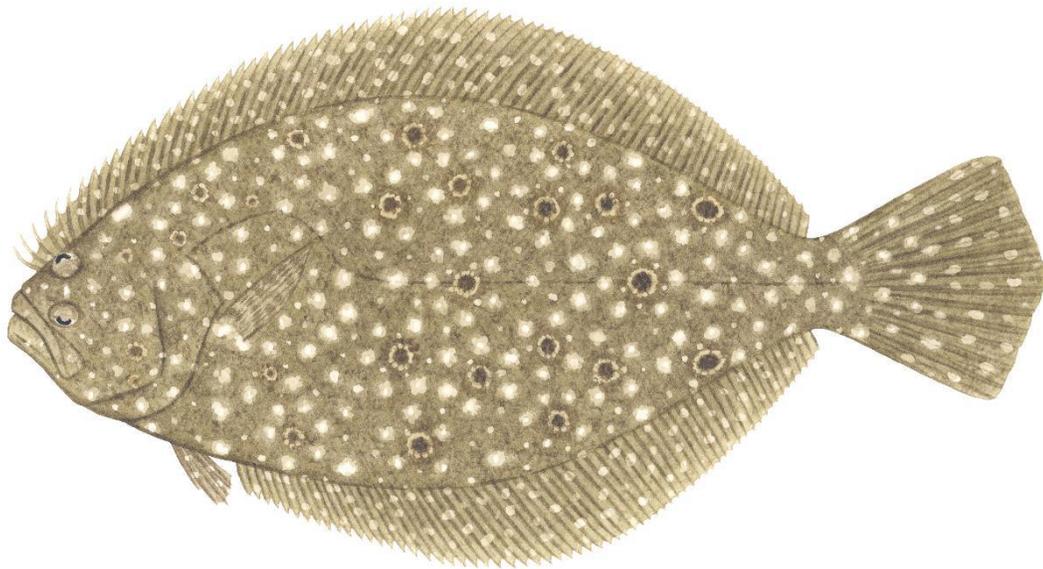


DELAWARE CENTER FOR THE  
**INLAND BAYS**  
Research. Educate. Restore.

**THE DELAWARE CENTER FOR THE INLAND BAYS  
INSHORE FISH AND BLUE CRAB SURVEY OF REHOBOTH  
BAY, INDIAN RIVER AND BAY, AND  
LITTLE ASSAWOMAN BAY  
FOR 2014**



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August 2016

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#### Citation Format

Kernehan, R.J., D.H. Bartow, R.W. Miller, and A.T. McGowan. 2016. Inshore fish and blue crab survey of Rehoboth Bay, Indian River and Bay and Little Assawoman Bay for 2014. Delaware Center for the Inland Bays, Rehoboth Beach, DE. 28 pp.

Cover Illustration: Summer flounder, *Paralichthys dentatus* by Val Kells © 2014. Val Kells, Marine Science Illustration, [www.valkellsillustration.com](http://www.valkellsillustration.com)

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## SUMMARY

Fixed sites along the shoreline of the Inland Bays were sampled from the last two weeks of April through October using similar methodologies to previous reports (Kernehhan et al. 2016). The sampling effort was a single 100-ft seine haul made parallel to shore with a 30-ft long bag seine. This unit of effort has been used throughout the study. A total of 208 samples at 16 sites yielded 3,402 total crabs along with 41,853 total fish comprised of 38 species. While the total number of fish species was the lowest ever recorded for this survey, the number of total fish, and the catch per unit effort were both greater than 2013. The most abundant species collected in 2014 were Atlantic silverside, mummichog, striped killifish, Atlantic menhaden, and sheepshead minnow, which represented over 91% of the overall fish catch. Catches of the 14 target species: Atlantic croaker, Atlantic menhaden, Atlantic silverside, bay anchovy, bluefish, mummichog, silver perch, spot, striped bass, striped killifish, summer flounder, weakfish, white mullet, and winter flounder, were examined individually. Of the 3,402 blue crabs caught in 2014, 1,939 were small (0 – 40 mm carapace length), 1,379 were medium (41 – 140 mm), and 84 were large specimens (>141 mm).

## INTRODUCTION

The 2014 Inshore Fish and Blue Crab Survey was the fourth annual volunteer seining study of the near-shore areas of Rehoboth Bay, Indian River and Bay, and Little Assawoman Bay, sponsored through the Delaware Center for the Inland Bays. Shallow, inshore areas are important to the aquatic community as they may be preferentially utilized by juvenile fish and crabs. While the Delaware Natural Resources and Environmental Control (DNREC) offshore bottom trawl surveys are informative, and are the more appropriate method for assessing populations for many species, the survey may fail to adequately characterize species which prefer the inshore areas during parts or all of their life cycle. Therefore, understanding how these environments are related in terms of species assemblages and habitat utilization in order to accurately assess species populations becomes increasingly more important. This survey represents the first comprehensive, long-term survey of these inshore areas in the Inland Bays.

The main objective of the current study was to generate comparative average catch data for all species, with an emphasis on 14 target fish species (seven forage and seven predator species) as well as blue crab. From these data,

trends in species abundance and distribution for each species can be monitored through time. The annual Inland Bays reports are distributed to state and federal regulatory organizations, academic institutions, and interested environmental organizations. Summary data are available to the above entities and the public through the annual reports. Complete data sets are available by request to the Center for the Inland Bays.

## METHODS AND MATERIALS

A total of 208 inshore seine samples were collected at 16 sites in Indian River and Bay, Rehoboth Bay, Little Assawoman Bay and tributaries (Figure 1) from the end of April through October. Site descriptions are listed in Table 1. One sampling event was collected during the second half of April, while two monthly sampling events were collected at the first and second half of each month from May through October. Each study site needed to be in close proximity to a road or parking lot for ease of access by volunteers in motor vehicles. To qualify as a sampling site, there had to be an open shoreline area of at least 100 feet in length, with a flat bottom and substrate that was not too soft to safely sample at all tidal stages. Four sites are located in Rehoboth Bay, while seven were located in Indian River and Bay, and five in Little Assawoman Bay and tributaries (Figure 1).

At each location, a single haul was made using a 30-foot long by 4-foot high bag seine with  $\frac{1}{4}$ -inch mesh. The bag is 4-foot long, 4-foot wide and 4-foot deep, located in the center of the net. The net was drawn, fully extended, parallel to the shore for 100 feet, swung onto shore and emptied. The only exception to this procedure was at Rosedale Beach (Site No. 6), where two 50-foot hauls were made due to the fact that a pier, too low to walk under, is located across the middle of the area. All fish were removed from the net, identified and counted. At least 25 specimens of each fish species were placed in buckets of water as quickly as possible to be measured to the nearest millimeter. Fish to be measured are selected in a haphazard fashion. The first 25 fish of each species which are scooped out of the holding bucket are measured. This may slightly bias measurements towards the largest fish of each haul, because the larger fish have less chance of avoiding the dip net and being removed from the holding bucket. All other fish and crabs were immediately counted and returned to the water to minimize mortality. When air temperature was extremely high, bottles of frozen water and aerators were placed in the buckets to reduce mortality for those specimens retained for measurement. Blue crabs were counted and categorized as small (less than 40 mm carapace width, less than 1-year old), medium (41-140 mm, 1-2 years old) or large (greater than 140 mm, adults more than 2 years old).

