

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, 2023 to December 31, 2023

Prepared By

Diandra Hall (Great Salt Pond Scientist)

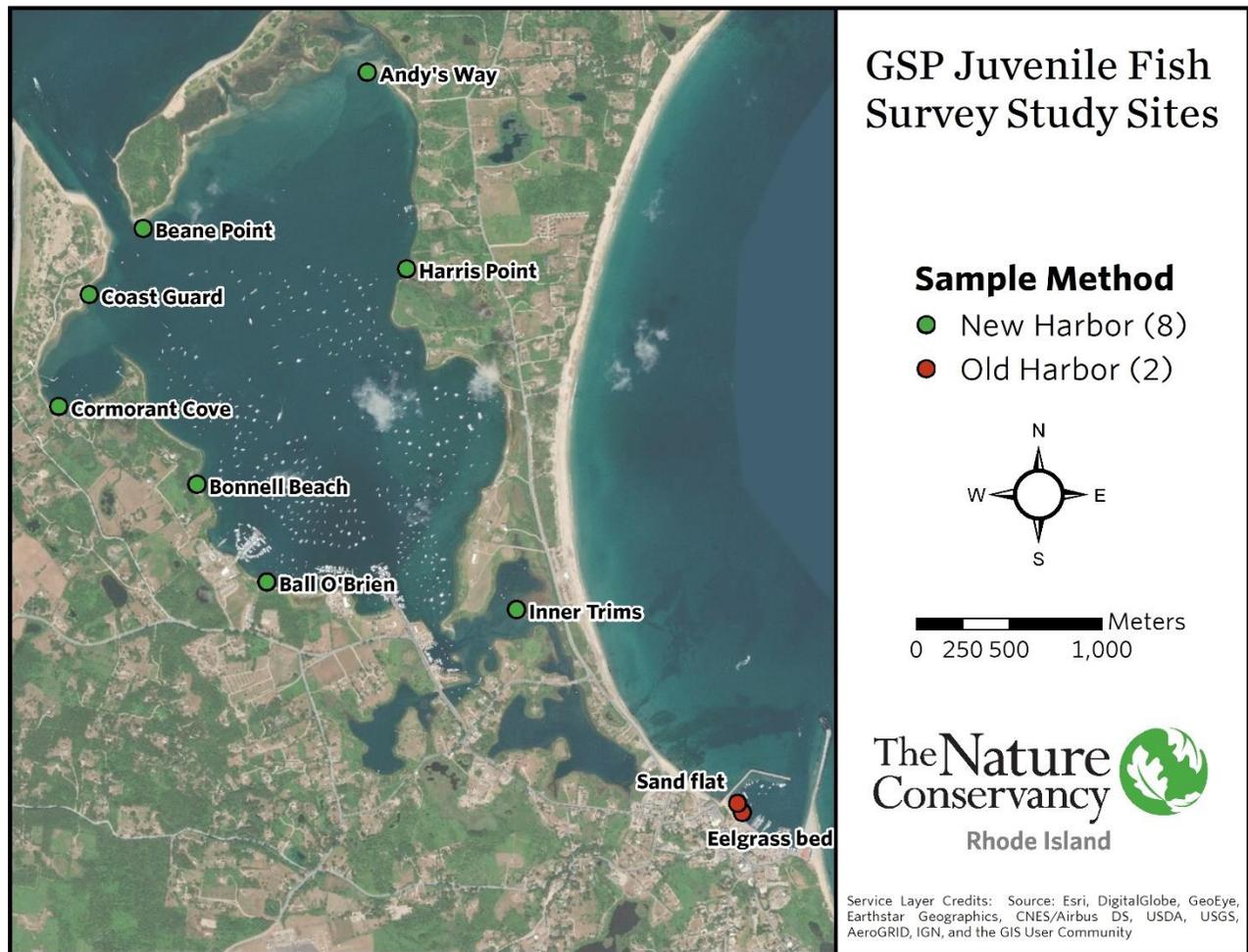
Approved By

Scott Comings, Associate State Director

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



Map of study area and sampling locations by site name.



SUMMARY:

During the 2023 season a total of 60 seines were hauled across 10 sites in May through October resulting in the enumeration of 16,502 individuals. Of the animals caught, 15,677 of those individuals were finfish and 825 were other marine invertebrates. A total of 3,276 individuals were measured and 55 species were identified (see Table 1). All scoped work was completed despite additional considerations for safely working in the field during the COVID-19 pandemic. All raw data have been shared with the appropriate Rhode Island Department of Environmental Management Division of Marine Fisheries staff for incorporation into existing datasets.

TARGET DATE:

December 31, 2023

NEXT STEPS:

Investigators intend to continue sampling with the same methodology for the 2024 field season. Additionally, the Block Island project team will coordinate with the primary investigators of the Coastal Ponds and Providence River Estuary juvenile fish surveys to evaluate variations in fish assemblages across study areas in Rhode Island.

REMARKS:

For the entire time series (2014-2023), 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. Other species of interest and their relative abundances were also included in this report. These species include members of the Clupeidae family: Atlantic menhaden and river herring (blueback herring and alewives), as well as three forage fish species: silversides spp., common mummichog, and striped killifish. Adults and juveniles of these fish species were not differentiated for data analysis or descriptive purposes. Of all the species caught, only finfish were included in the results of this report (all crustaceans and other marine invertebrates were excluded).

INTRODUCTION:

Estuaries are known as important habitat for many marine species and for fisheries. Often referred for as nurseries, these ecosystems provide essential grounds for spawning, feeding and growth development of species, particularly during early life stages (Able and Fahay 1998). In Rhode Island, estuaries are estimated to support about two-thirds of the economically important fish species along the East Coast of the United States (Boesch and Turner 1984; Able 2005). Many fisheries managers are concentrated on species that use estuaries as nurseries because they recognize that these areas contribute to the production of future recruits into recreational and commercial fisheries (Jänes et al. 2022). Continued evaluation of finfish assemblages in estuaries, particularly in response to changing climate, remains to be a critical part of their sustainability and the conservation of these coastal habitats.

On Block Island, Rhode Island, the Great Salt Pond is the defining estuarine habitat. Found in the center of the island, Great Salt Pond is about 1,000-acres in size, including the inner ponds, and is known for its varied slopes, deeper depths, and rich bottom communities (Hale 2000). Having unique offshore features, the pond is often described as a highly productive system for ecologically important species. While past fisheries assessments have supported this claim, a subsequent literature review revealed that there has been limited historical and empirical data on the Great Salt Pond (Neumann

1993; Katz 2000). Knowing that a holistic approach to evaluating the Great Salt Pond is critically important to understanding its role in supporting fish populations, the Division of Marine Fisheries and The Nature Conservancy entered into a cooperative agreement to study the estuary's fish assemblages, water quality, and benthic habitat.

In 2014, the juvenile fish seine survey was established on Block Island. The initial results of this monitoring revealed that the Great Salt Pond and Old Harbor supported recreationally and commercially important juvenile finfish. It also revealed that this study area could support additional opportunities for enhancing and protecting essential fish habitat. The continuation of the Block Island seine survey contributes directly to Division of Marine Fisheries' ability to evaluate juvenile fish populations across Rhode Island waters. It also aligns with other established seine surveys in coastal regions. Collectively, this long-term monitoring continues to build a strong time series and serves as a valuable tool in managing fish populations across the state.

