U.S. Army Corps of Engineers
Charleston District

APPENDIX B

CHARLESTON HARBOR POST 45
BENEFICIAL USE OF DREDGED MATERIAL
SUPPLEMENTAL ENVIRIONMENTAL ASSESSMENT
CHARLESTON, SOUTH CAROLINA

SCDNR Benthic Characterization: Crab Bank and Shutes Folly

30 September 2016

CHARLESTON HARBOR DREDGING PROJECT

ENVIRONMENTAL ASSESSMENT:

CRAB BANK AND SHUTES FOLLY
BENTHIC MACROFAUNAL ABUNDANCE AND DISTRIBUTION

Photos: 2012 SCDNR

FINAL REPORT

DNR

Submitted to:
U.S. Army Corps of Engineers
Charleston District

Prepared by:
Marine Resources Research Institute

CHARLESTON HARBOR DREDGING PROJECT ENVIRONMENTAL ASSESSMENT:

CRAB BANK AND SHUTES FOLLY

BENTHIC MACROFAUNAL ABUNDANCE AND DISTIRBUTION

FINAL REPORT

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A. Introduction and Objectives

Crab Bank is a South Carolina Department of Natural Resources (SCDNR) "Important Bird Area" for South Carolina. It is also known as the Crab Bank Seabird Sanctuary. The Crab Bank Seabird Sanctuary website states "Crab Bank supports colonies of nesting waterbirds because of its isolated nature and lack of mammalian predators. Although all species may not nest on the island each year, examples of species that have used the island include: brown pelican, least tern, royal tern, black skimmer, gull-billed tern, sandwich tern, common tern, laughing gull, Wilson's plover, American oystercatcher, willet, great egret, snowy egret, tricolored heron and ibis. Besides providing nesting habitat, the sanctuary provides winter loafing and feeding areas for numerous species" (https://www.dnr.sc.gov/mlands/managedland?p_id=215). While the island size is in a constant state of fluctuation, it has largely been migrating northeast over the last 15 years.

Shutes Folly provides nesting habitat for colonial seabirds due to its isolated nature, small size, and lack of predators. It is one of only nine active nesting sites in the entire state. Skimmers and oyster catchers like the shell hash that effaces the eastern side of Shutes Folly. The island has been identified by Charleston Harbor Wildlife as a site "often considered for restoration." Their website states that, "in 1997, wildlife biologists pressed for the island as a sight for dredge spoil to boost the small seabird colony there…" (http://charlestonharborwildlife.com/iwa/cp-sf/). However, this has not occurred to date. It should also be noted that Castle Pinckney, a historic site, sits atop the island. It is one of the oldest fortifications of its kind still extant and was built to provide defense of the coast. The site is experiencing erosion on the eastern end.

As part of an ongoing study to improve navigation efficiencies in Charleston Harbor, beneficial use of dredged material options are being explored by US Army Corps of Engineers (USACE) to enlarge Crab Bank and/or Shutes Folly. A better understanding of the existing sediment and macrobenthic community will provide baseline information in an evaluation of these islands. This information will aid decision making for potential beneficial use of dredged material projects.

The objective of this report is to characterize macrobenthic infauna at sites across Crab Bank and Shutes Folly, both of which are located in Charleston Harbor, Charleston County, South Carolina. A companion report discussing sediment composition across Crab Bank and Shutes Folly was also prepared (Tweel and Sanger 2015). All work was completed under USACE/SCDNR Cooperative Agreement # W912HP-12-1-0003.

B. Methods

Sampling areas

A total of 54 sampling locations across Crab Bank and Shutes Folly (27 each site) were identified within 1.5 hours of the low tide. Sampling occurred across five shore-perpendicular transects at each location (Figures 1 and 2). Each transect consisted of nine locations. The nine locations represented the high point of the island, and approximately mean high water, intertidal, mean low water, and sub-tidal on either side of the cross-section high point. The high point of

the island was visually identified for each transect. For the mean high water, intertidal, and mean low water areas, the wrack line from the preceding tide was identified and the distance between it and the water line was determined. This distance was divided into three zones representing high water, mean water, and low water levels, and the center point of these zones was sampled. Multipliers of 0.83, 0.5, and 0.17, respectively, were applied to the distance measurement to identify these zones. During reconnaissance on October 22, 2014, the exact location of each sampling site was documented. These coordinates were used to obtain the samples on November 4, 2014. At each transect location, a sediment core (2.6 cm wide and 9.0 cm deep) was collected. At transects A, C, and E, a macrobenthic core (7.8 cm wide and 9.0 cm deep) was collected at each location. Sites that were nearly pure oyster shell were not able to be cored, and hand grabs approximating the target volume were collected.

Laboratory methods

All sediment and macrobenthic samples were obtained by coring devices. Sediment samples were analyzed for sediment composition including the percentages (by weight) of sand, silt, clay, and calcium carbonate ($CaCO_3$) using procedures described by Folk (1980) and Pequegnat *et al.* (1981). $CaCO_3$ was quantified as a subset of the sand component. Samples comprised of oyster shell were not quantitatively analyzed but were documented as 100% sand or greater size class and 100% $CaCO_3$. The sand fractions from the analysis were dry-sieved using a Ro-tap mechanical shaker and grain size was determined by using fourteen 0.5 phi-interval (ϕ) screens, where phi = $-\log_2$ (grain diameter in mm) according to the Udden-Wentworth Phi classification (Brown and McLachlan 1990). Sediment data and site position (e.g., intertidal low) were used to classify sites into habitat types. Sites were classified as muddy or sandy if they were comprised of a majority of silt/clay or sand, respectively. All sediment data and analysis was presented in a report previously submitted to USACE (Tweel and Sanger 2015).

The macrobenthic samples were washed through a 0.5 mm mesh sieve. Organisms and sediment retained on the sieve were preserved in a buffered solution of 10% formalin/seawater with rose bengal stain. Macrobenthic organisms were identified to the lowest possible taxonomic level and enumerated by experienced taxonomists. Organisms belonging to order Tanaidacea and family Enchytraeidae, for instance, were very difficult to identify beyond these taxonomic levels due to their small size. Abundance data is presented in units of organisms per square meter. The macrobenthic data are analyzed and discussed in this report.

C. Results and Discussion

The 54 samples collected on Crab Bank and Shutes Folly represented a wide variety of coastal habitats. These sites varied primarily by elevation (and thus flooding regime) and sediment type, and included salt marsh, supratidal and intertidal oyster shell (shell rake), as well as inter- and sub-tidal zones characterized by both sandy and muddy substrates. Shutes Folly and Crab Bank macrobenthic infaunal communities were dominated by annelids (polychaetes and oligochaetes), crustaceans, and mollusks (Figure 3). Broad taxonomic groupings by site elevation are shown in Figure 4. Raw benthic data is included in Appendix A.

Crab Bank

Habitats on Crab Bank were generally sandy intertidal and subtidal areas containing reasonably similar macrobenthic communities for the species present in higher abundances. In addition to these sandier sites, there were two marsh sites along transect A, and two sites containing relic marsh sediment along the western end of transect C (CCWS, CCWL). The macrobenthic community on Crab Bank was mostly comprised of polychaetes, especially *Leitoscolopolos fragilis* and *Streblospio benedicti*, and these were at greatest abundance in the intertidal areas (Figures 3 and 5).