Fish were identified to the species level. The senior authors were present for most of the surveys to verify identifications. When questionable species were encountered in other samples, pictures or preserved specimens were transmitted to the senior author for identification or verification. Scientific names for species identified during 2014 are listed in Table 2.

Each seine sample was designated as one unit of effort. Rosedale Beach, which is surveyed with two 50-ft hauls, was combined, and counted as one unit of effort, since both hauls take place within minutes of each other, and because a pier separates the two hauls, neither haul is likely to influence the other. Catch-per-unit-effort (CPUE) was calculated for each species by dividing the total catch of that species in 2014 by the total number of seines (208). CPUE was also calculated for all fish by dividing the total catch of 2014 by the total number of seines (208). Percentage calculations for each species of fish do not include crabs in the calculation of total catch, and are therefore the percentage each species comprises of the overall fish catch.

The 14 target fish species chosen for individual results and discussion sections included seven important forage species which occur throughout the Inland Bays, and seven recreationally and commercially caught species in Delaware and other states. These species include: Atlantic croaker, Atlantic menhaden, Atlantic silverside, bay anchovy, bluefish, mummichog, silver perch, striped bass, striped killifish, summer flounder, weakfish, white mullet, and winter flounder. Blue crab are also considered a target species. Individual analyses were performed for all 15 target species.

Physical parameters of water temperature (measured to 0.1 degree centigrade, °C), dissolved oxygen (to 0.1 milligram per liter, mg/l), and salinity (to 0.1 part per thousand, ppt) were measured with either a YSI 85 or a YSI Pro 2030 meter at the beginning of each survey. The weather and wind conditions were noted for each sample as well as the stage of the tide. Tidal stages were categorized as low ebb or low flood if sampling began within 2 hours of low tide, mid-flood or mid-ebb if sampling began within 2 to 4 hours of low or high tide, and high ebb or high flood if sampling began within 2 hours of high tide.

## RESULTS

### *Physical Parameters*

Monthly average water temperatures ranged from a minimum of 11.4°C in April to a maximum of 29.9°C in August (Table 3). Salinity ranged from 2.8 ppt at Sandy Beach (the most upriver site in the survey) to 30.65 ppt (Table 4). Dissolved oxygen ranged from a minimum of 3.7 ppm to a maximum of 11 ppm (Table 5). Conditions were mostly homogenous at the Rehoboth Bay sites (1-4) for all

parameters within a single month, while Indian River (5-13) and Little Assawoman Bay (15-20) showed greater variability between locations within a single month.

### *Fish and Crab Catch Results*

A total of 38 species were collected in 2014 (Table 6), representing the lowest species richness throughout the history of this survey. Despite a reduction in species richness, the total number of fish (41,853) and the CPUE (201.21) was higher than in 2013. Both the total number of crabs (3,402) and the total crab CPUE (16.35) were the lowest of any year so far. Atlantic silverside, mummichog, striped killifish, Atlantic menhaden, and sheepshead minnow, comprised over 91% of the total catch (Table 6) in 2014. This is a slight departure from previous years, as bay anchovy and white mullet were previously 2 of the 5 most abundant species, but ranked 6<sup>th</sup> and 7<sup>th</sup> respectively in 2014. The most diverse sites were Rosedale Beach (#6) and Sandy Beach (#8), both of which are along the Indian River. Both sites had 24 different species collected during 2014 (Figure 2). Both of these sites are consistently in the top 5 most diverse sites for this survey each year. The site with the highest CPUE for fish was Kayak Launch (#1), with a CPUE of 877.84 (Figure 3). The observed CPUE at the Kayak Launch was more than double the CPUE of the next most productive site. The catch at Kayak Launch was dominated by striped killifish (36.85% of the total catch), sheepshead minnow (26.04%), and mummichog (21.52%). The most productive site for crabs was Sandy Beach (#8) (Figure 4). June was the most productive month in 2014, with a CPUE of 333.59 fish per seine (Figure 5). However, July was the most productive month for crabs (Figure 6), followed by June and then September.

### *Target Species*

Target species are species of special concern, either due to their importance for commercial or recreational fishermen, or due to their importance as food for larger species. A total of 14 fish species (7 predators and 7 forage species) have been defined as target species; Atlantic croaker, Atlantic menhaden, Atlantic silverside, bay anchovy, bluefish, mummichog, silver perch, spot, striped bass, striped killifish, summer flounder, weakfish, white mullet, and winter flounder. Blue crabs have also been designated as a target species based on their importance for recreational and commercial interests. While this survey has gathered a large amount of data thus far, reliable trends in populations cannot yet be assessed. Without trend information, we can only report on size frequency information, and

CPUE relative to previous years. In future years initial trends will be assessed. Length distributions of fish target species are depicted in Figure 7.

#### *Atlantic croaker*

A total of 528 Atlantic croaker were caught in 2014, for a CPUE of 2.53 fish per seine. The observed 2014 Atlantic croaker CPUE was much higher than any of the previous years. No previous survey year had a CPUE greater than 0.49 croaker per seine. The DNREC open water trawl survey also saw an increase in young-of-the-year croaker in the Inland Bays from 2013 to 2014 (Greco 2016). All croaker caught in 2014 were taken in September or October, which corresponds with the seasonal habitat utilization of croaker which in the Inland Bays as nursery grounds, similarly reported by Wang and Kernehan (1979). All croaker collected in 2014 were less than 100 mm, suggesting croaker that utilize inshore areas are primarily young-of-the-year specimens.

#### *Atlantic menhaden*

A total of 4,086 Atlantic menhaden were caught in 2014, resulting in a CPUE of 19.64 fish per seine. This CPUE was much higher than the CPUE of any previous year. Temporally, June was the dominant month for menhaden catches. Few menhaden were caught later than July in any survey season, which indicates that the juvenile menhaden utilize inshore areas between April and July primarily. The majority of menhaden caught in 2014 were less than 50 mm.

#### *Atlantic silverside*

A total of 17,266 Atlantic silversides were caught in 2014, for a CPUE of 83 fish per seine. The CPUE was higher than the CPUE of 2012 or 2013, but less than the CPUE of 2011. Atlantic silverside continue to be one of the most abundant species in this study, consistently in the top five most abundant species every year so far. Temporally, catches of silverside are high every month of the survey, with the peak catch totals occurring in August the last two seasons. Atlantic silverside lengths represented each stage of the species' life cycle, with sizes ranging from 12 – 147 mm, indicating the importance of these inshore areas to Atlantic silversides.

#### *Bay anchovy*

A total of 1,199 Bay anchovy were caught in 2014. The CPUE of 5.76 fish per seine is greater than any year so far. August and September were the most

productive months for Bay anchovy, a pattern also seen during the 2013 survey (Kernehan et al. 2016). The length frequency of Bay anchovy suggests a bimodal size distribution (Figure 7). One class of fish caught are primarily less than 30 mm, while the second class are primarily around 75 mm. A possible explanation for the distinct size classes observed in this study is that the smaller size class mode represents young-of-the-year, while the larger size class mode represents adult individuals utilizing the inshore areas to spawn.

