Inshore Fish and Blue Crab Survey of Rehoboth Bay, Indian River Bay, and Little Assawoman Bay

for 2015

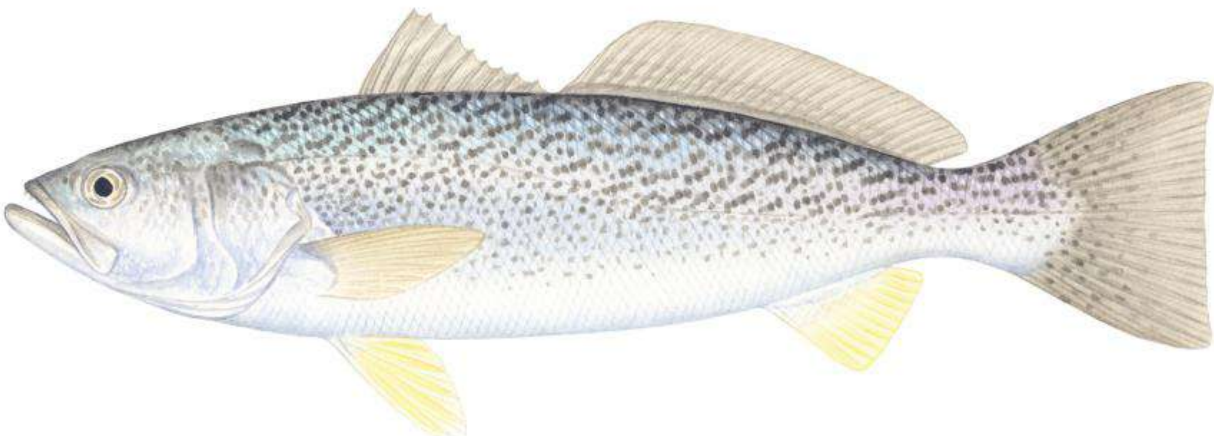

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Table of Contents

Table of Contents ii

Executive Summary 1

Introduction 2

Methods and Materials 2

Results 6

Physical Parameters 6

Fish and Crab Catch 12

- Target Species 17
- Atlantic Croaker 19
- Atlantic Menhaden 22
- Atlantic Silverside 25
- Bay Anchovy 28
- Bluefish 32
- Mummichog 35
- Silver Perch 38
- Spot 41
- Striped Bass 44
- Striped Killifish 47
- Summer Flounder 51
- Weakfish 54
- White Mullet 57
- Winter Flounder 60
- Blue Crab 63

Conclusions 66

Acknowledgements 66

Literature Cited 68

Appendix A A1

Appendix B A4

EXECUTIVE 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 (Kernehan 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 204 samples at 16 sites yielded 4,422 total Blue Crabs, along with 59,241 total fish, comprised of 45 species. The number of total fish, and the catch per unit effort were both the highest recorded by this survey to date. The most abundant species collected in 2015 were Atlantic Silverside, Mummichog, Striped Killifish, Atlantic Menhaden, and Sheepshead Minnow, which represented over 95% 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 4,422 Blue Crabs caught in 2015, 2,649 were small (0 – 40 mm carapace length), 1,650 were medium (41 – 140 mm), and 123 were large specimens (>141 mm).

INTRODUCTION

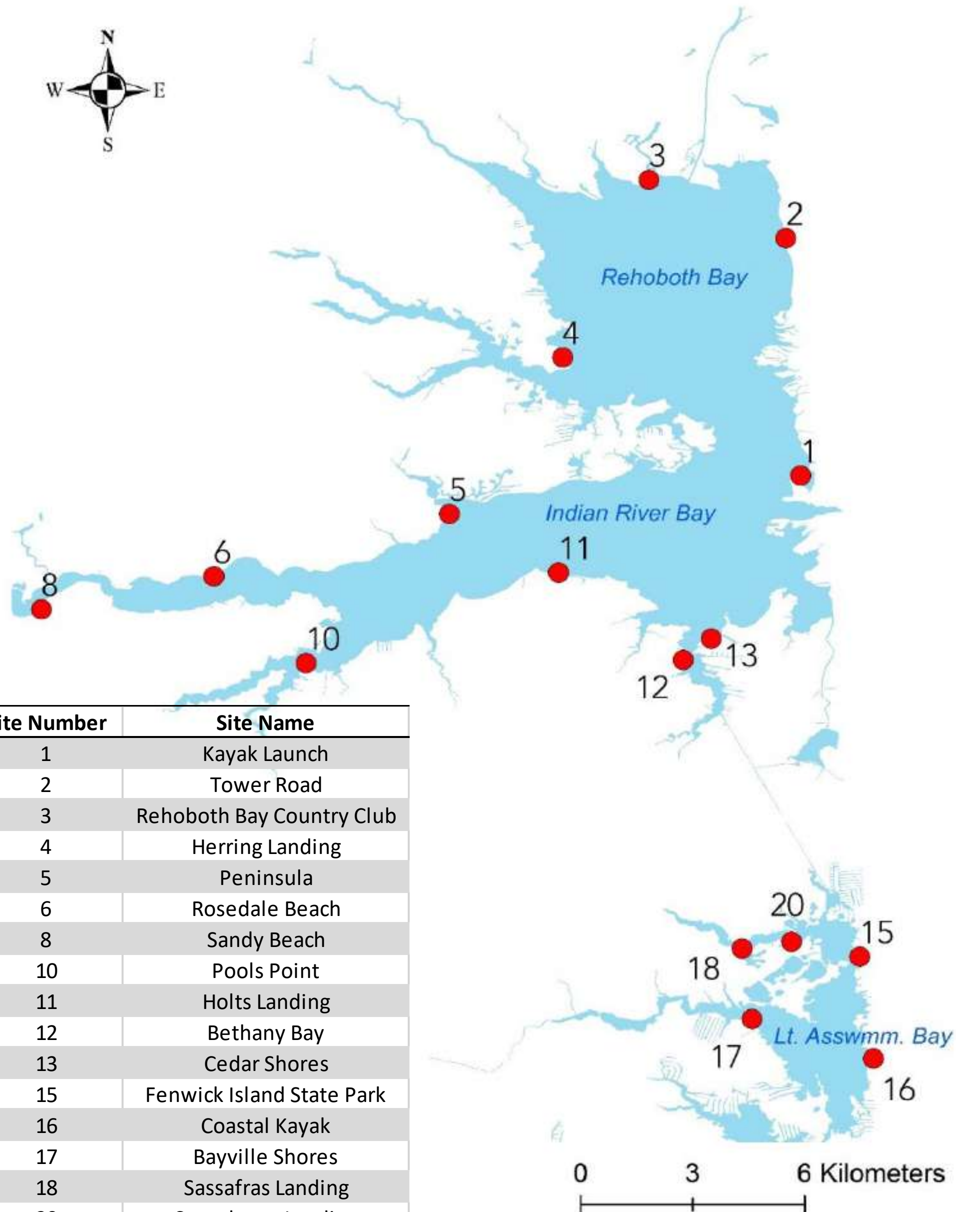
The 2015 Inshore Fish and Blue Crab Survey was the fifth annual volunteer seining study of the near-shore areas of Rehoboth Bay, Indian River and Bay, and Little Assawoman Bay, led by the Delaware Center for the Inland Bays. Shallow, inshore areas are important to the aquatic community as they may be preferentially utilized by juvenile fish and crabs. While the Delaware Department of 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 trawl 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. Furthermore, the importance of physical factors such as dissolved oxygen, salinity, and temperature can be assessed for individual species. 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 204 inshore seine samples were collected in 2015 at 16 sites in Indian River and Bay, Rehoboth Bay, Little Assawoman Bay and tributaries (Figure 1) from the end of April through October. Detailed site descriptions are available in the 2014 annual report (Kernehan et al. 2016). 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 occurred within 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 sample safely 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). These sites have been sampled since 2011.



Site Number	Site Name
1	Kayak Launch
2	Tower Road
3	Rehoboth Bay Country Club
4	Herring Landing
5	Peninsula
6	Rosedale Beach
8	Sandy Beach
10	Pools Point
11	Holts Landing
12	Bethany Bay
13	Cedar Shores
15	Fenwick Island State Park
16	Coastal Kayak
17	Bayville Shores
18	Sassafras Landing
20	Strawberry Landing

Figure 1. Map of the 16 sites seined in 2016.

At each location, a single haul was made using a 30-foot long by 4-foot high bag seine with ¼-inch mesh. The bag is 4-feet long, 4-feet wide and 4-feet deep, located in the center of the net. One volunteer wades off the shoreline into deeper water, while another volunteer remains closer to shore, usually in a foot or less of water. The net was drawn between them, fully extended, perpendicular to the shore, and is then walked parallel to the shore for 70 feet, when the deeper water volunteer swings inshore and both volunteers walk the net onto shore thereby seining 100 feet of shoreline. The only exception to this procedure was at Rosedale Beach (Site 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 at random. The first 25 fish of each species that are scooped out of the holding bucket are measured for total length (mm). The selection procedure for length frequency data may bias measurements. However, since the selection procedure is standardized across space and time, our data remains consistent for analyzing spatial and temporal comparisons within the survey. 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 authors for identification or verification. Scientific names for species identified during 2015 are listed in Appendix A.

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 a pier separates the two hauls. The arithmetic catch-per-seine was calculated for both the total fish catch, and total Blue Crab catch for 2015, by dividing the total number of fish or Blue Crab by the total number of seines in 2015 (204). Arithmetic catch-per-seine for each month and each site were calculated using the same approach. Species specific percent composition was calculated by dividing the total catch by the annual total number of each species. Percentage calculations for each species of fish do not include the annual number of crabs collected in the survey.

The 14 target fish species chosen for individual analyses, results, and discussion sections included seven important forage species that 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.

Differences in abundance between the three bays were calculated for each target species using pairwise Wilcoxon rank sum tests with a Bonferroni correction ($\alpha = 0.05$) for each species.

Physical parameters of water temperature (measured to 0.1 degree centigrade, ^{0}C), dissolved oxygen (to 0.1 milligram per liter, mg/l), and salinity (to 0.1 part per thousand, ppt) were measured with 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.

Correlations between the abundance of each target species and the measured dissolved oxygen, water temperature, and salinity values since the start of the survey in 2011 were assessed using Kendall's tau correlation tests ($\alpha = 0.05$) for each species. Additionally, pairwise Wilcoxon rank sum tests with Bonferroni corrections ($\alpha = 0.05$) were run to assess the influence of tidal stage on each target species' abundance.

Due to the large annual fluctuations in fish abundance, statistical trends of species populations are not yet appropriate, however, the geometric mean catch for each year of the survey are presented for each target fish species to better visualize the data. In addition, the geometric mean was calculated for each previous season, then the arithmetic mean and median of these values were calculated and plotted to show how the previous year compared to the time series averages.

RESULTS

Physical Parameters

Mean dissolved oxygen concentration ranged from a mean low of 3.35 mg/L at Bethany Bay (Site 12) in September, to a mean high of 12.10 mg/L at Peninsula (Site 5) in July (Table 1). Rehoboth Bay sites (1-4) and Little Assawoman Bay sites (15-20) had generally homogenous dissolved oxygen concentrations within a given month, while Indian River sites (5-13) exhibited greater variation. Little Assawoman sites had in general higher dissolved oxygen concentrations compared to the other two bays. It is important to note that the time of day each sample was taken was not standardized, and therefore comparisons between sites are not meaningful. Samples taken later in the day may have had higher oxygen levels than other samples simply because some samples were taken in the early morning (prior to 9 AM), before photosynthetic organisms raised oxygen levels. However, the measured oxygen levels still provide a good measure of the current conditions present when each seine took place, and are therefore valid for assessing the influence of dissolved oxygen on individual species' abundance.

Water temperature ranged from a mean low of 14.3 degrees Celsius in April at Cedar Shores (Site 13) to a mean high of 31.65 degrees Celsius at Sassafras Landing (Site 18) in July (Table 2). Like dissolved oxygen, Indian River sites exhibited a wider range of temperatures within a given month than the Rehoboth Bay and Little Assawoman Bay sites.

Salinity ranged from a mean low of 3.6 ppt at Sandy Beach (Site 8) in April to a mean high of 30.75 ppt at Cedar Shores (Site 13) in June (Table 3). Once again, Indian River sites showed greater variability within a given month, while the rest of the sites were fairly homogenous.

Correlations for each target species to dissolved oxygen, water temperature, and salinity since 2011 are presented in Table 4. It should be noted that while statistically significant, many of these correlations are weak, which suggests that additional unmeasured variables such as food availability, habitat type, and predation risk also influence fish distribution and abundance. A majority of species were correlated with salinity, though the direction of this correlation was species dependent. All species except Atlantic Croaker, Winter Flounder, and Weakfish were significantly positively correlated with water temperature. Surprisingly, a majority of species were negatively correlated with dissolved oxygen. While in general fish need healthy dissolved oxygen levels to survive, the sampling times in this study are primarily in the mid-morning to early afternoon, well into the upwards swing of the diel cycle. Surveys taken during the early morning or night hours would encounter lower dissolved oxygen values and likely have lower fish catch. In the absence of surveys taken during these hours, it appears that the oxygen levels encountered during the day in the inshore waters of the Inland Bays are sufficient for the many species of fish examined in this study.

Influence of tidal stage on fish and crab abundance was examined by first simplifying the tidal variables into three categories; High tide (high ebb and high flood), Mid tide (mid ebb and mid flood), and Low tide (low ebb and low flood). Then a series of pairwise Wilcoxon tests with Bonferroni corrections were run for each each species. Catch totals during the three tidal stages were not significantly different for Atlantic Croaker, Atlantic Menhaden, Silver Perch, Spot, Striped Bass, Summer Flounder, Weakfish, White Mullet, or Winter Flounder. Atlantic Silverside had a greater catch during high tide and mid tides than during low tides ($p < 0.01$, $p < 0.001$). Bay Anchovy had a greater catch at high tide compared to low tide and mid tide ($p < 0.001$, $p < 0.01$), and a greater catch at mid tide than low tide ($p < 0.01$), demonstrating a preference for deeper waters within the nearshore area. In support of this, Bay Anchovy are often collected in greater numbers by the DNREC open water trawl survey (Greco 2016), which samples areas that are frequently deeper than the areas sampled by this survey. Bluefish had a greater catch during the high tide than the low tide or the mid tide ($p < 0.001$, $p < 0.05$). This may be a response to the preferences of their prey (Bay Anchovy and Atlantic Silverside) which showed a greater abundance during higher tides as well. Mummichog had a greater catch during low tide than both high and mid tides ($p < 0.001$, $p < 0.001$), and a greater catch during mid tides than high tides ($p < 0.01$). Striped Killifish demonstrated the a similar pattern as Mummichog, with a greater catch at low tide compared to high and mid tides ($p < 0.001$, $p < 0.01$). Lastly, Blue Crab showed a similar pattern to both Striped Killifish and Mummichog, with a greater catch during low tide compared to high and mid tides ($p < 0.001$, $p < 0.01$). These last three species are all known to inhabit the marsh surface, with Mummichog and Striped Killifish often spawning in intertidal pools (Able and Fahay 2010). Therefore, it is unsurprising that these species all show an ability to tolerate low tides.

Table 1. Mean and standard deviation dissolved oxygen concentration (mg/L) for each site per month for 2015.

Site	Site Name	Bay	Apr	May	Jun	Jul	Aug	Sep	Oct
1	Kayak Launch	Rehoboth	6.7 +/- NA	6.2 +/- NA	5.6 +/- 1.41	6.5 +/- 0.28	5.25 +/- 0.49	7.4 +/- 0.14	7.9 +/- 0.85
2	Tower Rd	Rehoboth	7.1 +/- NA	7.1 +/- NA	6.8 +/- 0.99	7.55 +/- 0.21	7.8 +/- 2.83	8.85 +/- 1.48	8.55 +/- 1.48
3	Rehoboth Beach CC	Rehoboth	6.9 +/- NA	7.2 +/- NA	6.44 +/- 0.06	7.8 +/- 2.55	5.3 +/- 3.11	7.9 +/- 0.28	8.9 +/- 1.56
4	Herring Landing	Rehoboth	7.8 +/- NA	7.1 +/- NA	6.9 +/- 0.71	7.1 +/- 1.13	5.4 +/- 3.39	8.75 +/- 0.92	10.1 +/- 0.14
5	Peninsula	Indian River	6.3 +/- NA	6.35 +/- 2.33	6.4 +/- 1.98	12.1 +/- 4.1	8.55 +/- 2.9	6.85 +/- 2.33	9.1 +/- 0.14
6	Rosedale Beach	Indian River	5.4 +/- NA	6.5 +/- 1.7	7.15 +/- 0.21	9.05 +/- 0.49	5.2 +/- 0.28	6.8 +/- 0.42	8.9 +/- 1.27
8	Sandy Beach	Indian River	7.2 +/- NA	6.3 +/- 0.57	6.55 +/- 2.05	11.45 +/- 9.97	5.85 +/- 2.33	8.85 +/- 4.17	5 +/- 5.23
10	Pools Point	Indian River	6.6 +/- NA	6.85 +/- 1.91	5.75 +/- 0.64	6.45 +/- 3.04	5.8 +/- 0.14	4.8 +/- 2.96	7.8 +/- 3.82
11	Holts Landing	Indian River	7.9 +/- NA	6.3 +/- 0.99	6.15 +/- 1.06	7.05 +/- 1.63	6.4 +/- 0.28	4.65 +/- 2.9	7.9 +/- 5.23
12	Bethany Bay	Indian River	7.9 +/- NA	6.55 +/- 0.07	7.85 +/- 1.91	7.7 +/- 0.99	5.35 +/- 0.78	3.35 +/- 1.34	7.9 +/- 6.93
13	Cedar Shores	Indian River	8.5 +/- NA	6.6 +/- 0.71	6.45 +/- 1.34	7.15 +/- 1.91	5.8 +/- 2.97	4.15 +/- 0.21	7.05 +/- 4.17
15	Fenwick Island	Lt. Asswmn.	7.8 +/- NA	6.85 +/- 0.92	7.65 +/- 0.92	8.85 +/- 1.2	7.95 +/- 0.64	9.9 +/- 2.55	10.45 +/- 0.07
16	Coastal Kayak	Lt. Asswmn.	8.2 +/- NA	8.4 +/- 0.71	8.85 +/- 1.06	9.7 +/- 0.99	9.65 +/- 1.2	8.3 +/- 0.85	9.95 +/- 0.07
17	Bayville Shores	Lt. Asswmn.	9.6 +/- NA	7.3 +/- 1.7	8.1 +/- 1.41	8.15 +/- 1.34	7.25 +/- 0.92	7.4 +/- 1.13	9.6 +/- 2.12
18	Sassafras Landing	Lt. Asswmn.	8.5 +/- NA	7.7 +/- 0.85	8.15 +/- 0.07	8.7 +/- 1.56	7.5 +/- 0.57	8 +/- 0.57	9.1 +/- 1.13
20	Strawberry Landing	Lt. Asswmn.	10 +/- NA	7.7 +/- 0.28	8.8 +/- 0.57	6.9 +/- 0.28	7.7 +/- 1.13	7.6 +/- 1.7	9 +/- 0.14

Table 2. Mean and standard deviation water temperature (Celsius) for each site per month for 2015.

Site	Site Name	Bay	Apr	May	Jun	Jul	Aug	Sep	Oct
1	Kayak Launch	Rehoboth	15.1 +/- NA	20 +/- NA	24.8 +/- 1.98	26.4 +/- 0	27.9 +/- 1.98	20.8 +/- 0	15.5 +/- 4.53
2	Tower Rd	Rehoboth	16.2 +/- NA	20.1 +/- NA	26.95 +/- 2.9	26.1 +/- 1.7	27.25 +/- 2.19	21.65 +/- 1.2	15.7 +/- 2.97
3	Rehoboth Beach CC	Rehoboth	17.4 +/- NA	23 +/- NA	25.6 +/- 0	28.5 +/- 1.41	27.9 +/- 2.26	23.2 +/- 1.7	17 +/- 3.54
4	Herring Landing	Rehoboth	16.6 +/- NA	20.7 +/- NA	28.2 +/- 1.7	28.35 +/- 1.48	28.35 +/- 1.34	23.2 +/- 2.83	18.85 +/- 0.07
5	Peninsula	Indian River	16.8 +/- NA	23.6 +/- 1.7	23.9 +/- 0.28	26.7 +/- 3.54	27.2 +/- 2.26	23.25 +/- 4.31	17.2 +/- 3.11
6	Rosedale Beach	Indian River	18.1 +/- NA	24.45 +/- 2.9	26.45 +/- 1.91	28.8 +/- 2.12	25.9 +/- 0.28	24.8 +/- 6.08	16.8 +/- 2.83
8	Sandy Beach	Indian River	17.9 +/- NA	22.7 +/- 7.07	26.6 +/- 2.4	27.4 +/- 1.41	26.35 +/- 1.91	24.75 +/- 5.59	15.8 +/- 5.37
10	Pools Point	Indian River	15.3 +/- NA	28.5 +/- 4.95	27.45 +/- 2.76	29.15 +/- 1.2	25.4 +/- 0.14	22.55 +/- 2.19	18.05 +/- 4.31
11	Holts Landing	Indian River	16 +/- NA	20.65 +/- 4.45	25.85 +/- 3.89	28 +/- 0.57	24.55 +/- 0.64	22.9 +/- 1.98	17.6 +/- 4.67
12	Bethany Bay	Indian River	14.6 +/- NA	21.5 +/- 3.54	27.8 +/- 1.84	29.9 +/- 0	25.45 +/- 2.19	25.6 +/- 6.08	18.4 +/- 4.1
13	Cedar Shores	Indian River	14.3 +/- NA	20.55 +/- 3.18	28.65 +/- 1.06	29.85 +/- 0.78	25.4 +/- 1.27	25.6 +/- 6.08	17.05 +/- 7.14
15	Fenwick Island	Lt. Asswmn.	15.3 +/- NA	21.5 +/- 5.37	30.25 +/- 0.07	30.35 +/- 0.64	28.8 +/- 0.14	23 +/- 1.84	16.15 +/- 3.46
16	Coastal Kayak	Lt. Asswmn.	15.4 +/- NA	21.4 +/- 5.09	30.45 +/- 0.64	30.85 +/- 1.2	29.1 +/- 0.85	22.6 +/- 2.12	16.5 +/- 3.68
17	Bayville Shores	Lt. Asswmn.	16.3 +/- NA	22.7 +/- 5.23	30.7 +/- 1.41	30.9 +/- 0.28	29.05 +/- 0.78	23 +/- 1.98	16.65 +/- 3.61
18	Sassafras Landing	Lt. Asswmn.	16.9 +/- NA	24.35 +/- 4.45	31.35 +/- 0.92	31.65 +/- 0.49	29.75 +/- 1.77	23.1 +/- 2.26	15.85 +/- 3.89
20	Strawberry Landing	Lt. Asswmn.	16 +/- NA	23.65 +/- 5.16	30.75 +/- 1.06	30.5 +/- 0.85	29.2 +/- 1.84	22.75 +/- 1.91	16.1 +/- 3.54

Table 3. Mean and standard deviation salinity (ppt) for each site per month for 2015.

Site	Site Name	Bay	Apr	May	Jun	Jul	Aug	Sep	Oct
1	Kayak Launch	Rehoboth	28.6 +/- NA	27.6 +/- NA	29.15 +/- 0.92	29.25 +/- 0.92	29.5 +/- 1.7	29.95 +/- 1.06	29.05 +/- 0.35
2	Tower Rd	Rehoboth	26 +/- NA	26.7 +/- NA	27.5 +/- 1.27	27.25 +/- 0.21	29.45 +/- 1.63	29.6 +/- 0.71	27 +/- 1.27
3	Rehoboth Beach CC	Rehoboth	25.9 +/- NA	26.5 +/- NA	27.5 +/- 3.68	28.3 +/- 0.85	28.55 +/- 0.49	30.05 +/- 0.49	27.15 +/- 0.07
4	Herring Landing	Rehoboth	29.7 +/- NA	28.5 +/- NA	27.3 +/- 2.26	29.5 +/- 0.14	29.8 +/- 0.14	30.6 +/- 0.28	28.5 +/- 0
5	Peninsula	Indian River	24.6 +/- NA	26.1 +/- 0.85	22.2 +/- 7.92	28.7 +/- 0.14	28.35 +/- 0.78	29.15 +/- 0.35	26.65 +/- 1.34
6	Rosedale Beach	Indian River	17.6 +/- NA	23.95 +/- 3.61	18.3 +/- 5.09	20.55 +/- 7.71	25.9 +/- 0.57	24.7 +/- 2.55	21.2 +/- 0.14
8	Sandy Beach	Indian River	3.6 +/- NA	9.7 +/- 3.25	11.4 +/- 4.53	16.7 +/- 0.99	18.85 +/- 2.05	22.2 +/- 1.56	14.45 +/- 2.62
10	Pools Point	Indian River	19.1 +/- NA	24.75 +/- 1.06	25.2 +/- 0.99	17.85 +/- 9.97	24.9 +/- 0.42	25.25 +/- 1.2	21.2 +/- 1.7
11	Holts Landing	Indian River	21.1 +/- NA	28.05 +/- 0.49	19.05 +/- 15.49	20 +/- 10.75	28.85 +/- 0.21	27.85 +/- 2.76	26.15 +/- 1.91
12	Bethany Bay	Indian River	27.2 +/- NA	27.55 +/- 3.18	30.6 +/- 0.57	28.7 +/- 0.28	29.25 +/- 0.21	28.85 +/- 1.34	26.65 +/- 0.64
13	Cedar Shores	Indian River	26.1 +/- NA	29.15 +/- 1.48	30.75 +/- 0.64	29.45 +/- 0.07	27.4 +/- 2.83	28.9 +/- 1.41	25.1 +/- 0.14
15	Fenwick Island	Lt. Asswmn.	13.9 +/- NA	20 +/- 0.42	23.1 +/- 0.28	22.35 +/- 0.92	24.95 +/- 1.06	26.6 +/- 1.84	20.55 +/- 0.78
16	Coastal Kayak	Lt. Asswmn.	16.7 +/- NA	20.3 +/- 0.71	24.5 +/- 0.57	24.6 +/- 0.14	26.05 +/- 0.07	27.8 +/- 1.98	22.05 +/- 1.77
17	Bayville Shores	Lt. Asswmn.	14.9 +/- NA	17.05 +/- 0.78	28.35 +/- 10.39	22.7 +/- 0.57	24.25 +/- 0.78	26.05 +/- 3.04	19.5 +/- 0.28
18	Sassafras Landing	Lt. Asswmn.	8.3 +/- NA	13.9 +/- 1.13	20.6 +/- 0.28	20 +/- 0.99	23.45 +/- 1.63	25.15 +/- 3.89	16.8 +/- 2.4
20	Strawberry Landing	Lt. Asswmn.	11.8 +/- NA	15.25 +/- 0.78	21.95 +/- 0.21	21.5 +/- 0.42	23 +/- 0.71	25.25 +/- 1.2	17.95 +/- 0.07

Table 4. Correlations for each species to physical parameters since 2011 as assessed by Kendall's tau correlation tests (α = 0.01).

Species	Salinity p value	Salinity tau	Dissolved Oxygen P	Dissolved Oxygen tau	Water Temperature p value	Water Temperature tau	N
Atlantic Croaker	< 0.001	-0.0902	0.1764	-0.0347	0.0123	-0.0639	701
Atlantic Menhaden	< 0.01	-0.0734	0.2124	-0.0315	< 0.001	0.1064	7562
Atlantic Silverside	< 0.001	0.1334	< 0.01	-0.062	< 0.001	0.1085	84763
Bay Anchovy	0.0341	-0.0523	< 0.001	-0.1584	< 0.01	0.08	3262
Bluefish	0.1461	0.0368	< 0.001	-0.1419	< 0.001	0.1193	225
Mummichog	< 0.01	-0.0685	0.8070	-0.0055	< 0.001	0.1442	66083
Silver Perch	0.0323	0.0527	< 0.001	-0.135	< 0.001	0.1288	3414
Spot	0.0166	-0.0585	< 0.01	-0.0726	< 0.001	0.1434	8599
Striped Bass	0.2203	-0.0314	0.0165	-0.0617	< 0.01	0.0725	113
Striped Killifish	< 0.001	0.1047	< 0.01	-0.0739	< 0.001	0.0927	33344
Summer Flounder	< 0.001	-0.1841	< 0.001	-0.1001	< 0.001	0.0898	1040
Weakfish	< 0.01	-0.0757	0.0103	-0.0659	0.0120	0.0641	582
White Mullet	< 0.01	0.0792	< 0.001	-0.1194	< 0.001	0.1829	3597
Winter Flounder	0.0159	0.0612	< 0.001	-0.0865	0.1899	-0.0332	533
Blue Crab Small	< 0.001	-0.1113	0.0106	0.0579	< 0.001	0.1128	10532
Blue Crab Medium	< 0.001	-0.0803	0.6086	-0.0118	< 0.001	0.1919	5620
Blue Crab Large	< 0.001	-0.0838	0.1415	-0.0369	< 0.001	0.135	617
Blue Crab	< 0.001	-0.0952	0.0913	0.0376	< 0.001	0.1508	16769

Fish and Crab Catch Results

A total of 59,241 individual fish and 4,422 Blue Crabs were caught in 2015. The arithmetic catch-per-seine for 2015 was 290.39 fish per seine, and 21.67 crabs per seine, the greatest and second greatest, respectively, of any year so far. A total of 45 fish species were collected in 2015, which is higher than 2014, and above the average number of species caught per year since the start of the survey in 2011 (42.5).