Marsh habitats at the eastern portion of transect A contained the greatest overall abundance on the island (44,000 organisms/m^2), and these samples were dominated by *Streblospio benedicti*, enchytraeids (oligochaete), and the polychaete *Capitella capitata*. While not in high abundance, *Nereis succinea*, a large polychaete, was present only in marsh (transect A) and relic marsh (transect C) substrates.

Transect C contained the highest crustacean density on Crab Bank, and this was largely driven by the amphipods *Neohaustorius schmitzi* and *Lepidactylus dytiscus* as well as the isopod *Sphaeroma destructor* at the sandy high intertidal and supratidal sites. The silt/clay-dominated west subtidal site of transect C also contained the bivalve *Petricolaria pholadiformis* (False angelwings).

The lowest elevation macrobenthic habitat sampled on Crab Bank was transect E, and these sites were characterized by grain sizes of fine sand or greater (>62.5 µm) and no marsh or upland vegetation. The higher sites contained a greater proportion of calcium carbonate than the lower sites. Species composition reflects a greater inundation frequency than other high point sites, as the dominant high point species (*Exogone* sp., Tanaidacea, *Sphaeroma destructor*) were generally also associated with intertidal habitats. The greatest abundance along this transect was the polychaete *Leitoscolopolos fragilis*, which was present at all but two sites.

Shutes Folly

There was a higher range of elevations and sediment types sampled on Shutes Folly than on Crab Bank. This is reflected in a greater variety of sampled habitats that ranged from salt marsh and subtidal muddy sand to supratidal oyster shell deposits. Overall abundance at Shutes Folly was 3.6 times greater than at Crab Bank, and this was primarily driven by high intertidal abundance of crustaceans (up to 80,000 tanaids/m^2) and oligochaetes (up to 56,000 enchytraeids/m^2) on Shutes Folly (Figures 4 and 6). These species were especially abundant in the marsh habitats.

Transect A, at the north end of the island, was largely characterized by whole oyster shell. The western end transitions to deeper water rather abruptly, and the eastern end contains a more gradual transition from oyster shell to muddy sand flats. Macrobenthic communities reflect these differences. Muddy sand flat infaunal organisms at the eastern end were comprised of members of family tubificidae and the large polychaete *Laeonereis culveri*, none of which were present at other sites along transect A. The oyster shell habitats, both inter- and supratidal, contained relatively low abundances of macrobenthos, but the dominant organism was the isopod

Sphaeroma destructor. The western subtidal site was the only site along the transect to contain *Brachiodontes exustus* (scorched mussel) and *Crassostrea virginica* (eastern oyster), and the only site on the island with *Petrolisthes galathinus* (porcelain crab) and the amphipod genus *Gammarus.*

Transects C and E both transition from subtidal flats at the eastern end to oyster shell rake, and through salt marsh to subtidal sand flats on the western end. The flats on the western end extend more gradually than on the eastern side of Shutes Folly, and contain two shore-perpendicular bars of washed oyster shell between transects C and A. These flats also support several live oyster mounds in the embayment formed by the arcuate northern tip. Macrobenthic abundance along transect C was dominated by samples collected in salt marsh that were comprised of tanaids, enchytraeids, and the polychaete *Capitella capitata*. The shelly intertidal habitats on the eastern side were comparable to those along transect A, with a community comprised of isopods, oligochaetes (*Monopylephorus irroratus*, Tubificidae), and the polychaete *Streblospio benedicti*. The eastern subtidal site had higher than average populations of the mud snail *Ilyanassa obsoleta* and the sedentary polychaete *Spiochaetopterus costarum oculatus*.

Transect E followed a similar transect of habitats as C, but intertidal and subtidal sites tended to be muddier, and shell, when present, tended toward shell hash rather than whole shell. The greatest macrobenthic abundance occurred along transect E, at the eastern mid-intertidal site. This substrate had a high silt-clay content, and organisms present in high abundance included, in order of decreasing abundance: tanaids, the scorched mussel *Brachidontes exustus*, tubificids, and the bivalve *Sphenia antillensis*. The high point site was characterized by periwinkle snails (*Littorinidae*) and isopods (*Ligia* sp.). Marsh sites to the west of the high point on transect E exhibited similar species composition to the marsh sites along transect C, and shared the pattern of increasing macrobenthic abundance with decreasing elevation.

Summary

The full taxonomic lists for each island are presented in Tables 1 and 2, with species potentially relevant to shorebirds shown in bold. The shorebird-relevant benthic species list was developed from previous research related to piping plover (*Charadrius melodus*), red knot (*Calidris canutus*), and dunlin (*Calidris alpina*) and additional DNR staff knowledge (SCDNR 2015, Bergquist et al. 2011). No piping plover or red knot foraging has been observed on either island, but the islands are popular rookeries for a wide variety of species, and the intertidal zone of both islands provides foraging habitat for a variety of other shorebirds and wading birds (J. Thibault/SCDNR and M. Bimbi/USFWS, pers. comm.). The abundances of these benthic species were generally low.

Overall macrobenthic abundance was greatest at the mid-intertidal sites at both islands (Figure 4). Marsh sediments and relic marsh deposits typically contained higher abundances than nearby sandier sediments occurring at a similar position in the tidal frame. There was high inter-site variability on both islands (Figures 5 and 6), as sample site habitats ranged from salt marsh and subtidal muddy sand to supratidal oyster shell deposits. Species richness (number of species observed) increased with decreasing elevation for both islands (Figure 7). Total species richness for Shutes Folly (71) was greater than for Crab Bank (58), which may be due to the greater

variety of habitats provided by the larger range of sediment types and elevational gradients on Shutes Folly as compared to Crab Bank.

The macrobenthic community on Crab Bank and Shutes Folly was compared to subtidal sites (n=5) nearby in the Charleston Harbor from the SC Department of Natural Resources' South Carolina Estuarine and Coastal Assessment Program (SCECAP) (Figure 8). SCECAP employs a Young modified grab that is roughly 10 times the size of the cores collected on Crab Bank and Shutes Folly; however, an assessment of the total species richness provides a reasonable comparison of the benthic community. In general, the species found on the islands were also present in the deeper SCECAP samples; however, additional species were found in the SCECAP samples resulting in a much greater overall species richness (117). The greater richness is in agreement with the inverse relationship between species richness and site elevation observed in this study (Figure 7). This is not unexpected considering the intertidal and supratidal portions of the islands are more stressful for benthic infauna. Abundances within the subtidal SCECAP samples ranged from 1,875 to 13,625 organisms/m^2. This is comparable to the subtidal sites sampled for this study, but lower than many of the intertidal areas sampled, especially the marsh sites.

While mapping the sites on 2013 National Agricultural Imagery Program (NAIP) base imagery, it was noticed that the location of the oyster shell high point site on transect E of Shutes Folly (SEHP) was marsh as recently as 2013. This was confirmed by obtaining imagery at several time steps between March 2015 and February 2007. This rapid inland migration of oyster shell material is occurring at rates up to 4 m/yr (Figure 9), but the land-water interface is more stable. These habitat changes are discussed in greater detail in the Engineering Appendix to the Draft Integrated Feasibility Report and Environmental Impact Statement (USACE 2014).

