Division of Science and Research

Research Project Summary

April 2021

*New Jersey's Coastal Estuaries Inventory – Project Years 1-3 "Closing the loop: connecting stakeholders, data, and managers for fisheries success" (2016-2019)**

Principal Investigators
Mark Sullivan, Ph.D.[1] and Steve Evert[1]

Report prepared by
Bruce Ruppel[2]

[1] Stockton University
[2]NJDEP, Division of Science and Research

Abstract

This project engaged Stockton University faculty, staff, and students to collect year-round haul seine data and a local commercial fisher (stakeholder) to supply seasonal fyke net data over a 3-year period (2016–2019) to record the aquatic species present in the Mullica River-Great Bay (MRGB) estuary (NJ) for the NJDEP Marine Fisheries program. In total, 485 haul seine samples were collected, and 170,375 individual finfish/invertebrates were inventoried representing 95 unique species. During the winter/spring sampling efforts, 212 fyke net samples collected by a commercial partner inventoried 14,667 individuals from 39 species leading to a comparison of the sample method effectiveness for generating a more comprehensive inventory survey. The dominant species collected were Atlantic Menhaden (n=81,968), Atlantic Silverside (n=41,234), Bay Anchovy (n=15,796), and White Perch (n=14,641). Young-of-the-year (YOY) tracking from length frequency and seasonal "split" timing (spring, summer) data for Bluefish (n=1,252) showed age/size differences. White Perch were tracked from low salinity, shallow nursery grounds in summer (seine nets) to deeper bay environments in winter (fyke nets). Several Atlantic States Marine Fisheries Commission (ASMFC) managed species were collected. Striped Bass (n=272) appeared in both gears and provided YOY-age 1 samples for otolith microchemistry. Winter Flounder (n=740) and Summer Flounder (n=1,244) exhibited similar settlement patterns (inlet-bay, bay-river respectively) and reliably appeared in both gear types. Weakfish (n=3) was almost completely absent from both gear types. Of managed herring species, Alewife (n=426) dominated the winter/spring migration (fyke) and YOY summer recruitment (seine). Surprisingly, seine collections did not reveal an abundance of southern and/or expatriated species. However, winter fyke catches highlighted species that typically out migrate during the fall to offshore water or to warmer waters south, such as Summer Flounder and Atlantic Menhaden, respectively. Data obtained from utilizing fyke nets shows the importance of pairing collection methods and partners to sample suboptimal, data-poor time periods.

Introduction

Estuaries provide nursery habitat for over two-thirds of the economically important fish species along the east coast United States. A large percentage of these species spawn in the ocean/lower estuary, enter estuaries as larvae, grow as juveniles and survive to join the adult population. As a result, the composition, size, and abundance of estuarine juveniles are important indicators of population status. The Mullica River-Great Bay (MRGB) estuary provides a wide variety of essential fish habitats (EFH) for estuarine-dependent species. Atlantic Menhaden, Striped Bass, Bluefish, Summer Flounder, Winter Flounder and blue crab are commercially and recreationally important species that share critical links to New Jersey estuaries.
This project involved Stockton University faculty, staff, undergraduate students, recent graduates, as well as local commercial fishers to collect seasonal seine and fyke net data from a variety of locations in the MRGB (Figure 1). These datasets afforded students unparalleled, hands-on experience and training in the field and generated data needed by the NJDEP's Marine Fisheries program. Together, the seine and fyke components of this project showed the potential to bring together local university scientists, fishery scientists, commercial fishers, and undergraduate students to help better understand the population dynamics of a variety of commercially and recreationally important species. This project provided hands-on research at Stockton University, and generated standardized, multi-seasonal data for fisheries professionals. The longer-term goal of the project design is to develop an easily transferrable and replicable project for future years and other New Jersey estuaries.