The top five species for 2015 were Atlantic Silversides (50.35%), Mummichog (31.10%), Striped Killifish (11.10%), Atlantic Menhaden (1.4%), and Sheepshead Minnow (1.7%). These species combined for over 95% of total fish catch for 2015. This closely resembles the composition from 2014, where the same five species accounted for 91% of the catch. In the previous four years of the survey, these five species have accounted for 81% of the total fish catch.

Seasonally, there has been no consistency in which month has had the greatest fish catch per seine. In 2011 the peak month was September, which changed to April in 2012, then July in 2013, June in 2014, and finally August in 2015. In general however, the summer months of June July and August have had a greater catch per seine for fish than the spring or fall months. In support of this, August was the most productive month for both fish and crabs (Figures 2-3).

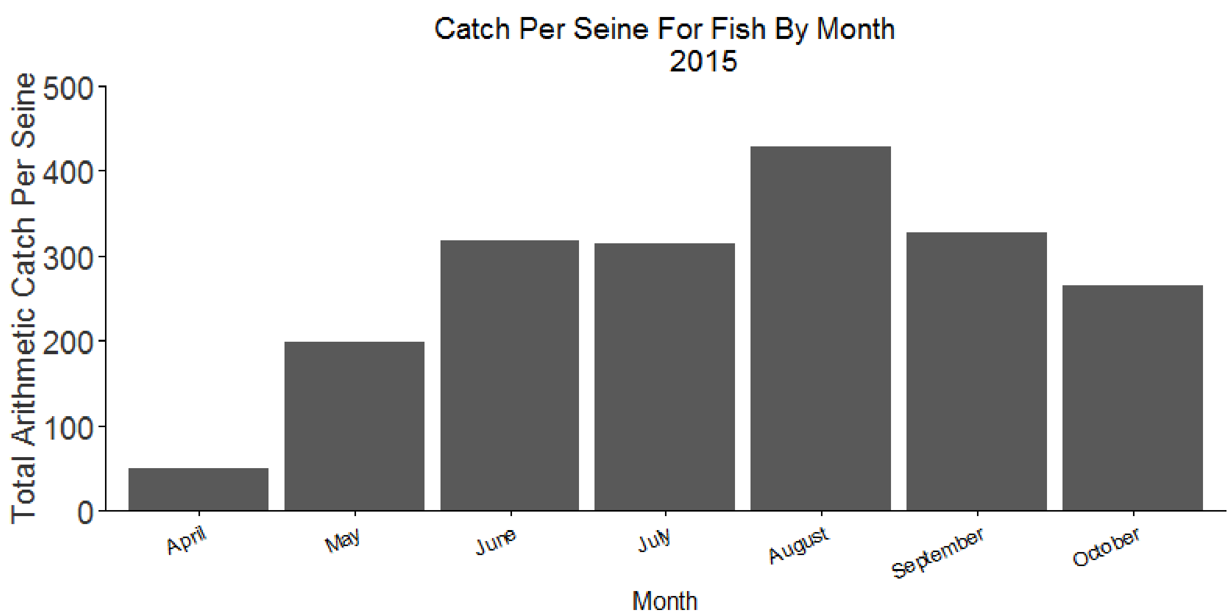


Figure 2. Fish catch per month during 2015.

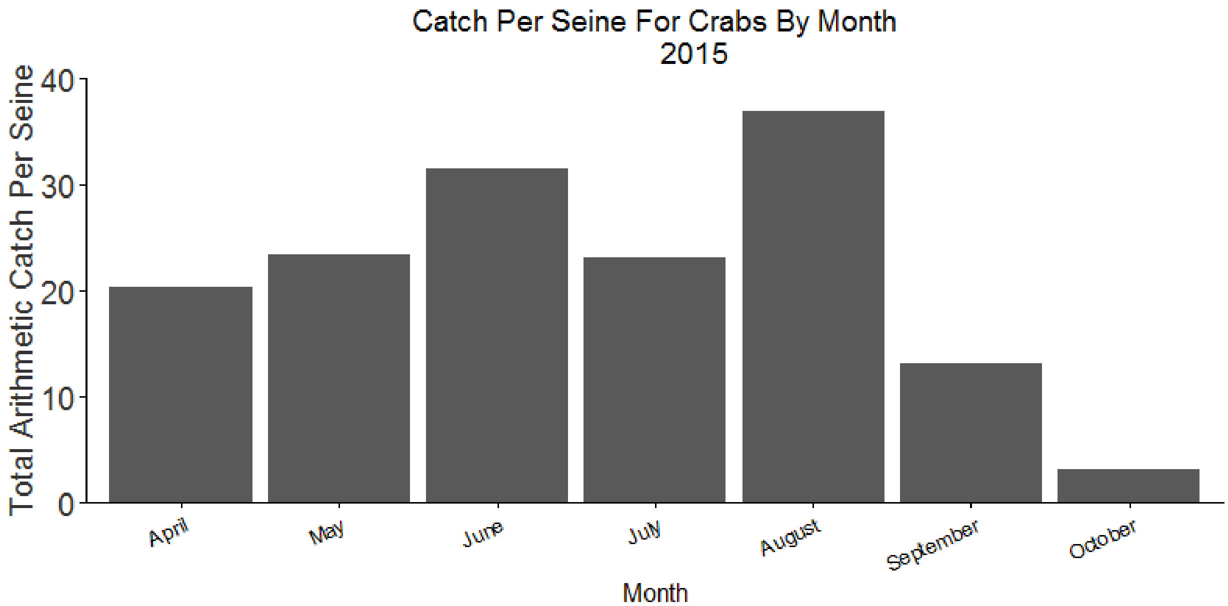


Figure 3. Blue Crab catch per month during 2015.

As in three of the last four years, Kayak Launch (Site #1) was again the most productive site for fish (Figure 4). Kayak Launch has consistently had a higher fish catch than other sites, mostly dominated by Striped Killifish (Figure 5). Consistent with each previous year, Sandy Beach (Site #8) was the most productive site for crabs (Figure 6). No other site came close to the number of crabs caught at Sandy Beach, demonstrating the importance of that site and it's mid-salinity waters to the Blue Crab population in the Inland Bays.

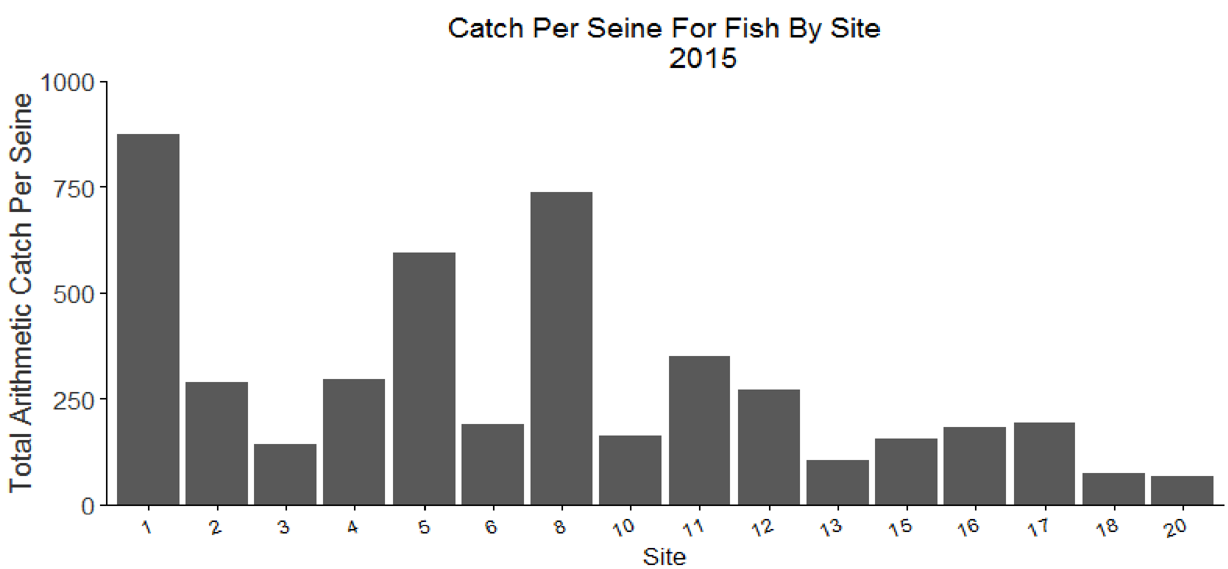


Figure 4. Catch per unit effort of fish per site during 2015.

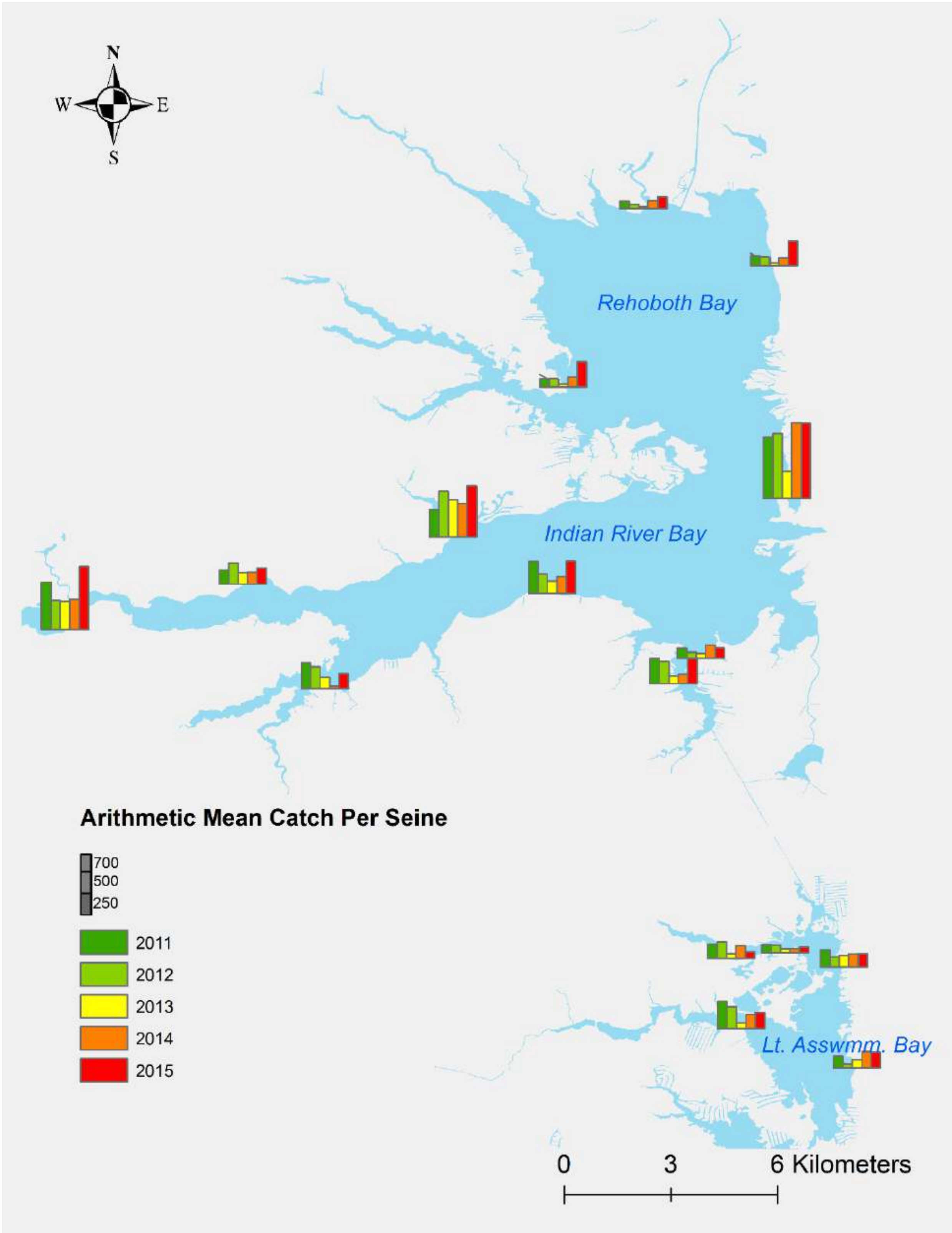


Figure 5. Arithmetic catch per seine at each site since 2011.

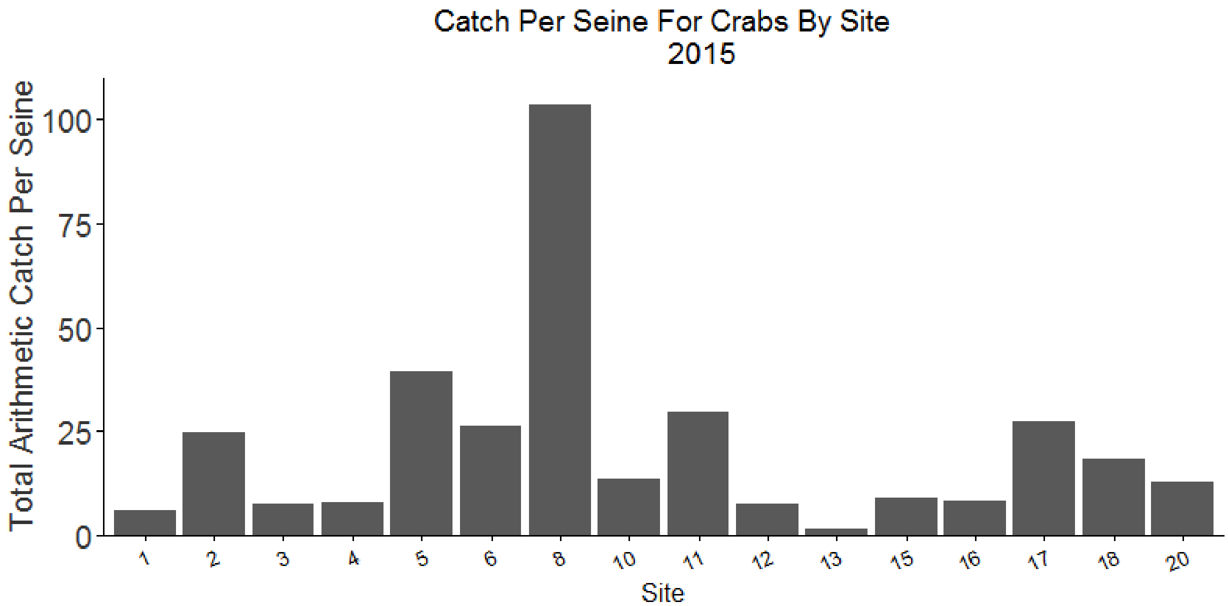


Figure 6. Catch per unit effort for crabs per site during 2015.

The most biologically diverse sites were Peninsula (Site #5), with 27 fish species collected, and Holts Landing (Site #11; Figure 7), with 23 fish species collected. Both sites are immediately opposite the Indian River Inlet and have been in the top five most species rich sites since the start of the program in 2011 (Figure 8).

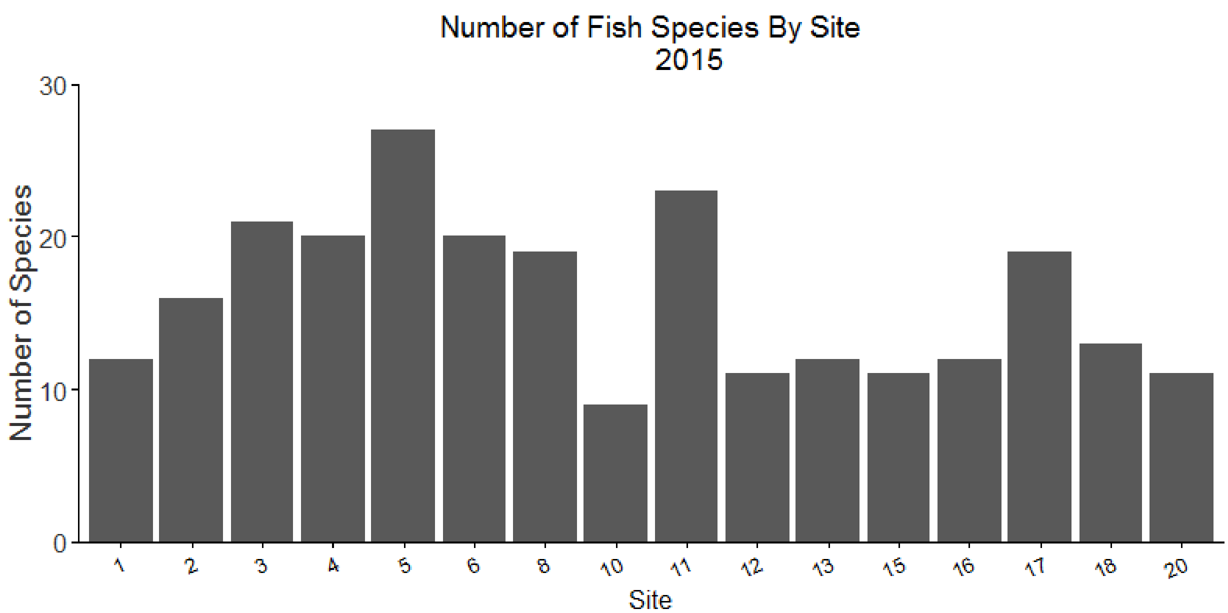


Figure 7. Number of species of fish caught per site during 2015

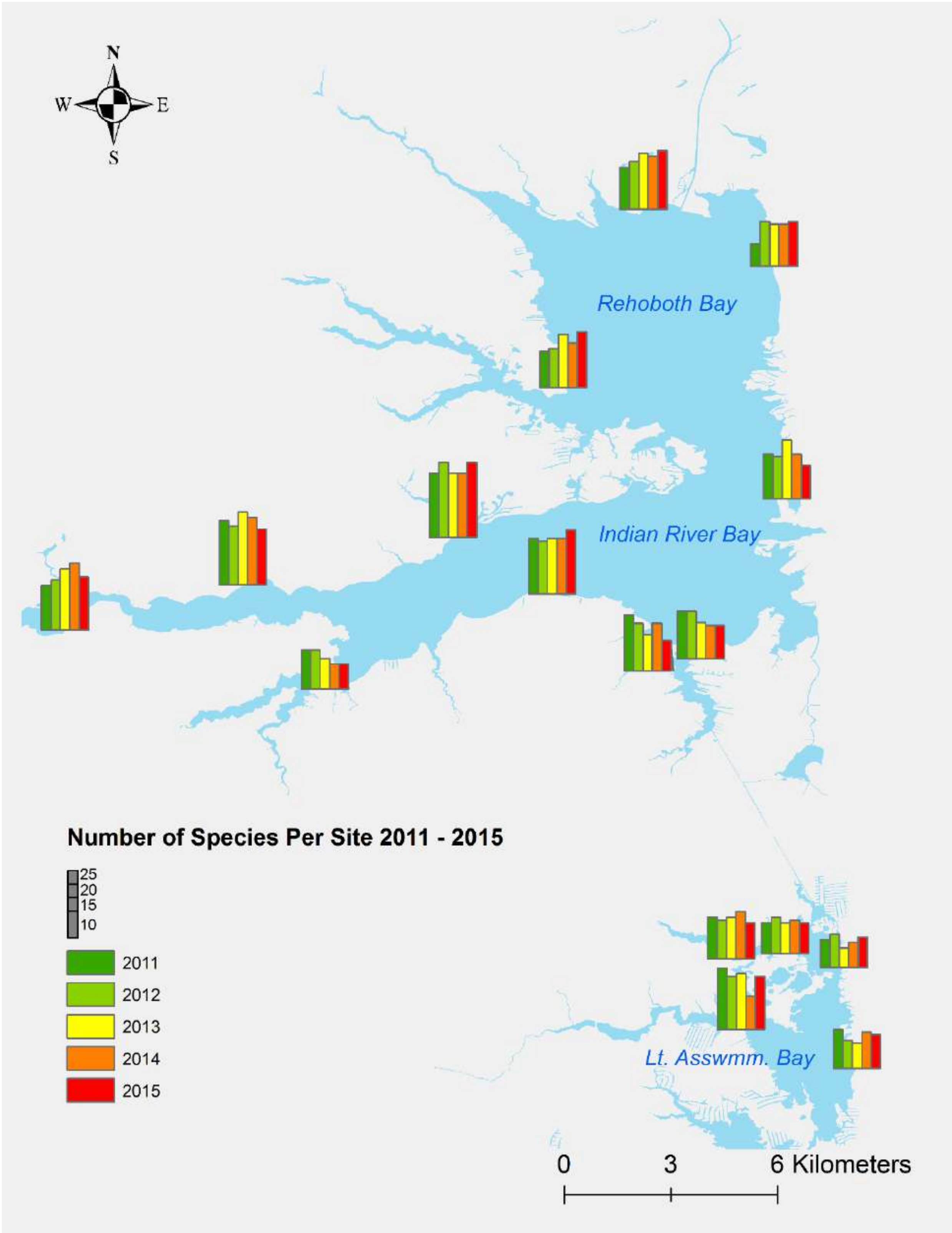


Figure 8. Species richness at each site since 2011.

Target Species

Target species are species of special concern, due either to their importance for commercial or recreational fishermen, or 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 fish 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.

2015 was a mixed year for target species. Blue Crab numbers were the second highest of any year so far, while Summer Flounder numbers were the lowest of any year so far. Length distributions of fish target species are depicted in Figure 9. The lengths of predatory species caught by this survey do not represent the full length distributions for these species, and illustrate that the specimens utilizing the inshore areas are typically juveniles, and as these species grow they become less frequent in inshore waters and are therefore utilizing deeper waters. Oppositely, species such as Mummichog and Atlantic Silverside are caught frequently at their maximum and minimum total lengths, indicating these species typically inhabit the inshore waters at all stages of their life cycle.

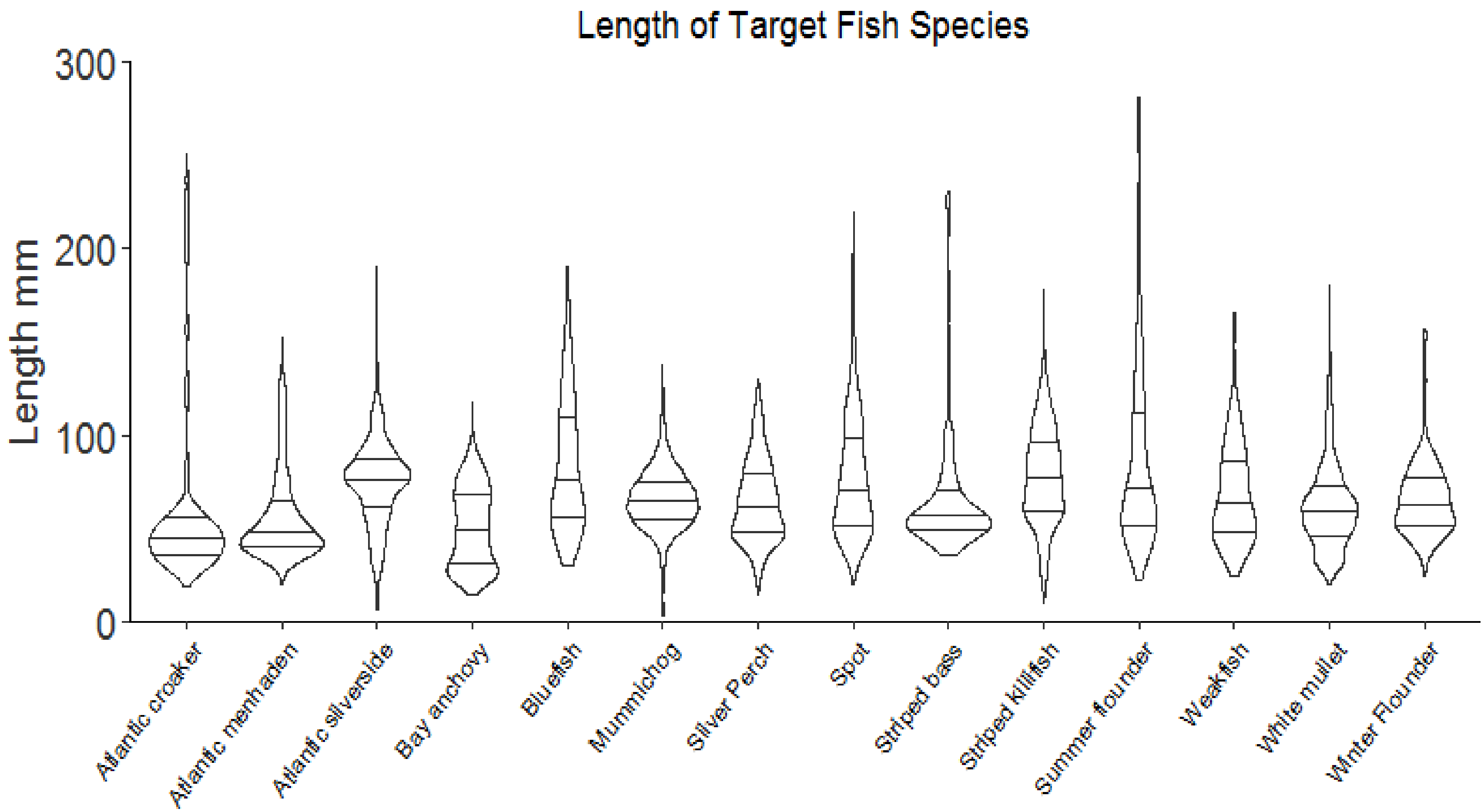


Figure 9. Fish Length by species for specimens caught from 2011 through 2015. Horizontal lines represent the 25th, 50th, and 75th quartiles. Length are capped at 300 mm, which excluded 9 specimens from the graph.

Atlantic Croaker

Only 8 Atlantic Croaker were caught in 2015, for a geometric mean catch of 0.022 fish per seine. This was the second fewest ever recorded by this survey, and was less than the time series mean and median (Figure 10). The DNREC open water trawl survey also reported decreases in the mean catch and the young-of-the-year index total between 2014 and 2015 for Atlantic Croaker (Greco 2016). As in previous years, most croaker were less than 100 mm in length, demonstrating that the specimens using the inshore areas are primarily young-of-the-year. September was the most productive month in 2015, but since the start of the survey in 2011, October has been the peak month for Atlantic Croaker abundance (Figure 11). This corresponds to the fall seasonal habitat utilization of croaker in the Inland Bays as reported by Wang and Kernehan (1979). Since 2011, Atlantic Croaker catch has been greater in Indian River Bay than in Little Assawoman Bay and Rehoboth Bay ($p < 0.001$, $p < 0.001$; Figure 12).