### *Bluefish*

A total of 62 bluefish were caught in 2014, resulting in a CPUE of 0.29, less than 2013, but greater than 2011 and 2012. Since 2011, the majority of bluefish have been caught between May and July, and almost all have been juveniles. This temporal pattern suggests that these fish were likely spawned in the early portion of the spawning season which has been reported to begin off North Carolina in May (Smith et al. 1994; Berrien and Sibunka 1999).

### *Mummichog*

A total of 8,194 mummichog were collected in 2014. Mummichog continue to be one the most abundant species in the survey, however, the CPUE was 39.39, the least of any year so far. May through July had the highest abundance of mummichog, with a strong decline in August. The seasonal decline likely represents the end of the spawning period for mummichog, which would result in less dense aggregations and therefore help explain the seasonal declines observed in the previous two years. Just like Atlantic silverside, all size classes of mummichog are represented in this study, indicating the importance of the inshore areas to all stages of the life cycle of mummichog.

### *Silver perch*

A total of 253 silver perch were caught in 2014, with a CPUE of 1.21, up from 2013, but down from 2011 and 2012. Temporally, August was the dominant month for silver perch specimens. Silver perch show a bell shaped size distribution with the majority of individuals measuring around 70 mm.

### *Spot*

Only 29 spot were collected in 2014 for a CPUE of 0.139. This is less than 2013, and dramatically less than 2012 when spot had a dominant year class. Spot have been shown to have dramatic fluctuations in annual abundance of young of

the year (Pacheco and Grant 1973; Fahay 2010). The large interannual variability associated with spot may explain the large annual fluctuations seen in this study. The DNREC open water trawl survey also reported less spot young-of-the-year in 2014 than 2013 and 2012 (Greco 2016). June through August were the dominant months for spot occurrence. The size distribution of spot did not show a distinct dominant size class, suggesting spot utilize inshore areas at different ages.

### *Striped bass*

The inshore areas surveyed in this study are not heavily utilized by striped bass. Only 4 specimens were caught in 2014, and no survey season has ever caught more than 43. Individuals that were captured in 2014 were less than 150 mm, taken between August and October, with at least one individual caught in each bay.

### *Striped killifish*

A total of 5,469 striped killifish were caught in 2014, resulting in a CPUE of 26.29, less than 2011 and 2012, but up from 2013. Killifish continue to be one of the most abundant species in this survey. Temporally, almost all months have high killifish catch totals. Just like Atlantic silverside and mummichog, all life cycles and size classes (20 – 175 mm) of striped killifish were collected in this study, demonstrating the intensive use of the inshore areas by striped killifish of all life stages.

### *Summer flounder*

A total of 147 summer flounder were caught in 2014. The CPUE of 0.70 was much less than 2013, but up from 2012 and 2011 levels. Unlike our study, the DNREC open water trawl survey reported an increase in young-of-the-year summer flounder from 2013 to 2014 (Greco 2016). The majority of summer flounder caught in this study were captured in May, and were less than 100 mm. The observed seasonal pattern in size suggests that inshore areas are utilized primarily by young-of-the-year summer flounder in the early spring which then move to deeper waters during the summer months.

### *Weakfish*

Only 58 weakfish were collected in 2014, resulting in a CPUE of 0.27. This was higher than the previous three years. DNREC open water trawl survey also reported an increase in young-of-the-year from 2013 to 2014 (Greco 2016).

Inshore areas do not appear to be heavily utilized by weakfish in the Inland Bays. Temporally, all weakfish were collected in July and August, and almost all specimens were young-of-the-year, indicating that the small proportion of weakfish that do use the inshore areas are young-of-the-year specimens.

#### *White mullet*

A total of 855 white mullet were caught in 2014, for a CPUE of 4.11, down from 2013 but up from 2011 and 2012. Almost all white mullet were taken in July, and most were specimens measuring less than 100 mm.

#### *Winter flounder*

Only 39 winter flounder were caught in 2014, resulting in a CPUE of 0.18, which is much lower than the CPUE of 2013. The DNREC open water trawl survey reported an increase in young-of-the-year from 2013 to 2014 (Greco 2016). The majority of winter flounder captured in this survey were taken in July, and were young-of-the-year specimens measuring less than 145mm.

#### *Blue crab*

1,939 small, 1,379 medium, and 84 large crabs were caught in 2014 for a cumulative CPUE of 16.35 crabs per seine, the fewest of any year so far. Correspondingly, each size class also had a lower CPUE in 2014 than 2013. Sandy beach (Site #8) was the most productive site for crabs, which is a lower to mid salinity site (Table 4). July was the most productive month for crabs.

## **ACKNOWLEDGEMENTS**

Our sincere thanks to all of those involved in field sampling during 2014. You are the backbone of the study and without your enthusiasm, professionalism and attention to the study protocol, this program would be impossible.

Our thanks to Chris Bason, Executive Director of the Delaware Center for the Inland Bays, Marianne Walch, Science Director for the Center, and other Center employees for their enthusiastic help and support for the study. Thanks also to the study's steering committee: Dr. Charles Epifanio, John Clark, Dr. Timothy Targett, Jordan Zimmerman, Roy Miller, Dr. Dennis Bartow and Colleen Kernehan Best for their evaluations and suggestions which continue to improve the study. Our very special thanks to Val Kells for the use of her outstanding

illustration which is shown on the cover of this publication. Additional thanks to Val for the use of her summer flounder illustration on the Study's T-shirts.

Thanks also to Delaware State Parks, Delaware DNREC and the Homeowners Associations or management companies of Bayville Shores, Bethany Bay, Rehoboth Beach Country Club and Sandy Beach for permission to sample at their sites. Also, special thanks to Val Ellenberger for her assistance with sampling permission for The Peninsula.

This report was reviewed by Marianne Walch, the Science and Restoration Coordinator at the Delaware Center for the Inland Bays, Andrew McGowan, the Environmental Scientist at the Delaware Center for the Inland Bays, and Edward Hale, Biometrician at the Delaware Division of Fish and Wildlife.

This project has been funded wholly or in part by the United States Environmental Protection Agency under assistance agreement (No. CE-993990-12-1) to Center for the Inland Bays. The contents of this document do not necessarily reflect the views and policies of the Environmental Protection Agency, nor does the EPA endorse trade names or recommend the use of commercial products mentioned in this document.