METHODS:

Ten stations on Block Island were sampled at monthly intervals from May through October (8 stations in the Great Salt Pond (New Harbor) and 2 stations in Old Harbor)). Investigators attempted to perform all seining on an incoming tide and in the intertidal zone at depths shallower than 2 meters. At each site a 130' long, 5.5' deep, 1/4" 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 Rhode Island Coastal Ponds and Embayments (conducted as part of F-61-R-23, Job #3).

For sampling in the Great Salt Pond, the net was deployed along the shoreline in a semi-circle by boat. In Old Harbor, sampling required investigators to set the net by hand and without the help of a vessel. The net was then hauled onto shore from both ends toward the beach by hand. All animals caught were gathered into the midpoint pocket and safely transferred into large water-filled totes. All collected animals were identified to genus or species and measured to the nearest centimeter for total length (TL) (except for flounder species which were measured to the nearest millimeter). Additionally, the gender, shell condition, and total carapace length of blue 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 per manufacturer recommendations.

RESULTS & DISCUSSION:

For the 2023 field season, a total of 60 seines were hauled across the 10 sampling sites. A total of 16,502 individuals were identified and enumerated, and 3,276 of those were measured. A total of 55 species were caught (Table 1). Of the species caught, only finfish were included in the results below.

Excluding Atlantic menhaden from the analysis, a mean of 260.92 ± 71.63 SE finfish was caught per haul in 2023. Catch per haul across sites was greatest at Ball O'Brien in the Great Salt Pond at 673.83 ± 597.27 SE and lowest at the eelgrass site in Old Harbor at 79.33 ± 35.91 SE (Figure 1). Catch per haul across months was greatest in September at 521.90 ± 190.05 SE and lowest in July at 68.40 ± 19.17 SE (Figure 2).

TARGET SPECIES

Winter Flounder (*Pseudopleuronectes americanus*)

Of the total 228 winter flounder caught in 2023 seines, 219 individuals were YOY, and 9 individuals were age 1+ (max length = 220 mm; Able and Fahay 1998; Berry et al. 1965; Meng et al. 2000). In 2023, winter flounder were collected during all months and caught at all sites except for Ball O'Brien in the Great Salt Pond. The most abundant site for winter flounder was the sand flat site in Old Harbor at a catch per haul of 11.67 ± 7.19 SE (Figure 3a). The most abundant site for winter flounder was the sand flat site in Old Harbor at a catch per haul of 11.67 ± 7.19 SE (Figure 3a). The most abundant month for winter flounder was June at a catch per haul of 6.40 ± 4.58 SE fish/seine haul (Figure 3b). The 2023 juvenile winter flounder abundance index was 3.80 ± 1.04 SE fish/seine haul, which was slightly higher than the 2022 index of 3.08 ± 0.60 SE. The Block Island 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 13 summer flounder were caught in 2023 beach seines ranging in size from 52mm to 190mm. Summer flounder were caught at 4 of the 10 sites: Beane Point and Cormorant Cove in the Great Salt Pond, and both sites in Old Harbor. Summer flounder were most abundant at the sand flat site in Old Harbor at a catch per haul of 1.33 ± 0.56 SE (Figure 3a). Most individuals were caught in May at a catch per haul of 0.60 ± 0.40 SE (Figure 3b). Since the start of the time series, summer flounder has been the least abundant catch for the interest group.

Tautog (*Tautoga onitis*)

During the 2023 survey 123 tautog were collected and ranged in size from 2cm to 15cm. This total number was a decrease from the 2022 survey when 381 juveniles were collected. The 2023 abundance index was 2.05 ± 0.92 SE, a decrease from the 2022 index 6.35 ± 1.57 SE. Tautog were caught at 7 of the 10 sites: Harris Point, Coast Guard, Cormorant Cove, Bonnell Beach, Ball O'Brien, and Inner Pond in the Great Salt Pond, and eelgrass bed in Old Harbor. Of the 7 sites they were caught, tautog were most abundant at Bonnell Beach at a catch per haul of 7.67 ± 6.17 SE (Figure 3a). Tautog were most abundant in September with a catch per haul of 7.70 ± 5.05 SE (Figure 3b).

Black Sea Bass (*Centropristis striata*)

A total of 284 black sea bass were caught in 2023, which was an increase from the 185 individuals that were collected in 2022. Black sea bass were caught at all sites except for Ball O'Brien in the Great Salt Pond and sand flat in Old Harbor. They were most abundant at Bonnell Beach at a catch per haul of 27.83 ± 23.88 SE (Figure 3a). Most individuals were caught in September at a catch per haul of 21.10 ± 14.35 SE (Figure 3b). Black sea bass ranged in size between 2cm and 11cm in 2023. The abundance index for black sea bass in 2023 was 4.73 ± 2.59 SE fish/seine haul. This was slightly higher than the 2022 index of 3.08 ± 1.17 SE fish/seine haul.

Scup (*Stenotomus chrysops*)

A total of 31 scup were caught in 2023 beach seines ranging in size from 3cm to 28cm. Scup were caught in August and September at 4 out of the 10 sites: Harris Point, Cormorant Cove, Bonnell Beach, and the eelgrass bed site in Old Harbor. They were most abundant at Bonnell Beach in the Great Salt Pond with a catch per haul of 2.17 ± 1.80 SE (Figure 3a). Most individuals were caught in September at a catch per haul of 2.90 ± 1.56 SE in 2023 (Figure 3b).

OTHER SPECIES OF INTEREST

Family Clupeidae

In 2023, two species of clupeids were collected during the sampling season: Atlantic menhaden and blueback herring. While other species of clupeids have been collected in past Block Island surveys (Alewife, Atlantic herring, and hickory shad), they were not captured during the 2023 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 while large schools of clupeid species were not encountered during the 2023 season, they were most likely present in the system and may have been missed during sampling.

Atlantic Menhaden (*Brevoortia tyrannus*)

In the 2023 sampling season, 22 Atlantic menhaden were caught and ranged in size between 3cm and 14cm. The total survey mean abundance index was 0.37 ± 0.26 SE. Atlantic menhaden were found in May, July, and August this year and at 3 out of the 10 sites: Ball O'Brien and Inner Pond sites in the Great Salt Pond and the sand flat site in Old Harbor. The species was most abundant at the sand flat site with a catch per haul of 2.67 ± 2.47 SE. The highest number of individuals were caught in August at a catch per haul of 1.50 ± 1.50 SE.

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

Both alewife (*Alosa pseudoharengus*) and blueback herring (*Alosa aestivalis*) are classified as river herring for the time series survey. However, no alewife individuals were caught during the 2023 sampling season. A total of 12 blueback herring were caught in 2023 and ranged in size from 6cm to 9cm. They were found in June and August at 2 sites in the Great Salt Pond: Harris Point and Andy's Way. The total survey mean abundance for blueback herring was 0.20 ± 0.15 SE fish/seine haul in 2023.

FORAGE FISH SPECIES

Forage fish species are commonly encountered across stations and months throughout the sampling season. In 2023, silversides, striped killifish, and common mummichog comprised 87.8% of the total fish catch, which was a higher percentage compared to past survey years. For the purposes streamlining report criteria, Atlantic silversides and inland silversides are collectively referred to as silversides (*Menidia spp.*).

Silversides spp. (*Menidia spp.*)

A total of 12,639 silversides were caught in 2023. The total mean abundance was 210.65 ± 69.77 SE in 2023 and was lower than last year's index of 307.97 ± 80.06 SE, making it the second lowest abundance index for the overall time series. The species was most abundant at the Ball O'Brien site in Great Salt Pond with a catch per haul of 666.33 ± 595.99 SE in 2023. The highest number of silversides were caught in September at a catch per haul of 392.20 ± 191.72 SE in 2023. Silversides ranged in size from 2cm to 14cm and were found in all months and at all sites. Silversides had the highest abundance of all species caught during the 2023 season. The species has ranked as the most abundant finfish species since the start of the Block Island survey in 2014.