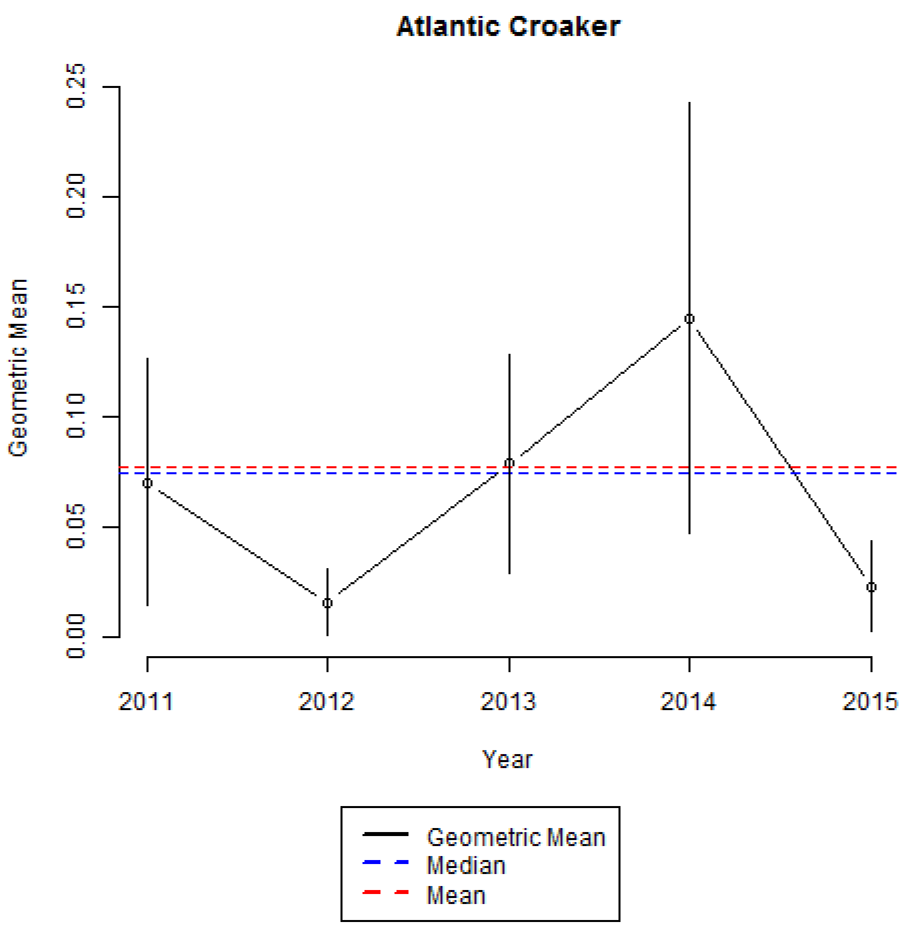


Figure 10. Geometric mean catch-per-seine for Atlantic Croaker, with the time series mean and median.

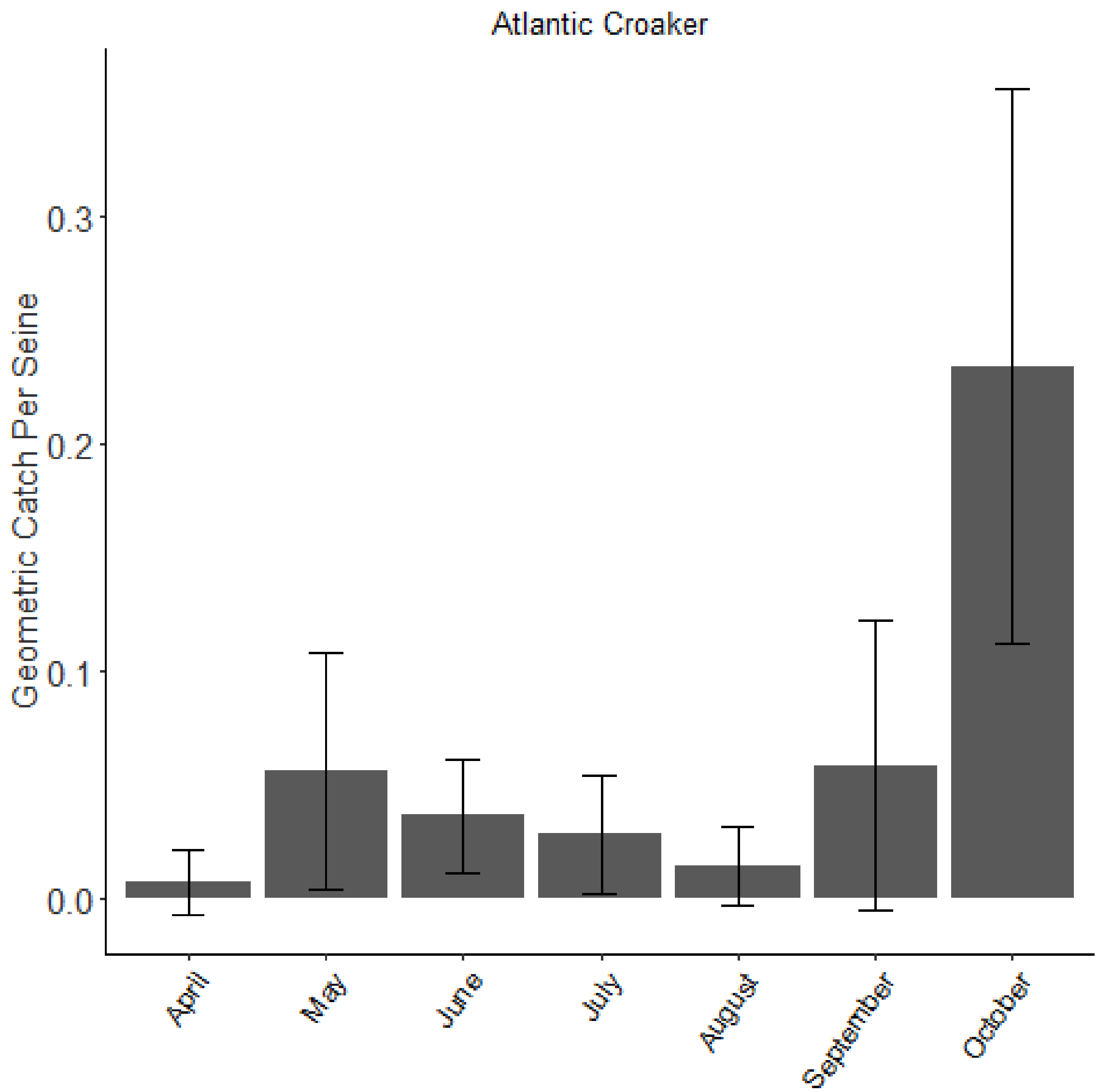


Figure 11. Geometric mean catch-per-seine since 2011 for Atlantic Croaker by month.

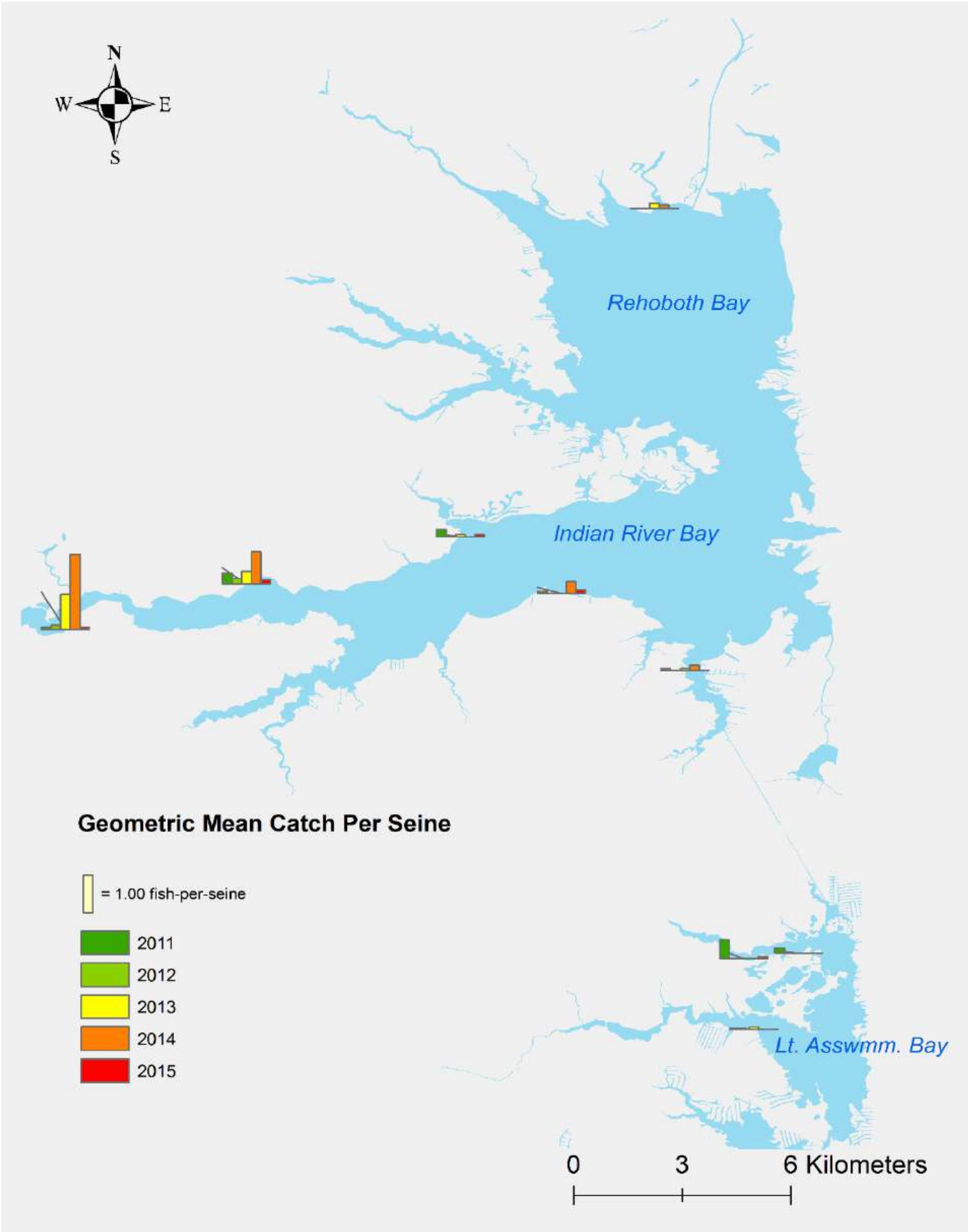


Figure 12. Geometric mean catch-per-seine since 2011 for Atlantic Croaker by site.

Atlantic Menhaden

A total of 879 Atlantic Menhaden were caught in 2015, for a geometric mean of 0.366 fish per seine, down from 2014 but above the time series mean and median (Figure 13). Seasonally, June was peak month for menhaden, a pattern seen throughout the survey (Figure 14). The majority of menhaden caught in 2015 were approximately 50 mm in length. Atlantic Menhaden were more abundant in Indian River Bay than in Little Assawoman Bay or Rehoboth Bay ($p < 0.001$, $p < 0.001$; Figure 15). Specifically, Atlantic Menhaden show a preference for up-river sites, which is supported by their negative correlation to salinity (Table 4).

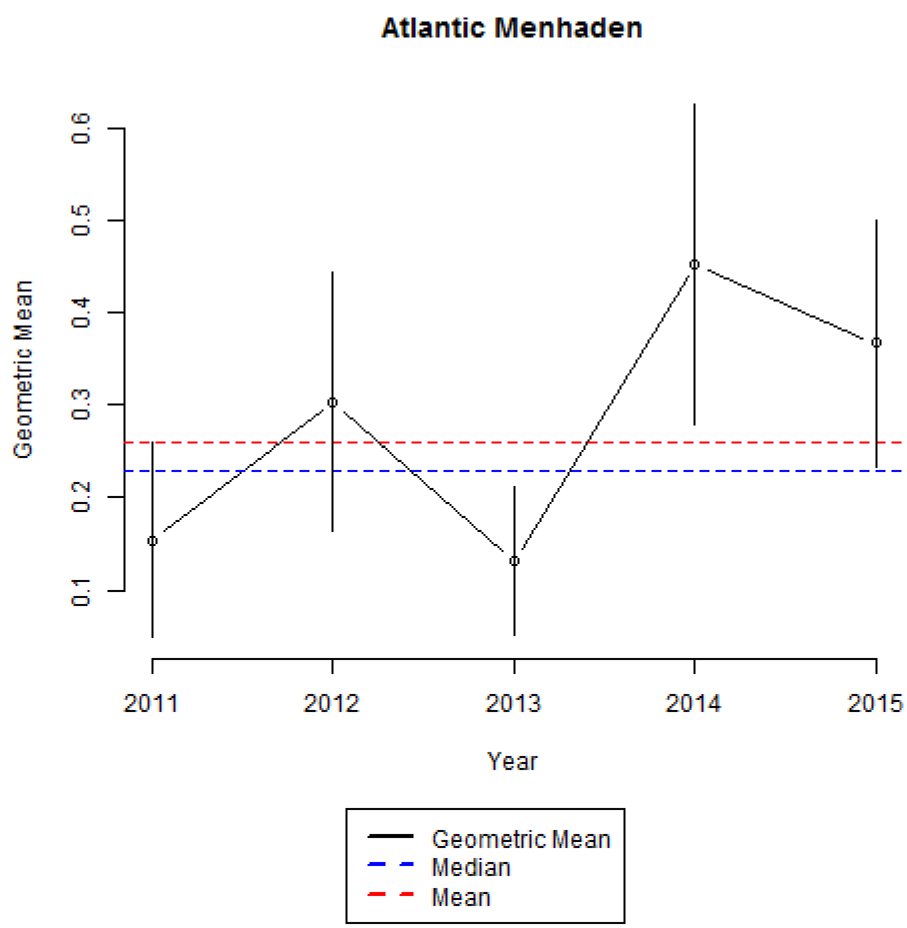


Figure 13. Geometric mean catch-per-seine for Atlantic Menhaden, with the time series mean and median.

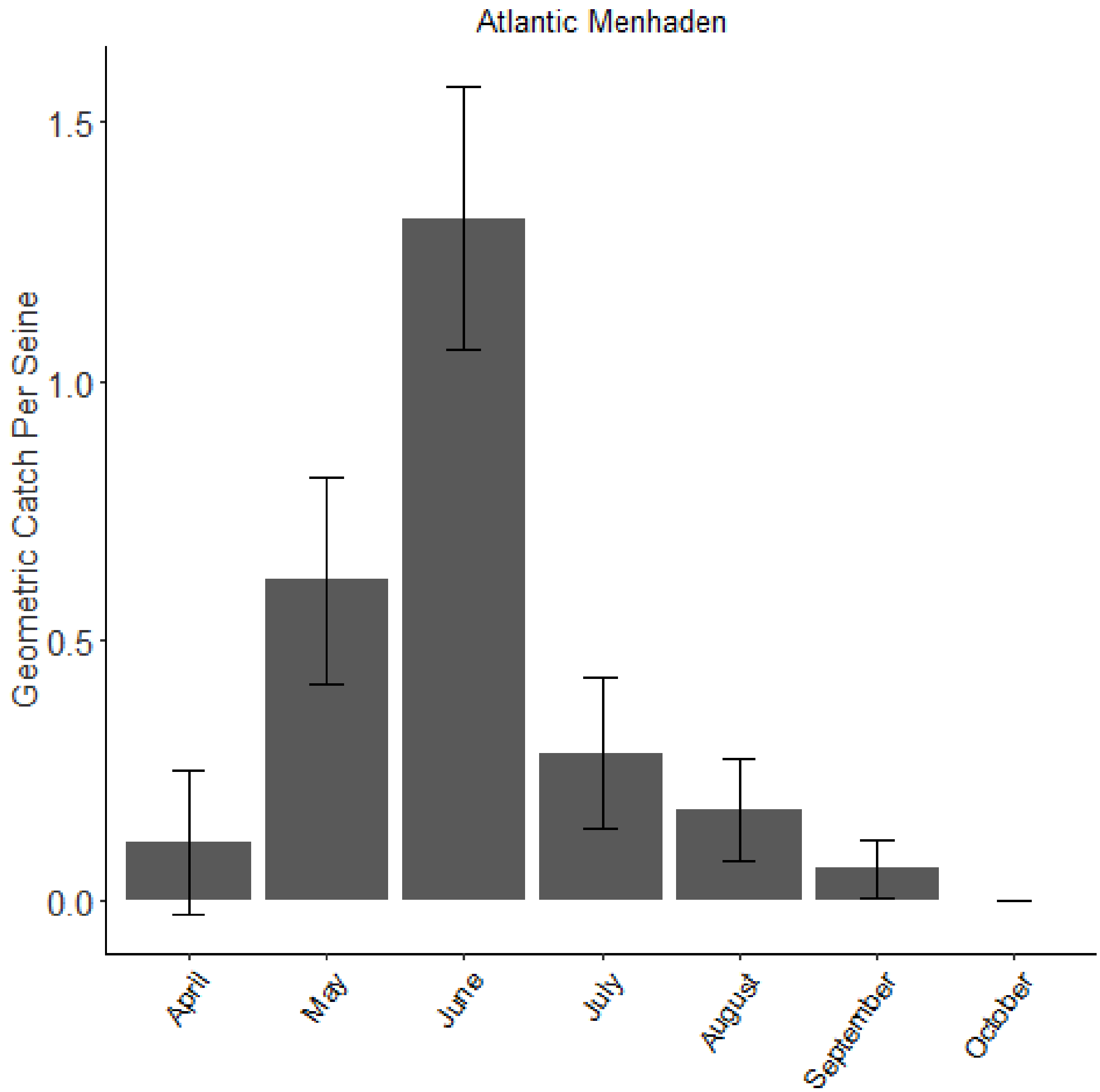


Figure 14. Geometric mean catch-per-seine since 2011 for Atlantic Menhaden by month.

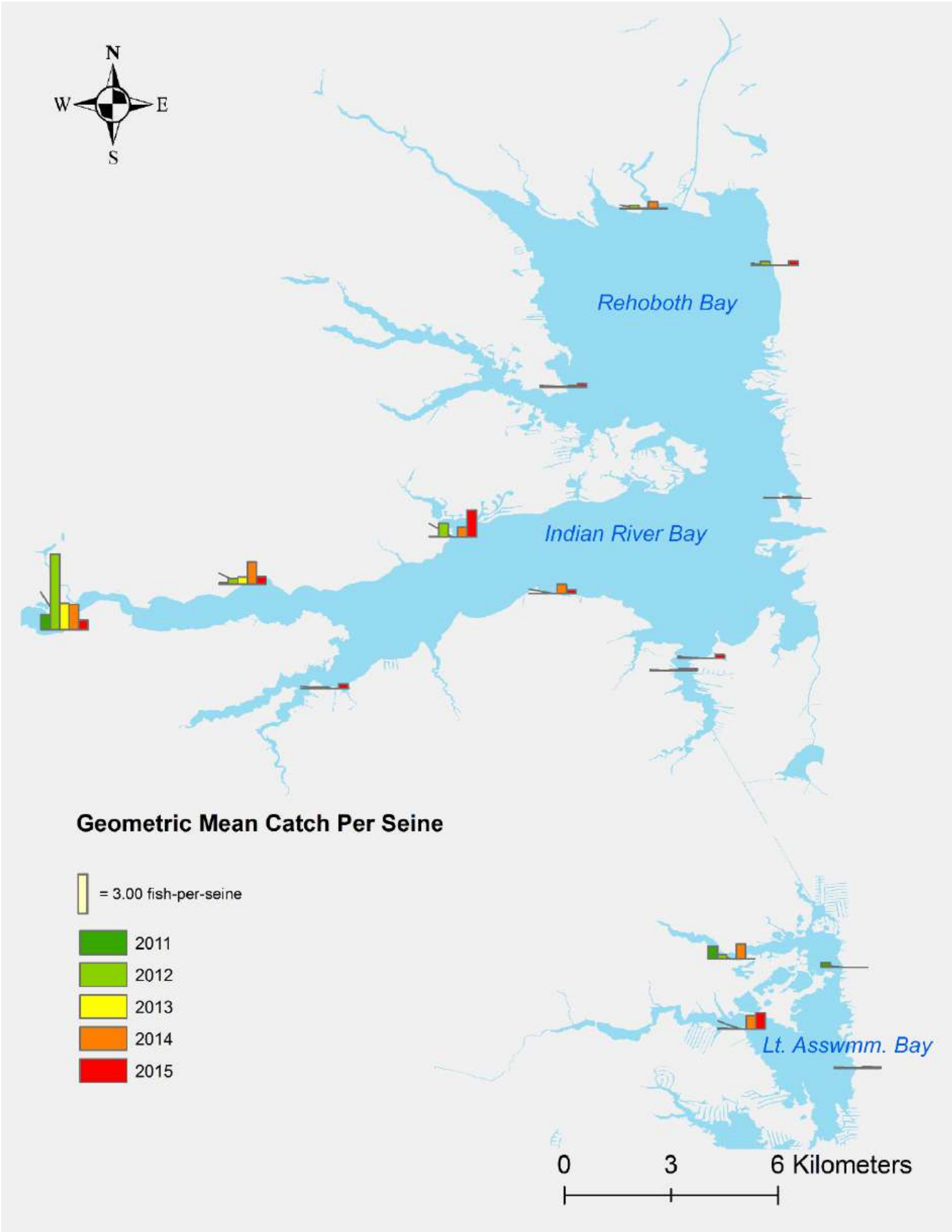


Figure 15. Geometric mean catch-per-seine since 2011 for Atlantic Menhaden by site.

Atlantic Silverside

A total of 29,829 Atlantic Silversides were caught in 2015, for a geometric mean catch of 28.51 fish per seine, the highest geometric mean of any year in the survey so far, and well above the time series mean and median (Figure 16). Atlantic Silversides are a critical forage species in the Inland Bays, and are consistently one of the top five most abundant species in this survey. The most productive month was August in 2015, but the species is common and widespread throughout the Inland Bays during all survey months, and has been most abundant in September grouping all survey years together (Figure 17). This species utilizes the inshore areas throughout its life cycle as evidenced by the large numbers of specimens caught at this species' maximum and minimum lengths (Figure 7). Atlantic Silverside catch was significantly greater in Rehoboth Bay than in Indian River Bay ($p < 0.001$) and greater in Little Assawoman Bay than Indian River Bay ($p < 0.01$; Figure 18). Specifically, Atlantic Silverside do not appear to be utilizing the less saline, upper portions of Indian River, which is supported by their positive correlation to salinity (Table 4).

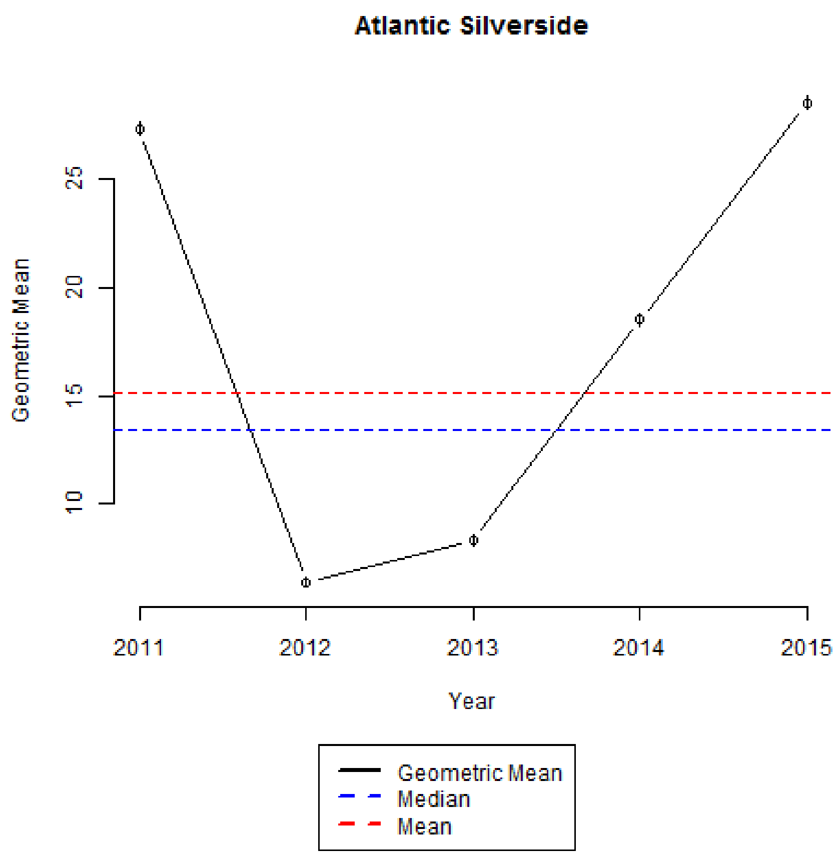


Figure 16. Geometric mean catch-per-seine for Atlantic Silverside, with the time series mean and median.

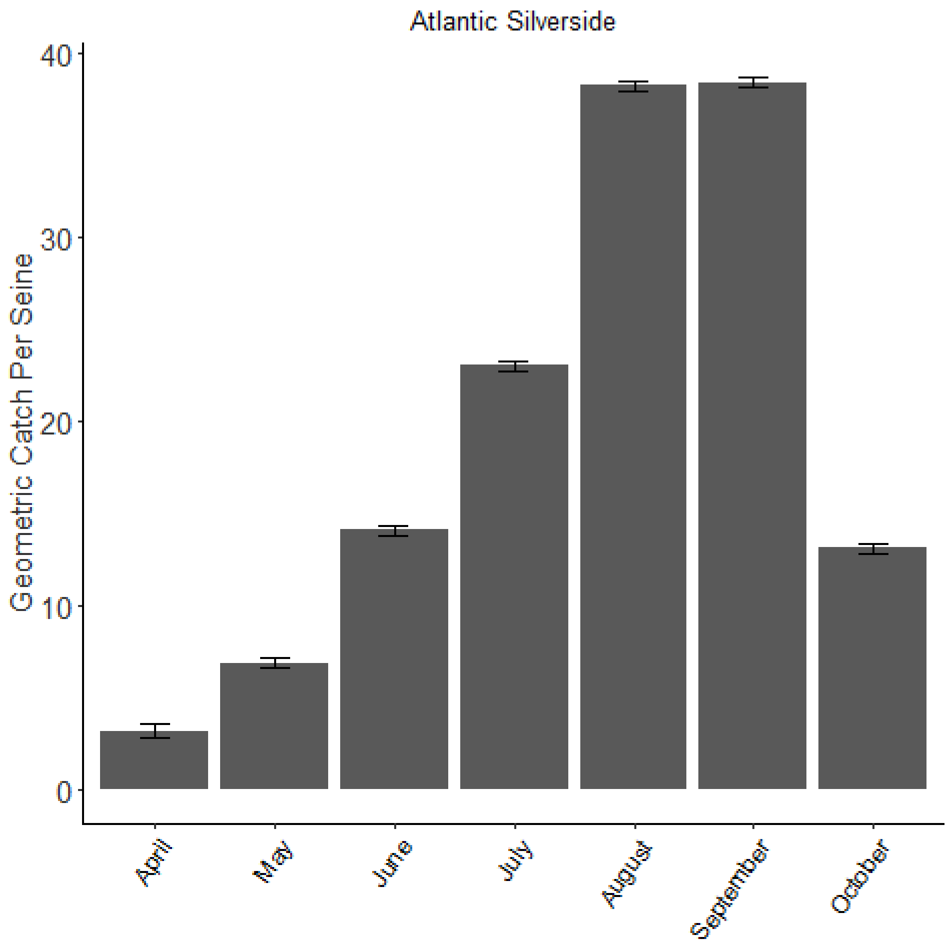


Figure 17. Geometric mean catch-per-seine since 2011 for Atlantic Silverside by month

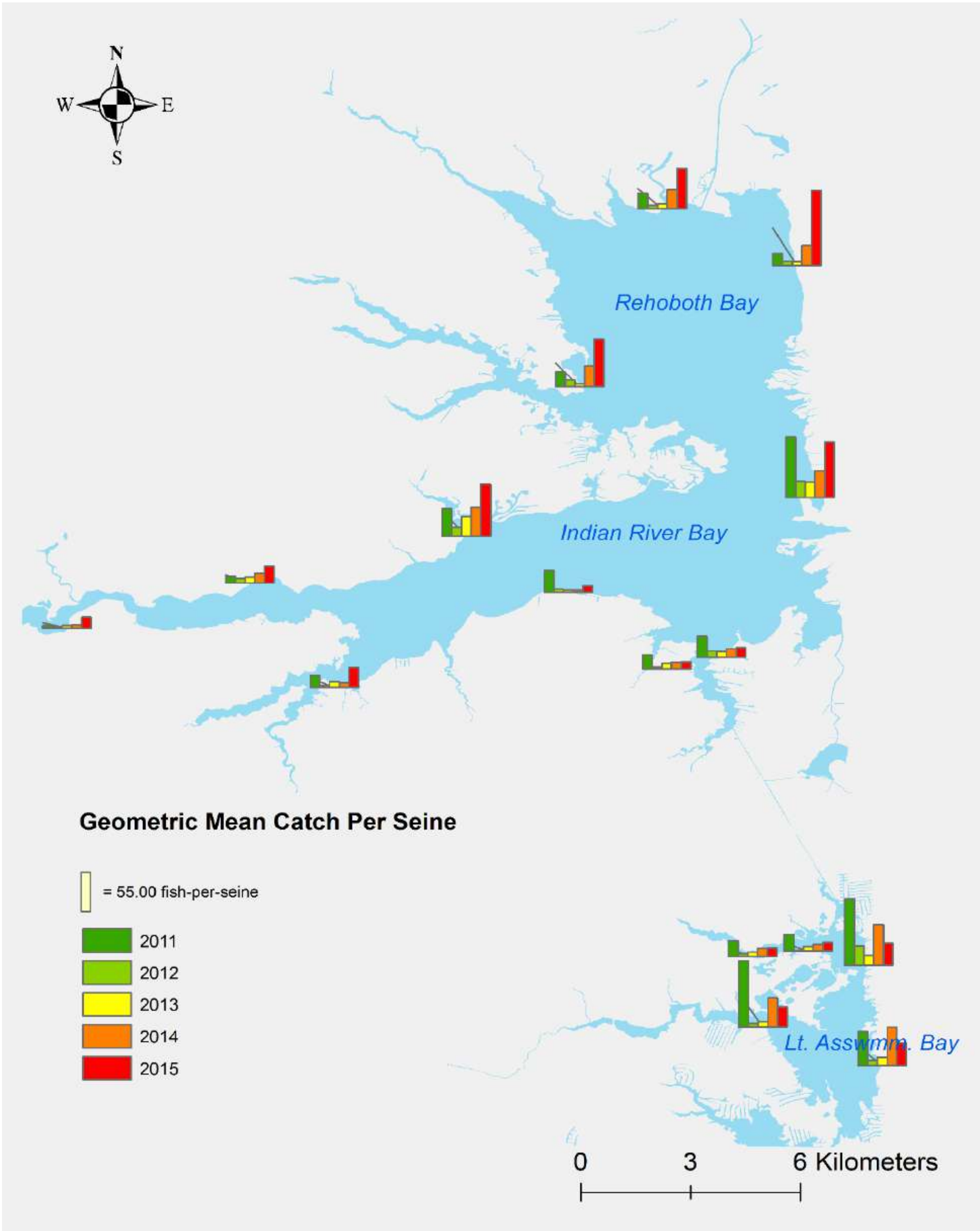


Figure 18. Geometric mean catch-per-seine since 2011 for Atlantic Silverside by site.

