Mon Louis Island Restoration
2018 Marsh Monitoring

Prepared for

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1.0 INTRODUCTION

The Mobile Bay National Estuary Program funded the project entitled "Mon Louis Island Restoration 2018 Marsh Monitoring" though a grant provided by the National Fish and Wildlife Gulf Environmental Benefit Fund, to restore the erosion-impacted northern tip of Mon Louis Island. The project is located at the mouth of East Fowl River, on the western shore of Mobile Bay, Alabama (Figure 1).

The restoration project began in July 2016, and included restoration and armoring of the receding shoreline, placement of dredged material to re-create eroded land, and creation of 4.8 acres of salt marsh habitat. A 1,400-foot continuous rock breakwater was constructed roughly along the 1995 footprint of the island, completed in early September 2016. Sandy material was hydraulically pumped from the Fowl River Open Water Disposal Area in Mobile Bay to provide a suitable substrate for marsh creation. A channel was then created to provide tidal inundation into the restoration site.

The restored marsh was initially prepared in March-April 2017 by planting nursery-grown stock of smooth cordgrass (*Spartina alterniflora*), salt meadow cordgrass (*Spartina patens*), and black needlerush (*Juncus roemerianus*). Barry A. Vittor & Associates, Inc. conducted a qualitative survey of the restoration site in July 2017 and found that some areas of the site had suffered high transplant mortality, particularly the black needlerush. Additional transplants were obtained and installed. Based on an inspection of the re-planted areas in mid-September 2017, it was concluded that the planting was satisfactorily completed.

Thompson Engineering, Inc. sub-contracted Barry A. Vittor & Associates, Inc. to perform environmental monitoring of the Mon Louis Island restoration. This report provides environmental survey data for Year 1 of the monitoring program.

2.0 METHODS

2.1 Sampling Plan

Sampling station locations are shown in Figure 1. The reference marsh is located on the north side of the mouth of East Fowl River, approximately 600 ft from the Mon Louis Island project site. Table 2-1 summarizes the number and types of samples collected during the September 2018 monitoring survey.

Table 2-1. Number and type of samples collected at the Mon Louis Island restoration site and reference marsh.

Site (No. Stations)	Vegetation Quadrat	Nekton Lift Nets	Macroinfauna Hand cores	Epifauna Quadrats	Sediment Texture/ TOC
Mon Louis Island (4)	N = 112	N = 12	N = 12	N = 12	N = 4
Reference (2)	--	N = 6	N = 6	N = 6	N = 2