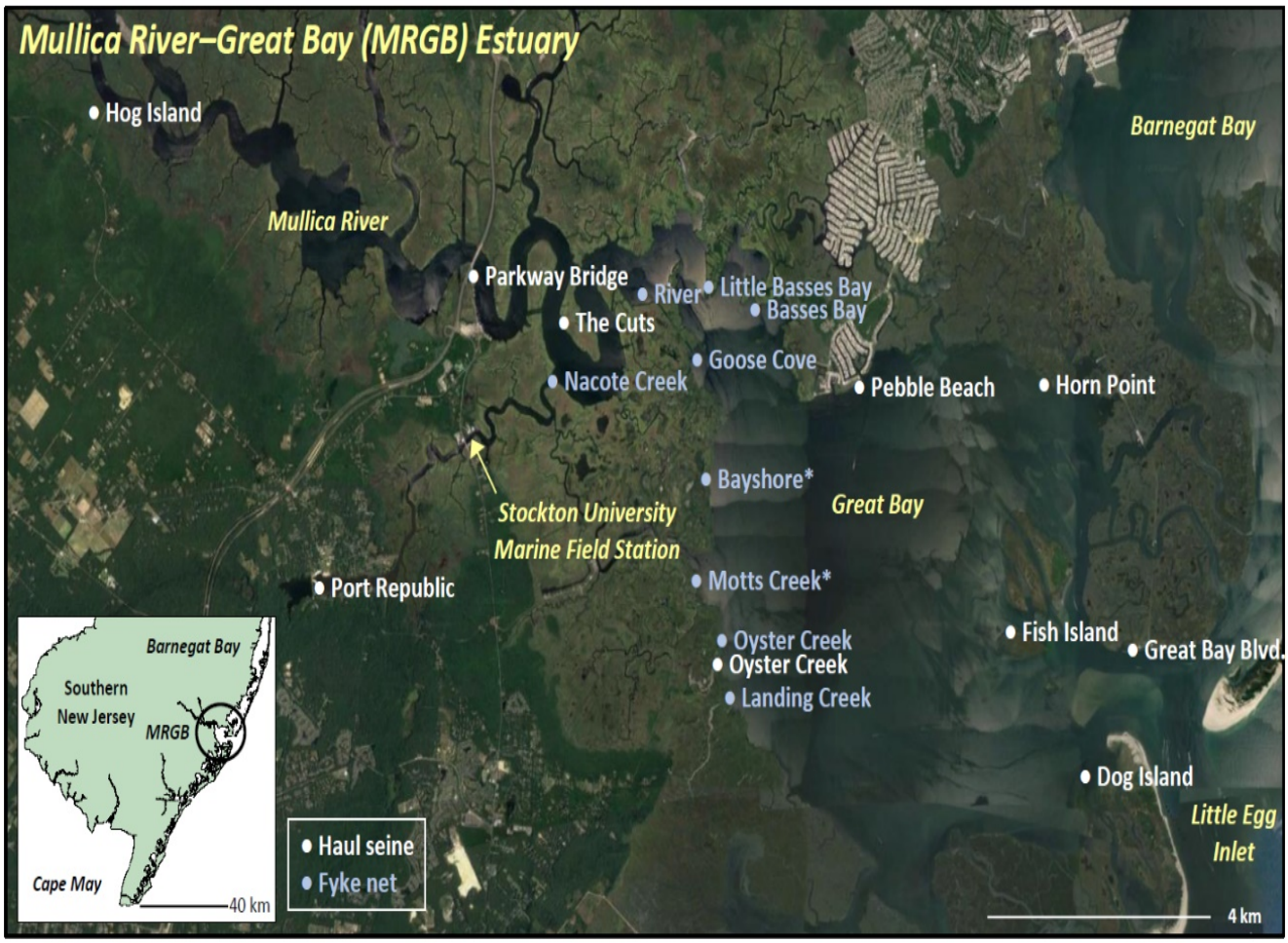

Figure 1. Haul seine (sites in white text) and fyke net (blue text) sites in the Mullica River-Great Bay (MRGB) Estuary, NJ.