Bay Anchovy

66 Bay Anchovy were caught in 2015 for a geometric mean catch of 0.09 fish per seine, the lowest geometric mean of any year so far, and well below the time series mean and median (Figure 19). The DNREC open water trawl survey also reported a decrease in the mean abundance of Bay Anchovy from 2014 to 2015 (Greco 2016). While Bay Anchovy are consistently among the top 20 most abundant species collected in this study, they are caught in much larger numbers by the DNREC open water trawl survey and have historically dominated that study's catch totals (Greco 2016). The consistently greater catch numbers from the DNREC study suggest that Bay Anchovy prefer the open waters sampled by DNREC, as opposed to the inshore waters sampled in this study. This claim is also supported by their preference for high tides over mid and low tides, and their preference for mid tides over low tides. August was the most productive month for Bay Anchovy in 2015, similar to the seasonality shown for the first 5 years of this survey (Figure 20). Bay Anchovy have been more abundant in Indian River Bay than Rehoboth Bay ($p < 0.05$). Specifically, Bay Anchovy appear to utilize two of the least saline sites in the survey (Sandy Beach Site #8, and Sassafras Landing Site #18; Figure 21) more so than other areas, which underlies the importance of these upriver areas for the Bay Anchovy population. This utilization of less saline environments is in line with their negative correlation to salinity (Table 4), and with movement patterns seen in other studies (Wang and Kernehan 1979; Dovel 1981). The majority of Bay Anchovy caught were less than 50 mm in length.

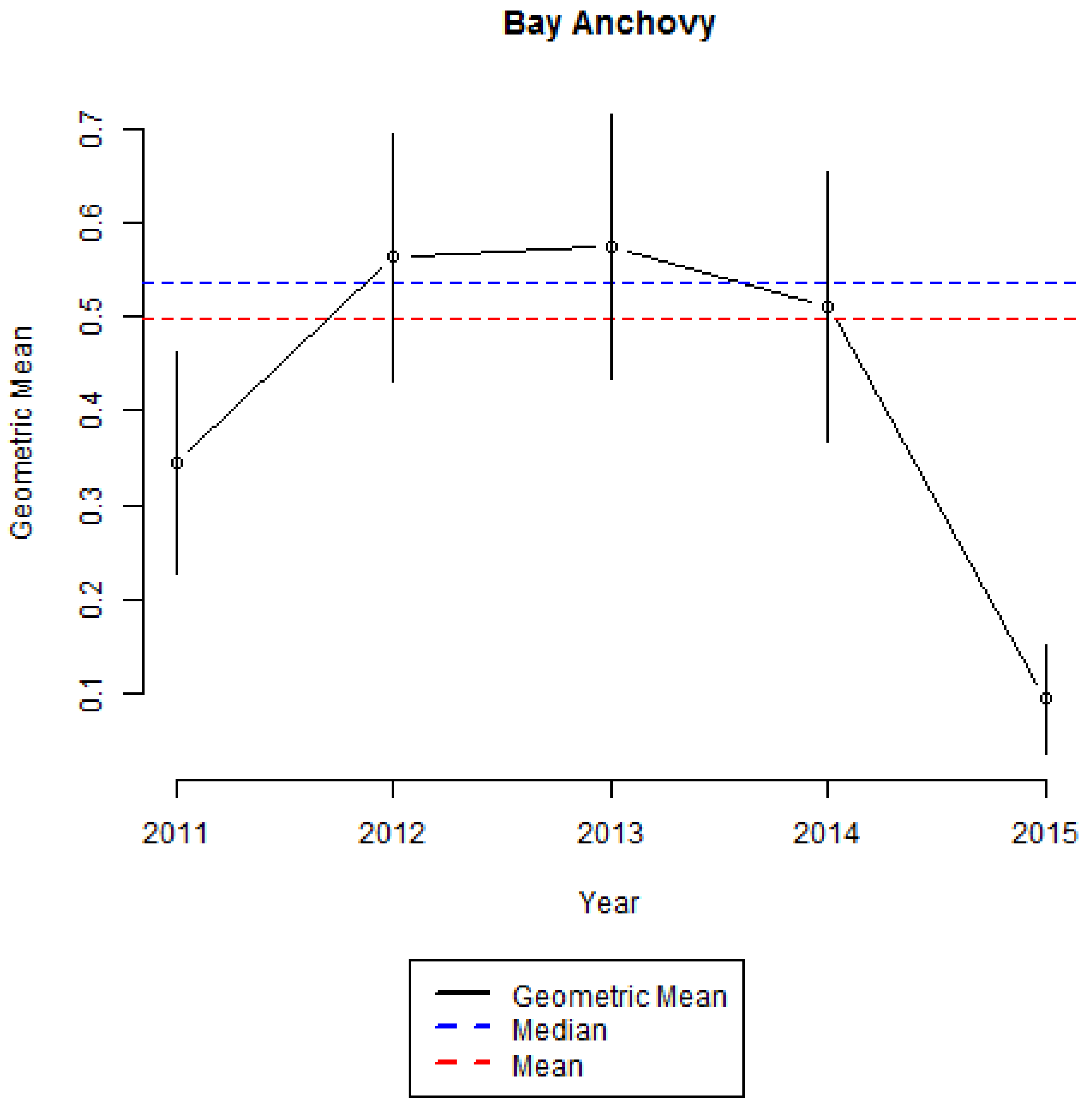


Figure 19. Geometric mean catch-per-seine for Bay Anchovy, with the time series mean and median.

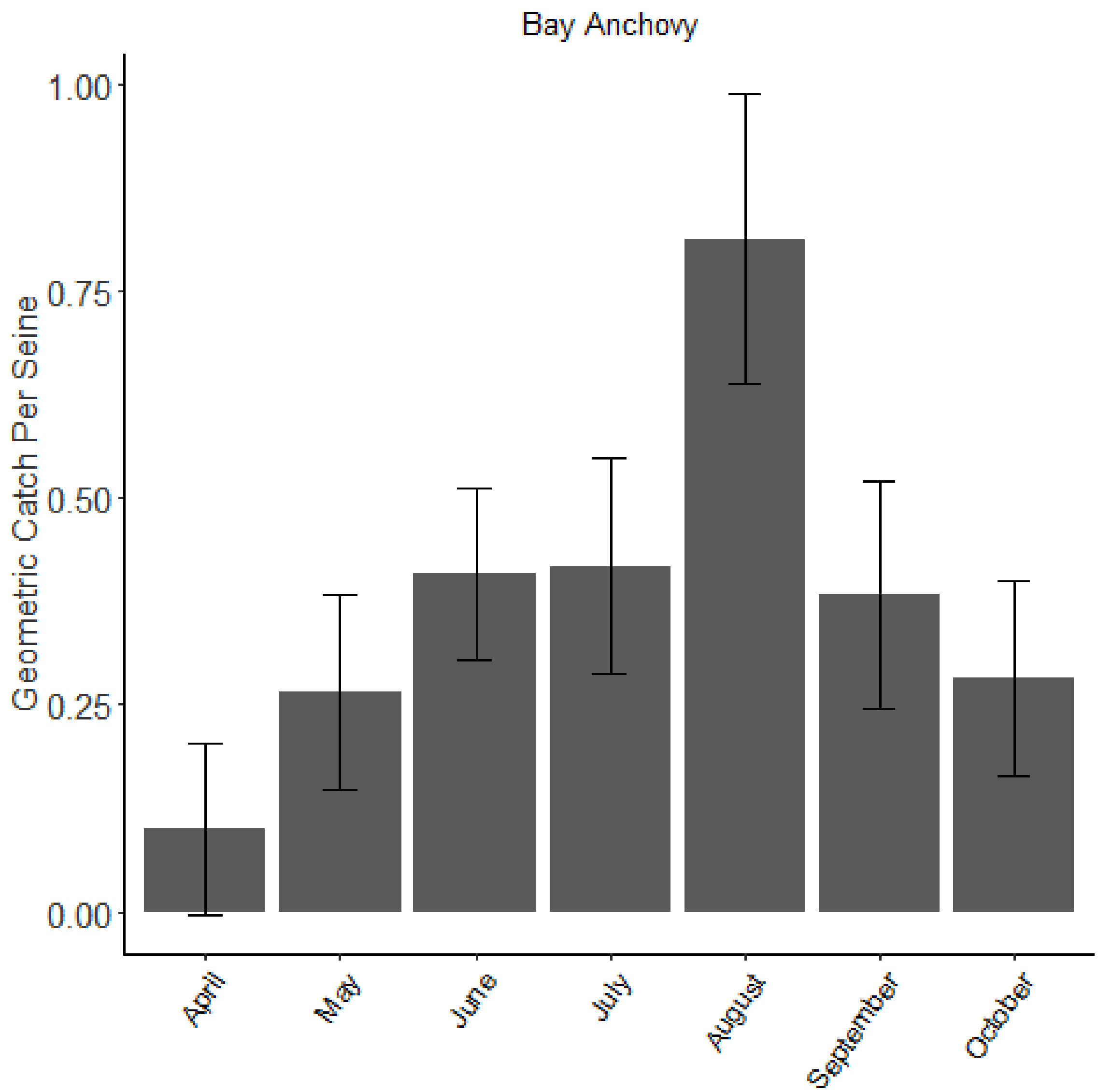


Figure 20. Geometric mean catch-per-seine since 2011 for Bay Anchovy by month.

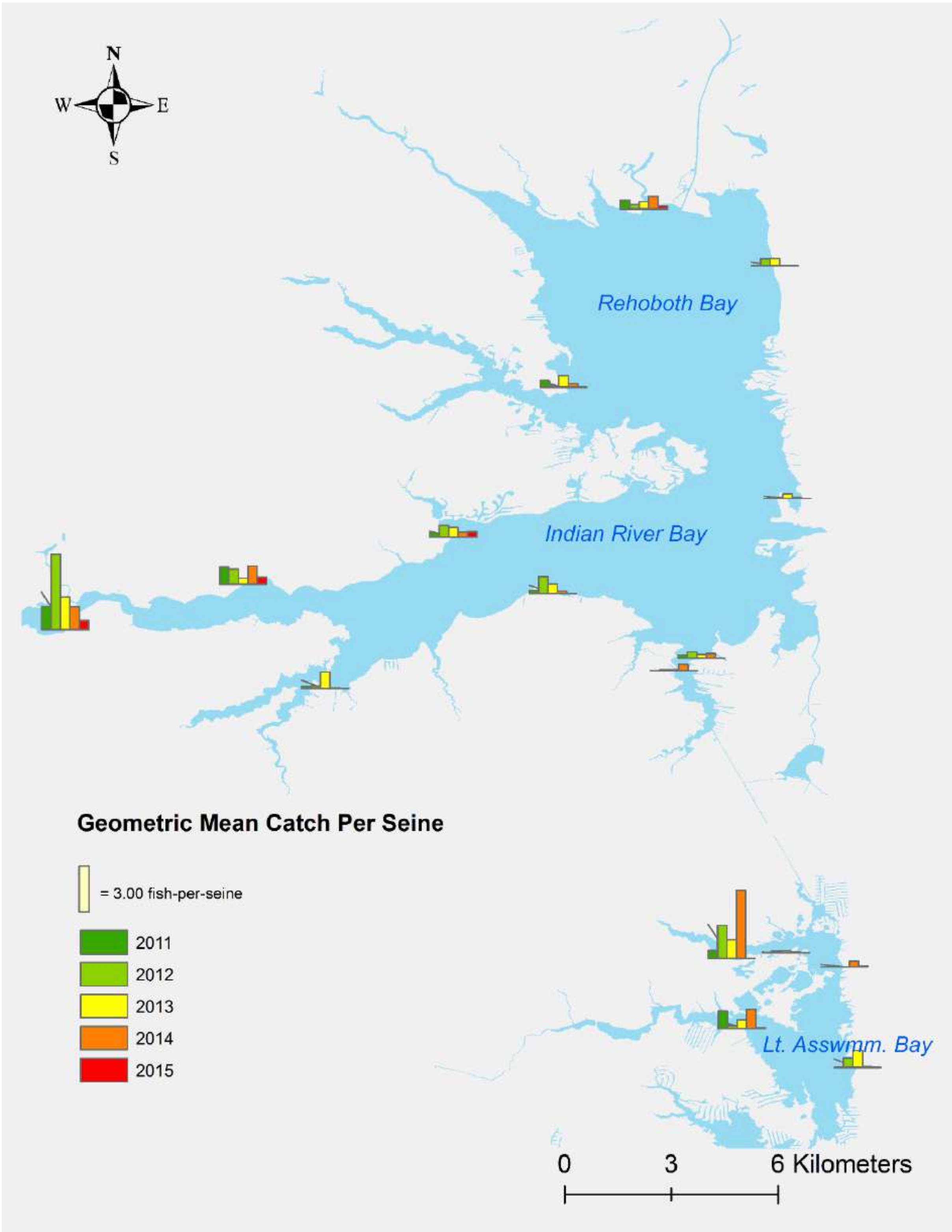


Figure 21. Geometric mean catch-per-seine since 2011 for Bay Anchovy by site.

Bluefish

A total of 31 Bluefish were captured in 2015, for a geometric mean of 0.073 fish per seine, less than 2014 and below the time series mean and median (Figure 22). Since 2011, June has been the most productive month for Bluefish (Figure 23). No Bluefish exceeded 165 mm in length, indicating that adults and larger juveniles do not use the inshore areas sampled in this study. Bluefish abundance did not differ between bays (Figure 24).

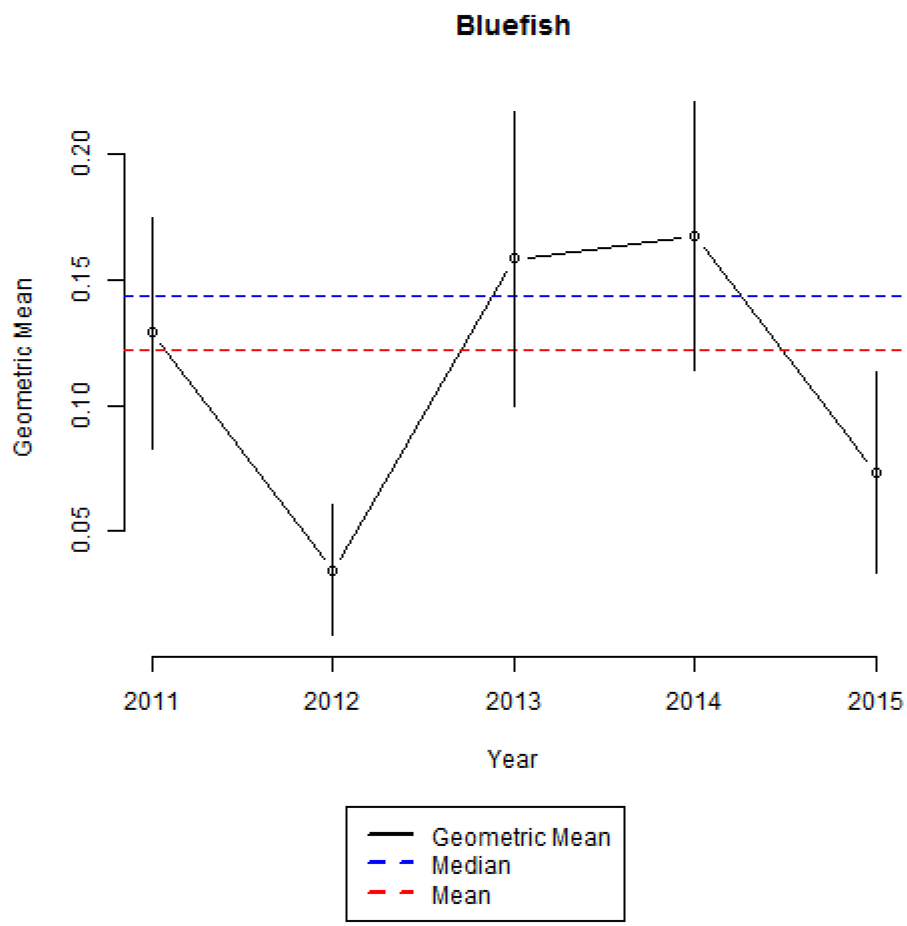


Figure 22. Geometric mean catch-per-seine for Bluefish, with the time series mean and median.

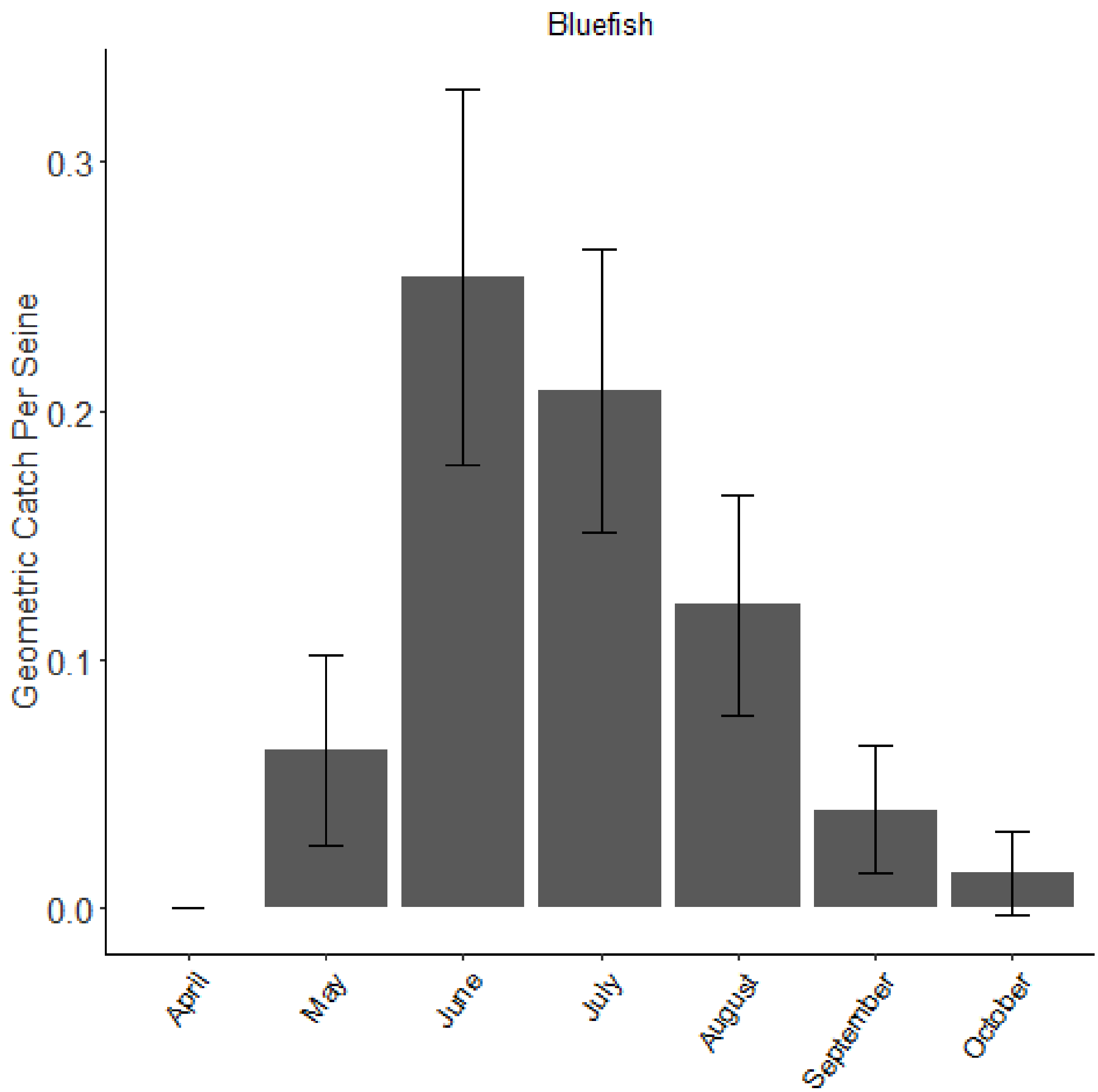


Figure 23. Geometric mean catch-per-seine since 2011 for Bluefish by month.

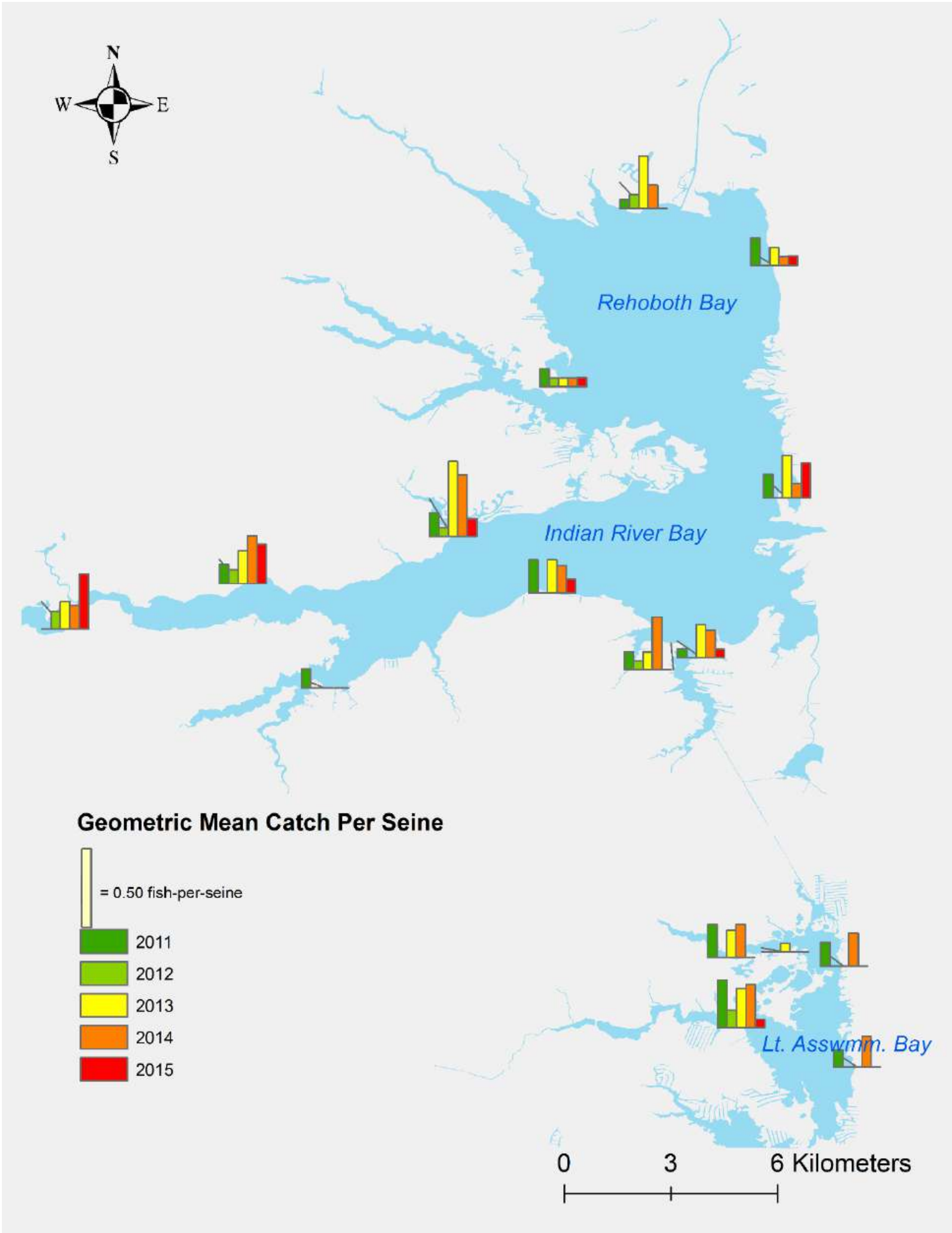


Figure 24. Geometric mean catch-per-seine since 2011 for Bluefish by site.

Mummichog

A total of 18,418 Mummichog were caught in 2015, for a geometric mean of 6.47 fish per seine, greater than 2014 and above the time series mean and median (Figure 25). Mummichog were present in large numbers every month with June being the most productive month since 2011 (Figure 26), and all size classes of this species were present, confirming the importance of inshore areas to this species. Mummichog have consistently been the most or second most abundant species in this study. Mummichog were more abundant in Indian River Bay than in Little Assawoman Bay or Rehoboth Bay ($p < 0.001$, $p < 0.001$), and more abundant in Little Assawoman Bay than Rehoboth Bay ($p < 0.01$). Mummichog do not appear to heavily utilize sites in the upper portions of Rehoboth Bay (Figure 27).

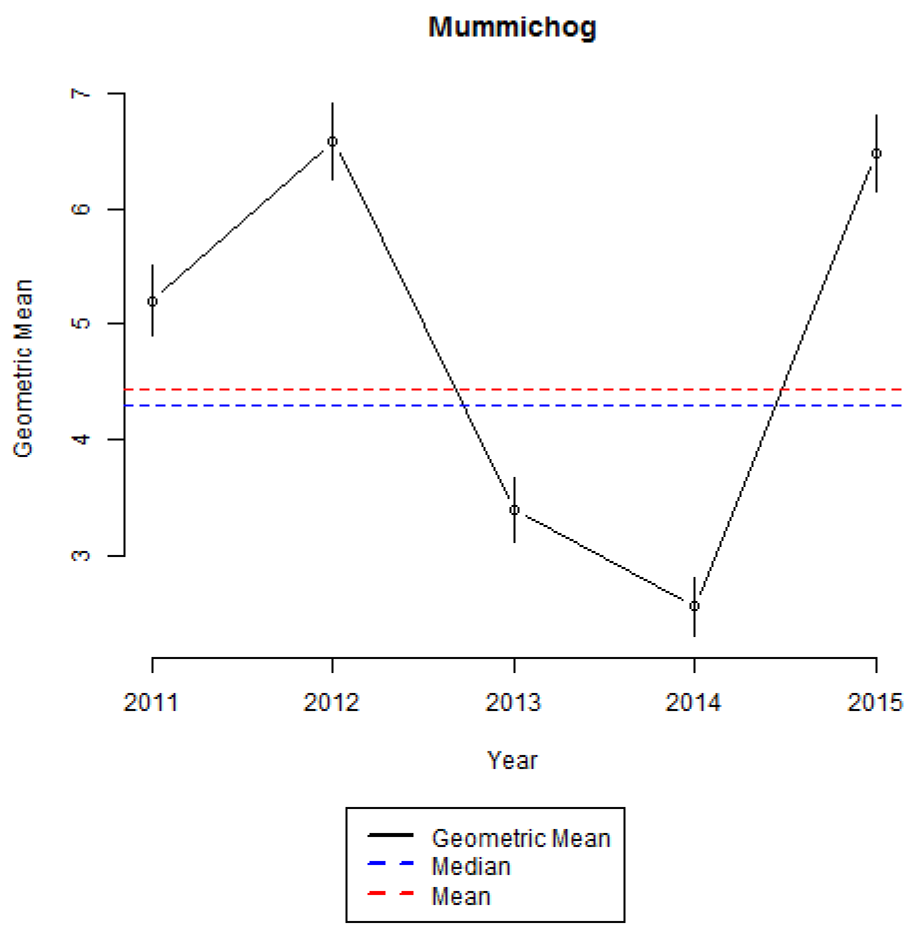


Figure 25. Geometric mean catch-per-seine for Mummichog, with the time series mean and median.