Striped Killifish (*Fundulus majalis*)

Seven-hundred and forty-six striped killifish were collected in 2023 and ranged in size from 3cm to 14cm. In 2023, striped killifish occurred during all months and at all sites except for Ball O'Brien in the Great Salt Pond. The total mean abundance was 12.43 ± 4.43 SE in 2023, which was lower than the 2022 index of 95.63 ± 31.30 SE. In 2023, the highest number of striped killifish were caught in

October at a catch per haul of 30.50 ± 20.11 SE, and they were most abundant at Andy's Way in the Great Salt Pond with a catch per haul of 88.33 ± 28.09 SE.

Mummichog (*Fundulus heteroclitus*)

A total of 376 mummichogs were caught in 2023 and ranged in size from 2cm to 11cm. The species was caught at all sites this season except for Cormorant Cove in Great Salt Pond and both sites in Old Harbor. Mummichogs had the highest abundance at Andy's Way with a catch per haul of 29.67 ± 27.90 SE in 2023. They were caught during all months in 2023 except for June. Mummichogs were most abundant in August at a catch per haul of 25.40 ± 16.62 SE. The total mean abundance was 6.27 ± 2.96 SE in 2023.

WATER QUALITY DATA

Water quality data for the 2023 season can be found in Table 2. In the Great Salt Pond, water temperature ranged from 13.8°C in June to 29.9°C in August. In Old Harbor, water temperature ranged from 11.9°C in June and 22.5°C in September. The mean salinity of the 8 sites in the Great Salt Pond was $29.86\text{ppt} \pm 0.12$ SE, and the mean salinity of the 2 sites in Old Harbor were $31.16\text{ppt} \pm 0.1$ SE. The lowest dissolved oxygen value recorded across the Great Salt Pond sites was 7.14mg/L in July at Harris Point, while the mean was $8.50\text{mg/L} \pm 0.08$ SE. In 2023, the eelgrass site in Old Harbor recorded the lowest dissolved oxygen value at 7.44mg/L in September, with a mean of $8.22\text{mg/L} \pm 0.21$ SE between the Old Harbor sites.

SUMMARY:

In 2023, investigators caught 44 species of finfish representing 28 families. These numbers are lower than 2022 when 52 species from 32 families were collected. The number of finfish individuals caught in 2023 decreased from the 2022 survey, with 15,677 collected in 2023, and 34,842 collected in 2022. This year also marked the second lowest number of individual species caught over the last 10 years of the Block Island juvenile fish survey. Frequency of all species caught by station during the 2023 Block Island survey can be found in the appendix. Additional data is available upon request.

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FIGURES:

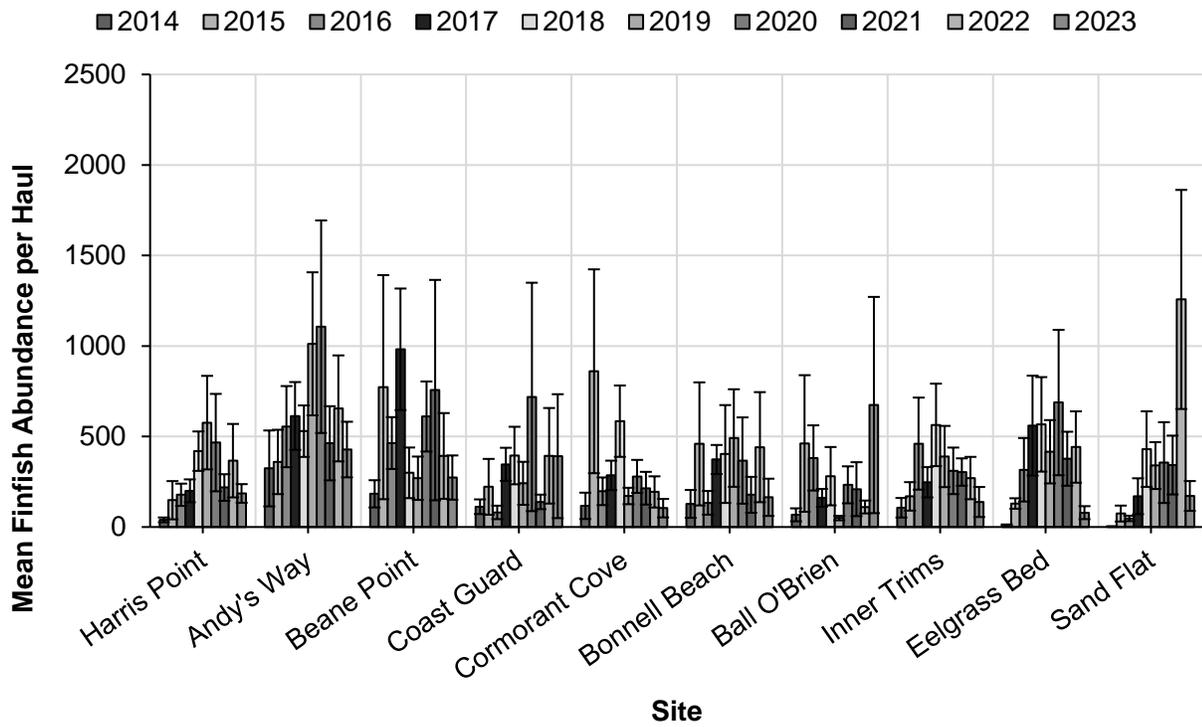


Figure 1. Mean abundance of finfish across sites (\pm SE) in 2014-2023 beach seines (excluding Atlantic menhaden).