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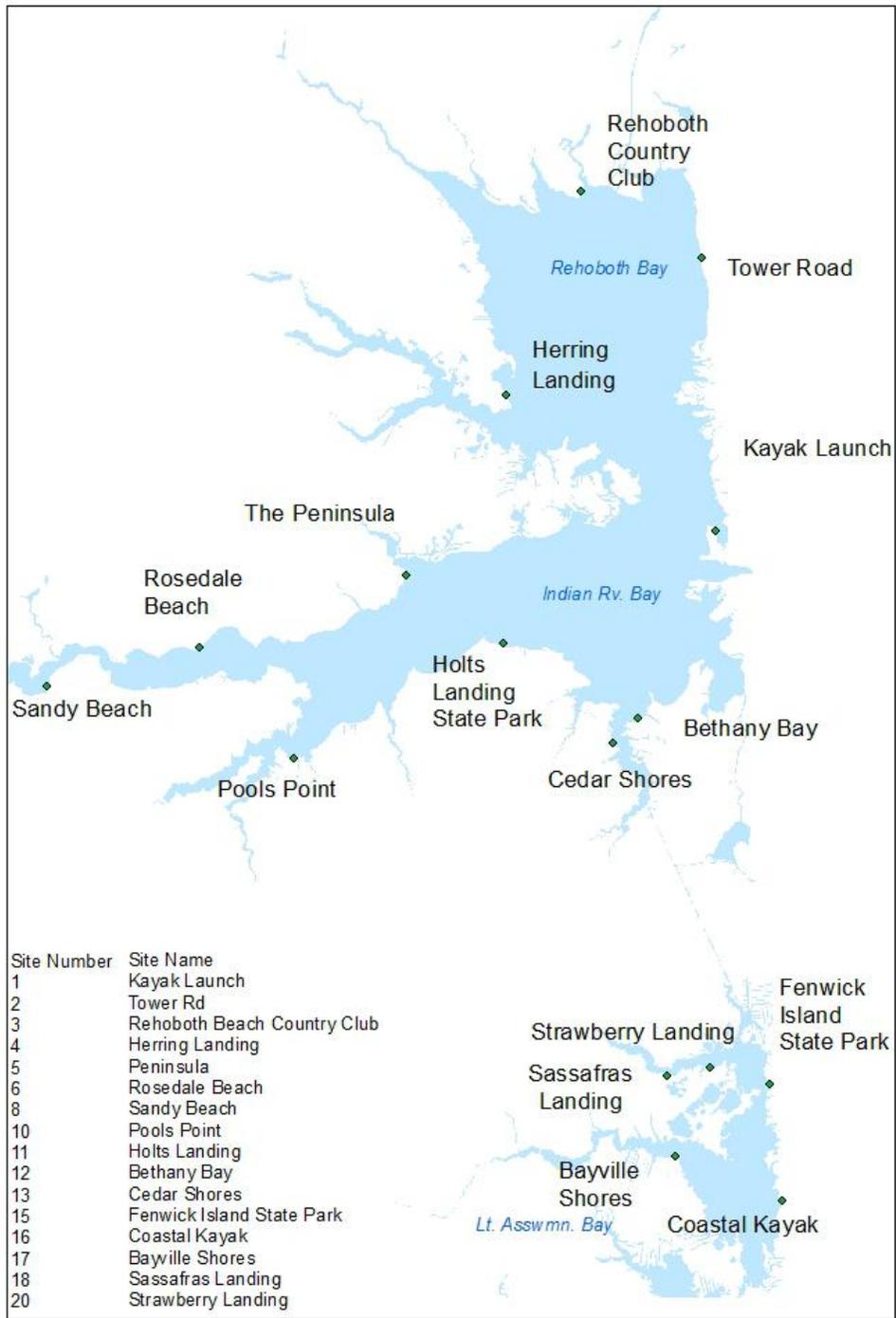


Figure 1. All 16 sites surveyed in 2014.

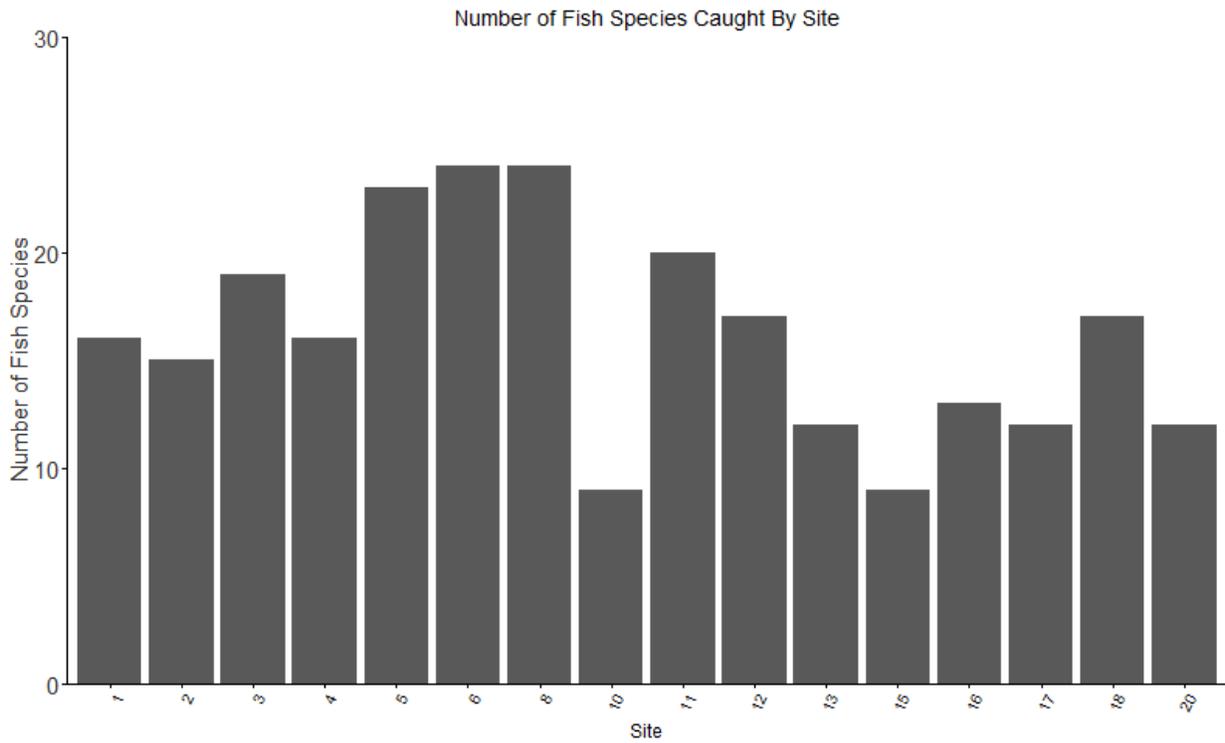
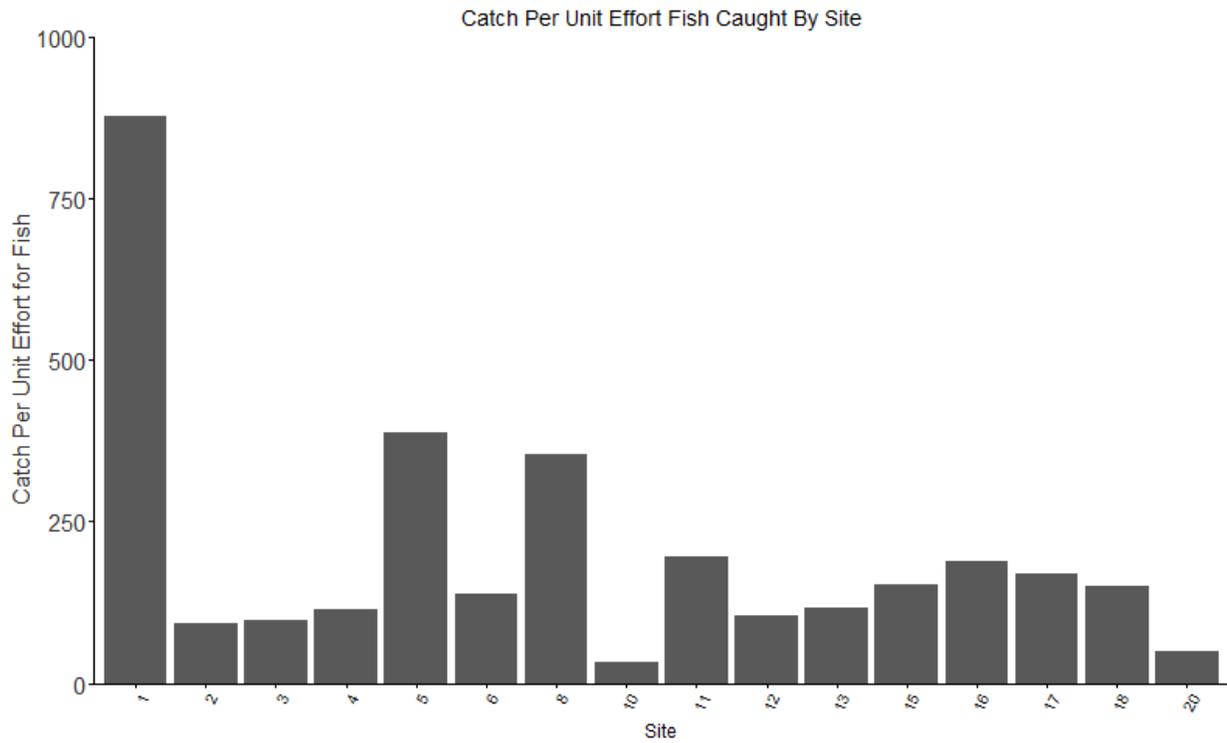
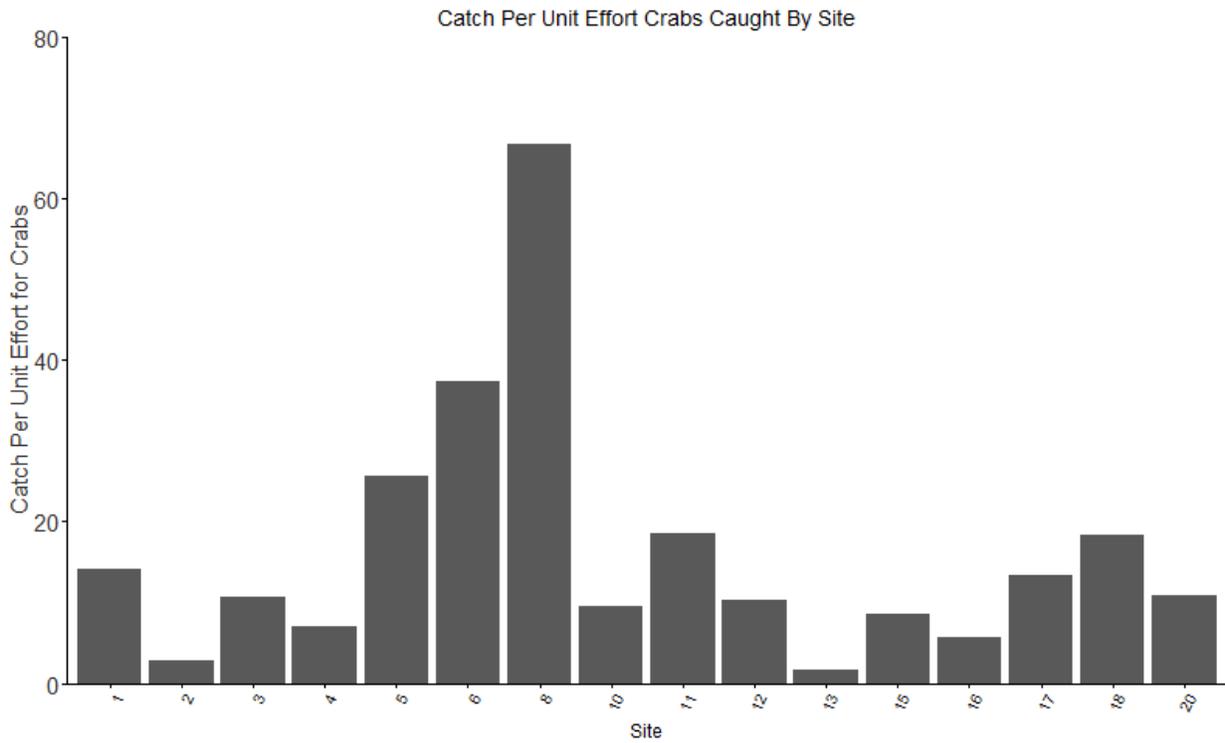