The information provided in this report, as well as the sediment report (Tweel and Sanger 2015), provide a better understanding of the overall habitat types and macrobenthic communities on Crab Bank and Shutes Folly. This information is an important first step in determining if the beneficial use of dredge material from the proposed Post 45 Charleston Harbor deepening is a viable source of material for increasing intertidal and subaerial habitats of Crab Bank and Shutes Folly. As discussed in the introduction, these islands are critical bird nesting sites which have eroded considerably over the past several decades (USACE 2014). The addition of material to increase the nesting and foraging habitat provided by these islands may be a viable option if suitable material and placement can be identified. Further discussions with appropriate agencies to discuss these findings in a greater environmental context will help identify the best management options for Crab Bank and Shutes Folly.

D. References

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Figure 1. Location of transects, sampling sites, and habitat classifications on Crab Bank. Transects A, C, and E were analyzed for macrobenthic community composition.

Figure 2. Location of transects, sampling sites, and habitat classifications on Shutes Folly. Transects A, C, and E were analyzed for macrobenthic community composition.

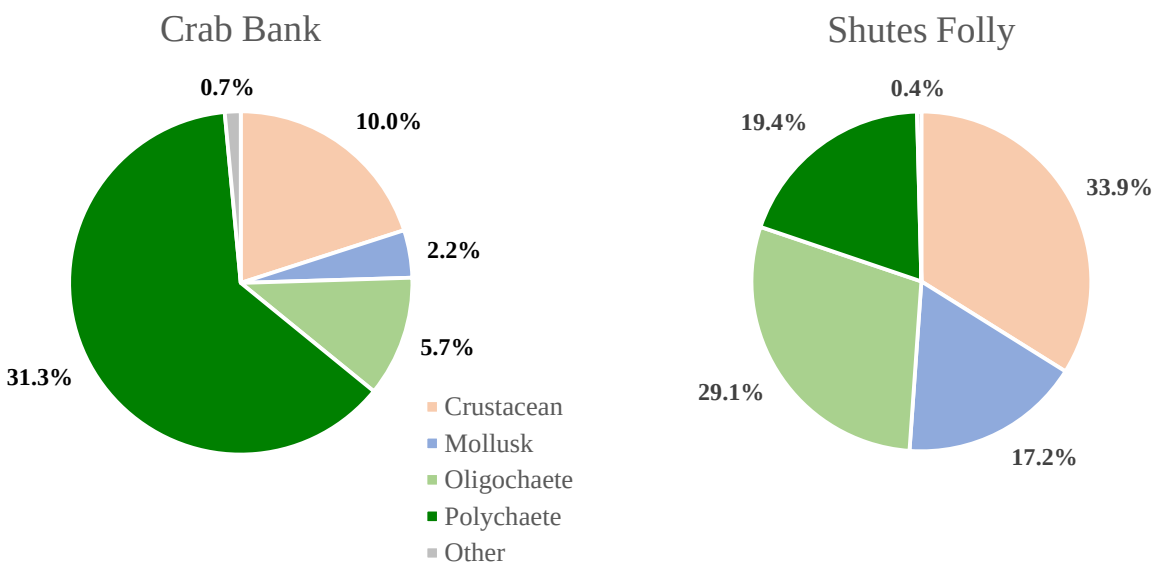

Figure 3. Taxonomic groupings of macrobenthic communities on Crab Bank (left) and Shutes Folly (right) for all sites combined (n=27).

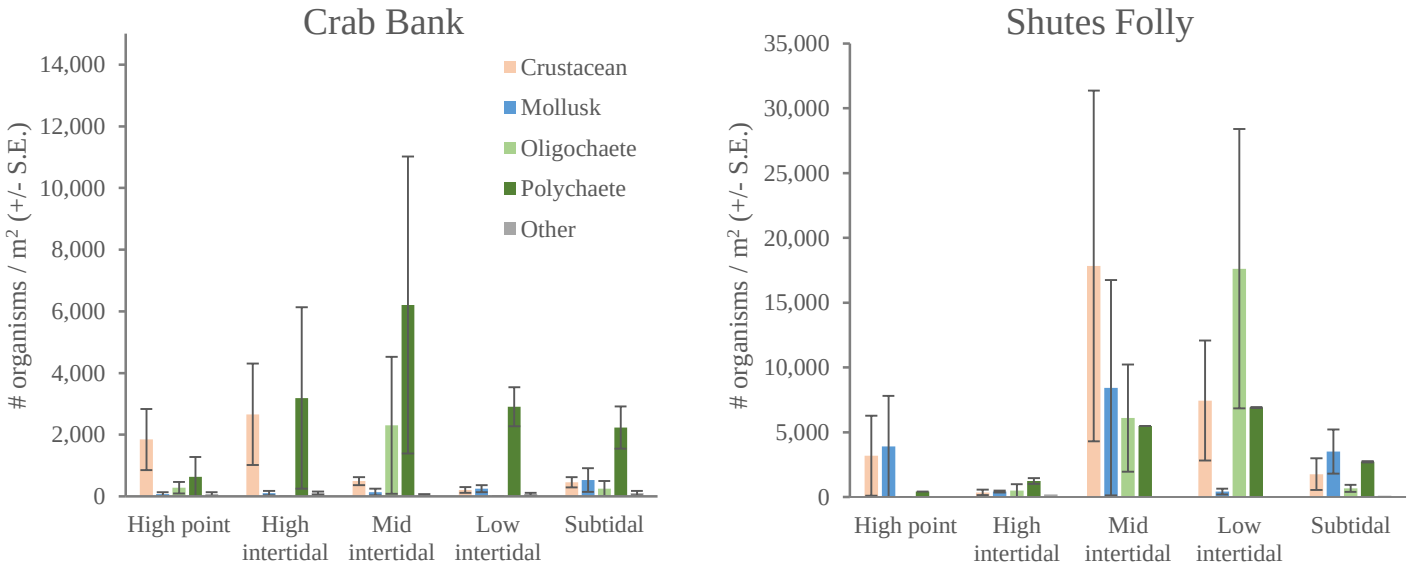

Figure 4. Taxonomic groupings for Crab Bank (left) and Shutes Folly (right) by site elevation type. Graphs are scaled for comparison between sites on each island (note different y-axis scales). All sites represent six samples except for High Point samples which represent three.

Figure 5. Macrobenthic taxonomic groupings and abundance by site at Crab Bank. Sites along transect E are highly clustered, but listed in order. Site CAWH had zero organisms.

Figure 6. Macrobenthic taxonomic groupings and abundance by site at Shutes Folly. Sites at transect A with no visible bar had either one or zero organisms.

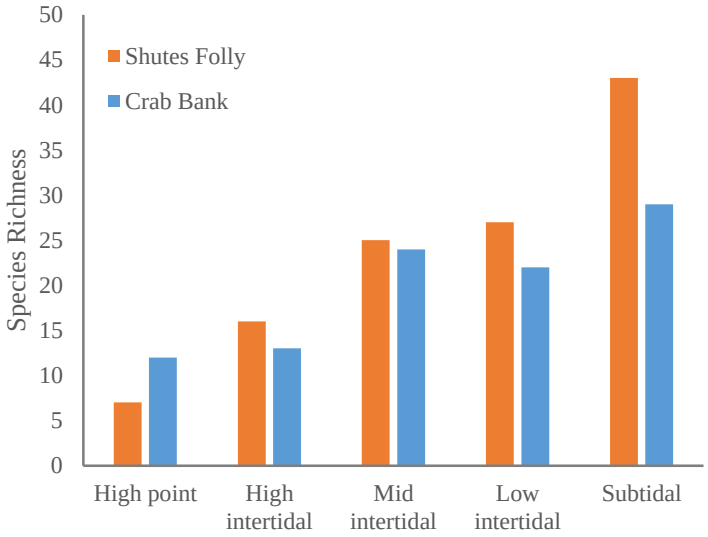

Figure 7. Species richness by site elevation type for Shutes Folly and Crab Bank.