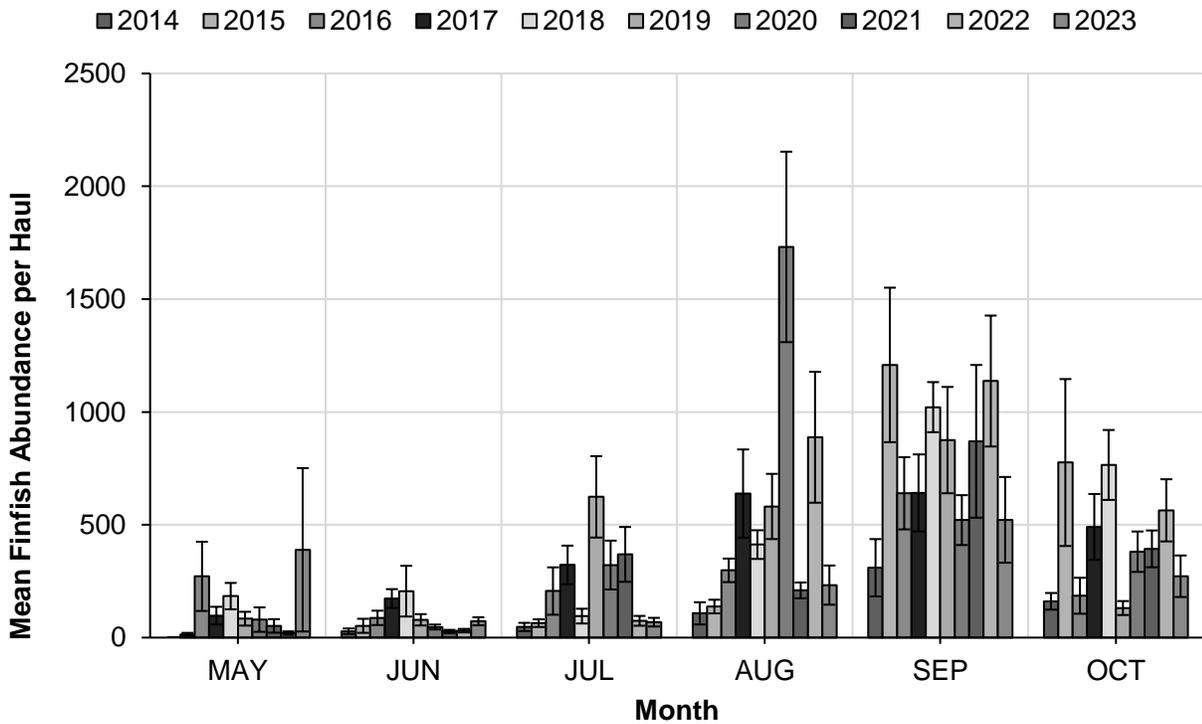


Figure 2. Mean abundance of finfish caught each month (\pm SE) in 2014-2023 beach seines (excluding Atlantic menhaden).

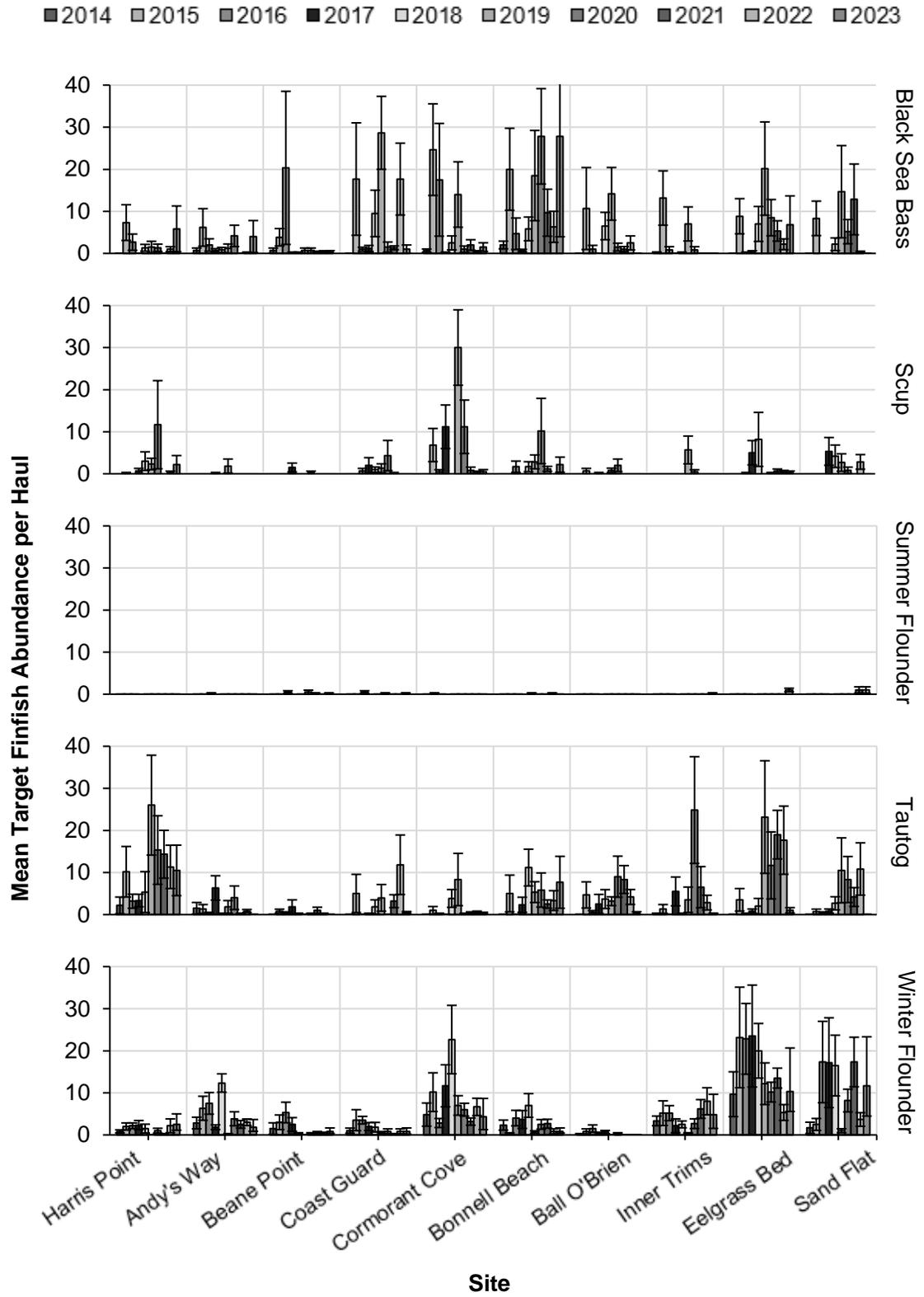


Figure 3a. Mean abundance of target finfish caught by site (\pm SE) in 2014-2023 beach seines.