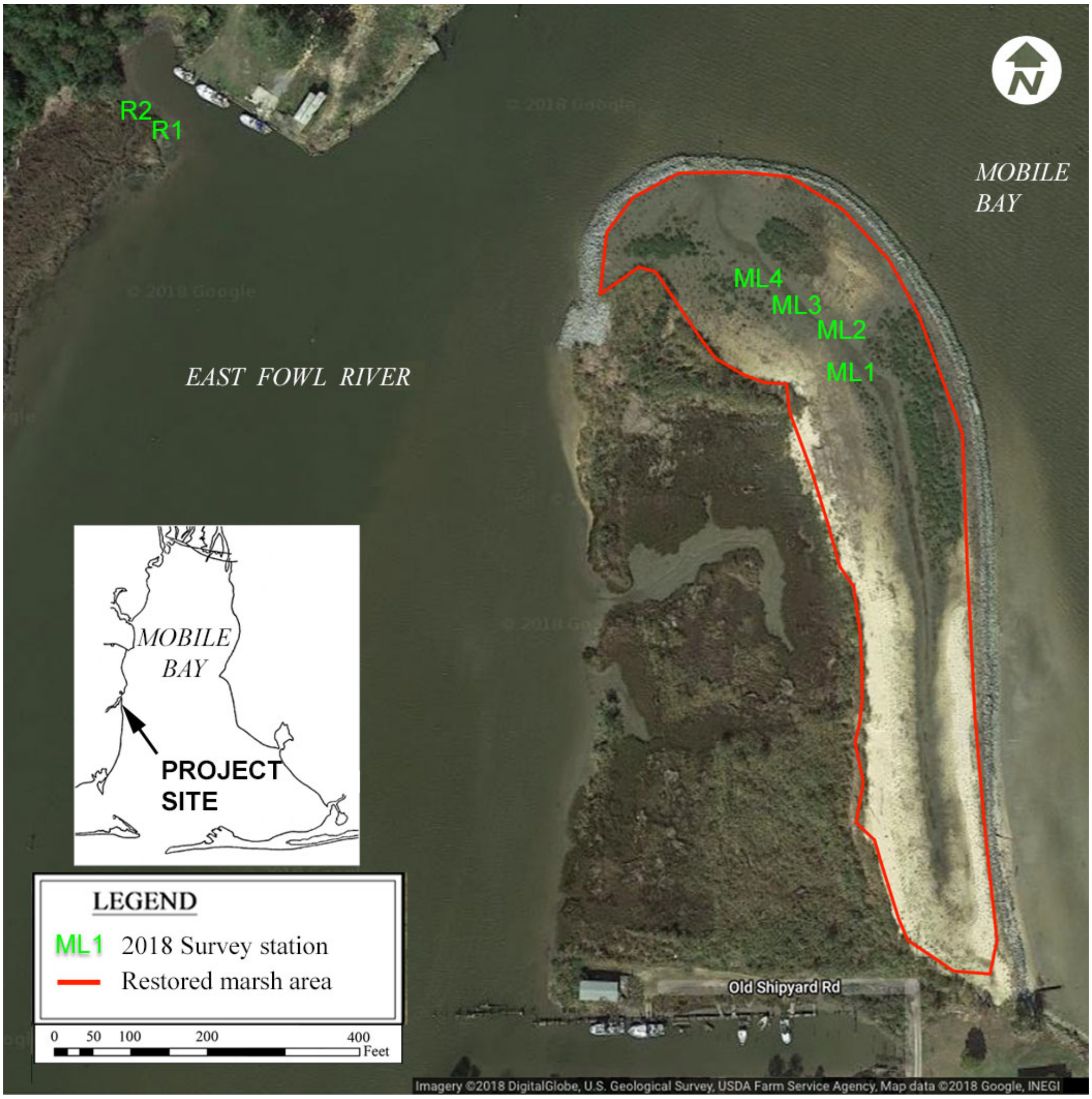

Figure 1. Location of the Mon Louis Island restoration project and faunal sampling stations.

2.2 Vegetation Coverage

Vegetation transects and quadrat locations are presented in Figure A-1 (Appendix A). Vegetation metrics were collected within standard 1-m^2 quadrats along 14 transects. The quadrat data collected included percent cover of individual species, an average height of the vegetation, and an estimate of overall vegetative cover of vegetation. Typically, quadrat data were collected at the beginning of each transect and then approximately every 5 meters.

2.3 HGM Model Assessment

A detailed hydrogeomorphic (HGM) model methodology is presented in Appendix A. The HGM model is a collection of concepts and methods that uses mathematically derived indices to assess the capacity of wetlands to perform specific ecological, geochemical, and hydrological functions, in comparison to similar wetlands within the Mississippi/Alabama coast reference domain (Schafer et al., 2007). When an HGM model variable is within the range of conditions observed in reference standard wetlands a variable sub-index value of 1.0 is assigned. As the condition deviates from reference standards, the variable sub-index is assigned based on the observed relationship between model variable condition and functional capacity (on a scale of 0.0 to 1.0). HGM assessment metrics were measured in the field during September 2018.

2.4 Nekton

A bottomless nylon lift net (6-m^2 area) was installed on the vegetated marsh surface at each survey station to sample nekton during tidal inundation. Lift nets were raised near high tide, and trapped nekton collected with dip nets. Lift net samples were collected September 17, 18, and 19, 2018.

Lift net contents were fixed in the field with 10% formalin, and subsequently washed and transferred to containers with 70% isopropanol. Nekton were identified to lowest practical identifiable level (LPIL) and counted. The number of individuals and number of taxa are reported for each station in Appendix B.