Figure 8. Yellow triangles indicate sites sampled for benthic macrofauna by SC Department of Natural Resources' South Carolina Estuarine and Coastal Assessment Program (SCECAP) between 2000 and 2010. White circles represent sites sampled for benthic macrofauna as part of this study.

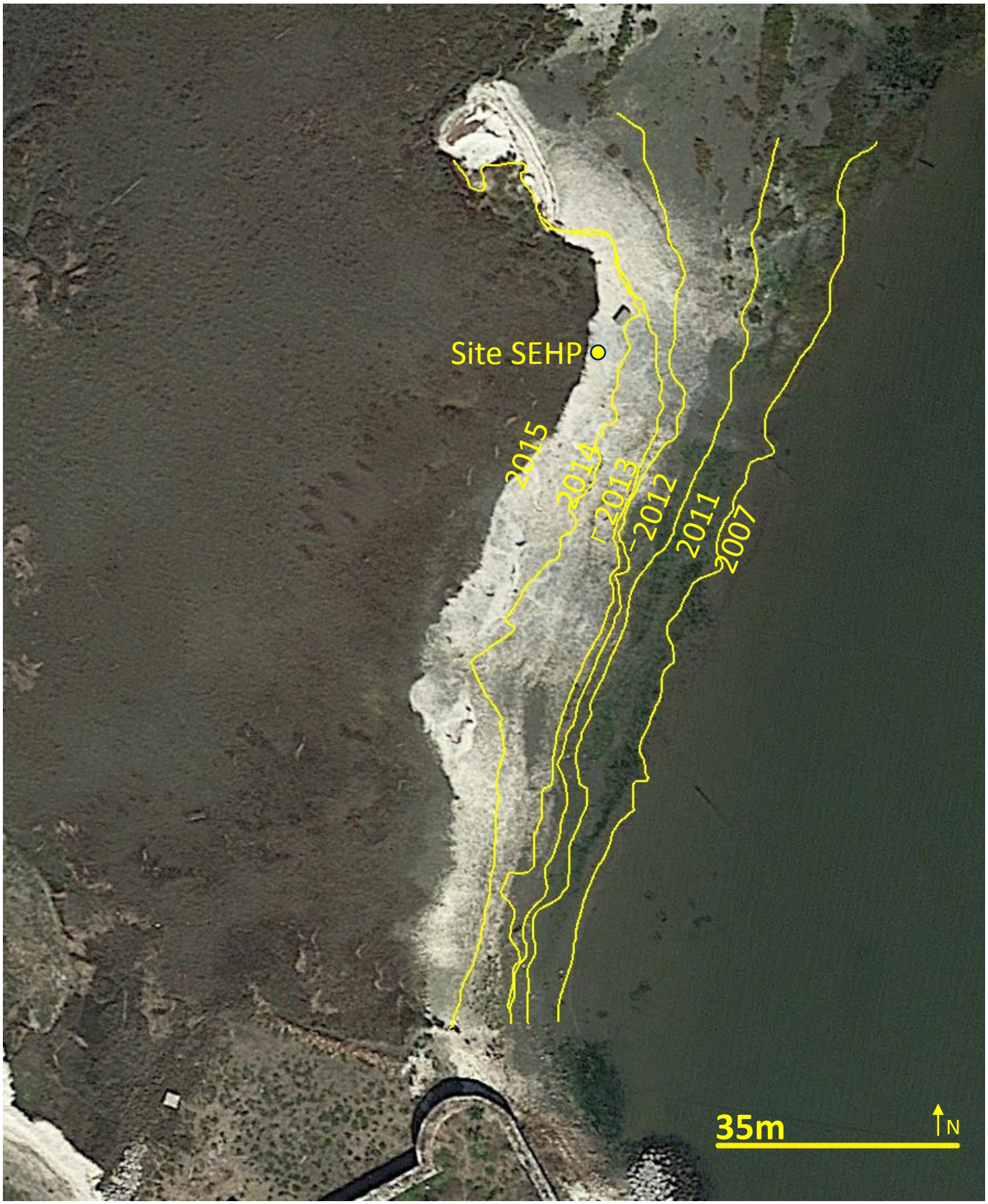

Figure 9. Yellow lines depict the inland limit of oyster shell rake at the southeast end of Shutes' Folly for various years. Shell migrated up to 35 meters between 2007 and 2015 (base image) in some areas. Location of the high point sampled along transect E was marsh as recently as 2013.

Table 1. Macrobenthic species list for Shutes Folly. Species shown in bold are known prey for shorebirds.

Shutes Folly	**Mean # / m²**		**Mean # / m²**
Tanaidacea	5075	*Eteone heteropoda*	24
Enchytraeidae	4145	*Heteromastus filiformis*	24
Brachidontes exustus	1513	*Uca pugnax*	24
Streblospio benedicti	1182	*Ampelisca verrilli*	16
Tubificidae	1127	Amphipoda	16
Sabellidae	654	*Aricidea* sp.	16
Sphaeroma destructor	559	*Assiminea succinea*	16
Sphenia antillensis	512	*Carinomella lactea*	16
Capitella capitata	441	Naticidae	16
Littorinidae	410	Nemertea	16
Ligia sp.	347	*Neopanope sayi*	16
Ilyanassa obsoleta	323	*Ocypode quadrata*	16
Leitoscoloplos sp.	260	Panopeidae	16
Leitoscoloplos fragilis	205	*Petricola pholadiformis*	16
Spiochaetopterus costarum oculatus	158	*Polydora socialis*	16
Laeonereis culveri	150	*Rhithropanopeus harrisii*	16
Nereis succinea	150	Syllidae	16
Crassostrea virginica	134	*Alpheus* sp.	8
Polydora cornuta	134	*Astyris lunata*	8
Petrolisthes galathinus	126	Capitellidae	8
Gammarus sp.	110	Corophiidae	8
Geukensia demissa	102	*Exogone dispar*	8
Tubificoides wasselli	102	*Hargeria rapax*	8
Monopylephorus irroratus	95	*Melita nitida*	8
Aricidea bryani	87	*Mulinia lateralis*	8
Gastropoda	63	*Nassarius acutus*	8
Acteocina canaliculata	55	*Notomastus latericeus*	8
Tellina sp.	55	*Nucula proxima*	8
Tubificoides brownae	55	Oligochaeta	8
Insecta	47	*Pagurus longicarpus*	8
Mediomastus sp.	47	*Paraonis fulgens*	8
Eobrolgus spinosus	39	*Scolelepis* sp.	8
Lepidactylus dytiscus	32	Spionidae	8
Nereididae	32	*Syllis* sp.	8
Pelecypoda	32	*Travisia parva*	8
Streptosyllis sp.	32		

Table 2. Macrobenthic species list for Crab Bank. Species shown in bold are known prey for shorebirds.