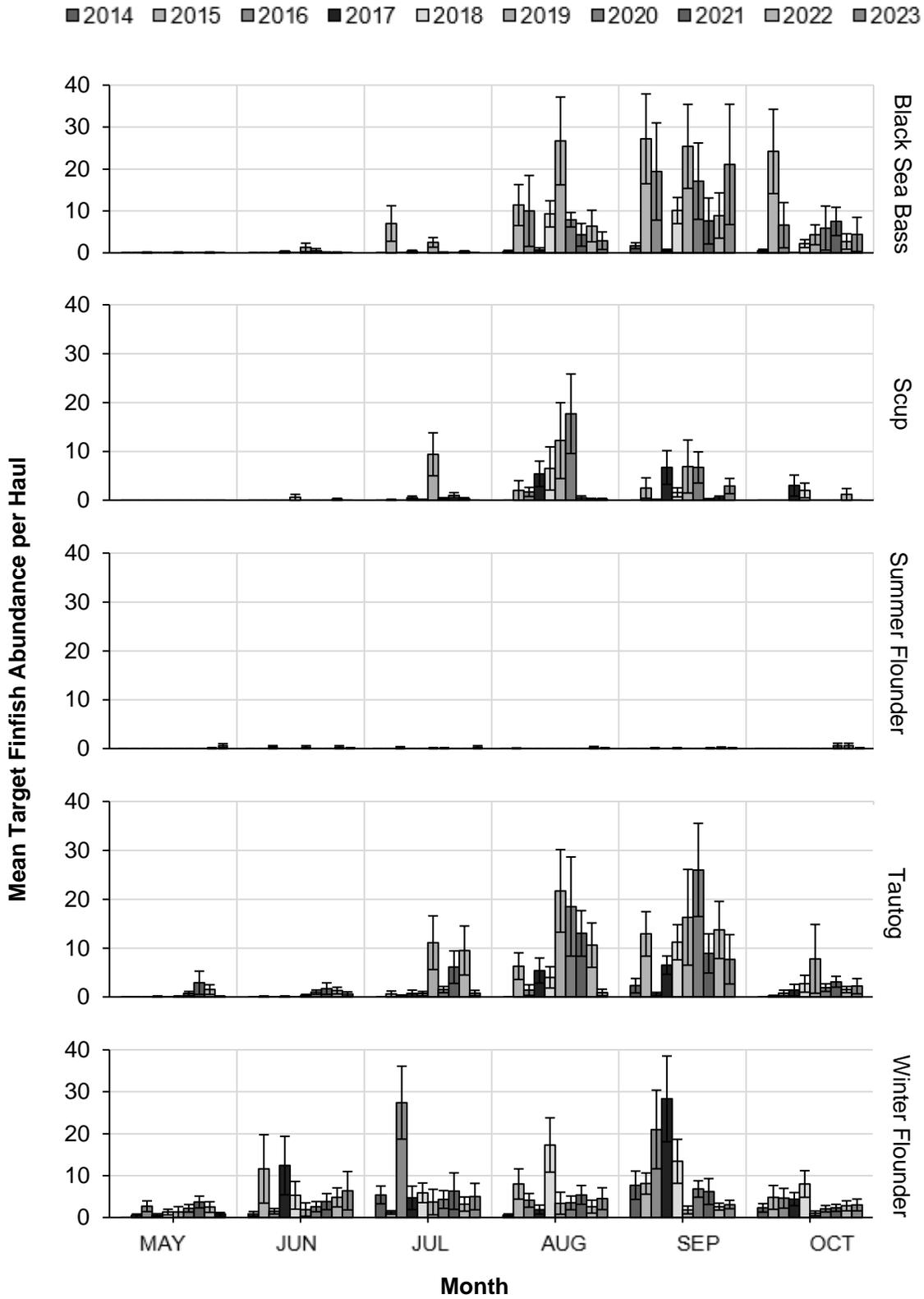


Figure 3b. Mean target finfish per haul (\pm SE) plotted for each month during the 2014-2023 field seasons.

TABLES:

Table 1. Scientific, common names, and total abundance of all species caught in beach seines during 2023.

Common Name	Scientific Name	Abundance
Atlantic Silverside	<i>Menidia menidia</i>	12639
Striped Killifish	<i>Fundulus majalis</i>	746
Silver Jenny	<i>Eucinostomus gula</i>	709
Green Crab	<i>Carcinus maenas</i>	638
Mummichog	<i>Fundulus heteroclitus</i>	376
Black Sea Bass	<i>Centropristis striata</i>	284
Winter Flounder	<i>Pseudopleuronectes americanus</i>	228
Blue Crab	<i>Calinectes sapidus</i>	137
Tautog	<i>Tautoga onitis</i>	123
Northern Sennet	<i>Sphyræna borealis</i>	119
Pollock	<i>Pollachius virens</i>	58
Mojarra spp.	<i>Gerreidae spp.</i>	50
Sheepshead Minnow	<i>Archosargus probatocephalus</i>	50
Northern Puffer	<i>Sphoeroides maculatus</i>	33
Cunner	<i>Tautogolabrus adspersus</i>	32
Scup	<i>Stenotomus chrysops</i>	31
Northern Kingfish	<i>Menticirrhus saxatilis</i>	26
Atlantic Menhaden	<i>Brevoortia tyrannus</i>	22
Northern Pipefish	<i>Syngnathus fuscus</i>	20
Pinfish	<i>Lagodon rhomboides</i>	18
Grubby	<i>Myoxocephalus aeneus</i>	17
Speckled Swimming Crab	<i>Arenaeus cribrarius</i>	14
Summer Flounder	<i>Paralichthys dentatus</i>	13
Blueback Herring	<i>Alosa aestivalis</i>	12
Northern Searobin	<i>Prionotus carolinus</i>	12
Spider Crab	<i>Libinia emarginata</i>	12
Leopard Searobin	<i>Prionotus scitulus</i>	9
Sargassum Swimming Crab	<i>Portunus sayi</i>	7
Spot	<i>Leiostomus xanthurus</i>	6
Atlantic Cod	<i>Gadus morhua</i>	5
Chain Pipefish	<i>Syngnathus louisianae</i>	5
Jonah Crab	<i>Cancer borealis</i>	5
Lady Crab	<i>Ovalipes ocellatus</i>	4
Striped Searobin	<i>Prionotus evolans</i>	4
Bay Scallop	<i>Argopecten irradians</i>	3
Dusky Pipefish	<i>Syngnathus floridae</i>	3

Table 1. (continued)

Common Name	Scientific Name	Abundance
Longfin Squid	<i>Loligo pealei</i>	3
Pigfish	<i>Orthopristis chrysoptera</i>	3
Rock Gunnel	<i>Pholis gunnellus</i>	3
Snakefish	<i>Trachinocephalus myops</i>	3
Spotted Whiff	<i>Citharichthys macrops</i>	3
Lizardfish spp.	<i>Synodontidae spp.</i>	2
Oyster Toadfish	<i>Opsanus tau</i>	2
Twospot Flounder	<i>Bothus robinisi</i>	2
American Eel	<i>Anguilla rostrata</i>	1
Atlantic Rock Crab	<i>Cancer irroratus</i>	1
Bluespotted Cornetfish	<i>Fistularia tabacaria</i>	1
Crevalle Jack	<i>Caranx hippos</i>	1
Horseshoe Crab	<i>Limulus polyphemus</i>	1
Lined Seahorse	<i>Hippocampus erectus</i>	1
Lookdown	<i>Selene vomer</i>	1
Naked Goby	<i>Gobiosoma bosc</i>	1
Ninespine Stickleback	<i>Pungitius pungitius</i>	1
Round Scad	<i>Decapterus punctatus</i>	1
Striped Bass	<i>Morone saxatilis</i>	1

Table 2. Water temperature, salinity, dissolved oxygen by site and month during the 2023 beach seines.

Site	Month	Temp. (°C)	Sal. (ppt)	DO (mg/L)	Site	Month	Temp. (°C)	Sal. (ppt)	DO (mg/L)
Harris Point	MAY	14.3	28.32	9.11	Cormorant Cove	MAY	14.8	28.84	9.08
	JUN	14.4	29.58	8.88		JUN	14.0	29.72	8.96
	JUL	25.2	30.11	7.14		JUL	21.0	30.16	8.03
	AUG	29.9	28.89	8.60		AUG	23.8	28.23	8.22
	SEP	24.5	30.93	7.82		SEP	22.7	30.51	7.95
	OCT	19.3	29.87	8.69		OCT	18.3	29.92	8.71
Andy's Way	MAY	16.1	28.24	9.12	Bonnell Beach	MAY	14.8	28.93	9.01
	JUN	14.4	30.11	8.67		JUN	14.5	29.76	8.84
	JUL	25.5	30.85	7.91		JUL	22.1	30.14	8.13
	AUG	24.7	30.04	8.40		AUG	24.0	30.01	9.00
	SEP	24.8	31.00	7.99		SEP	24.8	30.49	7.98
	OCT	19.9	29.92	8.72		OCT	19.1	29.66	8.81
Beane Point	MAY	14.2	29.10	9.07	Ball O'Brien	MAY	14.7	28.74	9.06
	JUN	14.3	30.36	8.91		JUN	13.8	29.89	8.54
	JUL	21.6	30.92	8.15		JUL	22.4	29.66	7.95
	AUG	24.3	30.18	8.70		AUG	23.8	30.14	8.61
	SEP	24.9	31.09	7.90		SEP	24.8	30.73	7.47
	OCT	19.1	29.99	8.63		OCT	18.6	29.11	8.48
Coast Guard	MAY	14.5	29.05	9.16	Inner Pond	MAY	14.6	28.16	9.33
	JUN	14.0	30.62	8.73		JUN	14.8	28.99	9.03
	JUL	21.3	30.77	8.28		JUL	23.1	30.64	8.55
	AUG	24.9	30.18	9.84		AUG	24.3	30.32	7.30
	SEP	22.3	31.03	7.88		SEP	25.3	30.41	7.46
	OCT	18.8	29.94	8.53		OCT	19.6	29.13	8.67
Eelgrass Bed	MAY	12.2	30.67	9.62	Sand Flat	MAY	12.2	30.66	9.61
	JUN	11.9	31.22	8.08		JUN	11.9	31.23	8.08
	JUL	21.3	31.39	7.77		JUL	21.7	31.42	7.69
	AUG	20.5	31.26	8.11		AUG	20.5	31.21	8.04
	SEP	22.5	31.69	7.44		SEP	22.5	31.70	7.46
	OCT	17.1	30.73	8.35		OCT	17.2	30.74	8.33

APPENDIX

Table 3a. Catch frequency of all species by site for the 2023 Block Island seine survey.