Spatial patterns in the lift net data were examined using multivariate cluster analysis. The cluster analysis was performed on a similarity matrix constructed from a raw abundance data matrix consisting of taxa and samples. To weight the contributions of common and rare taxa, raw counts of each individual taxon in a sample (n) were transformed to logarithms [$\log_{10}(n+1)$] prior to similarity analysis. The similarity matrix was generated using the Bray-Curtis similarity index (Bray and Curtis, 1957). Species accounting for the observed nekton assemblage differences among sample groups and within sample groups were identified using SIMPER procedure. SIMPER determines the average contribution of each taxon to characterizing a sample group or discriminating between pairs of sample groups resolved by cluster analysis. These analyses (cluster analysis, SIMPER) were performed using PRIMER v6 package (Clarke and Gorely, 2006).

2.5 Macroinfauna

Three replicate samples for macroinfauna were collected at each station using a 4-inch diameter hand core (0.0079 m^2). Sample contents were fixed in 10% formalin in the field. In the laboratory, samples were washed through a 0.5-mm sieve and transferred to containers with 70% isopropanol with rose Bengal stain. Macroinfauna were identified and counted to the LPIL and counted. The number of individuals in each taxon is reported for each station (Appendix C). Univariate summary statistics including number of taxa, number of individuals, density, Shannon's index of diversity (H') and Pielou's index of evenness (J') were calculated for each station. Macroinfaunal data were analyzed using multivariate methods as described in Section 2.4.

In addition to hand core samples, three replicate 0.25-m^2 quadrats were assessed at each station to qualitatively document epibenthic macrofauna such as snails and small crabs that are not readily sampled with the hand core. Quadrats were haphazardly placed with blind, over-the-shoulder tosses. Quadrat data are reported in Appendix C.

2.6 Sediment Texture and Total Organic Carbon

One sediment sample (about 250 grams) for grain size analysis and percent total organic carbon (TOC) was collected with the hand core at each station, and stored on ice. Grain size analysis was conducted using combined sieve and hydrometer methods according to recommended American Society for Testing Materials (ASTM) procedures. Samples were washed in demineralized water, dried, and weighed. Coarse and fine fractions (sand/silt) were separated by sieving through a U.S. Standard Sieve Mesh No. 230 (62.5 μm). Sediment texture of the coarse fraction was determined at 0.5-phi intervals by passing sediment through nested sieves. Weight of materials collected in each particle size class was recorded. Boyocouse hydrometer analyses were used to analyze the fine fraction (<62.5 μm). Percentages of gravel, sand, silt, and clay were recorded for each sample.

TOC was measured using an EA 1112 Analyzer. For each sample, a silver sample capsule was tared on a microbalance, which was interfaced to the analyzer. Approximately 15-20mg of sample sediment was placed in the capsule and its weight recorded to 0.001mg. Approximately 10 μl of concentrated nitric acid was added to the capsule and the sample was placed on a hot plate overnight at 80˚ C. The following day an additional 10 μl of concentrated nitric acid was added to the capsule and the sample was placed on a hot plate for at least one hour at 80˚ C, and then closed. A blank capsule was prepared for reference. Two standards of aspartic acid were weighed, and the sample and blank capsules were combusted with the chromatograph manually integrated to relate the instrument response to TOC concentration. After calibration, the percent carbon remaining in the sample was determined. Check standards and reference material were analyzed for quality control.

3.0 RESULTS

3.1 Vegetation Survey and HGM Model Analysis

A phylogenetic list of plant species and their percent cover in survey quadrats are presented in Appendix A. A total of 26 vascular plant species were identified. Vegetated coverage by all species was 39.3%.

Smooth cordgrass (*Spartina alterniflora*) comprised an average of 27.8% of the survey quadrat cover and occurred in 57% of the survey quadrats (Table 3-1). Salt meadow cordgrass (*Spartina patens*) was 6.2% of vegetated coverage and occurred in 32% of the quadrats. Black needlerush (*Juncus roemerianus*) averaged 1.0% cover and was present in 13.4% of the sampled quadrats.