Methods

Seine Net Surveys: Seining is a versatile sampling technique in a diversity of aquatic habitats typically sampling a large area in a short amount of time and are used to define EFH and other aquatic and biological assessments (Figure 2). Seine surveys were conducted at 2x/month frequency (May-October) and 1x/month (November-April). This established a year-round sampling component producing 180 samples per year. Ten seining sites were sampled with a 100' x 6' x "¼ mesh" seine. Seine hauls were performed perpendicular to each beach and haul out location. For each seine haul, all organisms were sorted into bins of seawater identified, counted, and measured to fork, total length, or carapace width. In addition, water temperature, salinity, dissolved oxygen, and pH were recorded with an YSI instrument.

Fyke Net Surveys: Fyke nets are commercially operated in New Jersey from November 1 to April 30 with most targeting Winter Flounder and White Perch (Figure 2). Fyke nets have been used in estuarine and river surveys to provide valuable data on relative abundance and indices of stock abundance. Fyke net sampling differs greatly from seine sampling. Due to the anchored positioning, long soak times, and bank-oriented sets almost all adult finfish are encountered. Fyke nets also allow for cold weather sampling of adult and migratory species. This project used a specific number of stations and standardized soak times, sampling frequency and operation during the regulatory fyke net season. Four sites (2 bay and 2 river) were established. Commercial netters provided the set up and break down of nets each month. Stockton personnel tended the set nets every ~48 hours during each sampling week (3 events/month). Sub-sampling and the collection of environmental data followed procedures described above for the haul seine. The fyke net approach highlights the importance and ability of pairing with experienced partners to sample during suboptimal and traditionally data-poor time periods.

Figure 2. Field photos of the haul seine and fyke net operations.

Results

In total, 95 species including 170,375 individual finfish (and select invertebrates) were inventoried from 485 winter and spring haul seine samples, while 39 species including 14,667 individuals were collected from the 212 fyke nets hauls (Table 1). For both gear types, the dominant species collected were Atlantic Menhaden (n=81,968), Atlantic Silverside (n=41,234), Bay Anchovy (n=15,796), and White Perch (n=14,641). See Figure 3 for a representative schematic of haul seine results.

