0.00	0.00	0.00	0.75			
Total	0	0	0	0	0	1	0	0	0	6			
												Total Fish	7

APPENDIX

Abundances of tautog in 2021 beach seines.

Month	Station										Mean	SD	SE
	GSP 1	GSP 2	GSP 3	GSP 4	GSP 5	GSP 6	GSP 7	GSP 8	OH 1	OH 2			
MAY	0	1	0	0	0	4	24	0	0	0	2.90	7.52	2.38
JUN	1	0	0	0	0	0	2	0	12	2	1.70	3.71	1.17
JUL	19	0	0	6	0	0	2	0	31	3	6.10	10.54	3.33
AUG	20	0	5	10	0	7	12	33	43	0	13.00	14.78	4.67
SEP	40	0	1	3	0	2	9	1	17	16	8.90	12.69	4.01
OCT	6	0	0	0	2	2	1	5	11	4	3.10	3.51	1.11
Mean	14.33	0.17	1.00	3.17	0.33	2.50	8.33	6.50	19.00	4.17			
SD	13.94	0.37	1.83	3.76	0.75	2.43	8.10	11.98	14.13	5.49			
SE	5.69	0.15	0.75	1.54	0.30	0.99	3.31	4.89	5.77	2.24			
Total	86	1	6	19	2	15	50	39	114	25			
													Total Fish 357

APPENDIX

Abundances of black sea bass in 2021 beach seines.

Month	Station										Mean	SD	SE
	GSP 1	GSP 2	GSP 3	GSP 4	GSP 5	GSP 6	GSP 7	GSP 8	OH 1	OH 2			
MAY	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
JUN	0	0	0	1	0	0	0	0	0	0	0.10	0.32	0.10
JUL	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
AUG	0	0	1	3	0	28	4	0	6	1	4.30	8.58	2.71
SEP	0	0	1	2	4	0	2	0	11	56	7.60	17.33	5.48
OCT	0	0	0	2	8	30	0	0	15	20	7.50	10.70	3.38
Mean	0.00	0.00	0.33	1.33	2.00	9.67	1.00	0.00	5.33	12.83			
SD	0.00	0.00	0.47	1.11	3.06	13.68	1.53	0.00	5.93	20.61			
SE	0.00	0.00	0.19	0.45	1.25	5.59	0.62	0.00	2.42	8.41			
Total	0	0	2	8	12	58	6	0	32	77			
													Total Fish
													195

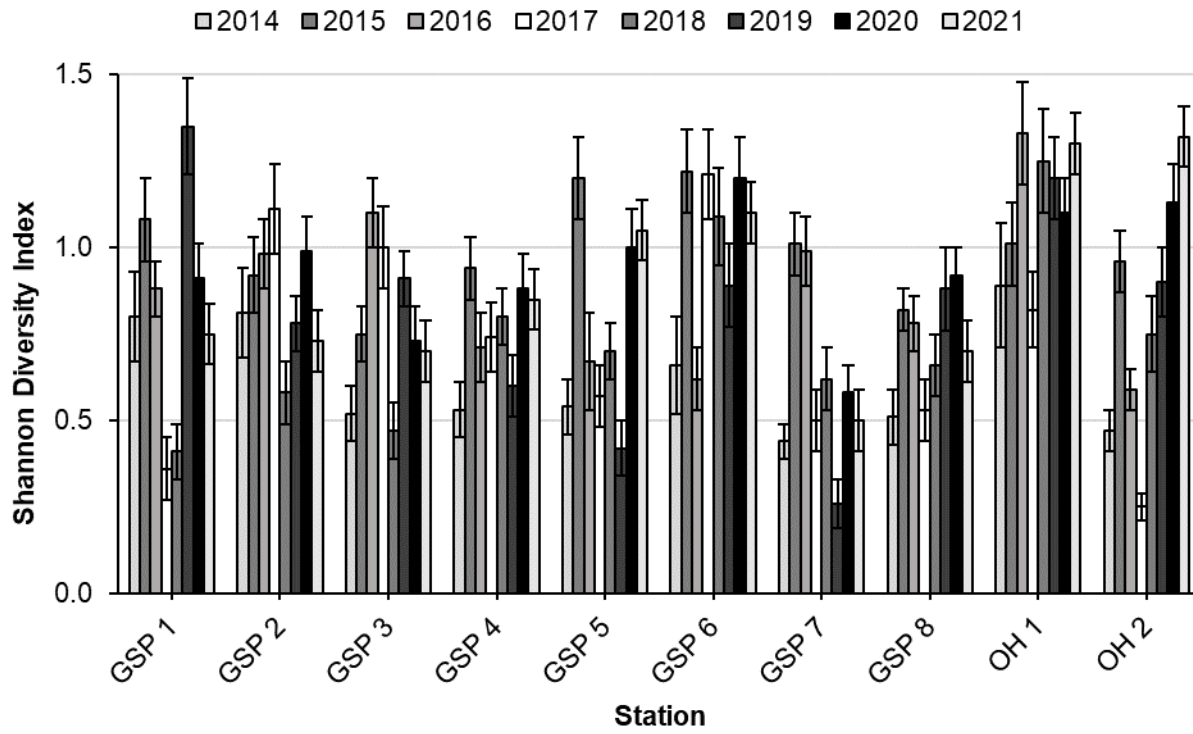
APPENDIX

Abundances of scup in 2021 beach seines.

Month	Station										Mean	SD	SE
	GSP 1	GSP 2	GSP 3	GSP 4	GSP 5	GSP 6	GSP 7	GSP 8	OH 1	OH 2			
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	0	0.00	0.00	0.00
JUL	0	0	0	0	5	2	0	0	3	0	1.00	1.76	0.56
AUG	0	0	0	1	0	4	0	0	0	0	0.50	1.27	0.40
SEP	0	0	0	0	0	1	0	0	1	0	0.20	0.42	0.13
OCT	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
Mean	0.00	0.00	0.00	0.17	0.83	1.17	0.00	0.00	0.67	0.00			
SD	0.00	0.00	0.00	0.37	1.86	1.46	0.00	0.00	1.11	0.00			
SE	0.00	0.00	0.00	0.15	0.76	0.60	0.00	0.00	0.45	0.00			
Total	0	0	0	1	5	7	0	0	4	0			
												Total Fish	17

APPENDIX

Mean Shannon diversity across stations in 2014-2021 beach seines.



APPENDIX

Cumulative number of finfish species by station in 2014-2021 beach seines.