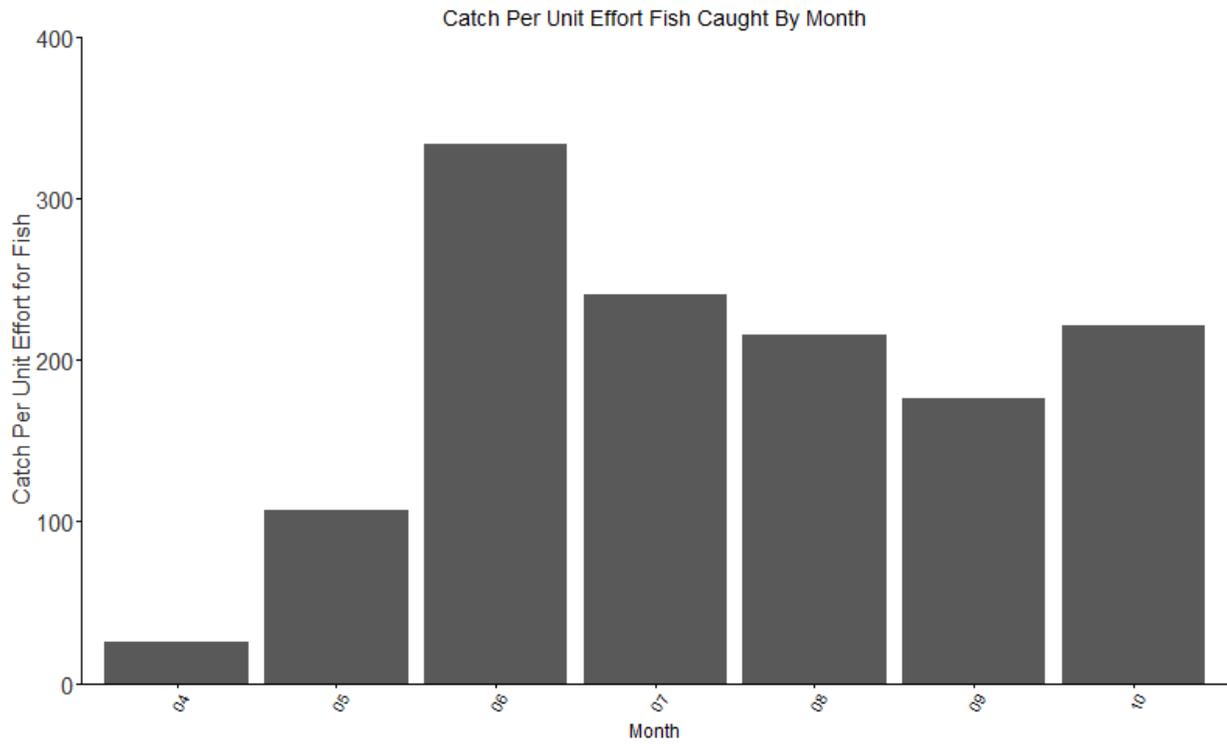
Figure 2. Number of species per site. Rosedale Beach (#6) and Sandy Beach (#8) were the most diverse with 24 species collected at both.