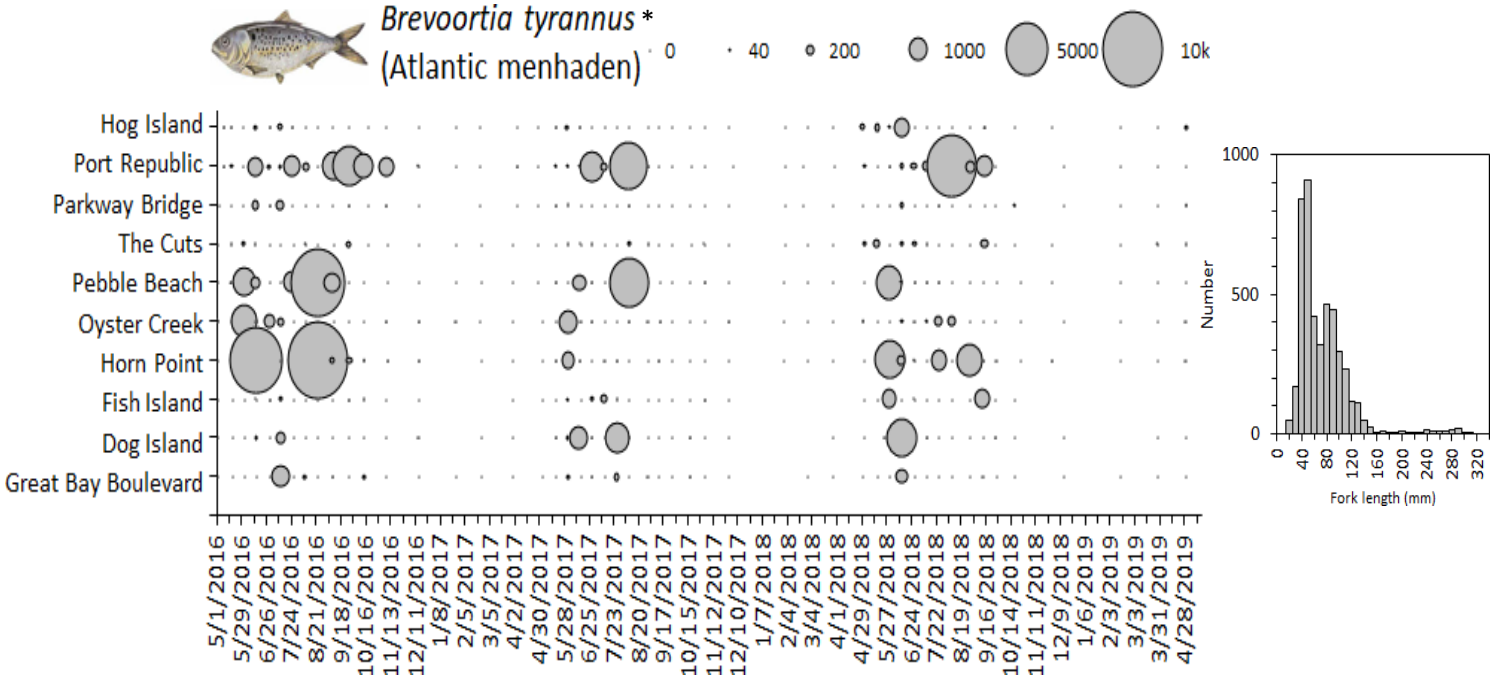

Figure 3: Example of haul seine data for Atlantic Menhaden in the Mullica River-Great Bay Estuary, including collection location and date, and catch per unit effort (CPUE) denoted by the size of the gray circle.

Young-of-the-year (YOY) tracking was possible for many species. Sampling strength and timing of "split" sampling (spring, summer) for Bluefish (n=1,252) identified length frequency data. White Perch were tracked from low salinity, shallow nursery grounds in summer seining to deeper bay environments in fyke net winter sampling. Striped Bass (n=272) appeared in both gear types with YOY age-1 samples provided for otolith microchemistry under a separate study. Winter Flounder (n=740) and Summer Flounder (n=1,244) had similar settlement patterns (inlet-bay, bay-river, respectively) and appeared in both gear types. Alewife Herring (n=426) dominated the winter/spring migration and YOY summer recruitment, but Weakfish (n=3) were almost completely absent from both gear types.

Seine collections did not reveal an abundance of southern and/or expatriated species (i.e. Gag Grouper, Green goby, butterflyfishes). However, winter fyke catches were highlighted by species that typically migrate out of estuaries during the fall to the adjacent shelf (Summer Flounder) or warmer waters south (Atlantic Menhaden).

Sampling during winter months presented several challenges. Sampling was not attempted during bay-wide freezing events and/or during periods of intense wind or extended cold weather. Seasonal harbor seal haul outs in the vicinity of the Fish Island site resulted in reduced collections during certain winter/spring periods. Nevertheless, the number of samples collected mirrored the original goals of the project and provided a valuable window into dynamics occurring during the winter months.

With respect to the haul seine, given the high volume of individuals collected (i.e., Atlantic Silversides and Mummichogs, n=48,577 total), there is the possibility that rare, cryptic species were overlooked (i.e. Rough Silverside, Spotfin Killifish). Similarly, due to the high volume of overall silverside catches, samples of Inland Silversides and Atlantic Silversides were stored (identified in field, preserved in 95% ETOH and frozen) from several mid-to-low salinity sites. Additionally, uncategorized individuals of herrings, killifishes, silversides, sunfishes, mullets and small, damaged, and/or otherwise problematic identifications were cataloged. Another point of consideration potentially affecting collection results is the fact that the seine netting only sampled beaches or low-lying marsh sites with suitable gear haul-out locations. Oyster beds and other heavily structured environments were not sampled perhaps explaining low numbers of species typically associated with these structures.