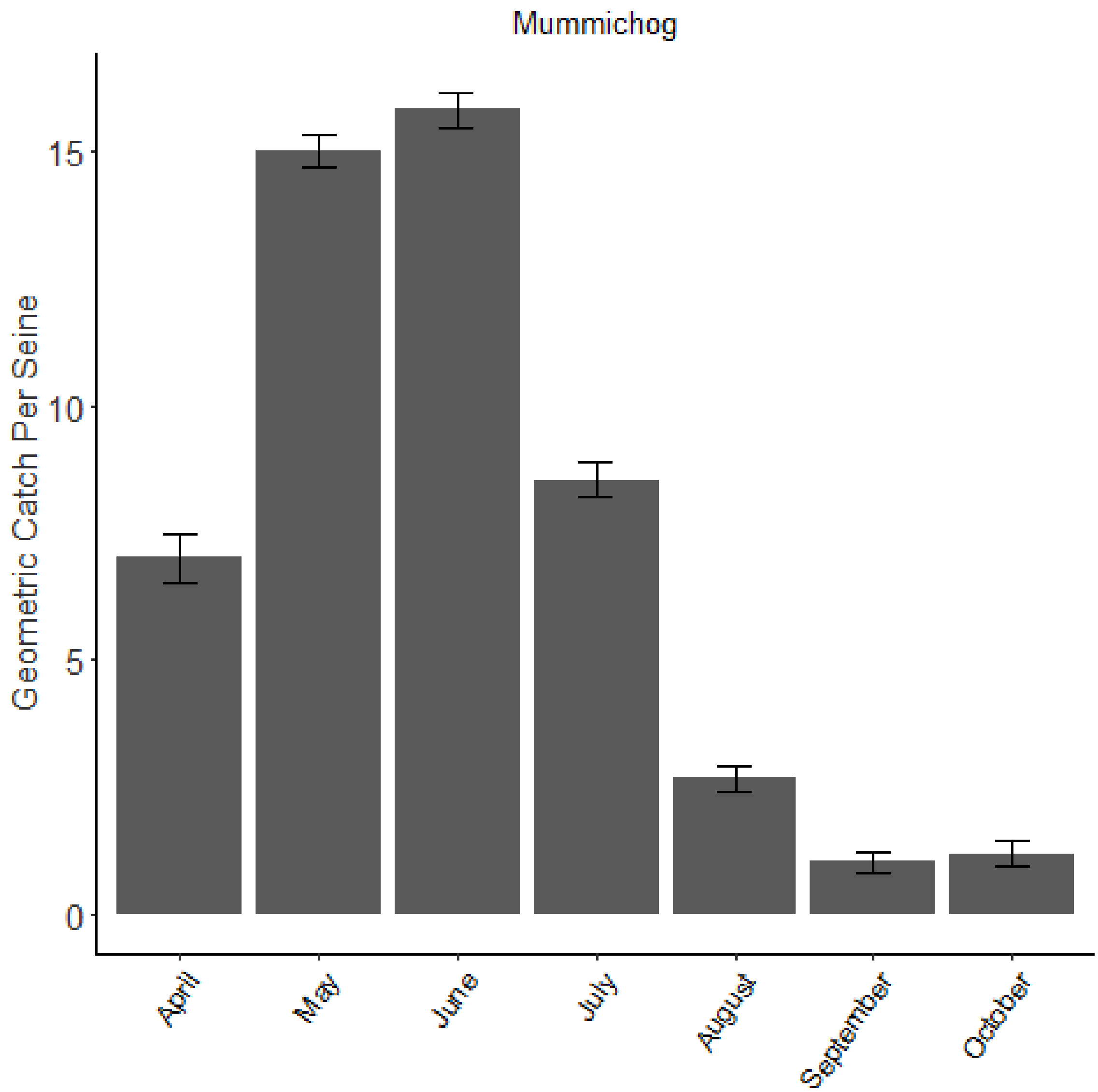


Figure 26. Geometric mean catch-per-seine since 2011 for Mummichog by month.

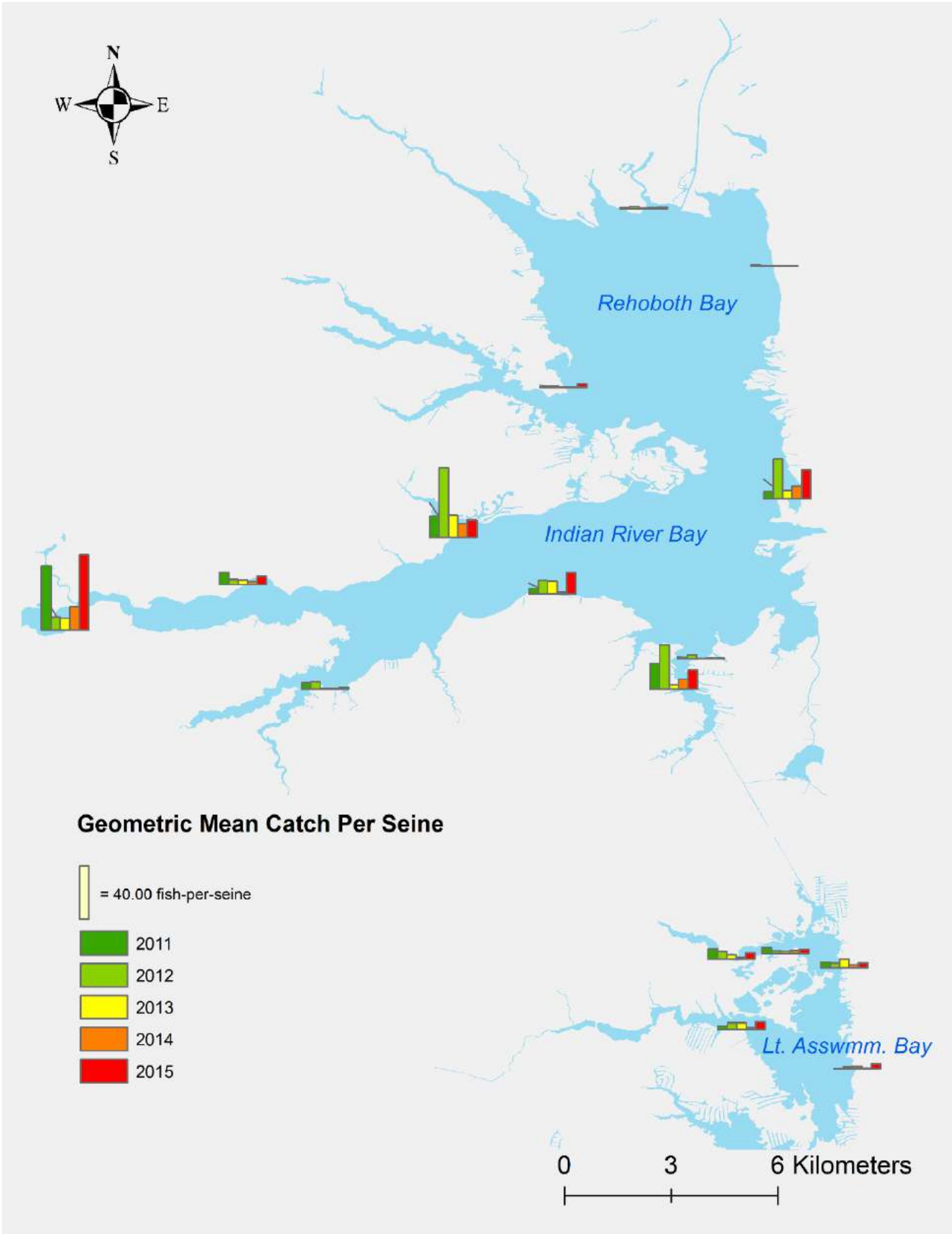


Figure 27. Geometric mean catch-per-seine since 2011 for Mummichog by site.

Silver Perch

641 Silver Perch were caught in 2015, for a geometric mean of 0.49 fish per seine, above the time series mean and median (Figure 28). Since 2011, August has been the most productive month for Silver Perch, a pattern also seen in 2015 (Figure 29). The majority of Silver Perch caught were less than 100 mm. Since 2011 Silver Perch have been more abundant in Indian River Bay than in Little Assawoman Bay and Rehoboth Bay ($p < 0.001$, $p < 0.01$), and more abundant in Rehoboth Bay than Little Assawoman Bay ($p < 0.01$; Figure 30).

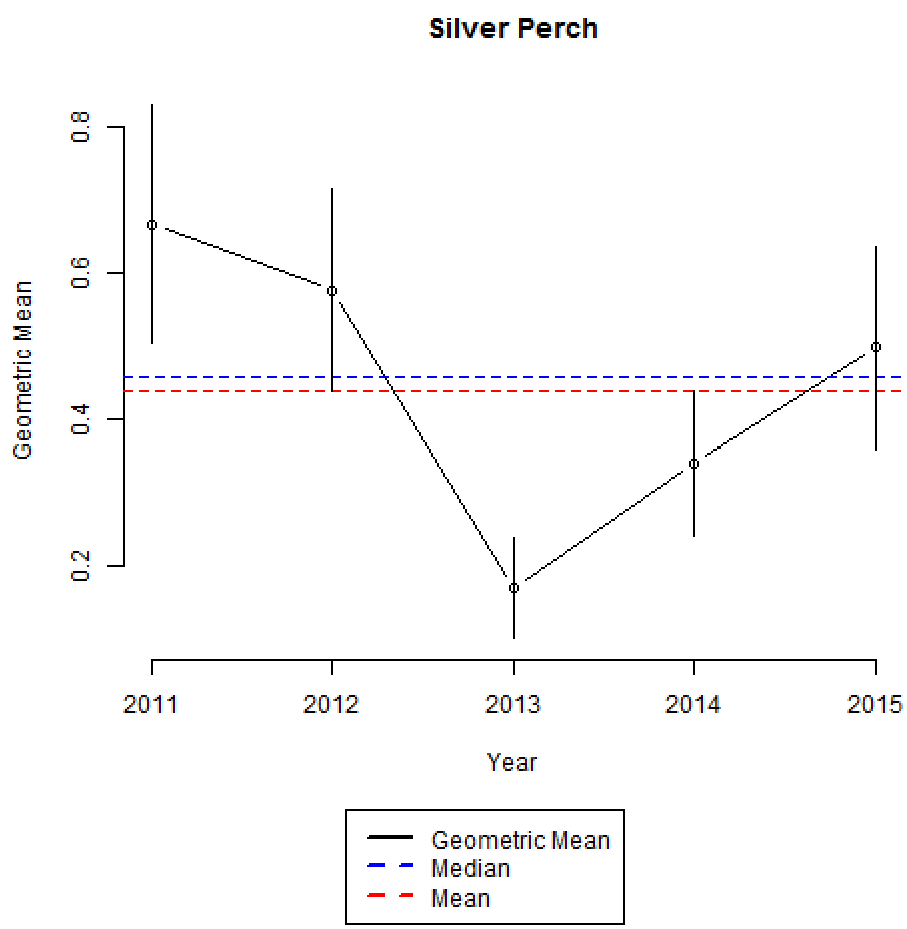


Figure 28. Geometric mean catch-per-seine for Silver Perch, with the time series mean and median.

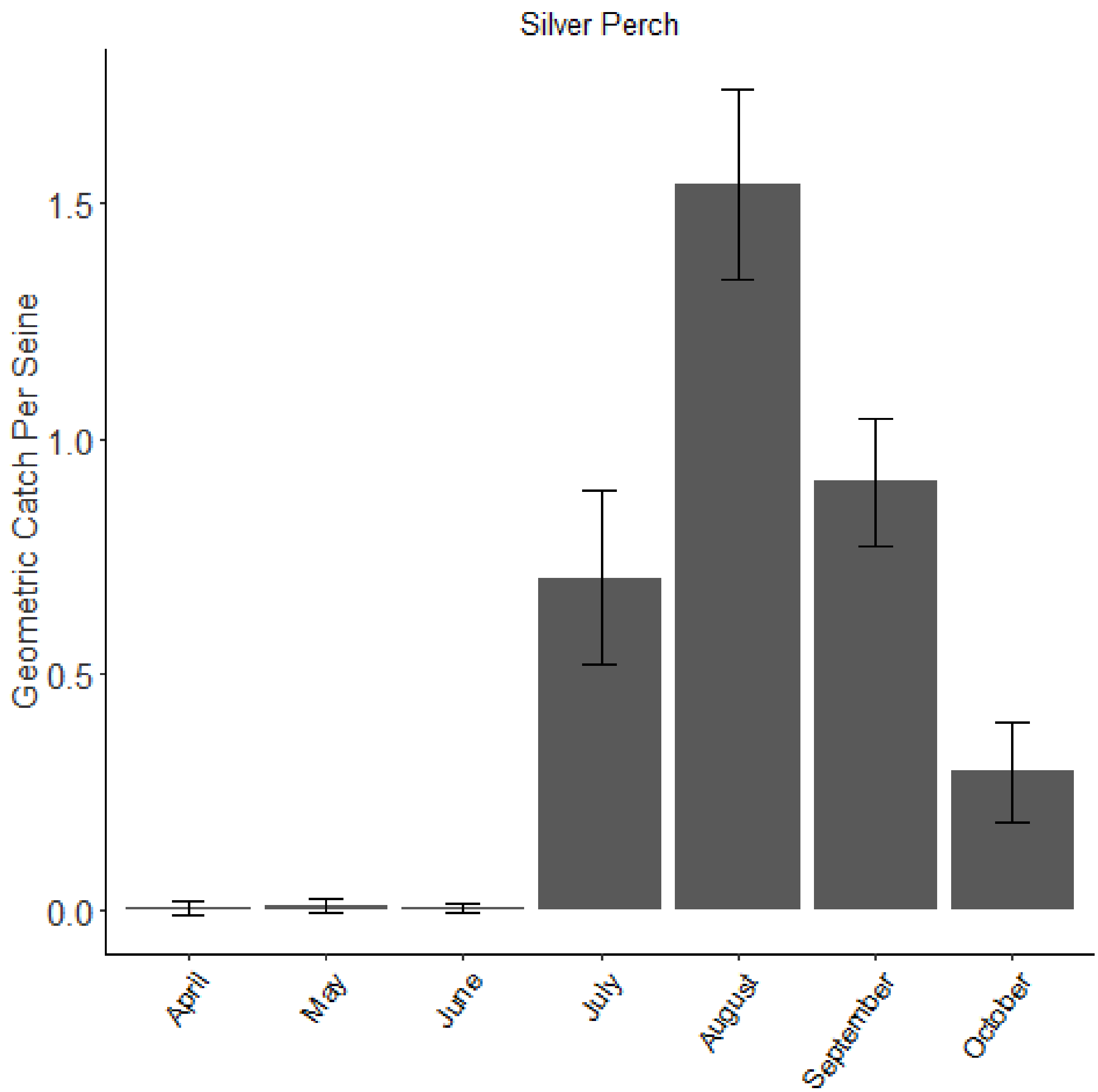


Figure 29. Geometric mean catch-per-seine since 2011 for Silver Perch by month.

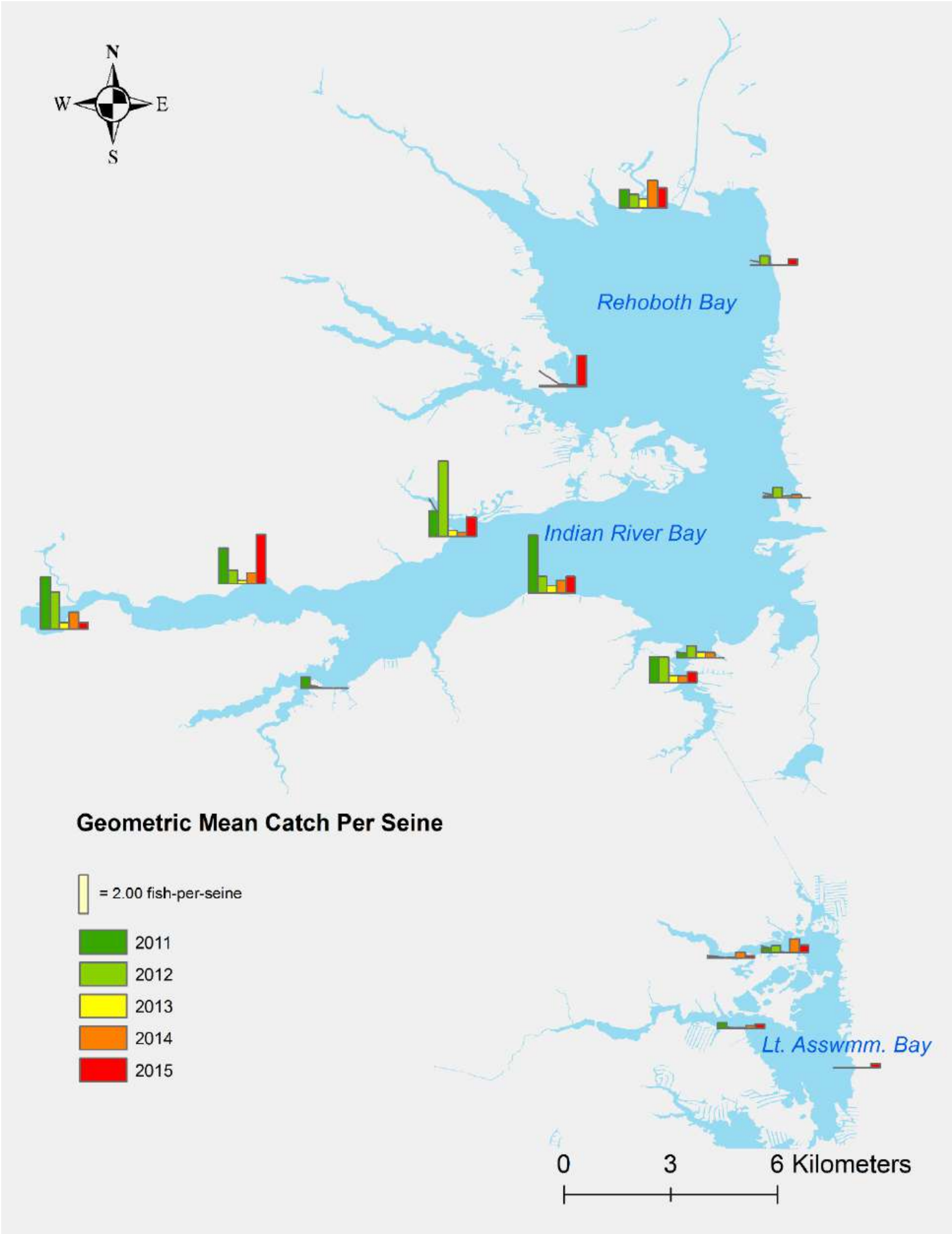


Figure 30. Geometric mean catch-per-seine since 2011 for Silver Perch by site.

Spot

A total of 193 Spot were caught in 2015, for a geometric mean of 0.15 fish per seine, an increase over 2014, but below the time series mean and median (Figure 31). Spot exhibit dramatic annual differences in abundance of young-of-the-year in the mid-Atlantic (Pacheco and Grant 1973; Able and Fahay 2010). Since 2011 June has been the peak month for Spot abundance, driven largely by the dominant year class of 2014 (Figure 32). The majority of Spot were approximately 100 mm. Spot have been more abundant in Indian River Bay than in Rehoboth Bay ($p < 0.01$; Figure 33).

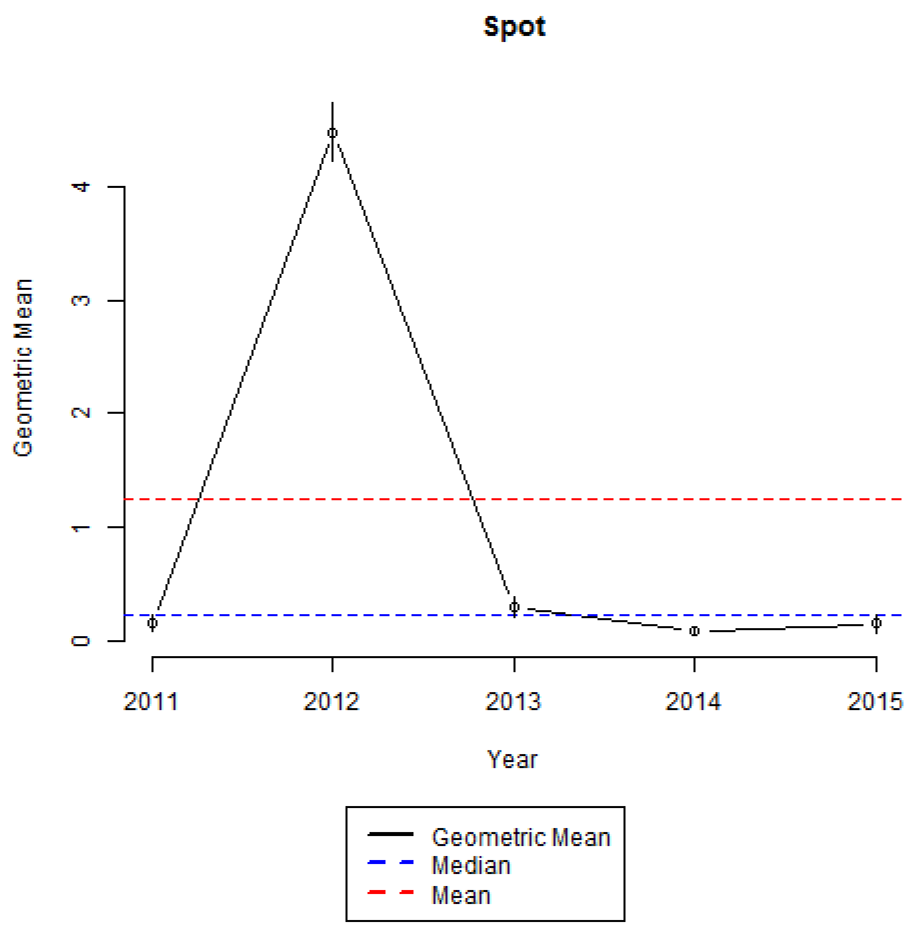


Figure 31. Geometric mean catch-per-seine for Spot, with the time series mean and median.

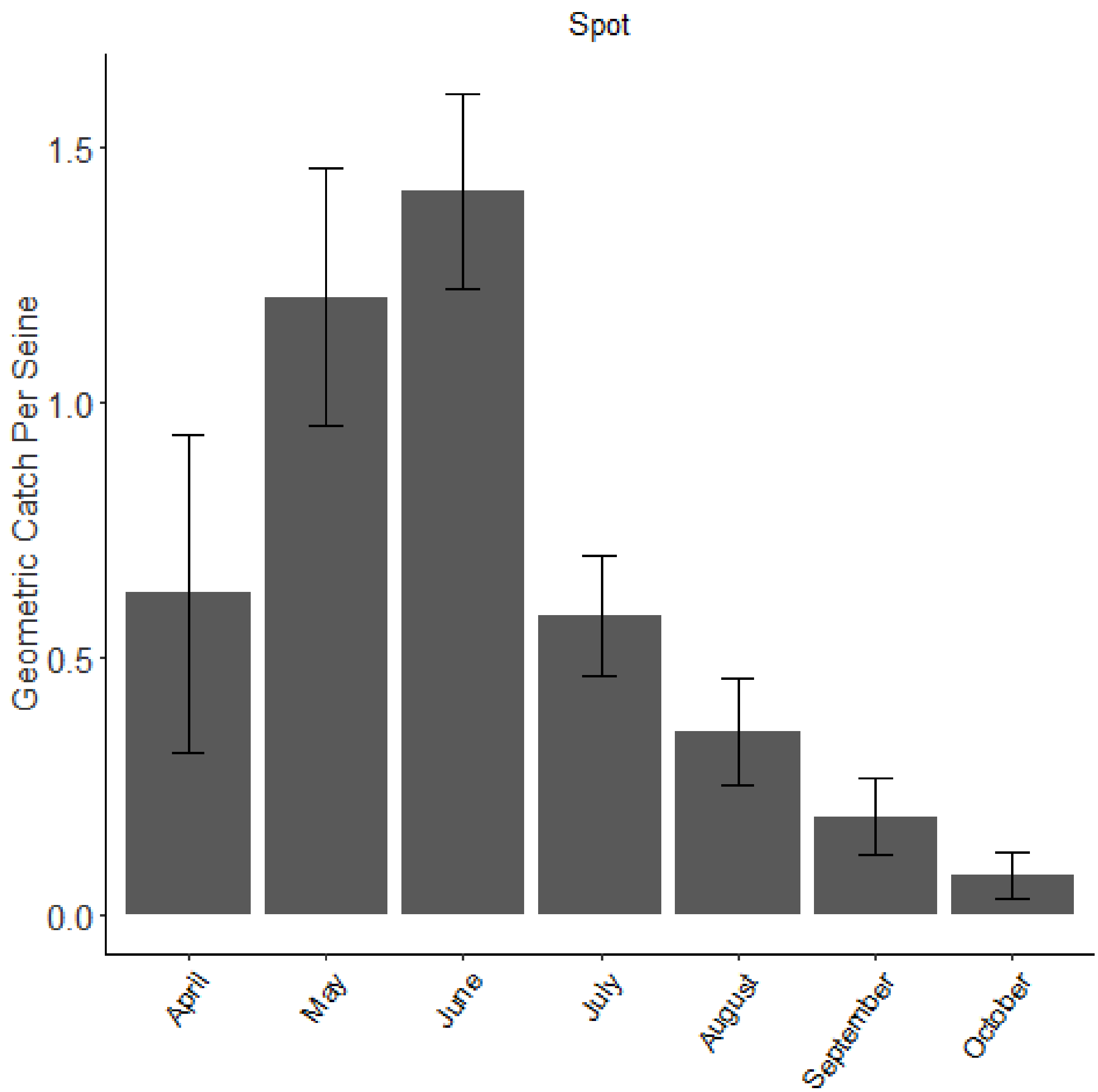


Figure 32. Geometric mean catch-per-seine since 2011 for Spot by month.

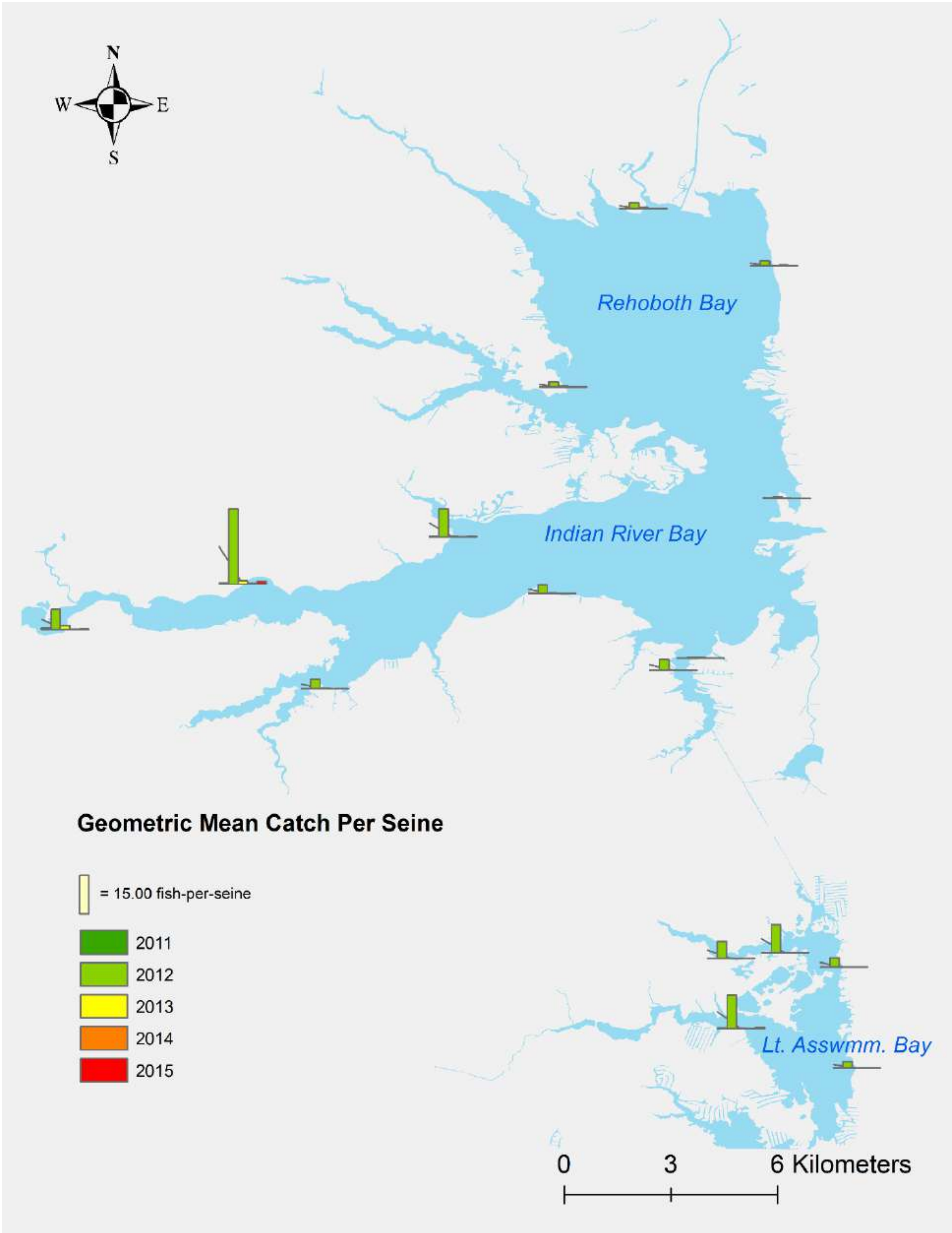


Figure 33. Geometric mean catch-per-seine since 2011 for Spot by site.