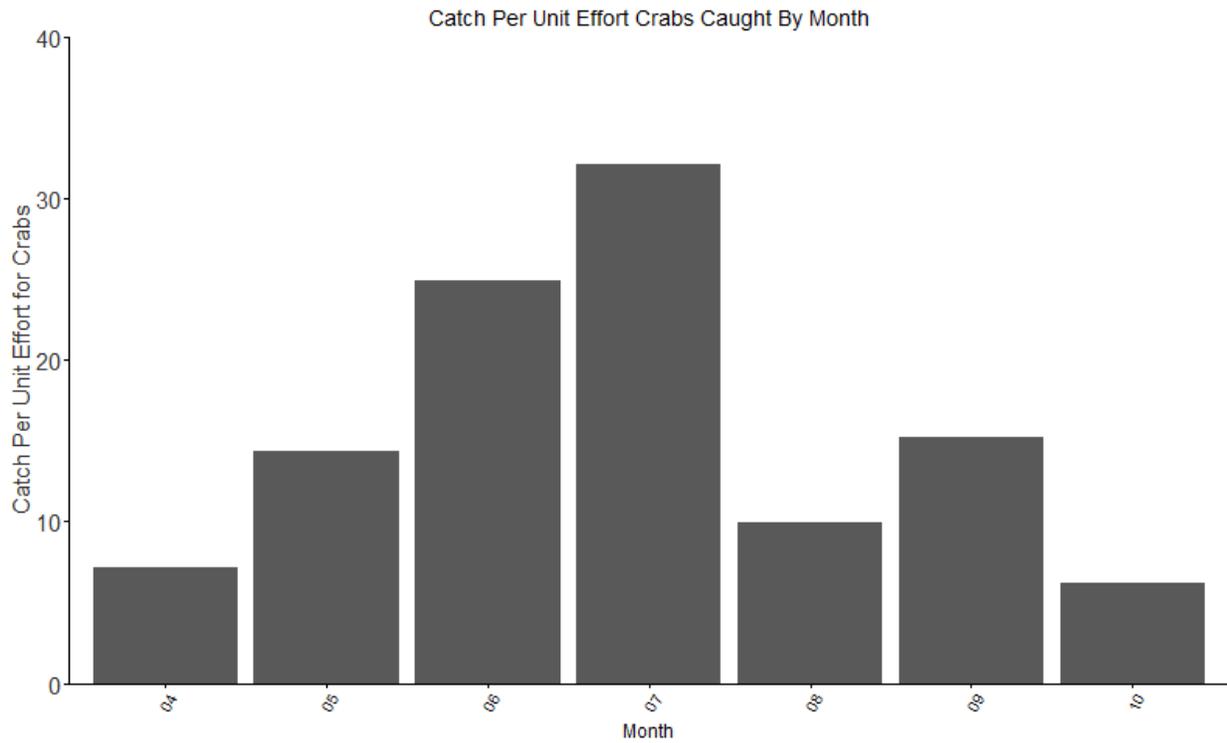
**Figure 3. Catch per unit effort (CPUE) at each site. Kayak Launch (#1) was the most productive site with a CPUE of 877.84 fish per seine.**



**Figure 4. Catch per unit effort (CPUE) of crabs by site. Sandy Beach (#8) was the most productive site for crabs in 2014.**



**Figure 5. Catch per unit effort (CPUE) per month. June was the most productive month in 2014.**



**Figure 6. Catch per unit effort (CPUE) of crabs per month. July was the most productive month for crabs in 2014, consistent with 2013 data.**

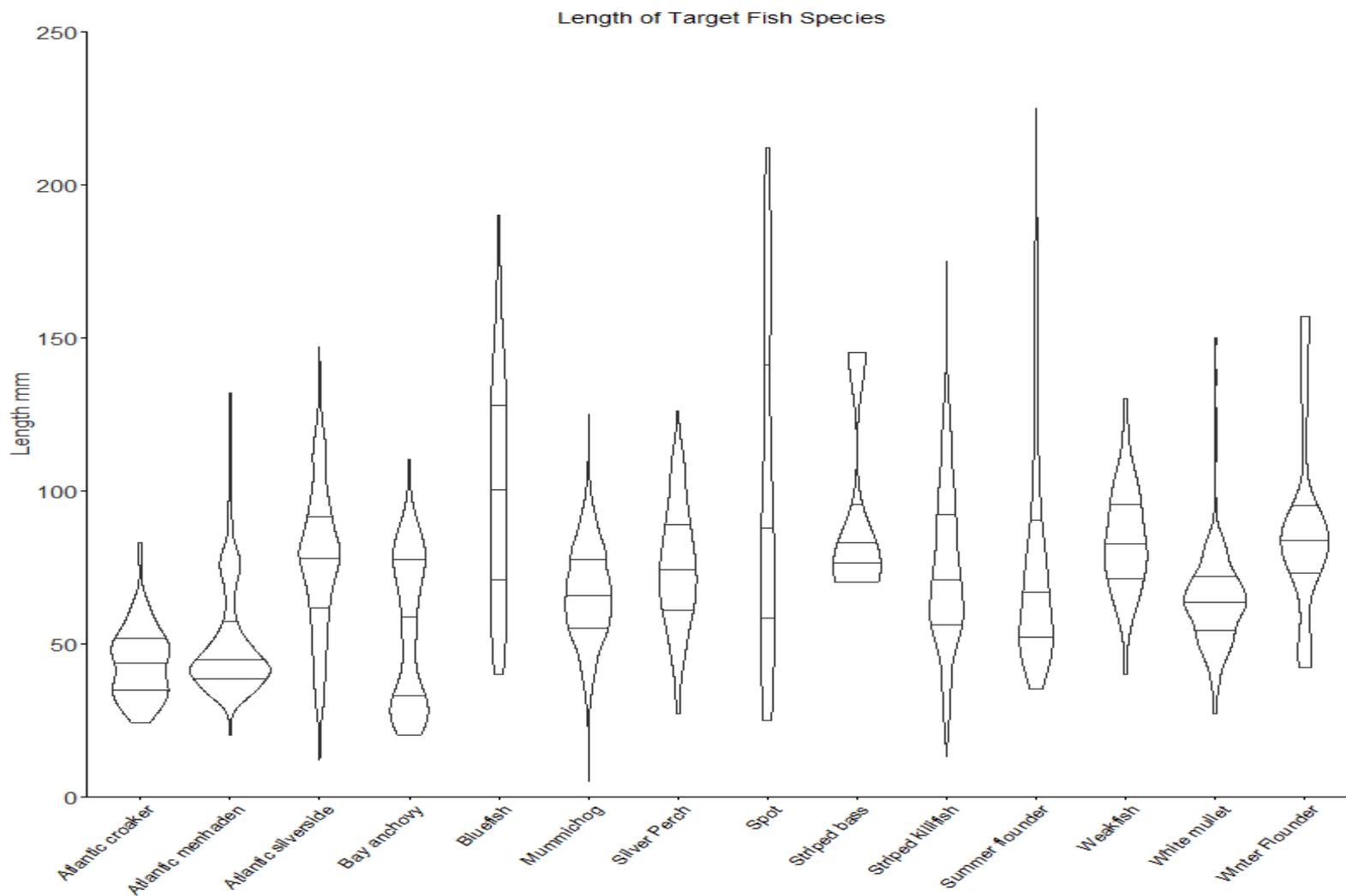


Figure 7. Fish lengths for target species caught in 2014. The wider the area the more fish were caught at that length. Horizontal lines represent the 25<sup>th</sup>, 50<sup>th</sup>, and 75<sup>th</sup> percentile of the data.