Discussion

The usefulness of this dataset lies in its application and has been designed for use by the NJDEP Marine Fisheries program. By itself, the data represent a three-year snapshot of finfishes and select invertebrates from a single estuary in southern New Jersey making it difficult to draw conclusions about the overall conservation status of a given species. However, this work paralleled concurrent sampling by Rutgers University in the MRGB (plankton net, otter trawl, gill net) and provides a unique opportunity to examine life history for select estuarine-dependent species. Temporal comparisons with historical datasets also offer the opportunity to investigate changes in assemblages over time (since the 1970s). The Barnegat Bay Partnership also collects bi-weekly seine data during portions of the year that could provide an interesting cross-estuary spatial comparison over similar time periods. Finally, numerous preserved specimens, initially used for identification confirmation and training, have been kept for future eDNA work, otolith microchemistry, and student training. As an additional layer to archival data mining projects and various modeling approaches, this project reflects the multiple benefits that can be realized from "natural history" oriented projects that involve intensively sampling a single system.

Conclusions

The results of this project:

- Engaged local stakeholders and colleagues through data collection, training, collaboration, and data transfer. Collaboration with commercial fyke net partner Newt Sterling was particularly rewarding. Sterling constructed, tended/sampled, and repaired where necessary all fyke nets used in the project and was able to provide valuable insightful identification advice for similar-looking species as well as a historical perspective on fluctuations in various local winter fisheries.

- Collected accurate and comprehensive scientific data that is relevant to multiple life stages of commercial and recreational species managed by NJDEP / ASMFC. These data are relevant to a variety of commercially and recreationally important regional species and generated robust abundance and length frequency data in both seine and fyke net approaches for Atlantic Menhaden, Alewife, Striped Bass, Spot, Summer Flounder, and Winter Flounder.

- Produced timely reports that were used immediately by fishery scientists in stock assessment model development. The project produced a volume of data that was shared with academic colleagues and other researchers interested in fish early life history stages, eDNA work, and/or problematic identifications.

- Developed protocols that are transferable to other estuaries in NJ. The netting components of this project were designed to be transferable to other systems or for continued use in the current system. The project illustrated the effort required with both collection gears to obtain high numbers of individuals from diverse habitats and seasonal ranges and highlighted how similar projects should adequately account for the time, effort and funding involved in the field, laboratory and quality control activities to successful undertake these assessment tools.

Table 1. Combined species list from haul seine and fyke net collections in the MRGB. See individual species accounts for size criteria used (total length, fork length, disc width, carapace width). ASMFC = species managed through the Atlantic States Marine Fisheries Commission. Preserved = species with select individuals in 95% ethanol or frozen. Totals do not include subsets of unidentified specimens.