Crab Bank	**Mean # / m²**		**Mean # / m²**
Leitoscoloplos fragilis	788	*Aricidea suecica*	16
Streblospio benedicti	780	*Carinomella lactea*	16
Enchytraeidae	465	*Cirriformia* sp.	16
Capitella capitata	449	***Drilonereis longa***	16
Lepidactylus dytiscus	410	***Geukensia demissa***	16
Laeonereis culveri	339	Insecta	16
Sphaeroma destructor	292	*Pinnixa* sp.	16
Heteromastus filiformis	268	*Scoletoma tenuis*	16
Tubificidae	134	Syllidae	16
Nereis succinea	118	*Syllis* sp.	16
Fabriciola sp.	102	*Uca pugnax*	16
Tanaidacea	95	*Abra aequalis*	8
Ampelisca verrilli	79	*Acteocina canaliculata*	8
Neohaustorius schmitzi	79	Amphipoda	8
Aricidea bryani	71	***Arabella mutans***	8
Petricola pholadiformis	71	Caprellidae	8
Eteone heteropoda	47	*Corbula contracta*	8
Exogone sp.	39	*Diopatra cuprea*	8
Ilyanassa obsoleta	39	*Ericthonius brasiliensis*	8
Mulinia lateralis	39	Gastropoda	8
Nemertea	39	*Goniadides carolinae*	8
Glycera americana	32	***Limulus polyphemus***	8
Mediomastus sp.	32	*Listriella clymenellae*	8
Spiochaetopterus costarum oculatus	32	*Lyonsia hyalina*	8
Exosphaeroma diminutum	24	*Oxyurostylis smithi*	8
Nereididae	24	*Pagurus acadianus*	8
Polydora cornuta	24	*Paraonis fulgens*	8
Scolelepis sp.	24	*Sphaerosyllis* sp.	8
Sphenia antillensis	24	*Tellina versicolor*	8

Appendix A. Raw data tables. Abundances are presented in units of organisms/m^2. A core containing one organism scaled to 1 m^2 becomes 213 organisms per m^2.

Crab Bank: Transect A	**CAWS**	**CAWL**	**CAWM**	**CAWH**	**CAHP**	**CAEH**	**CAEM**	**CAEL**	**CAES**
Abra aequalis	0	0	0	0	0	0	0	0	0
Acteocina canaliculata	0	0	0	0	0	0	0	0	0
Ampelisca verrilli	0	0	0	0	0	0	213	0	0
Amphipoda	0	0	0	0	0	0	0	0	0
Arabella mutans	0	0	0	0	0	0	0	0	0
Aricidea bryani	0	0	0	0	0	0	0	0	426
Aricidea suecica	0	0	0	0	0	0	0	0	0
Capitella capitata	0	426	0	0	0	0	9787	426	0
Caprellidae	0	0	0	0	0	0	0	0	0
Carinomella lactea	0	0	0	0	0	0	0	213	0
Cirriformia sp.	0	0	0	0	0	0	0	0	213
Corbula contracta	0	0	0	0	0	0	0	0	0
Diopatra cuprea	0	0	0	0	0	0	0	0	0
Drilonereis longa	213	0	0	0	0	0	0	0	213
Enchytraeidae	0	0	0	0	638	0	11702	0	0
Ericthonius brasiliensis	0	0	0	0	0	0	0	0	0
Eteone heteropoda	0	0	0	0	0	0	638	0	0
Exogone sp.	0	0	0	0	0	0	0	0	0
Exosphaeroma diminutum	0	0	0	0	0	0	0	0	0
Fabriciola sp.	0	0	0	0	0	0	2766	0	0
Gastropoda	0	0	0	0	0	0	0	0	0
Geukensia demissa	0	0	0	0	0	0	0	0	0
Glycera americana	0	0	0	0	0	0	0	0	0
Goniadides carolinae	0	0	0	0	0	0	0	0	0
Heteromastus filiformis	0	0	0	0	0	0	0	3617	426
Ilyanassa obsoleta	0	0	0	0	0	0	0	638	0
Insecta	0	0	0	0	0	213	0	0	0
Laeonereis culveri	0	2979	1064	0	0	0	0	426	0
Leitoscoloplos fragilis	0	0	0	0	0	0	0	0	0
Lepidactylus dytiscus	0	0	0	0	0	0	0	0	0
Limulus polyphemus	0	0	0	0	0	0	0	0	0
Listriella clymenellae	213	0	0	0	0	0	0	0	0
Lyonsia hyalina	0	0	0	0	0	0	0	0	0
Mediomastus sp.	0	0	0	0	0	0	213	0	0
Mulinia lateralis	0	0	0	0	0	0	0	0	0
Nemertea	0	0	0	0	0	0	213	0	213
Neohaustorius schmitzi	0	0	0	0	0	0	0	0	0
Nereididae	213	0	0	0	0	0	426	0	0
Nereis succinea	0	0	0	0	0	0	1277	0	0
Oxyurostylis smithi	0	0	0	0	0	0	0	0	0
Pagurus acadianus	0	0	0	0	0	0	0	0	0
Paraonis fulgens	0	0	0	0	0	0	0	0	0
Petricola pholadiformis	0	0	0	0	0	0	0	0	0
Pinnixa sp.	426	0	0	0	0	0	0	0	0
Polydora cornuta	0	0	0	0	0	0	213	0	0
Scolelepis sp.	0	0	0	0	0	0	0	0	0
Scoletoma tenuis	0	0	0	0	0	0	0	0	213
Sphaeroma destructor	0	0	638	0	0	0	0	0	0
Sphaerosyllis sp.	0	0	0	0	0	0	0	0	0
Sphenia antillensis	0	0	0	0	0	0	0	0	0
Spiochaetopterus costarum oculatus	213	0	0	0	0	0	0	0	0
Streblospio benedicti	0	213	213	0	0	0	14894	0	213
Syllidae	0	0	0	0	0	0	0	0	0
Syllis sp.	0	0	0	0	0	0	0	0	0
Tanaidacea	0	0	0	0	0	0	0	0	0
Tellina versicolor	0	0	213	0	0	0	0	0	0
Tubificidae	0	0	0	0	0	0	1702	0	0
Uca pugnax	0	0	0	0	0	0	213	0	0
Total Abundance	1277	3617	2128	0	638	213	44255	5319	1915