Table 1. Description of sampling sites for CIB Inshore Fish Survey - 2014

Site 1. Kayak Launch Site (Latitude 38.6165, Longitude -75.0704) – Delaware Seashore State Park launch site located behind the Indian River North Marina off Inlet Rd. on Rehoboth Bay. The seine haul is made from east to west starting at 100-ft to the east of the dock at the launch area. Substrate is sand and the shore is *Spartina* marsh grass, which is submerged at high tide, for the first 70 ft while the remainder of the shore is sand beach.

Site 2. Tower Road –Bay Side (Lat. 38.6752, Long. -75.0739) – located at the Delaware Seashore State Park, Tower Road – Bay Area off Rt. 1 South on Rehoboth Bay south of Dewey Beach. The seine haul is made from north to south starting from 100-ft north of the center parking area. The substrate is sand.

Site 3. Rehoboth Country Club (Lat. 38.6896, Long. -75.107) – located behind (south of) the 19<sup>th</sup> tee of Rehoboth Country Club off East Side Drive on Rehoboth Bay. The seine haul is made from west to east starting at 100-ft west of the small jetty at the end of the Country Club property. The substrate is sand while the shore is large slabs of concrete.

Site 4. Herring Landing (Lat. 38.6457, Long. -75.1278) – located at the end of the trail in the State wildlife area on the end of Camp Arrowhead Rd. The seine haul is made from west to east on Rehoboth Bay starting 100-ft west of the end of the trail. The substrate is sand around numerous drowned juniper stumps.

Site 5. The Peninsula (Lat. 38.607, Long. -75.1551) – located in The Peninsula development at the end of Bay Farm Rd. in the embayment on the east side of the pier off Indian River Bay. The seine haul is made from east to west starting at 100-ft east of the end of the embayment next to the pier. Substrate is sand near shore and mud out to the rip rap jetties (which are separated by 50-ft) that separate the embayment from the Bay. A large area of marsh grass is adjacent to the end of the east jetty and extends back into Lingo Creek.

Site 6. Rosedale Beach (Lat. 38.5916, Long. -75.2119) – located adjacent to the State boat launch ramp on Indian River. Two 50-foot seine hauls are made at this site due to the pier located close to the east side of the launch ramp. The first haul is made from east to west starting 50-ft east of the pier. The second haul is started at the west side of the pier and extends 50-ft to the sheet piling wall of the ramp. The substrate of the entire area is mud. The shoreline along the first seine area is

marsh grass bordered by a 6-inch mussel-covered drop-off. The shoreline of the second haul is a sandy beach.

Site 8. Sandy Beach (Lat. 38.5834, Long. -75.2535) – located at the end of Sandy Beach Drive off the end of Thorogoods Rd. The seine haul is made from west to east on Indian River starting 100-ft west of the dock. The net is pulled up onto the launch ramp next to the dock to unload the catch. The substrate is mud.

Site 10. Pools Point (Lat. 38.5682, Long -75.1876) – located at the intersection of Dogwood and Pepper Creek roads on Pepper Creek at the confluence with Indian River Bay. The seine haul is made from northwest to southeast starting at 100-ft northwest of the end of the trail from the parking area to the beach. Substrate is sand near shore and mud offshore.

Site 11. Holts Landing State Park (Lat. 38.5925, Long. -75.1288) – located off the west end of the parking lot at the end of Holts Landing Rd. on Indian River Bay. The seine haul is made from 100-ft west of and into the embayment at the end of the trail from the parking lot to the Bay. The bottom is a mixture of sand and mud. The shoreline is marsh grass and a rip rap jetty separates the embayment from the Bay. A narrow sand bar delineates the eastern end of the embayment.

Site 12. Bethany Bay (Lat. 38.5709, Long. -75.0987) – located in the development of Bethany Bay at the end of Railway Rd. Seining is conducted in front of Building No. 30474 at the end of the access trail on White Creek. The seine haul is made from east to west starting at 100-ft east of the end of the trail. The substrate is a mixture of mud and sand with abundant algae usually present. The shoreline is marsh grass for the first 70% of the seine haul with a sandy beach comprising the balance.

Site 13. Cedar Shores (Lat. 38.5762, Long. -75.0919) – located in the development of Cedar Shores at the end of Sandy Rd. on the confluence of White Creek and Indian River Bay. The site is located off the lawn in front of the development. The seine haul is made from east to west beginning 100-ft to the east of the stairs leading to the beach. The substrate is sand and the shore is rip rap.

Site 15. Fenwick Island State Park (Lat. 38.4975, Long. -75.0561) – Assawoman Recreation Area – located on the west side of Rt. 1 between South Bethany and the Kings Grant development on Little Assawoman Bay. The seine haul is made from north to south starting at 100-ft north of the center of the parking lot. Substrate is sand.

Site 16. Coastal Kayak (Lat. 38.4723, Long. -75.0528) – located on the west side of Rt. 1 approximately 1-mile north of Fenwick Island city limits on Little Assawoman Bay. The seine haul is made from north to south starting at 100-ft north of the center of the beach in front of the Kayak building. The substrate is sand.

Site 17. Bayville Shores (Lat. 38.4821, Long. -75.0821) - located at the end of Bayville Shores Dr., Ocean Vista Dr and the end of Sunset Ct. in the Bayville Shores development. The site is located to the northwest of the parking area at the end of Sunset Ct. on the confluence of Dirickson Creek and Little Assawoman Bay. The seine haul is made from east to west starting 100-ft north of the end of the access trail onto the beach. Substrate is a narrow band of sand along the shore and mud offshore.

Site 18. Sassafras Landing (Lat. 38.4995, Long. -75.0845) - located in Assawoman Wildlife Area at the kayak launch beach of Sassafras Landing on Miller Creek. The seine haul is made from east to west beginning 100-ft east of the launch beach. Substrate is sand.

Site 20. Strawberry Landing (Lat. 38.5012, Long. -75.0726) - located in Assawoman Wildlife Area on the south side of Miller Creek. The seine haul is made from 30-m to the west of the west end of the bulkhead along the front of Strawberry Landing. The haul is continued for 100-ft along the shoreline. The substrate is sand.

Table 2. Common and scientific names of fishes and blue crab caught in 2014.