				Size (mm)			Gear			
Family	**Genus species**	**Common name**	**Count**	**Ave**	**Min**	**Max**	**Seine**	**Fyke**	**ASMFC**	**Preserved**
Odontaspididae	*Carcharias taurus*	sand tiger shark	1	1030	1030	1030	X		X	
Carcharhinidae	*Carcharhinus plumbeus*	sandbar shark	1	625	625	625	X		X	
	Mustelus canis	smooth dogfish	1	478	478	478	X		X	
Rajidae	*Leucoraja eglanteria*	clearnose skate	7	441	400	480	X	X		
	Leucoraja erinacea	little skate	1	270	270	270	X			
	Leucoraja ocellata	winter skate	1	300	300	300		X		
Dasyatidae	*Dasyatis americana*	southern stingray	2	531	500	600	X			
	Dasyatis centroura	roughtail stingray	1	790	790	790	X			
	Dasyatis say	bluntnose stingray	1	430	430	430	X			
Myliobatidae	*Rhinoptera bonasus*	cownose ray	20	835	640	1000	X			
Anguillidae	*Anguilla rostrata*	American eel	105	266	50	650	X	X	X	
Clupeidae	*Alosa aestivalis*	Blueback herring	11	173	54	310	X	X	X	X
	Alosa mediocris	Hickory shad	3	332	276	374	X			
	Alosa pseudoharengus	Alewife	426	166	42	290	X	X	X	X
	Alosa sapidissima	American shad	2	474	450	498		X	X	
	Brevoortia tyrannus	Atlantic menhaden	81968	98	0	390	X	X	X	X
	Clupea harengus	Atlantic herring	226	183	31	300	X	X	X	X
	Dorosoma cepedianum	gizzard shad	32	261	82	510	X	X		
Engraulidae	*Anchoa hepsetus*	striped anchovy	390	62	31	110	X			X
	Anchoa mitchilli	bay anchovy	15796	55	13	98	X			X
Esocidae	*Esox americanus*	redfin pickerel	1	79	79	79	X			
	Esox niger	chain pickerel	4	217	164	320	X			
Cyprinidae	*Notemigonus crysoleucas*	golden shiner	13	142	84	186	X			X
Ictaluridae	*Ameiurus catus*	white catfish	74	297	196	475	X	X		
	Ameiurus natalis	yellow bullhead	1	211	211	211	X			
	Ameiurus nebulosus	brown bullhead	3	184	38	327	X			
	Ictalurus punctatus	channel catfish	3	287	180	431	X	X		
Phycidae	*Urophycis regia*	spotted hake	28	139	55	345	X	X		X
Gadidae	*Pollachius virens*	pollock	22	48	36	73	X			X
Batrachoididae	*Opsanus tau*	oyster toadfish	83	71	19	250	X	X		X
Hemiramphidae	*Hyporhamphus meeki*	American halfbeak	5	181	126	219	X			
Belonidae	*Strongylura marina*	Atlantic needlefish	209	263	62	436	X			
Cyprinodontidae	*Cyprinodon variegatus*	sheepshead minnow	435	35	21	60	X			
	Fundulus diaphanus	banded killifish	716	65	20	110	X			X
	Fundulus heteroclitus	mummichog	7343	53	13	156	X	X		X
	Fundulus majalis	striped killifish	706	79	13	150	X			X
	Lucania parva	rainwater killifish	57	28	15	42	X			X
Atherinidae	*Menidia beryllina*	inland silverside	199	53	25	80	X			X
	Menidia menidia	Atlantic silverside	41234	70	11	152	X			X
Gasterosteidae	*Gasterosteus aculeatus*	threespine stickleback	15	56	13	68	X			X
	Apeltes quadracus	fourspine stickleback	39	43	24	65	X	X		X
Syngnathidae	*Hippocampus erectus*	lined seahorse	12	96	63	125	X			
	Syngnathus fuscus	northern pipefish	309	134	49	244	X	X		
Triglidae	*Prionotus carolinus*	northern searobin	6	79	35	142	X			X
	Prionotus evolans	striped searobin	26	364	49	452	X	X		X
Moronidae	*Morone americana*	white perch	14641	190	12	392	X	X		X
	Morone saxatilis	striped bass	272	337	91	790	X	X	X	X
Serranidae	*Centropristis striata*	black sea bass	28	93	47	196	X	X	X	
Centrarchidae	*Enneacanthus obsesus*	banded sunfish	1	45	45	45	X			X
	Lepomis gibbosus	pumpkinseed	186	76	30	167	X			X
	Lepomis macrochirus	bluegill	56	48	22	135	X			X
	Micropterus salmoides	largemouth bass	5	284	79	414	X	X		
Percidae	*Etheostoma olmstedi*	tessellated darter	4	68	59	75	X			X
	Perca flavescens	yellow perch	1	72	72	72	X			
Pomatomidae	*Pomatomus saltatrix*	bluefish	1252	122	29	757	X	X	X	X
Rachycentridae	*Rachycentron canadum*	cobia	4	98	57	152	X		X	
Echeneidae	*Echeneis naucrates*	sharksucker	1	156	156	156	X			