Crab Bank: Transect C	**CCWS**	**CCWL**	**CCWM**	**CCWH**	**CCHP**	**CCEH**	**CCEM**	**CCEL**	**CCES**
Abra aequalis	0	213	0	0	0	0	0	0	0
Acteocina canaliculata	0	0	0	0	0	0	0	0	0
Ampelisca verrilli	0	0	0	0	0	0	0	213	638
Amphipoda	0	0	0	0	0	0	0	0	0
Arabella mutans	0	0	0	0	0	0	0	0	213
Aricidea bryani	0	0	0	0	0	0	0	0	0
Aricidea suecica	0	0	0	0	0	0	426	0	0
Capitella capitata	0	0	1064	0	0	0	0	213	0
Caprellidae	0	0	0	0	0	0	0	0	213
Carinomella lactea	0	0	0	0	0	0	0	0	0
Cirriformia sp.	0	0	0	0	0	0	0	0	213
Corbula contracta	0	0	0	0	0	0	0	0	0
Diopatra cuprea	0	0	0	0	0	0	0	0	213
Drilonereis longa	0	0	0	0	0	0	0	0	0
Enchytraeidae	0	0	0	0	213	0	0	0	0
Ericthonius brasiliensis	0	0	0	0	0	0	0	0	213
Eteone heteropoda	0	0	213	0	0	0	0	213	0
Exogone sp.	0	0	0	0	0	0	0	0	0
Exosphaeroma diminutum	0	0	0	0	0	0	0	0	0
Fabriciola sp.	0	0	0	0	0	0	0	0	0
Gastropoda	0	0	0	0	0	0	0	0	0
Geukensia demissa	0	0	0	426	0	0	0	0	0
Glycera americana	426	213	0	0	0	0	0	0	0
Goniadides carolinae	0	0	0	0	0	0	0	0	0
Heteromastus filiformis	0	0	0	0	0	0	0	3191	0
Ilyanassa obsoleta	0	0	0	0	0	0	426	0	0
Insecta	0	0	0	0	213	0	0	0	0
Laeonereis culveri	1702	0	1489	0	0	0	0	851	0
Leitoscoloplos fragilis	0	0	0	0	0	638	0	0	0
Lepidactylus dytiscus	0	0	0	4255	1064	5745	0	0	0
Limulus polyphemus	0	0	0	0	0	0	0	0	0
Listriella clymenellae	0	0	0	0	0	0	0	0	0
Lyonsia hyalina	0	0	0	0	0	0	0	0	0
Mediomastus sp.	0	0	0	0	0	0	0	213	213
Mulinia lateralis	0	0	0	0	0	0	213	0	0
Nemertea	0	0	0	0	0	0	0	0	426
Neohaustorius schmitzi	0	0	213	426	1277	0	213	0	0
Nereididae	0	0	0	0	0	0	0	0	0
Nereis succinea	1064	851	0	0	0	0	0	0	0
Oxyurostylis smithi	0	0	0	0	0	0	0	0	0
Pagurus acadianus	0	213	0	0	0	0	0	0	0
Paraonis fulgens	0	0	0	0	0	0	0	0	0
Petricola pholadiformis	1702	213	0	0	0	0	0	0	0
Pinnixa sp.	0	0	0	0	0	0	0	0	0
Polydora cornuta	0	0	0	0	0	0	0	0	0
Scolelepis sp.	0	0	0	0	0	0	0	0	0
Scoletoma tenuis	0	0	0	0	0	0	0	0	213
Sphaeroma destructor	0	0	213	4681	851	213	0	0	0
Sphaerosyllis sp.	0	0	0	0	0	0	0	0	0
Sphenia antillensis	638	0	0	0	0	0	0	0	0
Spiochaetopterus costarum oculatus	0	0	0	0	0	0	0	0	0
Streblospio benedicti	2128	1064	0	0	0	0	0	0	0
Syllidae	0	0	0	0	0	0	0	0	0
Syllis sp.	0	0	0	0	0	0	0	0	0
Tanaidacea	0	0	638	0	0	0	0	0	0
Tellina versicolor	0	0	0	0	0	0	0	0	0
Tubificidae	0	0	0	0	0	0	0	0	1489
Uca pugnax	0	0	0	0	213	0	0	0	0
Total Abundance	7660	2766	3830	9787	3830	6596	1277	4894	4043

Crab Bank: Transect E	**CEWS**	**CEWL**	**CEWM**	**CEWH**	**CEHP**	**CEEH**	**CEEM**	**CEEL**	**CEES**
Abra aequalis	0	0	0	0	0	0	0	0	0
Acteocina canaliculata	213	0	0	0	0	0	0	0	0
Ampelisca verrilli	426	0	0	0	0	0	0	213	426
Amphipoda	0	0	0	0	213	0	0	0	0
Arabella mutans	0	0	0	0	0	0	0	0	0
Aricidea bryani	426	0	0	0	0	0	0	426	638
Aricidea suecica	0	0	0	0	0	0	0	0	0
Capitella capitata	0	0	0	213	0	0	0	0	0
Caprellidae	0	0	0	0	0	0	0	0	0
Carinomella lactea	0	0	0	0	0	0	0	213	0
Cirriformia sp.	0	0	0	0	0	0	0	0	0
Corbula contracta	0	0	0	0	0	0	0	213	0
Diopatra cuprea	0	0	0	0	0	0	0	0	0
Drilonereis longa	0	0	0	0	0	0	0	0	0
Enchytraeidae	0	0	0	0	0	0	0	0	0
Ericthonius brasiliensis	0	0	0	0	0	0	0	0	0
Eteone heteropoda	0	0	0	0	0	0	213	0	0
Exogone sp.	0	0	0	213	851	0	0	0	0
Exosphaeroma diminutum	0	0	0	638	0	0	0	0	0
Fabriciola sp.	0	0	0	0	0	0	0	0	0
Gastropoda	0	0	0	0	213	0	0	0	0
Geukensia demissa	0	0	0	0	0	0	0	0	0
Glycera americana	0	0	0	0	0	0	0	0	213
Goniadides carolinae	0	0	0	0	0	0	0	213	0
Heteromastus filiformis	0	0	0	0	0	0	0	0	0
Ilyanassa obsoleta	0	0	0	0	0	0	0	0	0
Insecta	0	0	0	0	0	0	0	0	0
Laeonereis culveri	0	426	0	0	213	0	0	0	0
Leitoscoloplos fragilis	0	426	426	17447	851	426	851	0	213
Lepidactylus dytiscus	0	0	0	0	0	0	0	0	0
Limulus polyphemus	0	0	0	213	0	0	0	0	0
Listriella clymenellae	0	0	0	0	0	0	0	0	0
Lyonsia hyalina	0	0	0	0	0	0	0	213	0
Mediomastus sp.	0	0	0	0	0	0	0	213	0
Mulinia lateralis	638	0	0	213	0	0	0	0	0
Nemertea	0	0	0	0	0	213	0	0	0
Neohaustorius schmitzi	0	0	0	0	0	0	0	0	0
Nereididae	0	0	0	0	0	0	0	0	0
Nereis succinea	0	0	0	0	0	0	0	0	0
Oxyurostylis smithi	0	0	0	0	0	0	0	0	213
Pagurus acadianus	0	0	0	0	0	0	0	0	0
Paraonis fulgens	0	0	213	0	0	0	0	0	0
Petricola pholadiformis	0	0	0	0	0	0	0	0	0
Pinnixa sp.	0	0	0	0	0	0	0	0	0
Polydora cornuta	0	0	0	0	0	0	0	0	426
Scolelepis sp.	426	0	0	0	0	0	0	0	213
Scoletoma tenuis	0	0	0	0	0	0	0	0	0
Sphaeroma destructor	0	638	213	0	213	0	213	0	0
Sphaerosyllis sp.	0	0	0	0	0	213	0	0	0
Sphenia antillensis	0	0	0	0	0	0	0	0	0
Spiochaetopterus costarum oculatus	213	0	0	0	0	0	0	0	426
Streblospio benedicti	851	0	0	0	0	0	638	213	638
Syllidae	0	0	0	0	0	0	213	213	0
Syllis sp.	0	426	0	0	0	0	0	0	0
Tanaidacea	0	0	213	0	1702	0	0	0	0
Tellina versicolor	0	0	0	0	0	0	0	0	0
Tubificidae	0	0	0	0	0	0	426	0	0
Uca pugnax	0	0	0	0	0	0	0	0	0
Total Abundance	3191	1915	1064	18936	4255	851	2553	2128	3404