Striped Bass

Similar to all previous survey years, the inshore areas were not heavily utilized by Striped Bass in 2015. Only five fish were caught, for a geometric mean of 0.017 fish per seine, below the time series mean and median (Figure 34). Most individuals taken in the first five years of the survey have been juveniles measuring less than 200 mm and have been captured in July (Figure 35). Catch has not differed between the bays, though the upper portions of the Little Assawoman Bay appear to have the highest geometric mean catch per seine values since 2011 (Figure 36).

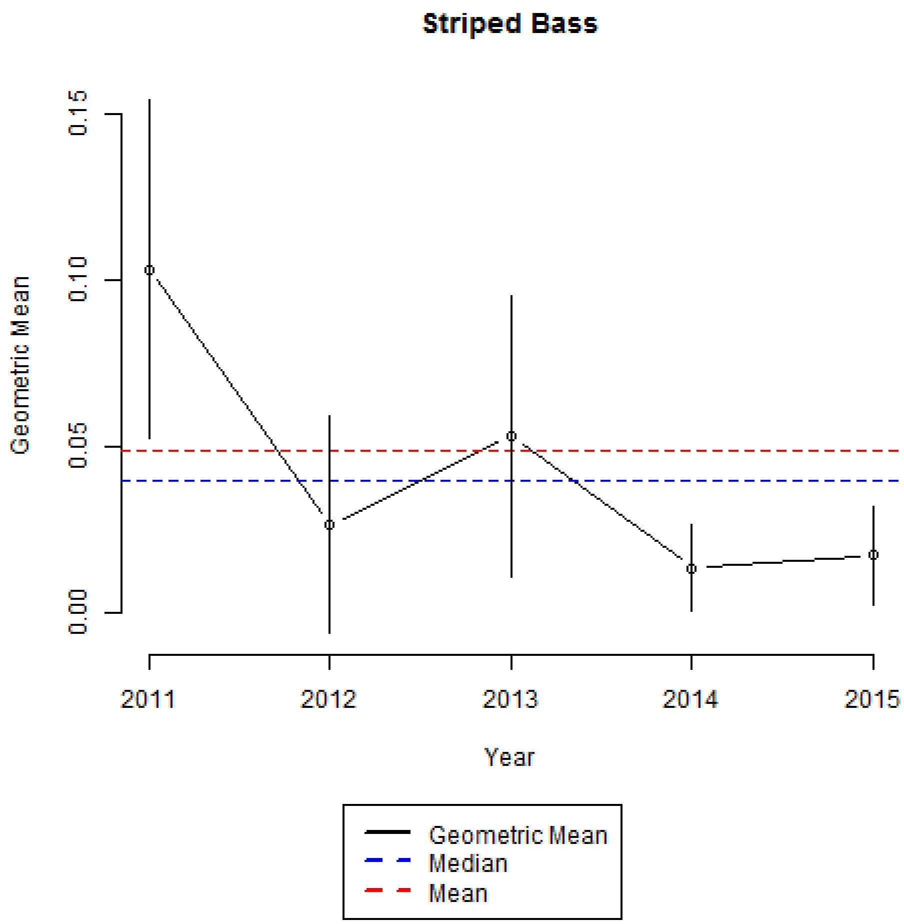


Figure 34. Geometric mean catch-per-seine for Striped Bass, with the time series mean and median.

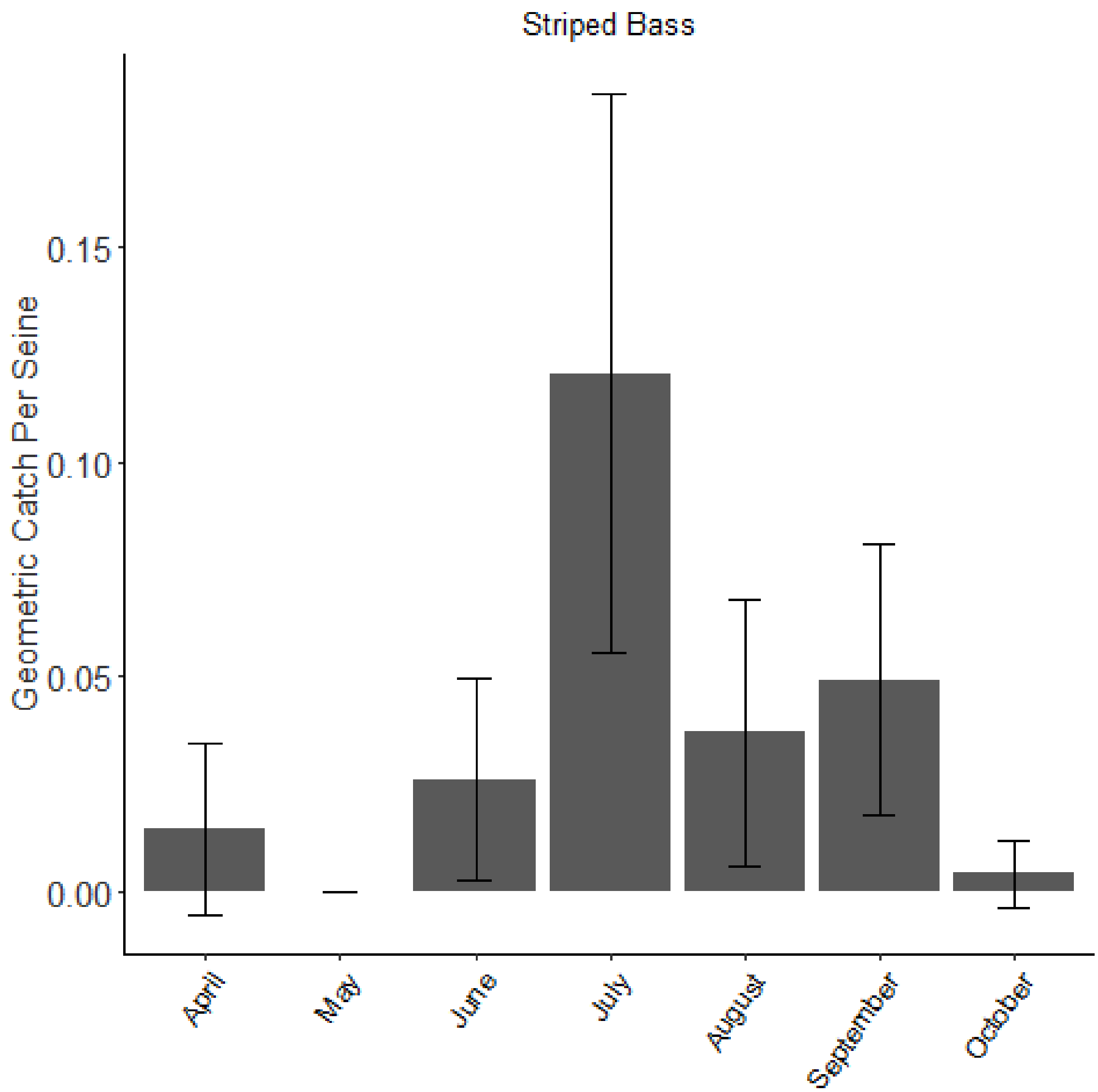


Figure 35. Geometric mean catch-per-seine since 2011 for Striped Bass by month.

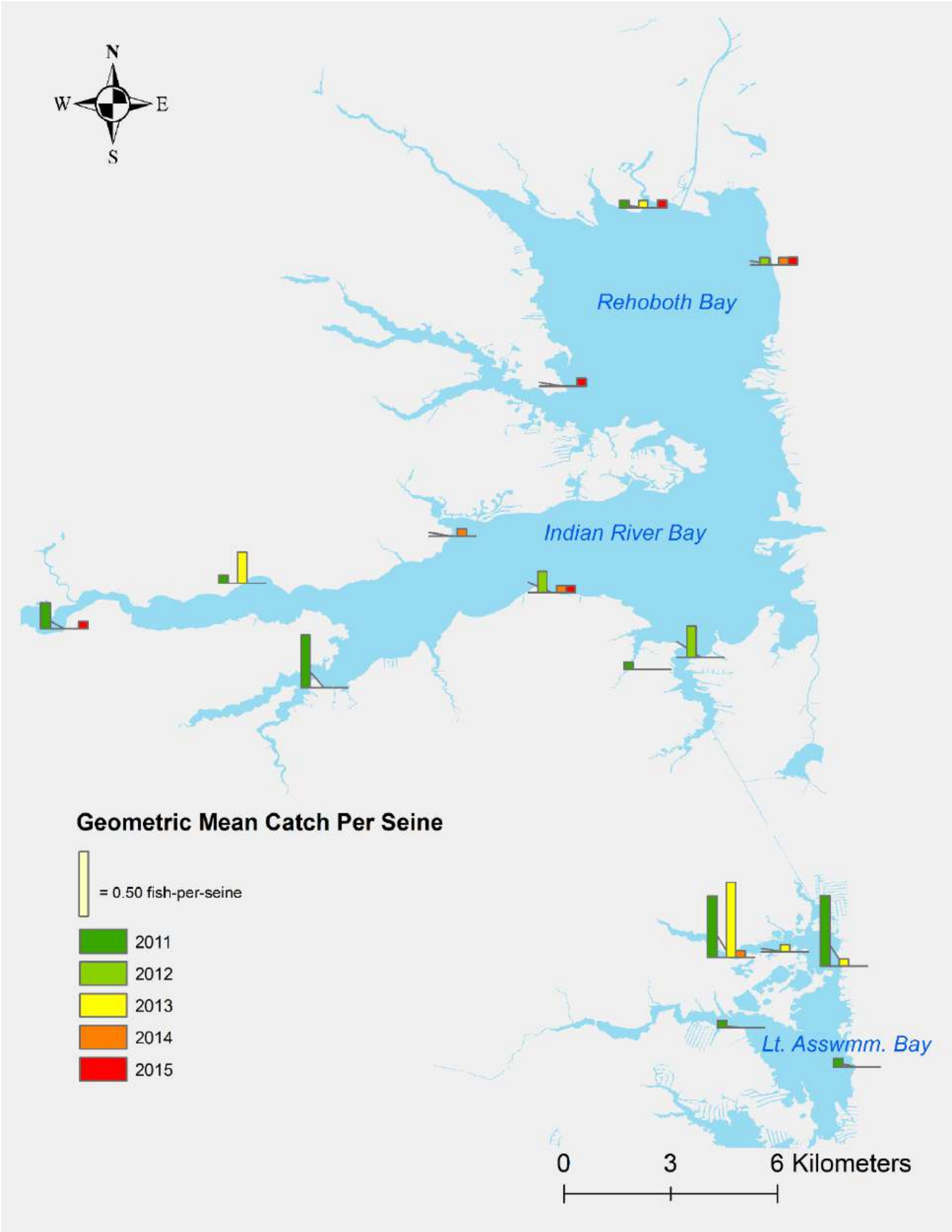


Figure 36. Geometric mean catch-per-seine since 2011 for Striped Bass by site.

Striped Killifish

6,554 Striped Killifish were caught in 2015, for a geometric mean of 3.61 fish per seine, greater than 2014 and above the time series median but below the mean (Figure 37). Like Atlantic Silversides and Mummichog, Striped Killifish are consistently one of the top 3 most abundant species every year. All size classes are present throughout the survey period, and Striped Killifish are widespread and abundant in every month of the survey with a peak in June (Figure 38), indicating the importance of the inshore areas to this species. Striped Killifish catch has been greater in Indian River Bay than in Little Assawoman Bay ($p < 0.01$), and greater in Rehoboth Bay than in Little Assawoman Bay ($p < 0.05$). Specifically, Striped Killifish catch has been substantially greater at Kayak Launch (Site #1) in Rehoboth Bay (Figure 39). Kayak Launch is generally one of the more saline sites in the survey (Table 3), which is preferred by Striped Killifish (Able and Fahay 2010; Table 4). What differentiates Kayak Launch from other high saline sites however, is the availability of smooth cordgrass at all tidal heights, and a firm sandy bottom, both of which are preferred habitats (Harvey 1998; Balouskus and Targett 2016). The next two most abundant sites (Peninsula, Site #5 and Holts Landing, Site #11) are both high salinity and have a sandy bottom, but lack smooth cordgrass.

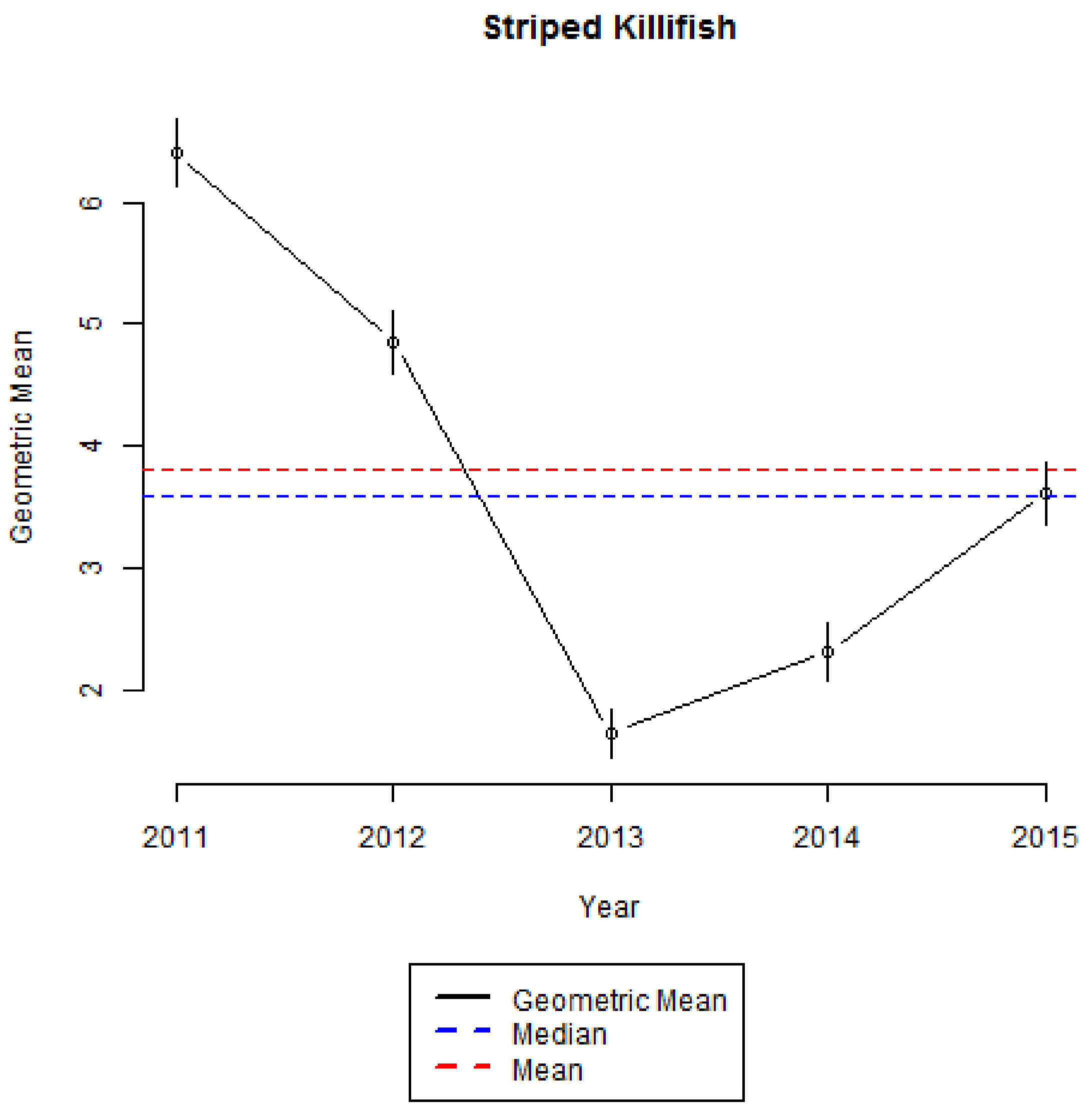


Figure 37. Geometric mean catch-per-seine for Striped Killifish, with the time series mean and median.

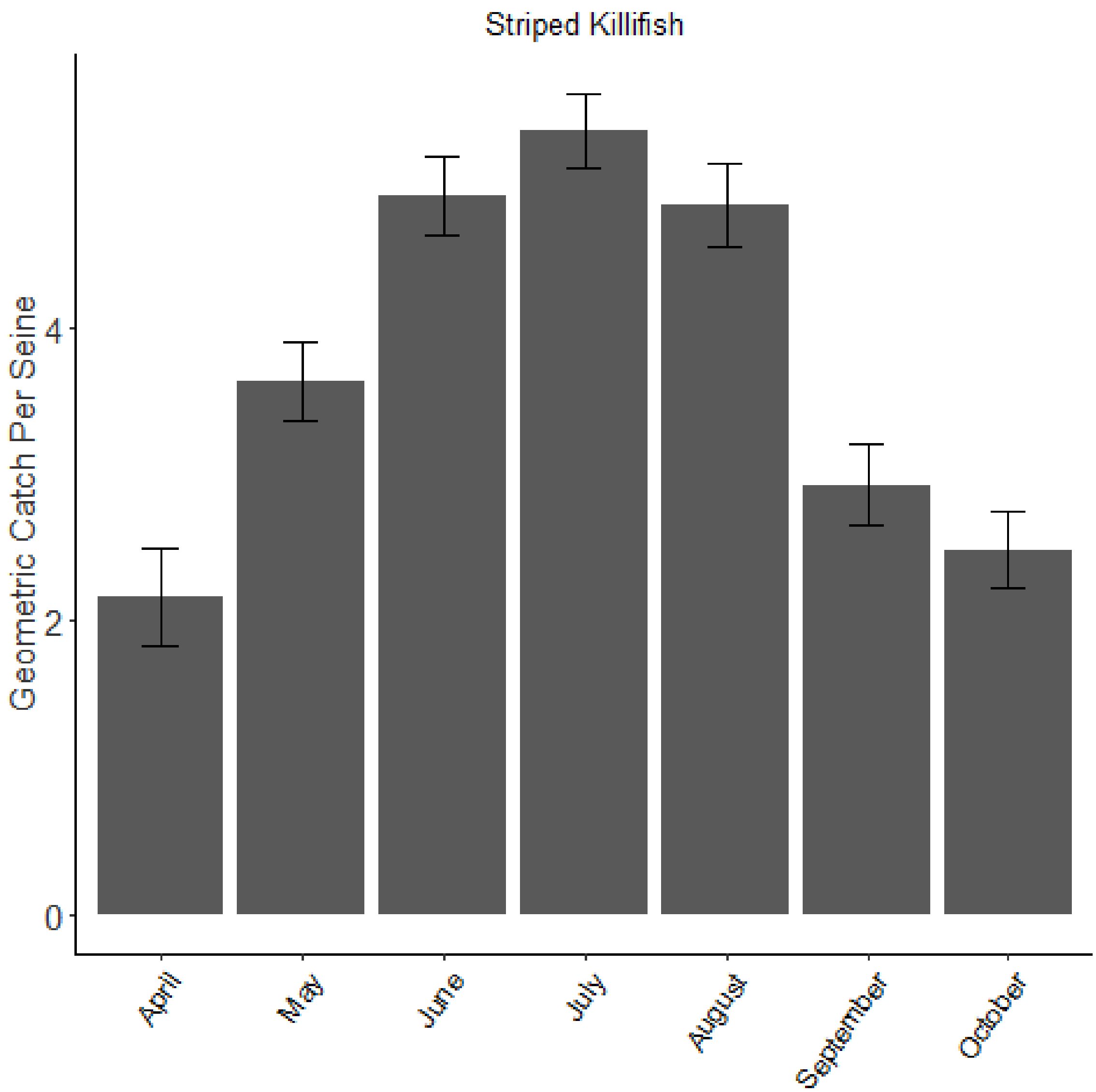


Figure 38. Geometric mean catch-per-seine since 2011 for Striped Killifish by month.

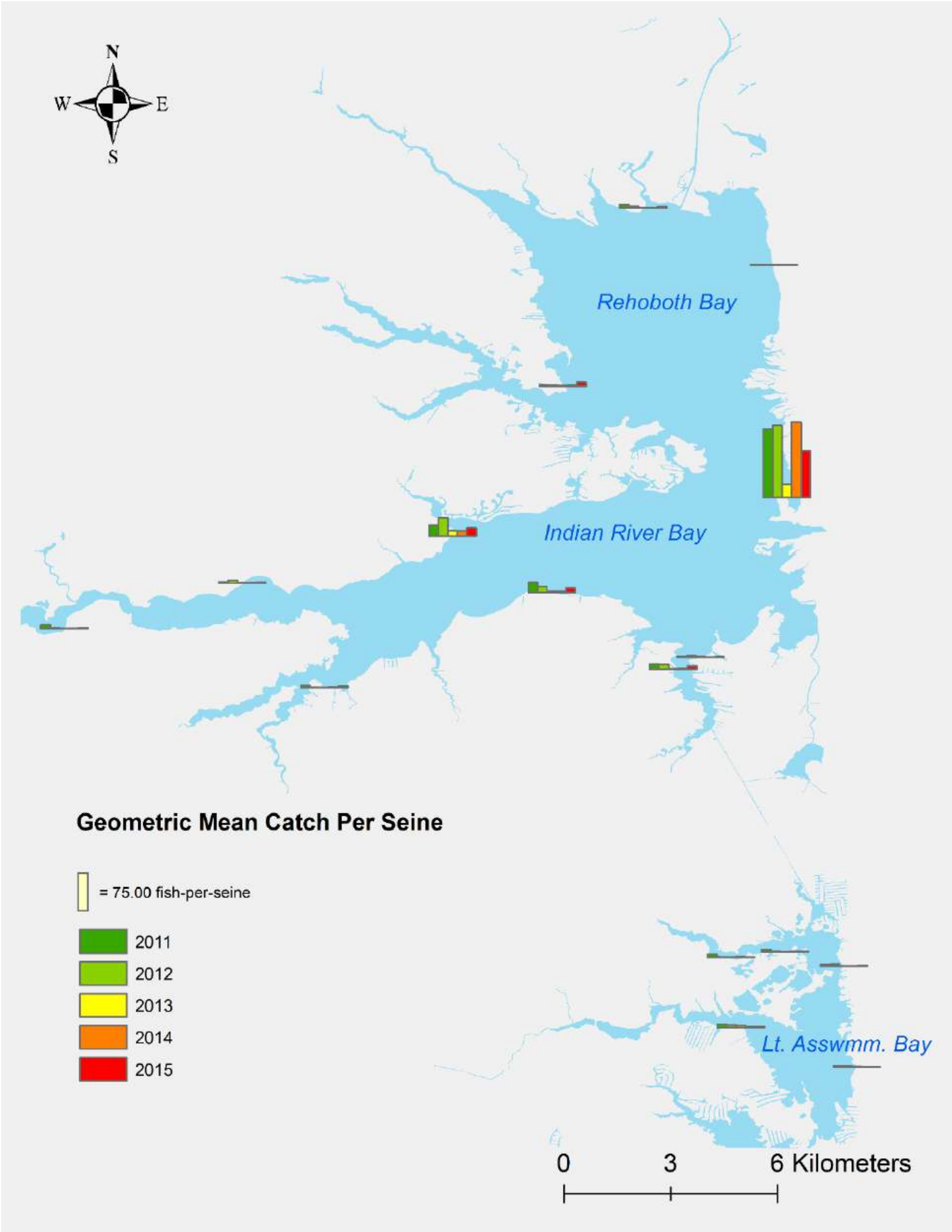


Figure 39. Geometric mean catch-per-seine since 2011 for Striped Killifish by site.

Summer Flounder

Only 28 Summer Flounder were caught in 2015, for a geometric mean of 0.06 fish per seine, less than 2014 and below the time series mean and median (Figure 40). The DNREC open water trawl survey also reported a decrease in Summer Flounder abundance and young-of-the-year recruitment in the Inland Bays for 2015 (Greco 2016). Young-of-the-year flounder have been caught in early spring, with a peak in May and decreases in catch totals as the summer continues (Figure 41), suggesting that the inshore areas are used as nursery grounds by the young-of-the-year flounder which then move into deeper waters during the summer months. Summer flounder have been more abundant in Indian River Bay than in Rehoboth Bay ($p < 0.001$) and more abundant in Rehoboth Bay than in Little Assawoman Bay ($p < 0.001$). Up-river sites appear to be important for young-of-the-year Summer Flounder in the Inland Bays (Figure 42), which is supported by their negative correlation to salinity (Table 4).

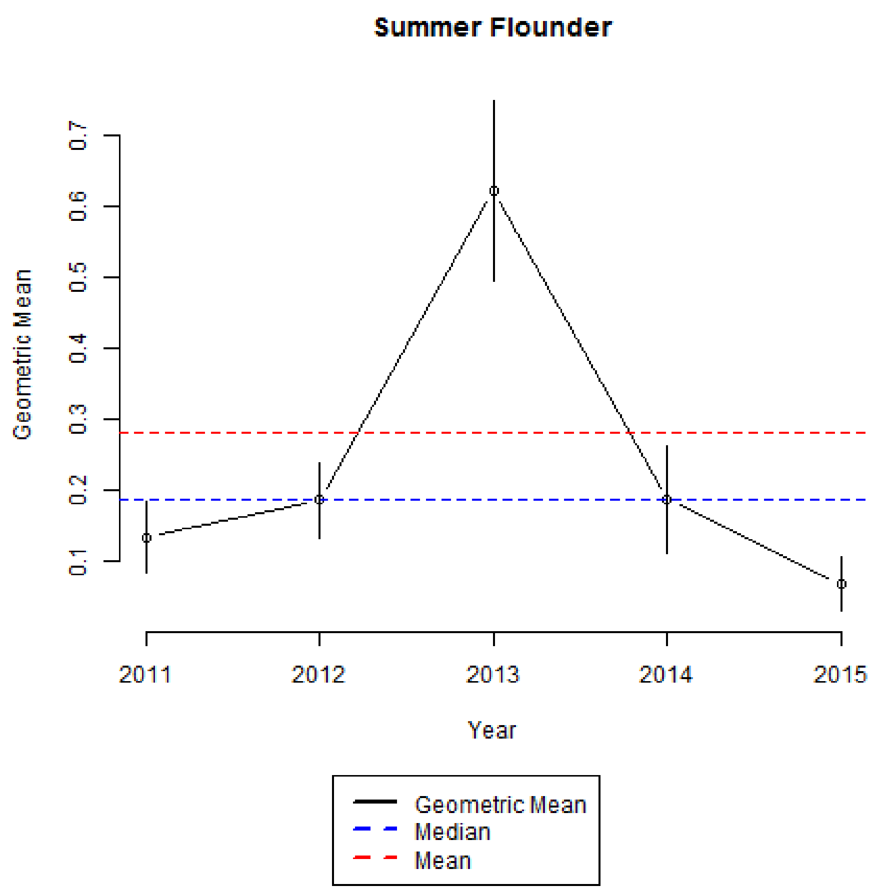


Figure 40. Geometric mean catch-per-seine for Summer Flounder, with the time series mean and median.