Species	Harris Point	Andy's Way	Beane Point	Coast Guard	Comorant	Coye	Bonnell Beach	Ball O'Brien	Inner Pond	Eelgrass Bed	Sand Flat
American Eel (<i>Anguilla rostrata</i>)	1										
Atlantic Cod (<i>Gadus morhua</i>)						1	3		1		
Atlantic Menhaden (<i>Brevoortia tyrannus</i>)							2	4			16
Atlantic Rock Crab Male (<i>Cancer irroratus</i>)						1					
Bay Scallop (<i>Argopecten irradians</i>)					2			1			
Black Sea Bass (<i>Centropristis striata</i>)	35	24	2	6	9	167			41		
Blue Crab (<i>Callinectes sapidus</i>)	1	6	1	1		1	1	17	23	86	
Blueback Herring (<i>Alosa aestivalis</i>)	9	3									
Bluespotted Cornetfish (<i>Fistularia tabacaria</i>)		1									
Chain Pipefish (<i>Syngnathus louisianae</i>)	3				1				1		
Creville Jack (<i>Caranx hippos</i>)											1
Cunner (<i>Tautoglabrus adspersus</i>)	13				5	10			4		
Dusky Pipefish (<i>Syngnathus floridae</i>)		1							1	1	
Green Crab (<i>Carcinus maenas</i>)	33	11	17	42	29	34	37	13	310	112	
Grubby (<i>Myoxocephalus aenaenus</i>)	2		1		1	5			8		
Horseshoe Crab (<i>Limulus polyphemus</i>)				1							
Jonah Crab (<i>Cancer borealis</i>)			2		3						
Lady Crab (<i>Ovalipes ocellatus</i>)		1	3								
Leopard Searobin (<i>Prionotus scitulus</i>)		1	4						1	3	
Lined Seahorse (<i>Hippocampus erectus</i>)					1						
Lizardfish (<i>Synodontidae spp.</i>)			2								
Longfin Squid (<i>Loligo pealei</i>)					2	1					
Lookdown (<i>Selene vomer</i>)											1
Mojarras (<i>Gerreidae spp.</i>)					41	4			2	3	
Mummichog (<i>Fundulus heteroclitus</i>)	90	178	6	5		16	22	59			
Naked Goby (<i>Gobiosoma bosc</i>)					1						
Ninespine Stickleback (<i>Pungitius pungitius</i>)								1			
Northern Kingfish (<i>Menticirrhus saxatilis</i>)		19			1			1	2	3	
Northern Pipefish (<i>Syngnathus fuscus</i>)	1			3	4	1	1		8	2	
Northern Puffer (<i>Sphoeroides maculatus</i>)	2	4	3	9	1	9	1	2	2		
Northern Searobin (<i>Prionotus carolinus</i>)					3	6			1	2	
Northern Sennet (<i>Sphyræna borealis</i>)	11	1	6	44	24	10	4	1	10	8	
Oyster Toadfish (<i>Opsanus tau</i>)								2			
Pigfish (<i>Orthopristis chrysoptera</i>)	3										
Pinfish (<i>Lagodon rhomboides</i>)	2	5		9	1				1		
Pollock (<i>Pollachius virens</i>)	1			4			11		32	10	
Rock Gunnel (<i>Pholis gunnellus</i>)					1			2			
Round Scad (<i>Decapterus punctatus</i>)	1										
Sargassum Swimming Crab (<i>Portunus sayi</i>)	7										
Scup (<i>Stenotomus chrysops</i>)	13				3	13			2		
Sheepshead Minnow (<i>Archosargus probatocephalus</i>)	22	28									
Silver Jenny (<i>Eucinostomus gula</i>)	96	132		2	329	116	1	31	2		
Silversides (<i>Atherinopsidae spp.</i>)	620	1629	1561	2254	162	570	3998	653	283	909	
Snakefish (<i>Trachinocephalus myops</i>)			3								
Speckled Swimming Crab (<i>Arenaeus cribrarius</i>)			9							5	
Spider Crab (<i>Libinia emarginata</i>)	3	2	2		1	1		1		2	
Spot (<i>Leiostomus xanthurus</i>)					4	1			1		
Spotted Whiff (<i>Citharichthys macrops</i>)											3
Striped Bass (<i>Morone saxatilis</i>)						1					
Striped Killifish (<i>Fundulus majalis</i>)	110	530	41	4	1	4		47	3	6	
Striped Searobin (<i>Prionotus evolans</i>)		1	2						1		
Summer Flounder (<i>Paralichthys dentatus</i>)			1		3				1	8	
Tautog (<i>Tautoga onitis</i>)	63			3	2	46	2	1	6		
Twospot Flounder (<i>Bothus robinisi</i>)			2								
Winter Flounder (<i>Pseudopleuronectes americanus</i>)	15	11	5	5	26	5		29	62	70	

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Table 4a. Species presence by site for May 2023 beach seines.

MAY	Site										
Species	Harris Point	Andy's Wzy	Beane Point	Coast Guard	Comorant Cove	Bonnell Beach	Ball O'Brien	Inner Pond	Feelgrass Bed	Sand Flat	Total
Atlantic Cod					1	1		1			3
Atlantic Menhaden						1					1
Blue Crab							1	1			2
Chain Pipefish				1							1
Cunner				1							1
Dusky Pipefish		1									1
Green Crab	1		1	1	1	1	1	1	1		9
Grubby				1							1
Jonah Crab			1								1
Lady Crab			1								1
Mummichog							1				1
Northern Pipefish				1				1	1		3
Pollock			1			1		1	1		4
Silversides	1	1	1	1	1	1	1				8
Striped Killifish							1				1
Summer Flounder				1					1		2
Tautog				1							1
Winter Flounder			1	1				1	1		4

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Table 4b. Species by site for June 2023 beach seines.

JUN	Site										
Species	Harris Point	Andy's Way	Beane Point	Coast Guard	Cormorant Cove	Bonell Beach	Ball O'Brien	Inner Pond	Eelgrass Bed	Sand Flat	Total
Blue Crab								1			1
Blueback Herring	1	1									2
Cunner	1										1
Dusky Pipefish									1		1
Green Crab	1		1	1	1	1	1	1	1		8
Grubby	1										1
Horseshoe Crab			1								1
Jonah Crab				1							1
Naked Goby				1							1
Northern Pipefish				1				1	1		3
Northern Puffer			1								1
Pollock	1										1
Silversides	1	1	1	1	1	1	1	1			9
Spider Crab				1			1				2
Striped Bass					1						1
Striped Killifish		1					1				2
Summer Flounder									1		1
Tautog	1					1					2
Winter Flounder	1			1			1	1	1		5

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Table 4c. Species presence by site for July 2023 beach seines.