Shutes Folly: Transect A	**SAWS**	**SAWL**	**SAWM**	**SAWH**	**SAHP**	**SAEH**	**SAEM**	**SAEL**	**SAES**
Acteocina canaliculata	0	0	0	0	0	0	0	213	0
Alpheus sp.	213	0	0	0	0	0	0	0	0
Ampelisca verrilli	0	0	0	0	0	0	0	0	0
Amphipoda	0	0	0	0	0	0	0	0	0
Aricidea bryani	0	0	0	0	0	0	0	0	0
Aricidea sp.	0	0	0	0	0	0	0	0	0
Assiminea succinea	0	0	0	0	0	0	0	0	0
Astyris lunata	0	0	0	0	0	0	0	0	0
Brachidontes exustus	426	0	0	0	0	0	0	0	0
Capitella capitata	0	0	0	0	0	0	0	0	0
Capitellidae	0	0	0	0	0	0	0	0	0
Carinomella lactea	0	0	0	0	0	0	0	0	213
Corophiidae	213	0	0	0	0	0	0	0	0
Crassostrea virginica	3617	0	0	0	0	0	0	0	0
Enchytraeidae	0	0	0	0	0	0	0	0	0
Eobrolgus spinosus	638	0	0	0	0	0	426	0	0
Eteone heteropoda	0	0	0	0	0	0	0	0	0
Exogone dispar	0	0	0	0	0	0	0	0	0
Gammarus sp.	2979	0	0	0	0	0	0	0	0
Gastropoda	0	0	0	213	0	0	0	0	0
Geukensia demissa	0	426	0	0	0	638	0	0	0
Hargeria rapax	0	0	0	0	0	0	0	0	0
Heteromastus filiformis	0	0	0	0	0	0	0	0	0
Ilyanassa obsoleta	0	0	0	0	0	0	0	0	0
Insecta	0	0	0	0	0	0	0	0	0
Laeonereis culveri	426	0	0	0	0	0	0	426	638
Leitoscoloplos fragilis	0	0	0	0	0	0	426	0	0
Leitoscoloplos sp.	0	0	0	0	0	0	6596	0	0
Lepidactylus dytiscus	0	0	0	0	0	0	0	0	0
Ligia sp.	0	0	0	0	0	0	0	0	0
Littorinidae	0	0	0	0	0	0	0	0	0
Mediomastus sp.	0	0	0	0	0	0	213	213	213
Melita nitida	0	0	0	0	0	0	0	0	213
Monopylephorus irroratus	0	0	0	0	0	0	0	1064	0
Mulinia lateralis	0	0	0	0	0	0	0	0	0
Nassarius acutus	0	0	0	0	0	0	0	0	0
Naticidae	0	0	0	0	0	0	0	0	0
Nemertea	0	0	0	0	0	0	0	0	0
Neopanope sayi	426	0	0	0	0	0	0	0	0
Nereididae	0	0	0	0	0	638	0	0	0
Nereis succinea	0	0	0	0	0	0	0	0	0
Notomastus latericeus	0	0	0	0	0	0	0	0	0
Nucula proxima	0	0	0	0	0	0	213	0	0
Ocypode quadrata	0	0	0	0	0	0	0	0	0
Oligochaeta	0	0	0	0	0	0	0	0	0
Pagurus longicarpus	0	0	0	0	0	0	0	0	0
Panopeidae	0	0	0	0	0	0	0	213	0
Paraonis fulgens	0	213	0	0	0	0	0	0	0
Pelecypoda	0	0	0	0	0	0	0	0	0
Petricola pholadiformis	0	0	0	0	0	0	0	0	0
Petrolisthes galathinus	3404	0	0	0	0	0	0	0	0
Polydora cornuta	0	0	0	0	0	0	0	0	0
Polydora socialis	0	0	0	0	0	0	0	0	0
Rhithropanopeus harrisii	0	0	0	0	0	0	0	0	426
Sabellidae	0	0	0	0	0	0	0	0	0
Scolelepis sp.	0	0	0	0	0	0	0	0	213
Sphaeroma destructor	0	213	0	0	0	0	10213	0	0
Sphenia antillensis	3830	0	0	0	0	0	0	0	0
Spiochaetopterus costarum oculatus	0	0	0	0	0	0	0	0	0
Spionidae	0	0	0	0	0	0	0	0	0
Streblospio benedicti	0	0	0	0	0	0	213	0	0
Streptosyllis sp.	0	426	0	0	0	426	0	0	0
Syllidae	0	213	0	0	0	0	0	0	0
Syllis sp.	0	0	0	0	0	0	0	0	0
Tanaidacea	0	0	0	0	0	0	0	0	0
Tellina sp.	0	0	0	0	0	0	0	0	0
Travisia parva	0	0	0	0	0	0	0	0	0
Tubificidae	426	0	0	0	0	0	0	213	638
Tubificoides brownae	0	0	0	0	0	0	0	0	0
Tubificoides wasselli	0	0	0	0	0	0	0	1489	851
Uca pugnax	0	0	0	0	0	0	0	0	0
Total Abundance	16596	1489	0	213	0	1702	18298	3830	3404

Shutes Folly: Transect C	SCWS	SCWL	SCWM	SCWH	SCHP	SCEH	SCEM	SCEL	SCES
Acteocina canaliculata	0	0	0	0	0	0	0	0	426
Alpheus sp.	0	0	0	0	0	0	0	0	0
Ampelisca verrilli	0	0	0	0	0	0	0	0	213
Amphipoda	213	0	0	0	213	0	0	0	0
Aricidea bryani	0	0	0	0	0	0	0	0	851
Aricidea sp.	426	0	0	0	0	0	0	0	0
Assiminea succinea	0	0	0	0	0	0	0	0	0
Astyris lunata	0	0	0	0	0	0	0	0	213
Brachidontes exustus	0	0	0	0	0	0	0	0	0
Capitella capitata	0	6809	0	0	0	0	213	0	0
Capitellidae	0	0	213	0	0	0	0	0	0
Carinomella lactea	0	0	0	0	0	0	0	0	0
Corophiidae	0	0	0	0	0	0	0	0	0
Crassostrea virginica	0	0	0	0	0	0	0	0	0
Enchytraeidae	0	56170	0	0	0	0	0	0	0
Eobrolgus spinosus	0	0	0	0	0	0	0	0	0
Eteone heteropoda	213	0	0	0	0	0	426	0	0
Exogone dispar	0	0	0	0	0	0	0	0	0
Gammarus sp.	0	0	0	0	0	0	0	0	0
Gastropoda	0	0	0	0	0	0	0	0	0
Geukensia demissa	0	1489	0	0	0	0	0	0	0
Hargeria rapax	0	0	0	0	0	0	0	0	0
Heteromastus filiformis	0	0	0	0	0	0	0	0	0
Ilyanassa obsoleta	0	0	0	0	0	0	0	0	8723
Insecta	0	0	0	1277	0	0	0	0	0
Laeonereis culveri	0	638	0	0	0	0	0	638	0
Leitoscoloplos fragilis	213	0	0	0	0	0	4894	0	0
Leitoscoloplos sp.	0	0	426	0	0	0	0	0	0
Lepidactylus dytiscus	0	0	0	0	0	0	0	0	0
Ligia sp.	0	0	0	0	0	0	0	0	0
Littorinidae	0	0	0	0	0	0	0	0	0
Mediomastus sp.	213	0	0	0	0	0	0	0	213
Melita nitida	0	0	0	0	0	0	0	0	0
Monopylephorus irroratus	0	0	0	0	0	0	1489	0	0
Mulinia lateralis	213	0	0	0	0	0	0	0	0
Nassarius acutus	213	0	0	0	0	0	0	0	0
Naticidae	0	0	0	213	0	213	0	0	0
Nemertea	0	213	0	0	0	0	0	0	213
Neopanope sayi	0	0	0	0	0	0	0	0	0
Nereididae	0	0	0	0	0	0	0	0	0
Nereis succinea	0	0	0	0	0	0	0	0	0
Notomastus latericeus	213	0	0	0	0	0	0	0	0
Nucula proxima	0	0	0	0	0	0	0	0	0
Ocypode quadrata	0	426	0	0	0	0	0	0	0
Oligochaeta	0	0	0	0	0	0	0	0	213
Pagurus longicarpus	213	0	0	0	0	0	0	0	0
Panopeidae	0	0	0	0	0	0	0	0	0
Paraonis fulgens	0	0	0	0	0	0	0	0	0
Pelecypoda	213	0	0	0	0	0	0	0	0
Petricola pholadiformis	0	0	0	0	0	0	0	0	0
Petrolisthes galathinus	0	0	0	0	0	0	0	0	0
Polydora cornuta	0	0	0	0	0	0	213	0	0
Polydora socialis	0	0	0	0	0	0	0	0	0
Rhithropanopeus harrisii	0	0	0	0	0	0	0	0	0
Sabellidae	0	14255	0	0	0	0	0	0	0
Scolelepis sp.	0	0	0	0	0	0	0	0	0
Sphaeroma destructor	0	0	0	0	0	0	1064	0	0
Sphenia antillensis	0	0	0	0	0	213	0	0	0
Spiochaetopterus costarum oculatus	0	0	0	0	0	0	0	0	3191
Spionidae	213	0	0	0	0	0	0	0	0
Streblospio benedicti	2979	213	638	0	213	0	0	2553	0
Streptosyllis sp.	0	0	0	0	0	0	0	0	0
Syllidae	0	0	0	0	0	0	0	0	0
Syllis sp.	0	0	0	0	0	0	0	0	0
Tanaidacea	851	20000	1489	213	0	0	213	0	0
Tellina sp.	851	0	0	0	0	0	0	0	426
Travisia parva	0	0	0	213	0	0	0	0	0
Tubificidae	0	0	426	0	0	0	638	0	0
Tubificoides brownae	1277	0	0	0	0	0	0	0	0
Tubificoides wasselli	213	0	0	0	0	0	0	0	213
Uca pugnax	0	0	0	0	0	0	0	0	0
Total Abundance	8723	100213	3191	1915	426	426	9149	3191	14894