<u>Common Name</u>	<u>Scientific Name</u>
American eel	<i>Anguilla rostrate</i>
Atlantic croaker	<i>Micropogonias undulatus</i>
Atlantic menhaden	<i>Brevoortia tyrannus</i>
Atlantic needlefish	<i>Strongylura marina</i>
Atlantic silverside	<i>Menidia menidia</i>
Bay anchovy	<i>Anchoa mitchilli</i>
Black drum	<i>Pogonias cromis</i>
Black sea bass	<i>Centropristis striata</i>
Blackcheek tonguefish	<i>Symphurus plagiusa</i>
Bluefish	<i>Pomatomus saltatrix</i>
Bluntnose stingray	<i>Dasyatis say</i>
Crevalle jack	<i>Caranx hippos</i>
Fourspine stickleback	<i>Apeltes quadracus</i>
Hogchoker	<i>Trinectes maculatus</i>
Inland silverside	<i>Menidia beryllina</i>
Mummichog	<i>Fundulus heteroclitus</i>
Naked goby	<i>Gobiosoma bosc</i>
Northern kingfish	<i>Menticirrhus saxatilis</i>

Northern pipefish	<i>Sygnathus fuscus</i>
Northern puffer	<i>Sphoeroides maculatus</i>
Oyster toadfish	<i>Opsanus tau</i>
Permit	<i>Trachinotus falcatus</i>
Pinfish	<i>Lagodon rhomboides</i>
Rainwater killifish	<i>Lucania parva</i>
Sheepshead minnow	<i>Cyprinodon variegatus</i>
Silver perch	<i>Bairdiella chrysoura</i>
Skilletfish	<i>Gobiesox strumosus</i>
Spot	<i>Leiostomus xanthurus</i>
Spotfin mojarra	<i>Eucinostomus argenteus</i>
Spotted hake	<i>Urophycis regia</i>
Striped anchovy	<i>Anchoa hepsetus</i>
Striped bass	<i>Morone saxatilis</i>
Striped killifish	<i>Fundulus majalis</i>
Summer flounder	<i>Paralichthys dentatus</i>
Weakfish	<i>Cynoscion regalis</i>
White mullet	<i>Mugil cephalus</i>
White perch	<i>Morone americana</i>
Winter flounder	<i>Pseudopleuronectes americanus</i>
Blue crab	<i>Callinectes sapidus</i>

**Table 3. Mean water temperatures (°C) at each site for each month.**

<b>Site</b>	<b>April</b>	<b>May</b>	<b>June</b>	<b>July</b>	<b>August</b>	<b>September</b>	<b>October</b>
1	12.7	18.45	24.1	24.1	24.9	23.7	16.75
2	11.4	19.5	24.85	25.9	25	22.35	15.95
3	13.8	20	26.85	27.05	26.55	23.1	17.2
4	13.8	21.35	26.45	25.5	27.2	23.55	17.6
5	13.5	21.05	25.05	25.9	23.85	20.25	20.35
6	16.5	22.1	26.55	29.4	25.4	22.55	21.55
8	16.4	23.3	27.35	28.3	25.65	24	19.1
10	16.6	18.75	25.4	27.8	29.9	22.45	17
11	16.4	17.45	23.9	27.75	30.1	21.7	16.1
12	17.2	18.2	25.15	26.85	29.05	22	14.7
13	16.1	17.9	23.45	26	28.8	21.45	14.85
15	18.2	23.35	28.8	27.6	25.9	24.75	17.45
16	17.2	23.15	28.55	28.35	26.2	24.8	17.2
17	18.5	23.3	28.45	28.9	25.65	25.2	17.7
18	19.2	24.3	29.65	29.35	25.4	25.9	16.75
20	18.3	23.3	29.15	28.35	25.45	25.1	17.1

**Table 4. Mean salinity (ppt) at each site for each month.**

Site	April	May	June	July	August	September	October
1	27.8	29.7	29.55	29.65	30.3	30.25	30.65
2	26.5	27.95	29.05	28.15	29.3	30.65	28.85
3	27.3	28.4	27.85	27.05	28.8	30.35	29.5
4	27.3	28.9	28.95	28.35	29.4	30.75	30.55
5	26.7	25.05	27.35	27	27.65	28.6	22.4
6	11.1	18.95	21.95	20.9	23.4	22.6	23.05
8	2.8	7.25	13.15	14.5	17.35	15.3	15.65
10	17.8	19.2	24.3	24.75	23.3	24.4	16.5
11	21.4	24.9	28.15	27.35	26.95	28.5	28.25
12	27.1	26.35	30.7	28.7	28.4	29	29.8
13	25.9	26.95	28.35	29.65	28.05	29.4	30.1
15	19.3	19.6	23.2	25.95	25.1	27.15	26.95
16	20.6	21.25	24.4	27.15	27.4	27.65	26.75
17	17.4	18.05	15.85	25.45	24.3	24.9	25.3
18	11.6	15	20.4	21.9	21.15	23.85	25.05
20	15.5	17.15	22.45	25.4	23.4	25.95	26.45

**Table 5. Mean dissolved oxygen (ppm) at each site for each month.**

Site	April	May	June	July	August	September	October
1	8	7.1	6.85	4.65	4.8	5.3	6.4
2	8.6	7.05	4.75	6.45	6.3	6.95	7.75
3	6.4	8.65	6.1	5.35	5	5.7	7.2
4	6.4	7.35	7.1	6.15	6.6	7.55	8
5	7.5	6.15	5.5	5.05	6.85	7.75	5.5
6	8.2	4.55	5.4	4.85	4.8	6.55	5.55
8	6.9	6	6.95	6	4.35	6.5	6
10	8.4	5.75	5.8	8	5.95	7.55	9.6
11	8	7.35	4.65	3.7	5.1	6.8	9.9
12	8.9	8.15	5.2	6.25	4.5	7.65	9.15
13	7.6	7.85	4.75	5.7	4.45	7.2	9.25
15	7.8	8.55	8.4	6.1	6.3	6.15	7.4
16	8.7	9.35	8.3	6.95	7.15	7.35	8.85
17	11	8.3	7.55	6.35	6.8	7.6	8.5
18	10.2	8.6	9.3	6.45	6.2	5.25	8.1
20	8.3	9.3	6.55	6.55	6.9	5.65	8.45

**Table 6. Catch per unit effort for each species, as well as total number caught in 2014.**

Species	Total Caught	CPUE
Atlantic silverside	17266	83.00962

Mummichog	8194	39.39423
Striped killifish	5469	26.29327
Atlantic menhaden	4086	19.64423
Sheepshead minnow	3234	15.54808
Bay anchovy	1199	5.764423
White mullet	855	4.110577
Atlantic croaker	528	2.538462
Silver Perch	253	1.216346
Summer flounder	147	0.706731
Blackcheek tonguefish	110	0.528846
Black drum	85	0.408654
Northern kingfish	71	0.341346
Bluefish	62	0.298077
Weakfish	58	0.278846
Northern pipefish	39	0.1875
Winter flounder	39	0.1875
Spot	29	0.139423
Striped anchovy	19	0.091346
Spotfin mojarra	15	0.072115
American eel	13	0.0625
White perch	12	0.057692
Naked goby	11	0.052885
Hogchoker	10	0.048077
Rainwater killifish	7	0.033654
Spotted hake	6	0.028846
Atlantic needlefish	5	0.024038
Crevalle jack	4	0.019231
Oyster toadfish	4	0.019231
Permit	4	0.019231
Pinfish	4	0.019231
Striped bass	4	0.019231
Inland silverside	3	0.014423
Northern puffer	3	0.014423
Skilletfish	2	0.009615
Black sea bass	1	0.004808
Bluntnose stingray	1	0.004808
Fourspine stickleback	1	0.004808