Carangidae	*Carangoides bartholomaei*	yellow jack	1	137	137	137	X			X
	Caranx hippos	crevalle jack	18	59	31	121	X			X
	Selene vomer	lookdown	1	72	72	72	X			
	Trachinotus falcatus	permit	111	67	21	110	X			X
	Trachurus lathami	rough scad	1	49	49	49	X			X
Lutjanidae	*Lutjanus griseus*	gray snapper	3	62	32	111	X			
Gerreidae	*Eucinostomus* sp.	mojarras	30	54	30	86	X			X
Sparidae	*Archosargus probatocephalus*	sheepshead	3	79	26	108	X	X		X
	Lagodon rhomboides	pinfish	77	84	15	192	X	X		X
Sciaenidae	*Bairdiella chrysoura*	silver perch	7882	73	14	185	X			X
	Cynoscion regalis	weakfish	3	287	80	451	X	X	X	
	Leiostomus xanthurus	spot	475	74	15	184	X	X	X	X
	Menticirrhus saxatilis	northern kingfish	115	95	21	416	X	X		X
	Micropogonias undulatus	Atlantic croaker	23	60	30	172	X		X	X
	Pogonias cromis	black drum	82	146	76	260	X	X	X	
	Sciaenops ocellatus	red drum	2	61	58	64	X		X	X
Mullidae	*Upeneus* sp.	goatfish	1	54	54	54	X			
Chaetodontidae	*Chaetodon ocellatus*	spotfin butterflyfish	1	12	12	12	X			
Mugilidae	*Mugil cephalus*	striped mullet	116	117	28	246	X	X		X
	Mugil curema	white mullet	138	102	30	219	X			X
Labridae	*Tautoga onitis*	tautog	104	91	17	215	X	X	X	X
Blenniidae	*Hypsoblennius hentzi*	feather blenny	2	63	52	74	X			
Gobiidae	*Gobiesox strumosus*	skilletfish	11	35	28	71	X			X
	Gobiosoma bosc	naked goby	124	31	16	53	X			X
	Gobiosoma ginsburgi	seaboard goby	1	42	42	42	X			X
Sphyraenidae	*Sphyraena borealis*	northern sennet	18	117	58	185	X			
Stromateidae	*Peprilus triacanthus*	butterfish	2	117	39	195	X	X		
Paralichthyidae	*Etropus microstomus*	smallmouth flounder	14	75	51	96	X			X
	Paralichthys dentatus	summer flounder	1244	225	15	580	X	X	X	X
Scophthalmidae	*Scophthalmus aquosus*	windowpane flounder	23	225	56	313	X	X		
Pleuronectidae	*Pseudopleuronectes americanus*	winter flounder	740	99	22	443	X	X	X	X
Achiridae	*Trinectes maculatus*	hogchoker	708	69	25	295	X	X		X
Ostraciidae	*Lactophrys* sp.	trunkfish	1	12	12	12	X			X
Diodontidae	*Chilomycterus schoepfi*	striped burrfish	41	101	14	286	X			
Tetraodontidae	*Sphoeroides maculatus*	northern puffer	104	164	30	295	X	X		
Limulidae	*Limulus polyphemus*	Atlantic horseshoe crab	114	228	120	310	X	X	X	
Cancridae	*Cancer* sp.	rock / jonah crab	65	100	67	163	X	X	X	
Portunidae	*Callinectes sapidus*	blue crab	5258	54	5	251	X	X		
	Ovalipes ocellatus	lady crab	137	34	10	70	X			
	Carcinus maenas	green crab	19	47	27	68	X			

* This RPS is summarized from the PI report. Sullivan, M. and S. Evert. 2020. New Jersey's Coastal Estuaries Inventory – Project Years 1-3. Closing the loop: connecting stakeholders, data, and managers for fisheries success. Submitted to the New Jersey Department of Environmental Protection, Trenton, NJ.

RESEARCH PROJECT SUMMARY

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Division of Science and Research
Mail code 428-01, P.O. Box 420
Trenton, NJ 08625

Phone: (609) 940-4080
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