Shutes Folly: Transect E	**SEWS**	**SEWL**	**SEWM**	**SEWH**	**SEHP**	**SEEH**	**SEEM**	**SEEL**	**SEES**
Acteocina canaliculata	851	0	0	0	0	0	0	0	0
Alpheus sp.	0	0	0	0	0	0	0	0	0
Ampelisca verrilli	213	0	0	0	0	0	0	0	0
Amphipoda	0	0	0	0	0	0	0	0	0
Aricidea bryani	1489	0	0	0	0	0	0	0	0
Aricidea sp.	0	0	0	0	0	0	0	0	0
Assiminea succinea	0	0	0	0	0	426	0	0	0
Astyris lunata	0	0	0	0	0	0	0	0	0
Brachidontes exustus	0	0	0	0	0	0	40426	0	0
Capitella capitata	0	1064	1064	213	0	0	2553	0	0
Capitellidae	0	0	0	0	0	0	0	0	0
Carinomella lactea	0	0	0	0	0	0	0	0	213
Corophiidae	0	0	0	0	0	0	0	0	0
Crassostrea virginica	0	0	0	0	0	0	0	0	0
Enchytraeidae	213	44681	8085	2553	0	0	213	0	0
Eobrolgus spinosus	0	0	0	0	0	0	0	0	0
Eteone heteropoda	0	0	0	0	0	0	0	0	0
Exogone dispar	0	0	0	0	0	0	213	0	0
Gammarus sp.	0	0	0	0	0	0	0	0	0
Gastropoda	0	0	426	213	638	213	0	0	0
Geukensia demissa	0	0	0	213	0	0	0	0	0
Hargeria rapax	0	0	213	0	0	0	0	0	0
Heteromastus filiformis	213	0	0	0	0	0	426	0	0
Ilyanassa obsoleta	0	0	0	0	0	0	0	0	0
Insecta	0	0	0	0	0	0	0	0	0
Laeonereis culveri	0	0	0	0	851	0	0	426	0
Leitoscoloplos fragilis	0	0	0	0	0	0	0	0	0
Leitoscoloplos sp.	0	0	0	0	0	0	0	0	0
Lepidactylus dytiscus	0	0	0	0	0	851	0	0	0
Ligia sp.	0	0	0	0	9362	0	0	0	0
Littorinidae	0	0	0	0	11064	0	0	0	0
Mediomastus sp.	0	0	0	0	0	0	0	0	213
Melita nitida	0	0	0	0	0	0	0	0	0
Monopylephorus irroratus	0	0	0	0	0	0	0	0	0
Mulinia lateralis	0	0	0	0	0	0	0	0	0
Nassarius acutus	0	0	0	0	0	0	0	0	0
Naticidae	0	0	0	0	0	0	0	0	0
Nemertea	0	0	0	0	0	0	0	0	0
Neopanope sayi	0	0	0	0	0	0	0	0	0
Nereididae	0	0	213	0	0	0	0	0	0
Nereis succinea	0	1277	426	0	0	0	1277	1064	0
Notomastus latericeus	0	0	0	0	0	0	0	0	0
Nucula proxima	0	0	0	0	0	0	0	0	0
Ocypode quadrata	0	0	0	0	0	0	0	0	0
Oligochaeta	0	0	0	0	0	0	0	0	0
Pagurus longicarpus	0	0	0	0	0	0	0	0	0
Panopeidae	0	0	213	0	0	0	0	0	0
Paraonis fulgens	0	0	0	0	0	0	0	0	0
Pelecypoda	0	0	0	0	0	0	0	213	426
Petricola pholadiformis	0	0	0	0	0	0	0	0	426
Petrolisthes galathinus	0	0	0	0	0	0	0	0	0
Polydora cornuta	0	426	426	0	0	0	2553	0	0
Polydora socialis	213	0	0	0	0	0	0	213	0
Rhithropanopeus harrisii	0	0	0	0	0	0	0	0	0
Sabellidae	0	0	3404	0	0	0	0	0	0
Scolelepis sp.	0	0	0	0	0	0	0	0	0
Sphaeroma destructor	0	0	0	0	0	426	3191	0	0
Sphenia antillensis	0	0	0	0	0	0	9574	213	0
Spiochaetopterus costarum oculatus	1064	0	0	0	0	0	0	0	0
Spionidae	0	0	0	0	0	0	0	0	0
Streblospio benedicti	638	7872	5957	5957	0	0	0	2340	2340
Streptosyllis sp.	0	0	0	0	0	0	0	0	0
Syllidae	0	0	0	0	213	0	0	0	0
Syllis sp.	0	213	0	0	0	0	0	0	0
Tanaidacea	426	22979	8298	638	0	0	81702	213	0
Tellina sp.	0	0	0	0	0	0	0	0	213
Travisia parva	0	0	0	0	0	0	0	0	0
Tubificidae	0	1915	213	426	0	0	25532	0	0
Tubificoides brownae	0	213	0	0	0	0	0	0	0
Tubificoides wasselli	0	0	0	0	0	0	0	0	0
Uca pugnax	0	638	0	0	0	0	0	0	0
Total Abundance	5319	81277	28936	10213	22128	1915	167660	4681	3830