JUL	Site										
Species	Harris Point	Andy's Way	Beane Point	Coast Guard	Cormorant Cove	Bonnell Beach	Ball O'Brien	Inner Pond	Eelgrass Bed	Sand Flat	Total
American Eel	1										1
Atlantic Menhaden							1		1		2
Atlantic Rock Crab					1						1
Blue Crab	1	1		1		1	1	1			6
Chain Pipefish	1										1
Cunner	1							1			2
Green Crab	1	1	1	1	1	1		1	1		9
Grubby			1					1			2
Mummichog	1	1									2
Northern Kingfish								1			1
Northern Pipefish	1							1			2
Northern Sennet									1		1
Rock Gunnel							1				1
Round Scad	1										1
Silversides	1	1	1	1		1	1	1	1	1	9
Spider Crab	1	1				1					3
Spot								1			1
Striped Killifish	1	1							1		3
Summer Flounder									1		1
Tautog	1							1			2
Winter Flounder	1	1	1					1	1	1	6

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Table 4d. Species presence by site for August 2023 beach seines.

AUG	Site										
Species	Harris Point	Andy's Way	Beane Point	Coast Guard	Cormorant Cove	Bonnell Beach	Ball O'Brien	Inner Pond	Eelgrass Bed	Sand Flat	Total
Atlantic Menhaden								1			1
Bay Scallop				1			1				2
Black Sea Bass		1		1	1						3
Blue Crab	1						1		1		3
Blueback Herring	1										1
Cunner				1							1
Green Crab			1	1	1			1	1		5
Grubby					1						1
Longfin Squid				1							1
Lookdown									1		1
Mojarras				1	1						2
Mummichog	1	1	1			1	1				5
Northern Kingfish		1		1			1		1		4
Northern Pipefish			1	1		1		1			4
Northern Puffer			1	1	1		1				4
Northern Searobin				1	1						2
Northern Sennet	1	1	1		1	1	1	1			8
Pinfish	1	1		1	1						4
Rock Gannel				1							1
Scup					1						1
Sheepshead Minnow	1	1									2
Silver Jenny	1										1
Silversides	1	1	1	1	1	1	1	1	1	1	10
Snakefish			1								1
Spider Crab			1								1
Spot				1	1						2
Striped Killifish	1	1		1				1	1		5
Summer Flounder									1		1
Tautog				1	1	1					3
Winter Flounder					1	1		1	1		4

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Table 4e. Species presence by site for September 2023 beach seines.

SEP	Site										
Species	Harris Point	Andy's Way	Beane Point	Coast Guard	Cormorant Cove	Bonnell Beach	Ball O'Brien	Inner Pond	Eelgrass Bed	Sand Flat	Total
Black Sea Bass	1	1		1	1	1					5
Blue Crab		1	1			1				1	4
Bluespotted Cornetfish		1									1
Crevalle Jack									1		1
Cunner	1					1					2
Green Crab	1		1	1	1	1	1		1	1	8
Grubby	1					1					2
Lady Crab		1									1
Leopard Searobin		1	1								2
Lizardfish			1								1
Longfin Squid						1					1
Mummichog	1	1	1			1	1	1			6
Northern Kingfish		1								1	2
Northern Pipefish						1					1
Northern Puffer	1	1		1	1	1	1		1		7
Northern Searobin					1	1				1	3
Northern Sennet	1			1		1	1		1	1	6
Pigfish	1										1
Pinfish		1		1							2
Sargassum Swimming Crab	1										1
Scup	1				1	1			1		4
Sheepshead Minnow		1									1
Silver Jenny	1	1			1	1		1	1		6
Silversides	1	1	1	1	1	1	1	1	1	1	10
Snakefish			1								1
Speckled Swimming Crab			1								1
Spider Crab	1	1	1								3
Striped Killifish	1	1	1			1		1		1	6
Striped Searobin		1	1								2
Summer Flounder			1								1
Tautog	1			1		1					3
Twospot Flounder			1								1
Winter Flounder	1	1		1		1			1	1	6

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Table 4f. Species presence by site for October 2023 beach seines.

OCT	Site										
Species	Harris Point	Andy's Way	Beane Point	Coast Guard	Cormorant Cove	Bonnell Beach	Ball O'Brien	Inner Pond	Eelgrass Bed	Sand Flat	Total
Black Sea Bass	1	1						1			3
Blue Crab							1	1	1		3
Chain Pipefish								1			1
Cunner	1							1			2
Dusky Pipefish								1			1
Green Crab	1	1	1	1	1			1	1		7
Grubby								1			1
Leopard Searobin								1	1		2
Lined Seahorse				1							1
Mojarras								1	1		2
Mummichog			1	1		1	1				5
Ninespine Stickleback							1				1
Northern Pipefish								1			1
Northern Puffer								1			1
Northern Searobin				1				1	1		3
Oyster Toadfish							1				1
Pinfish	1							1			2
Rock Gunnel							1				1
Sheepshead Minnow	1	1									2
Silver Jenny		1		1	1		1	1			5
Silversides	1	1	1	1	1	1	1	1	1	1	10
Speckled Swimming Crab									1		1
Spider Crab	1								1		2
Spotted Whiff									1		1
Striped Killifish	1	1	1	1	1	1					6
Striped Searobin								1			1
Summer Flounder								1			1
Tautog	1			1		1		1	1		5
Winter Flounder	1	1	1	1		1		1	1	1	8

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Table 5a. Abundances of winter flounder in 2023 beach seines.

Month	Site										Mean	SD	SE	Total
	Harris Point	Andy's Way	Beane Point	Coast Guard Station	Cormorant Cove	Bornell Beach	Ball O'Brien	Inner Pond	Eelgrass Bed	Sand Flat				
MAY	0	0	3	0	1	0	0	0	1	3	0.80	1.23	0.39	8
JUN	3	0	0	0	6	0	0	2	6	47	6.40	14.47	4.58	64
JUL	1	3	1	0	0	0	0	3	32	10	5.00	9.97	3.15	50
AUG	0	0	0	0	19	2	0	21	3	0	4.50	8.25	2.61	45
SEP	9	6	0	4	0	2	0	0	5	5	3.10	3.18	1.00	31
OCT	2	2	1	1	0	1	0	3	15	5	3.00	4.47	1.41	30
Mean	2.50	1.83	0.83	0.83	4.33	0.83	0.00	4.83	10.33	11.67				
SD	3.39	2.40	1.17	1.60	7.55	0.98	0.00	8.04	11.66	17.61				
SE	1.38	0.98	0.48	0.65	3.08	0.40	0.00	3.28	4.76	7.19				
Total	15	11	5	5	26	5	0	29	62	70				
													Total Fish	228

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Table 5c. Abundances of black sea bass in 2023 beach seines.

Month	Site										Mean	SD	SE	Total
	Harris Point	Andy's Way	Beane Point	Coast Guard Station	Cormorant Cove	Bornell Beach	Ball O'Brien	Inner Pond	Eelgrass Bed	Sand Flat				
MAY	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0
JUN	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0
JUL	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0
AUG	0	0	2	0	6	21	0	0	0	0	2.90	6.64	2.10	29
SEP	33	23	0	6	3	146	0	0	0	0	21.10	45.37	14.35	211
OCT	2	1	0	0	0	0	0	0	41	0	4.40	12.88	4.07	44
Mean	5.83	4.00	0.33	1.00	1.50	27.83	0.00	0.00	6.83	0.00				
SD	13.33	9.32	0.82	2.45	2.51	58.50	0.00	0.00	16.74	0.00				
SE	5.44	3.80	0.33	1.00	1.02	23.88	0.00	0.00	6.83	0.00				
Total	35	24	2	6	9	167	0	0	41	0	Total Fish 284			

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Table 5e. Abundances of tautog in 2023 beach seines.