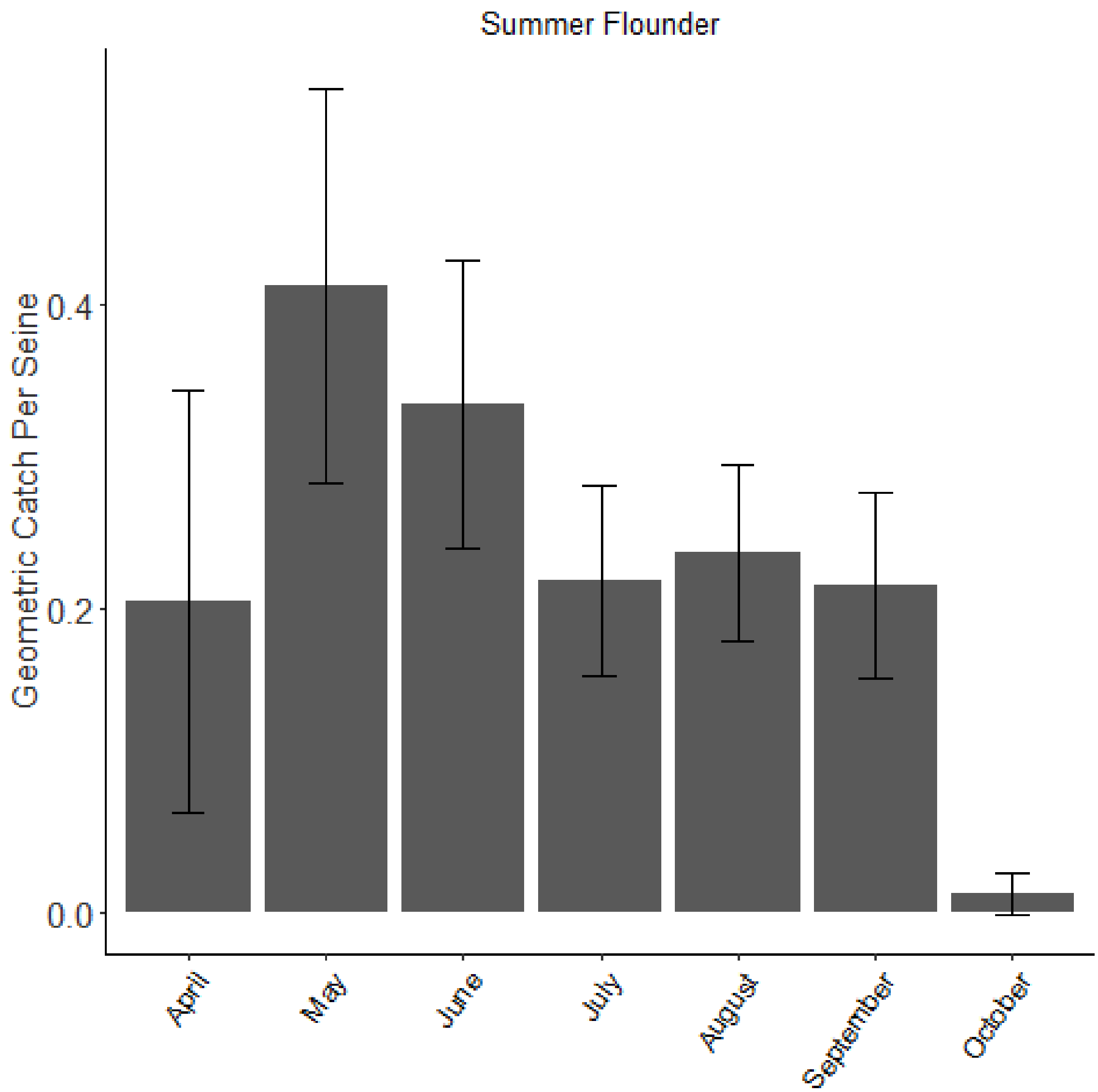


Figure 41. Geometric mean catch-per-seine since 2011 for Summer Flounder by month.

Figure 42. Geometric mean catch-per-seine since 2011 for Summer Flounder by site.

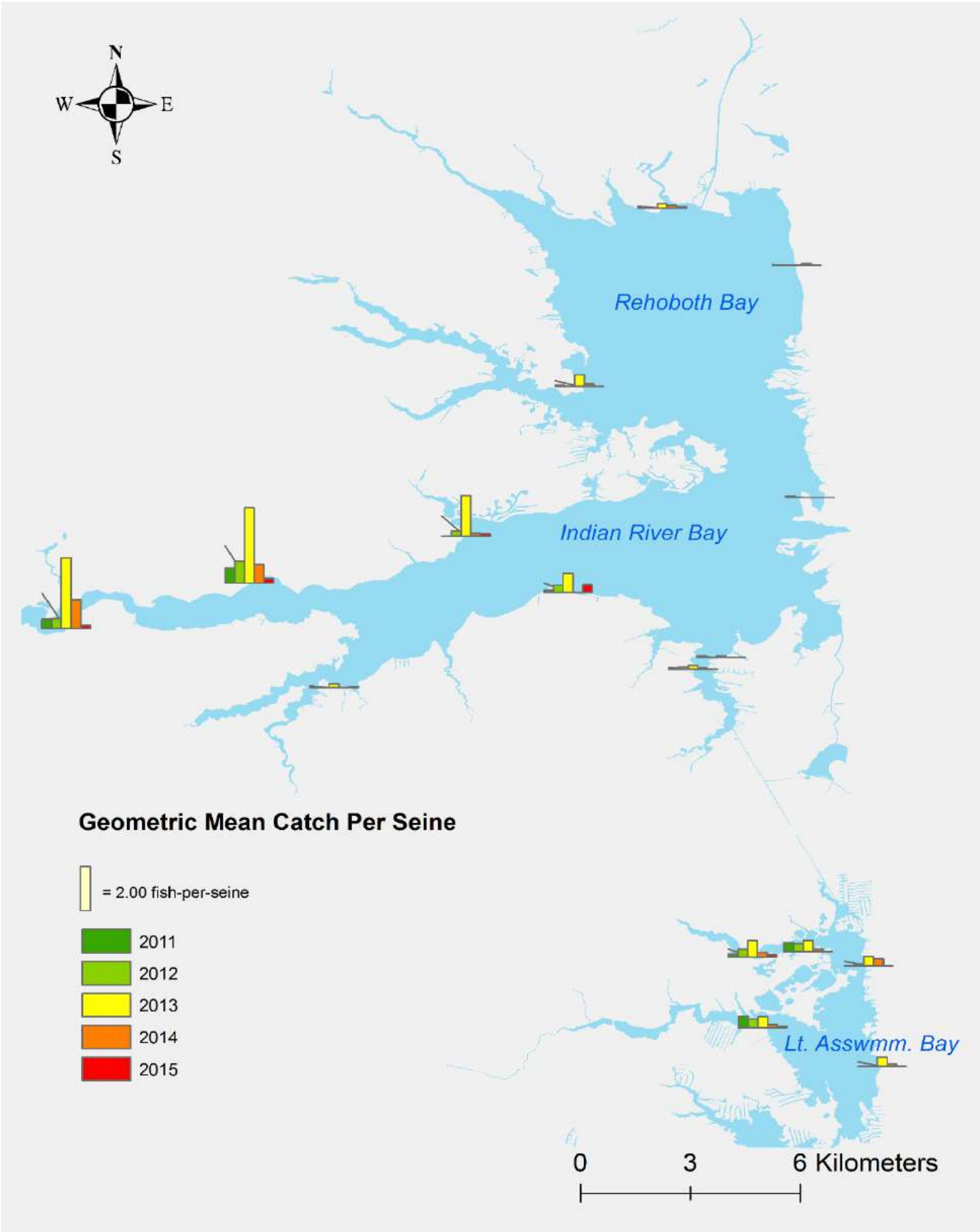


Figure 42. Geometric mean catch-per-seine since 2011 for Summer Flounder by site.

Weakfish

455 Weakfish were caught in 2015, for a geometric mean of 0.125 fish per seine, the most of any survey year so far and above the time series mean and median (Figure 43). Interestingly, the DNREC open water trawl survey reported a decrease in annual relative abundance of juveniles and adults in the Inland Bays, but an increase in young-of-the-year for 2015 (Greco 2016). Weakfish young-of-the-year showed a dramatic increase in 2015 for this survey as well. Since 2011 Weakfish have been caught primarily in August, with a second peak in October (Figure 44). Weakfish have been more abundant in Indian River Bay than Little Assawoman Bay and Rehoboth Bay ($p < 0.001$, $p < 0.001$). Weakfish have been particularly abundant at the up-river locations (Figure 45), which is supported by their negative correlation with salinity (Table 4).

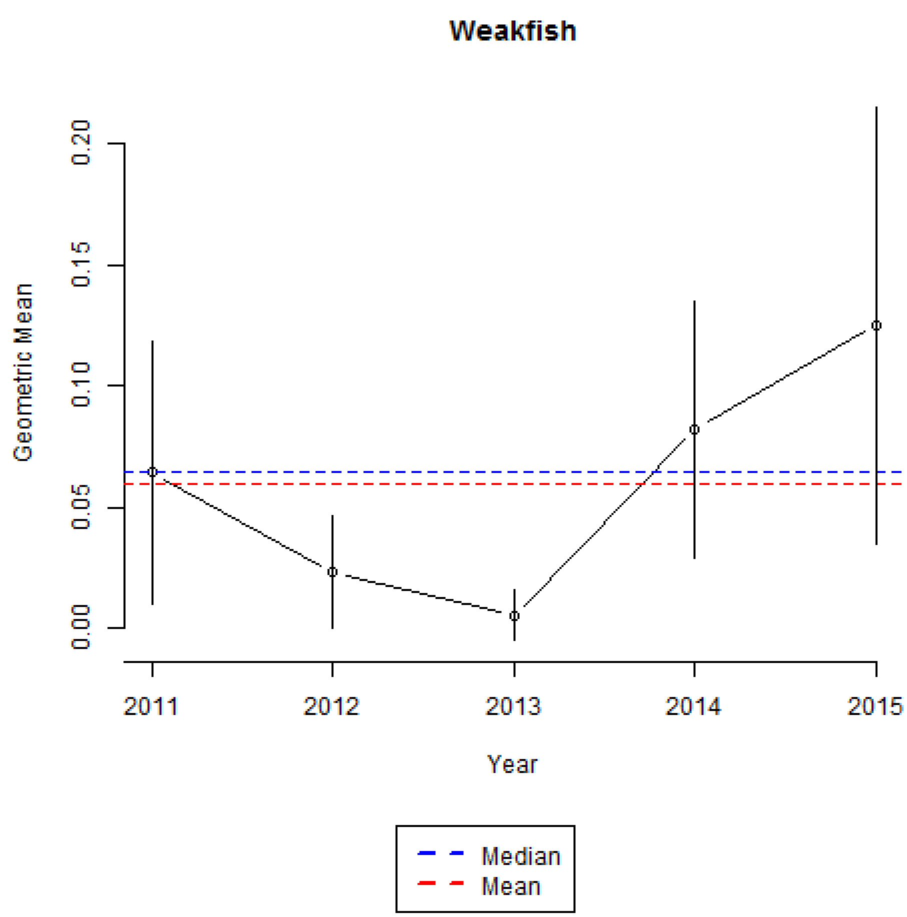


Figure 43. Geometric mean catch-per-seine for Weakfish, with the time series mean and median.

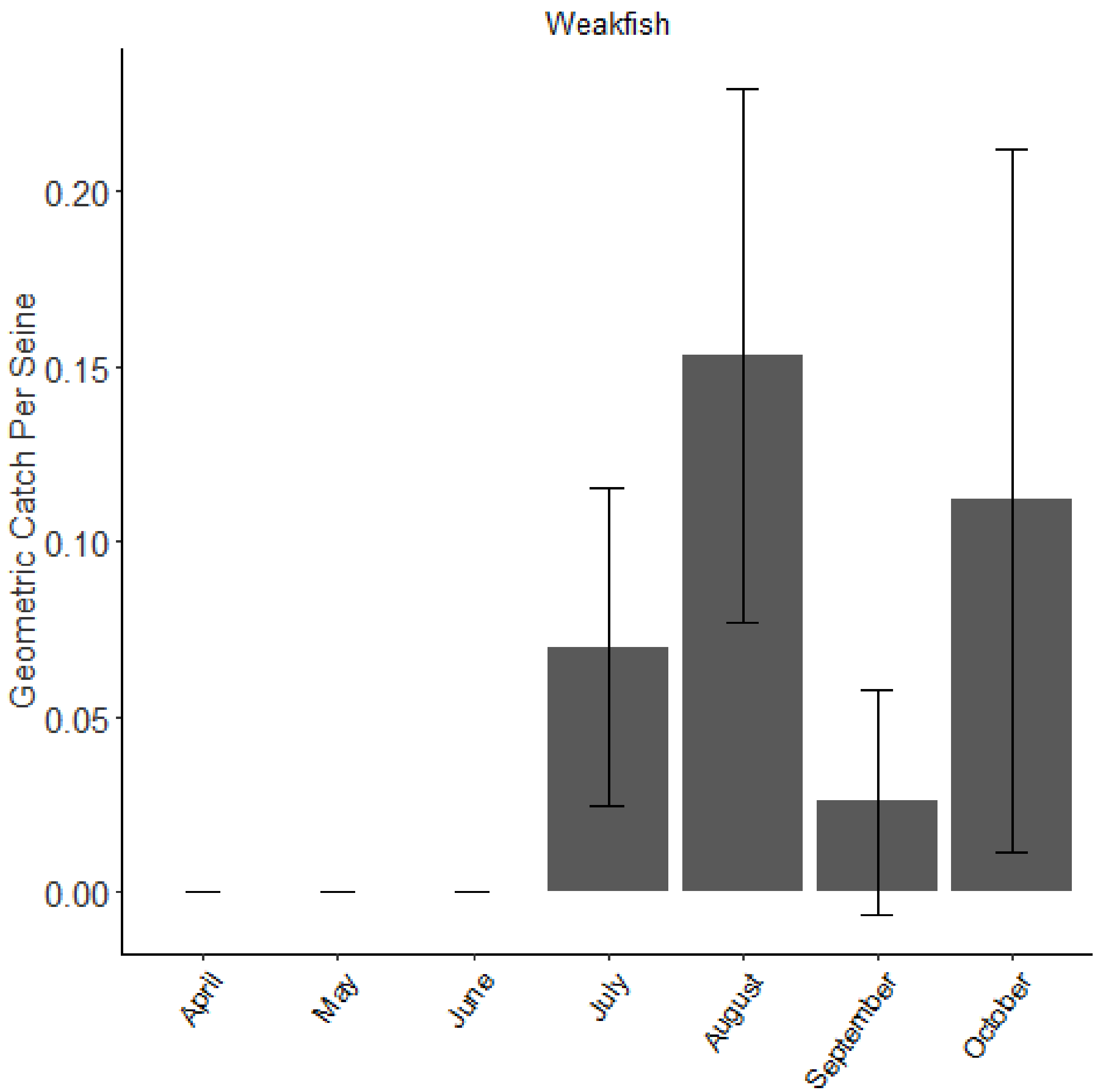


Figure 44. Geometric mean catch-per-seine since 2011 for Weakfish by month.

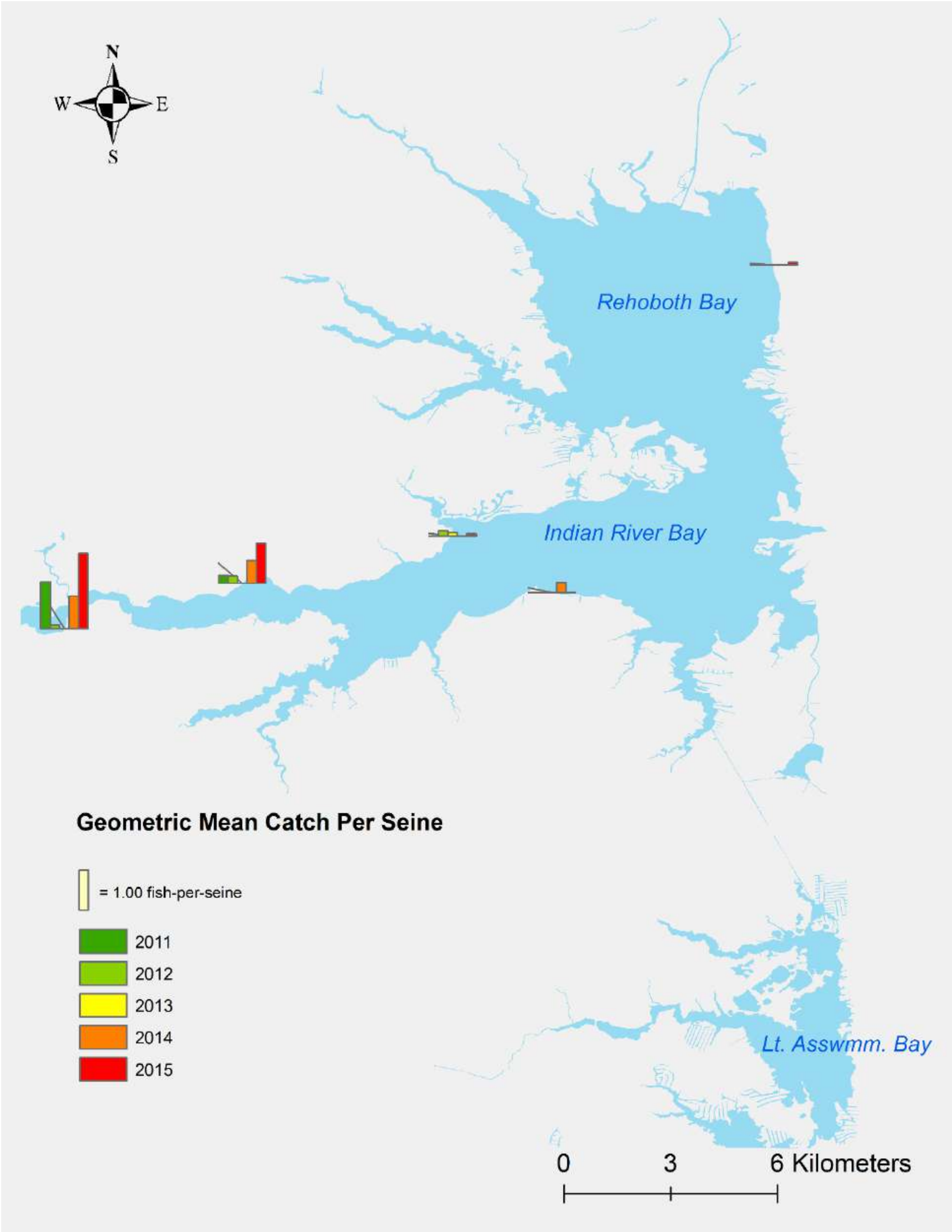


Figure 45. Geometric mean catch-per-seine since 2011 for Weakfish by site.

White Mullet

A total of 377 White Mullet were caught in 2015, for a geometric mean of 0.36 fish per seine, greater than 2014 and above the time series mean and median (Figure 46). The majority of specimens measured less than 50 mm. Since 2011, the most productive month has been July (Figure 47). While White Mullet have been caught in greater numbers in Indian River Bay and Rehoboth Bay than in Little Assawoman Bay ($p < 0.001$, $p < 0.05$), there is a noticeable difference in abundance between high salinity sites near the inlet, and other sites (Figure 48). Correspondingly, White Mullet catch has been positively correlated with salinity since 2011 (Table 4).

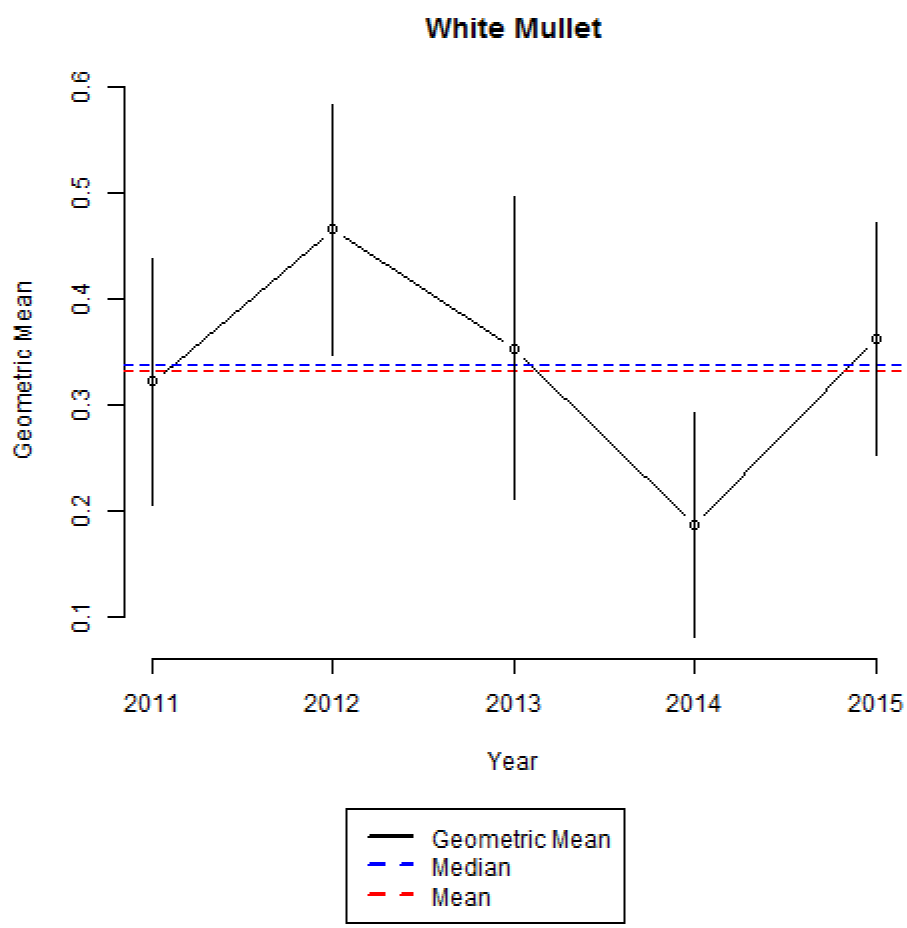


Figure 46. Geometric mean catch-per-seine for White Mullet, with the time series mean and median.

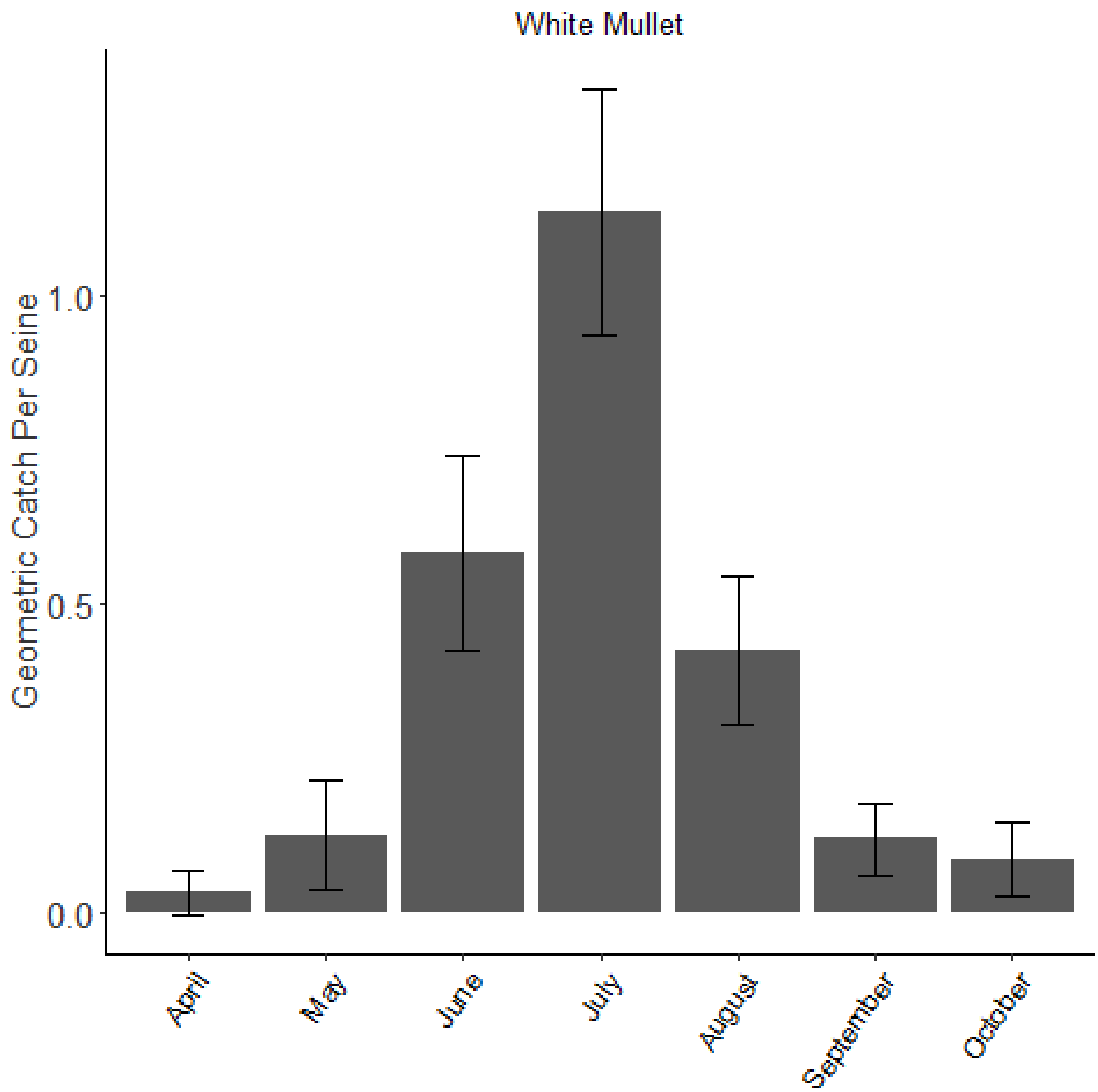


Figure 47. Geometric mean catch-per-seine since 2011 for White Mullet by month.

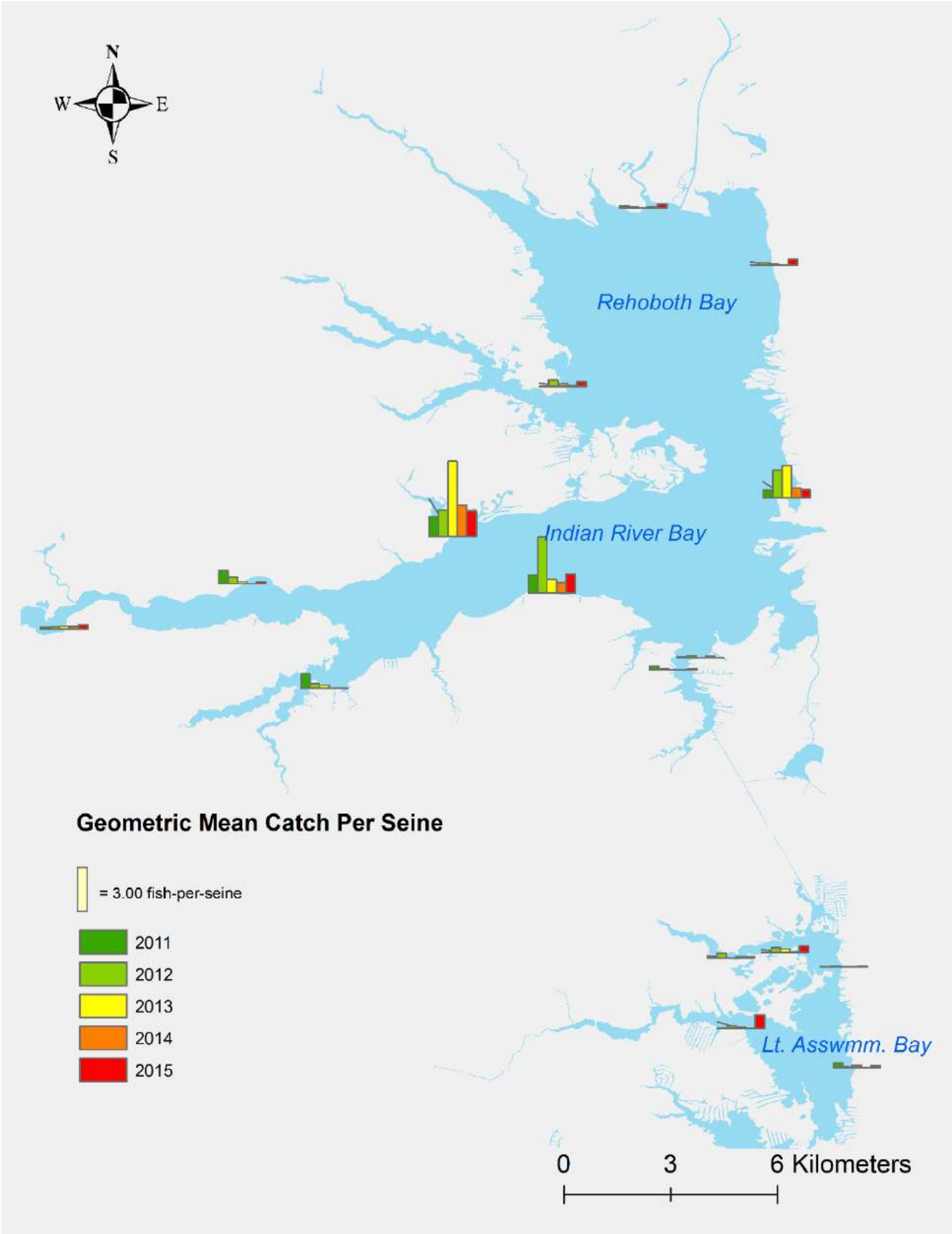


Figure 48. Geometric mean catch-per-seine since 2011 for White Mullet by site.

Winter Flounder

Only seven Winter Flounder were caught in 2015 for a geometric mean of 0.019 fish per seine, the lowest of any year so far and below the time series mean and median (Figure 49). The DNREC open water trawl survey also reported decreases in annual abundance and young-of-the-year in the Inland Bays (Greco 2016). The majority of Winter Flounder captured by this survey have been less than 100 mm in length, and have been caught in June (Figure 50). Winter Flounder catch has been greater in Indian River Bay and Rehoboth Bay than in Little Assawoman Bay ($p < 0.001$, $p < 0.001$; Figure 51), and it does not appear that Little Assawoman Bay is heavily utilized by juvenile Winter Flounder in the Inland Bays for reasons not fully understood.

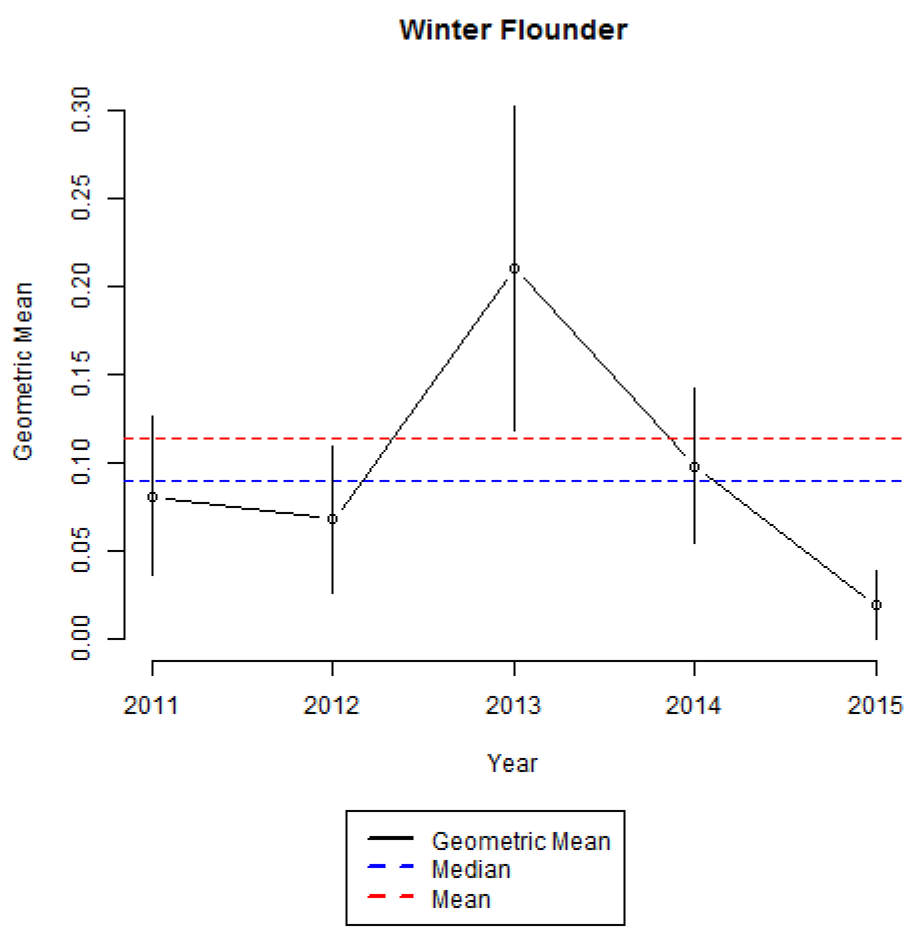


Figure 49. Geometric mean catch-per-seine for Winter Flounder, with the time series mean and median.

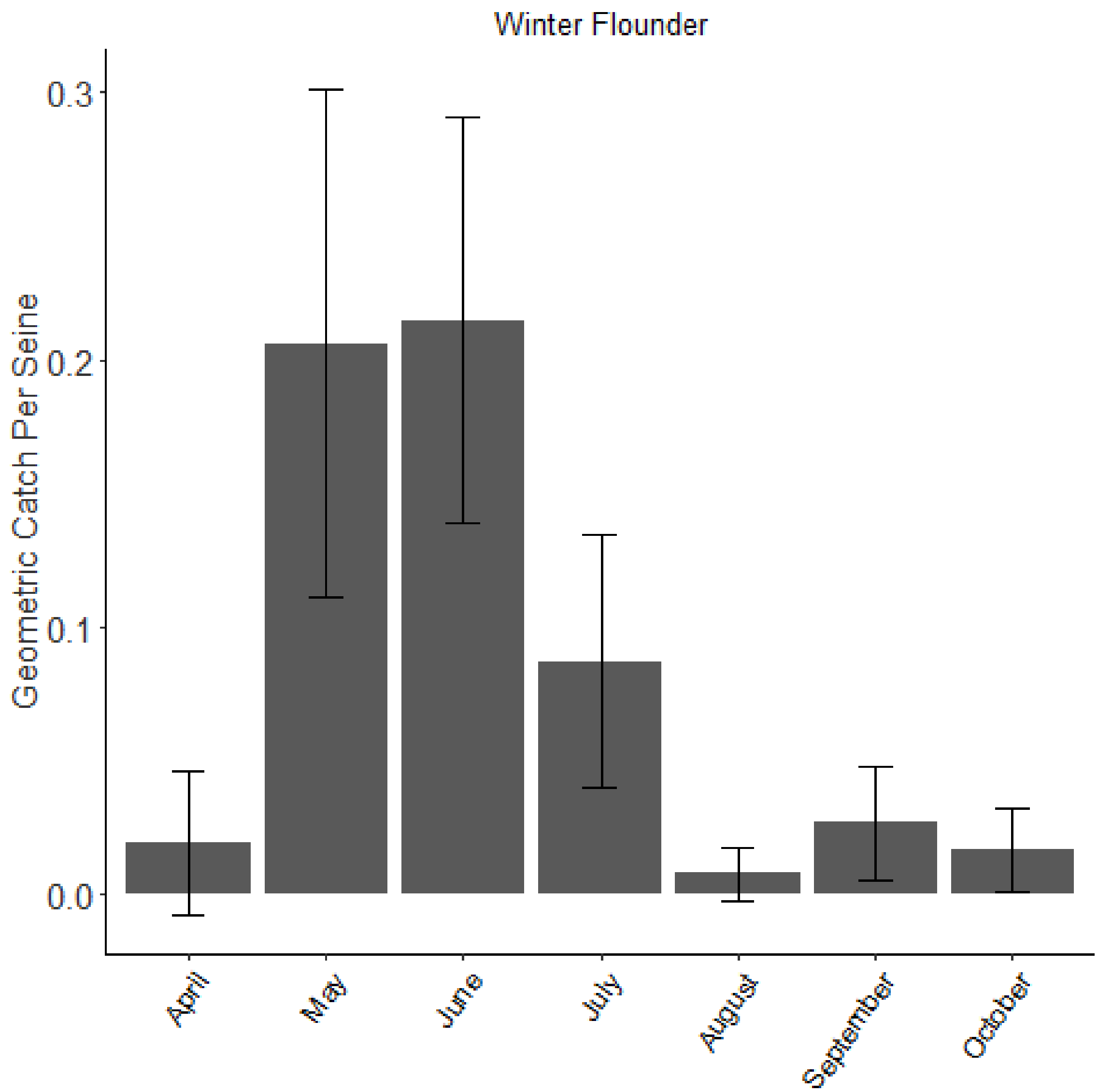


Figure 50. Geometric mean catch-per-seine since 2011 for Winter Flounder by month.

Figure 51. Geometric mean catch-per-seine since 2011 for Winter Flounder by site.

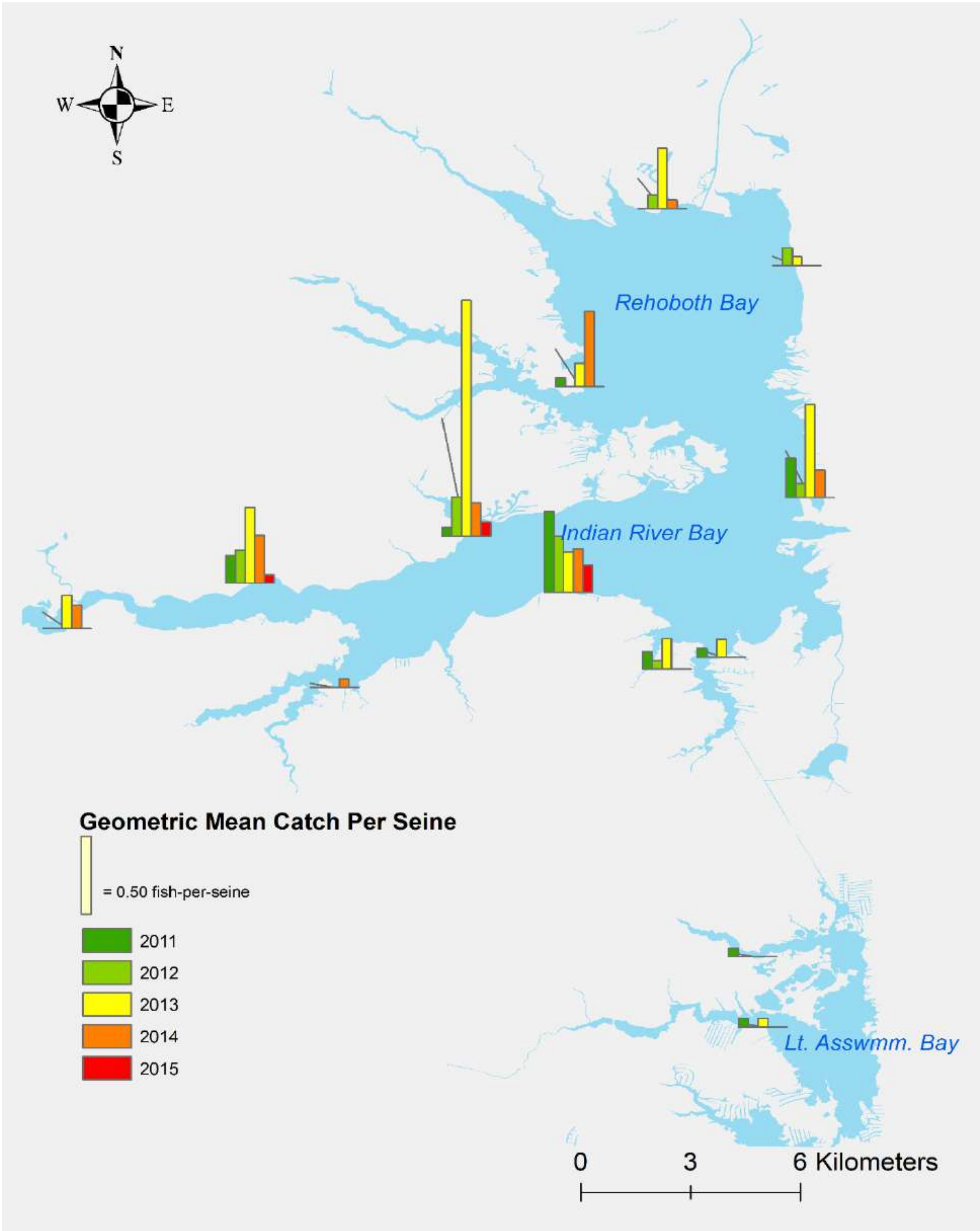


Figure 51. Geometric mean catch-per-seine since 2011 for Winter Flounder by site.

Blue Crab

A total of 4,422 Blue Crabs were caught in 2015, for a geometric mean of 6.78 crabs per seine, the second highest recorded by this survey and above both the time series mean and median (Figure 52). 2,649 small crabs, 1,650 medium crabs, and 123 large crabs were caught in 2015, all greater than the 2014 totals. Since 2012, when this survey first began totaling Blue Crabs, June has been the most productive month, with a steadily decreasing Blue Crab abundance following June (Figure 53). Blue Crab catch was greater in Indian River Bay and Little Assawoman Bay than in Rehoboth Bay ($p < 0.001$, $p < 0.001$). Interestingly, while macroalgae has been shown to be an important habitat for Blue Crabs in the Inland Bays (Epifano et al. 2003), many of the sites surveyed by this study which have the greatest density of macroalgae did not have the greatest abundance of Blue Crab. Far and away and most productive site for Blue Crab is Sandy beach (Site #8; Figure 54). This site historically has the lowest salinity of any of the surveyed sites. Correspondingly, Blue Crab catch was negatively correlated with salinity (Table 4).

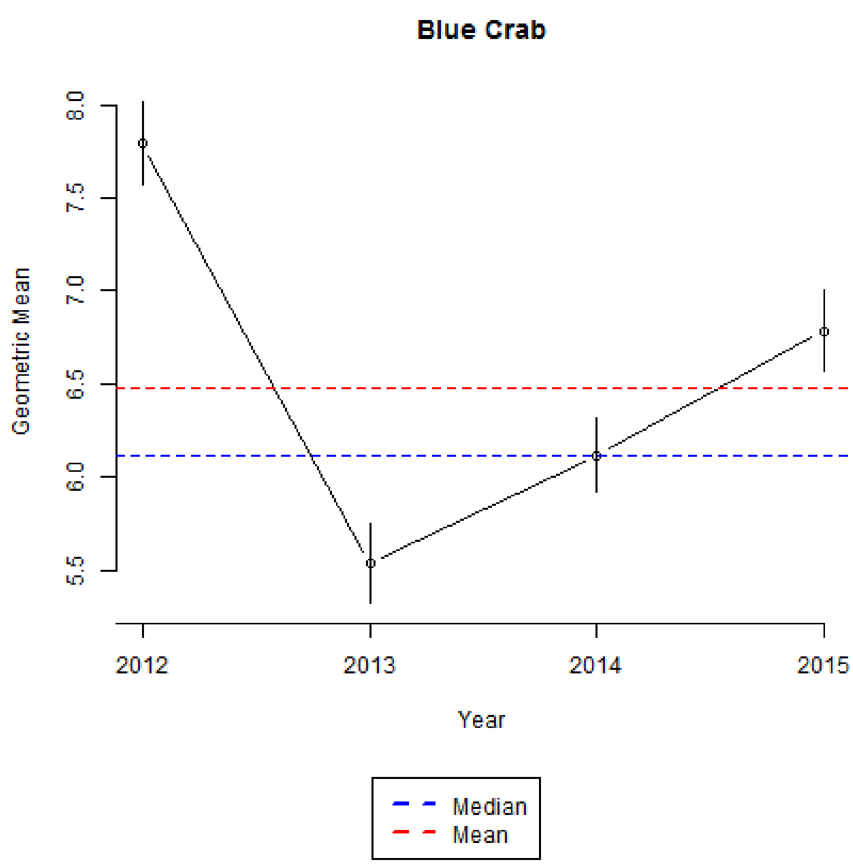


Figure 52. Geometric mean catch-per-seine for Blue Crab, with the time series mean and median.

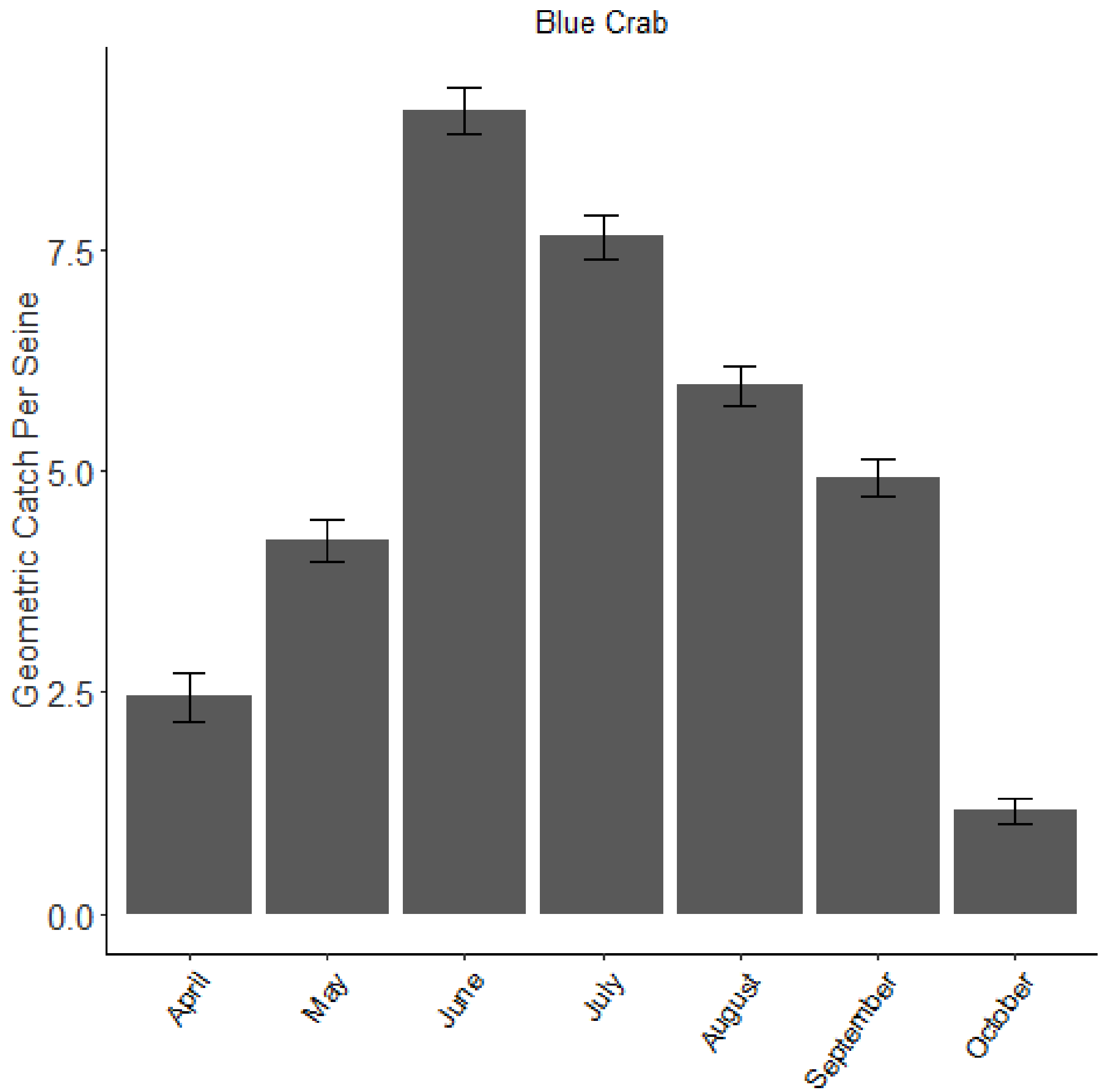


Figure 53. Geometric mean catch-per-seine since 2011 for Blue Crab by month.

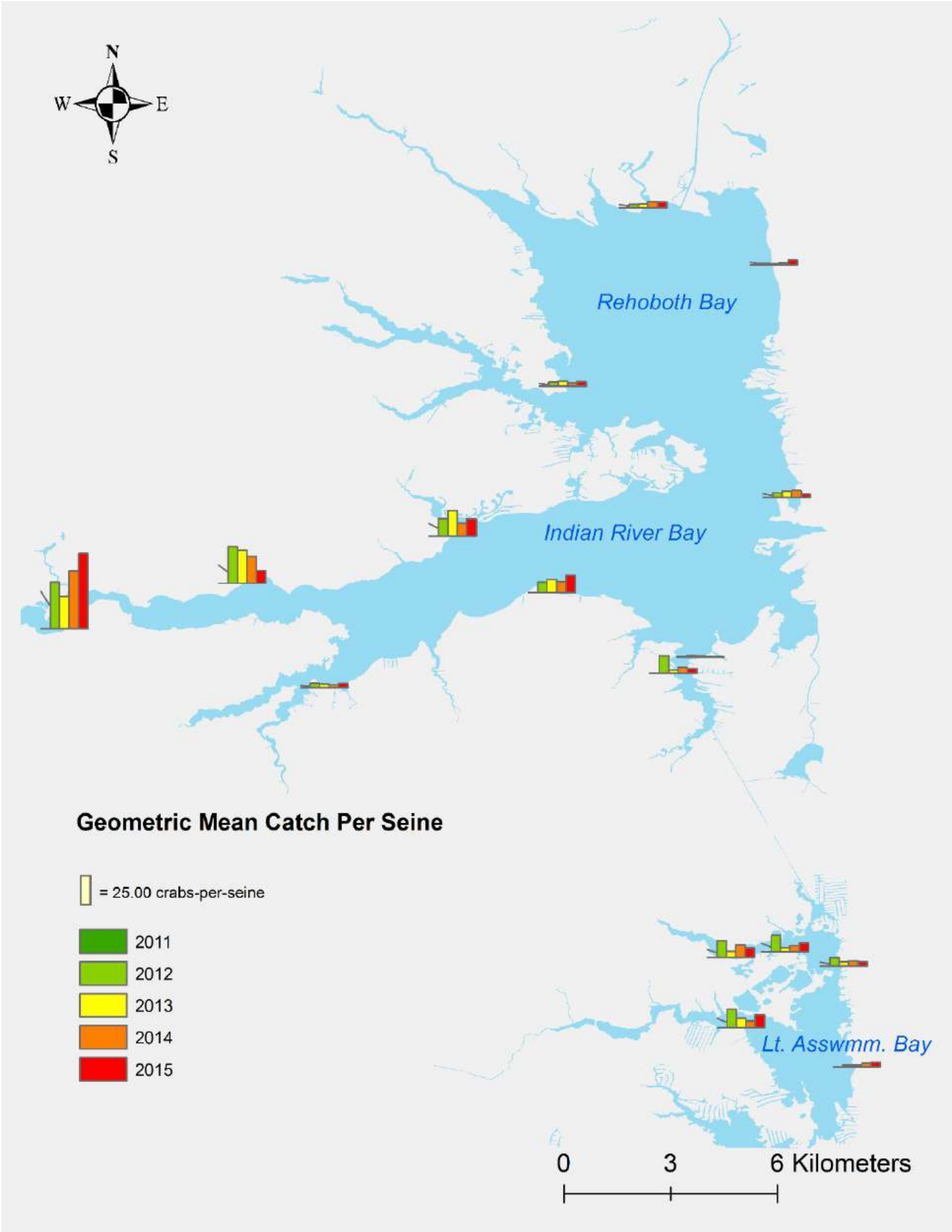


Figure 54. Geometric mean catch-per-seine since 2011 for Blue Crab by site.

CONCLUSIONS

In summary, 2015 marked the fifth successful year of the inshore fish and blue crab survey for the Inland Bays. Catch-per-seine for fish was the highest of any survey year to date, and crab catch-per-seine was the second highest. While some species such as Winter Flounder and Summer Flounder had their lowest recorded geometric mean catch-per-seine in any survey year so far, species like Atlantic Silverside and Weakfish had their highest recorded geometric mean catch-per-seine values. Overall, additional years of data are needed before species trends can be accurately assessed, but some patterns in species distributions are becoming clear.

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Our sincere thanks to all of those involved in field sampling during 2015. You are the backbone of the study and without your enthusiasm, professionalism and attention to the study protocol, this program would be impossible.

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Appendix A. Common and scientific names of fishes and Blue Crab caught during 2015 season, with the total number of specimens caught for the 2015 season.

Common Name	Scientific Name	Number of Specimens Caught
American Eel	*Anguilla rostrate*	31
Atlantic Croaker	*Micropogonias undulatus*	8
Atlantic Menhaden	*Brevoortia tyrannus*	879
Atlantic Needlefish	*Strongylura marina*	8
Atlantic Silverside	*Menidia menidia*	29,829
Bay Anchovy	*Anchoa mitchilli*	66
Black Drum	*Pogonias cromis*	125
Blue Crab	*Callinectes sapidus*	4,422
Bluefish	*Pomatomus saltatrix*	31
Bluntnose Stingray	*Dasyatis say*	2
Crevalle Jack	*Caranx hippos*	4
False Silverstripe Halfbeak	*Hyporhamphus meeki*	19
Florida Pompano	*Trachinotus carolinus*	36
Fourspine Stickleback	*Apeltes quadracus*	11
Gray Snapper	*Lutjanus griseus*	15
Hogchoker	*Trinectes maculatus*	51
Inshore Lizardfish	*Synodus foetens*	7

Ladyfish	*Elops saurus*	1
Mummichog	*Fundulus heteroclitus*	18,418
Naked Goby	*Gobiosoma bosc*	22
Northern Kingfish	*Menticirrhus saxatilis*	13
Northern Pipefish	*Sygnathus fuscus*	39
Northern Puffer	*Sphoeroides maculatus*	1
Oyster Toadfish	*Opsanus tau*	23
Permit	*Trachinotus falcatus*	17
Pigfish	*Bodianus unimaculatus*	1
Pinfish	*Lagodon rhomboides*	171
Rainwater Killifish	*Lucania parva*	35
Sheepshead Minnow	*Cyprinodon variegatus*	1,018
Silver Perch	*Bairdiella chrysoura*	641
Spot	*Leiostomus xanthurus*	193
Spotfin Butterflyfish	*Chaetodon ocellatus*	1
Spotfin Mojarra	*Eucinostomus argenteus*	37
Spotted Hake	*Urophycis regia*	1
Striped Anchovy	*Anchoa hepsetus*	10
Striped Bass	*Morone saxatilis*	5
Striped Blenny	*Meiacanthus grammistes*	1
Striped Burrfish	*Chilomycterus schoepfi*	1

Striped Killifish	*Fundulus majalis*	6,554
Striped Mullet	*Mugil curema*	14
Summer Flounder	*Paralichthys dentatus*	28
Threespine Stickleback	*Gasterosteus aculeatus*	18
Weakfish	*Cynoscion regalis*	455
White Mullet	*Mugil cephalus*	377
White Perch	*Morone americana*	17
Winter Flounder	*Pseudopleuronectes americanus*	7

Appendix B. Quality Control Report

SUMMARY

Data recorded during the 2015 Inshore Fish and Blue crab survey was tested according to the quality control measures outlined in the program's EPA approved QAPP. These measures included a random sampling of 10% of the data for accuracy, at least one seine per team was performed under direct supervision from the Program manager, and routine calibration of equipment. In summary, minor inaccuracies were found to be present in the random sampling of data sheets, but were corrected, and all datasheets were reviewed a second time. Due to staff limitations, some teams did not receive a supervisory seine from the Program Manager, furthermore, YSI calibration was infrequent.

ISSUES AND CORRECTIVE ACTIONS

Minor inaccuracies in data entry did occur in 2015. Issues such as multiple spellings for the same species, and occasional errors in data entry were present, but very infrequently. Despite the infrequent occurrence of these errors, all data sheets were reviewed a second time by the current Program Manager to correct any errors.

Due to staff limitations during the 2015 season, the then Program Manager was unable to attend a seine for each team. However, the volunteer survey coordinator did attend each team's survey at least once in the Program Manager's absence and has verified all teams were following the proper protocol.

YSI calibration was performed infrequently. Values measured by the YSI's do not visually appear incorrect and are within the usual range of values seen in previous years.

RECOMMENDATIONS

Data entry is now performed by Center for the Inland Bays staff, which may improve data entry accuracy. Along with this change, at various points in the data analysis for the yearly reports, checks are made to ensure that the data contains no egregious errors like duplicate seine data entries.

Since 2015 a new Program Manager has been appointed to oversee the program. This Program Manager has the allotted hours to oversee each team's survey at least once. YSI calibration will be performed weekly during the 2016 field season.