		Site										Mean	SD	SE	Total
		Harris Point	Andy's Way	Beane Point	Coast Guard Station	Cormorant Cove	Bornell Beach	Ball O'Brien	Inner Pond	Eelgrass Bed	Sand Flat				
Tautog	Month														
	MAY	0	0	0	0	1	0	0	0	0	0	0.10	0.32	0.10	1
	JUN	4	0	0	0	0	0	2	0	0	0	0.60	1.35	0.43	6
	JUL	5	0	0	0	0	0	0	0	3	0	0.80	1.75	0.55	8
	AUG	0	0	0	1	1	7	0	0	0	0	0.90	2.18	0.69	9
	SEP	38	0	0	1	0	38	0	0	0	0	7.70	15.97	5.05	77
	OCT	16	0	0	1	0	1	0	1	3	0	2.20	4.94	1.56	22
	Mean	10.50	0.00	0.00	0.50	0.33	7.67	0.33	0.17	1.00	0.00				
	SD	14.69	0.00	0.00	0.55	0.52	15.11	0.82	0.41	1.55	0.00				
	SE	6.00	0.00	0.00	0.22	0.21	6.17	0.33	0.17	0.63	0.00				
Total	63	0	0	3	2	46	2	1	6	0					
											Total Fish				
											123				

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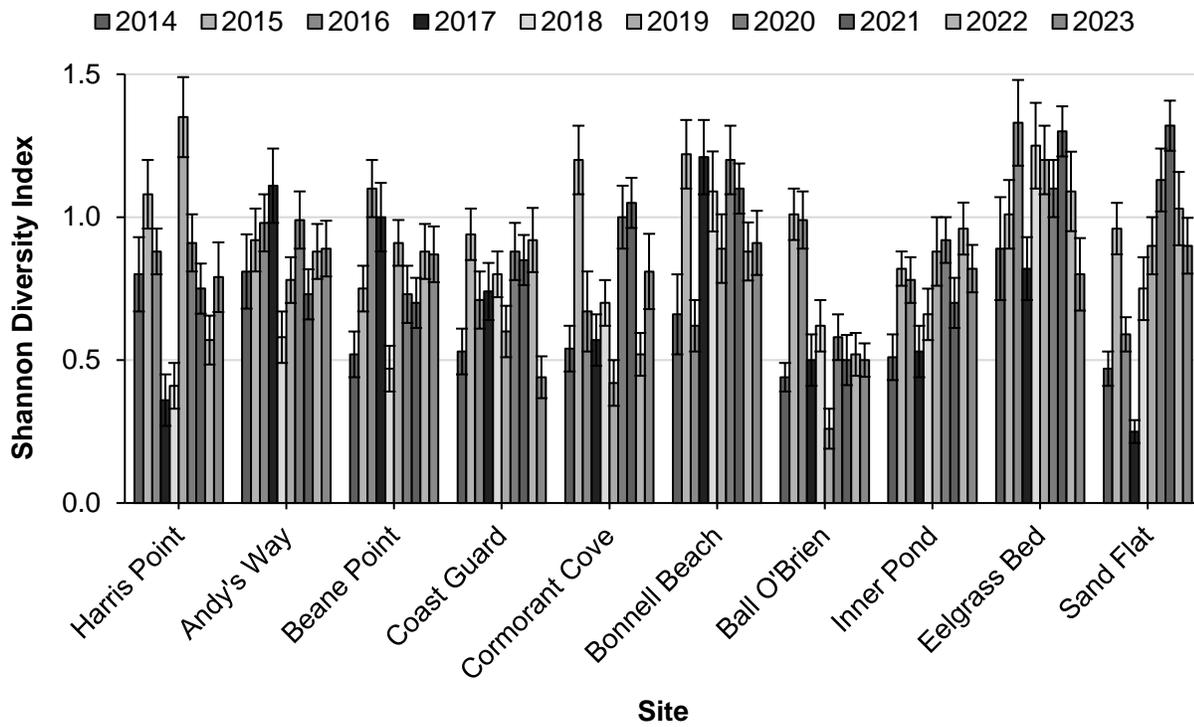


Figure 4. Mean Shannon diversity across sites in 2014-2023 beach seines.

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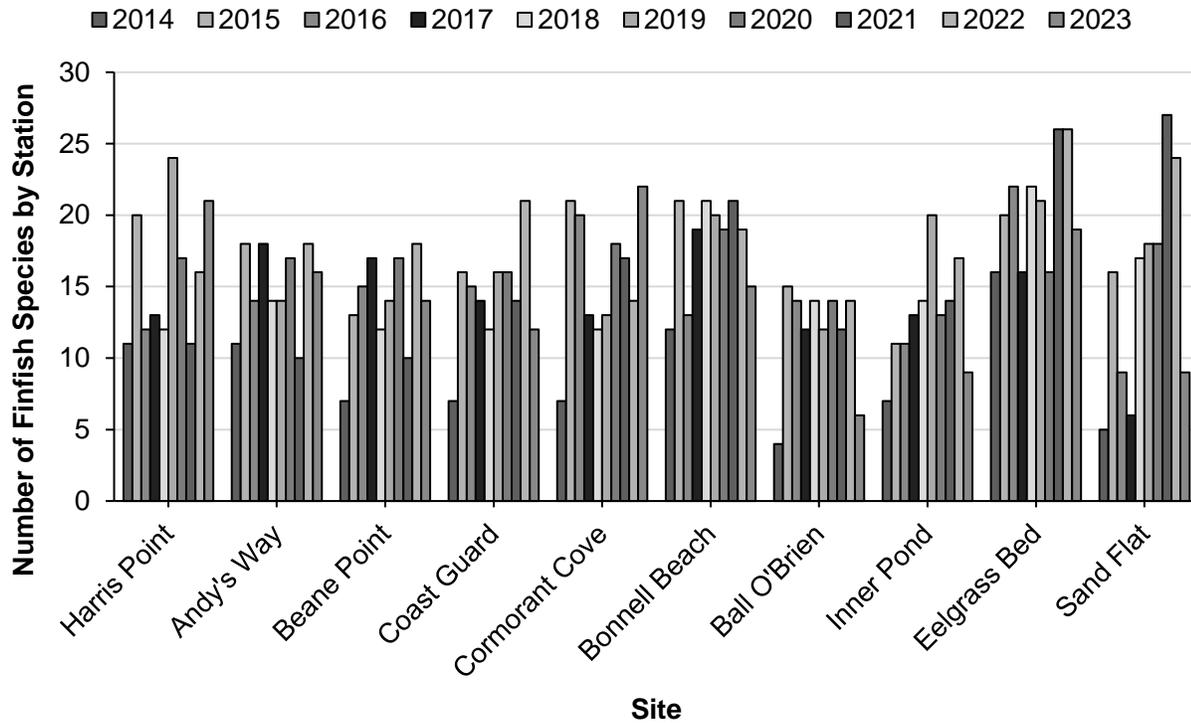


Figure 5. Cumulative number of finfish species by site in 2014-2023 beach seines.