Table 3-1. Plant species with at least 0.30% average cover.		
Species	Average % Cover	No. Quadrats (% of total)
Spartina alterniflora	27.8	64 (57.1)
Spartina patens	6.2	36 (32.1)
Juncus roemerianus	1.0	15 (13.4)
Paspalum vaginatum	0.80	4 (3.6)
Phragmites mauritianus †	0.70	16 (14.3)
Distichlis spicata	0.60	5 (4.5)
Myriophyllum spicatum †	0.50	2 (1.8)
Aeschynomene indica	0.30	2 (1.8)
Bolboschoenus robustus	0.30	3 (2.7)
Panicum repens †	0.30	4 (3.6)

† = non-native

Table 3-2 lists individual and average Functional Capacity Index (FCI) scores for the five ecosystem functions evaluated in the HGM model assessment. The restored marsh has a reduced potential for wave energy attenuation (FCI= 0.62) due to rock armoring and low percent vegetative cover. The score for the Biogeochemical Cycling function is also reduced (0.53) because of low cover, which limits potential for organic carbon production, degradation, and export.

Table 3-2. Functional Capacity Index (FCI) scores for ecosystem functions evaluated by the tidal marsh HGM model.	
HGM Function	FCI
Wave Energy Attenuation	0.62
Biogeochemical Cycling	0.53
Nekton Utilization Potential	0.92
Provide Habitat for Tidal Marsh Dependent Wildlife	0.72
Plant Community Composition /Structure	0.20
	Average: 0.60

The FCI score for Nekton Utilization potential (0.92) is highest of the five functions, due to the extent of aquatic edge along the tidal creek, and a V_{HYDRO} value (0.75) indicating adequate site accessibility for nekton. The wildlife habitat FCI score (0.53) is lowered due to low cover and a relatively small patch size. The site receives a low 0.20 value for “Maintaining Plant Community Composition and Structure” due to the sparse vegetative cover.

3.2 Nekton

A phylogenetic list of nekton collected in lift nets and the station taxa counts are presented in Appendix B. Table 3-3 presents lift net community statistics. Lift nets at Station ML1 yielded 12 total taxa, followed by R2 (10 taxa), with means of 7.3 and 5.7, respectively. Station ML4 also had a mean of 5.7 taxa per replicate. Stations ML2 and R1 yielded the fewest total number of taxa, with 6 taxa each, with means of 5 and 4.3 taxa per replicate, respectively.

Table 3-3. Nekton community statistics based on lift net contents at Mon Louis Island and reference survey stations.					
Station	Total Number of Taxa	Mean Number of Taxa (Std. Dev.)	Mean Density (Individuals/m^2) (Std. Dev.)	Shannon Diversity (H')	Pielou Evenness (J')
ML1	12	7.3 (1.5)	17.3 (13.2)	0.85	0.34
ML2	6	5.0 (0.0)	10.2 (3.8)	0.81	0.45
ML3	7	4.7 (1.2)	14.4 (3.4)	0.65	0.33
ML4	9	5.7 (1.2)	13.5 (5.0)	1.17	0.53
R1	6	4.3 (0.6)	13.4 (2.9)	1.24	0.69
R2	10	5.7 (2.1)	17.9 (12.0)	0.93	0.40

Mean nekton densities per were greatest at Stations R2 (17.9 individuals/m^2) and ML1 (17.3), while Station ML2 had the lowest mean density (10.2 individuals/m^2) (Table 3-3). Diversity ranged from 1.24 at R1 to 0.65 at ML3. Taxa evenness ranged from 0.69 at R1 to 0.33 at ML3.

Table 3-4 lists the most abundant taxa collected in lift nets. Grass shrimp (*Palaemonetes*), white shrimp (*Litopenaeus setiferus*), and blue crabs (*Callinectes sapidus*) were collected at all six stations. Except for Station R2, where white shrimp were the most abundant taxon, grass shrimp were numerically dominant at all stations (Appendix Table B-2). Bay anchovy (*Anchoa mitchilli*) was collected only at R1 and R2, whereas squareback marsh crab (*Armases cinereum*) and Gulf killifish (*Fundulus grandis*) occurred only at ML stations.

Table 3-4. Most abundant nekton collected in lift nets.		
Taxonomic Name	Total Count	Station Occurrence
Palaemonetes (LPIL)	923	ML1 ML2 ML3 ML4 R1 R2
Litopenaeus setiferus	387	ML1 ML2 ML3 ML4 R1 R2
Callinectes sapidus	101	ML1 ML2 ML3 ML4 R1 R2
Anchoa mitchilli	79	R1 R2
Armases cinereum	13	ML1 ML2 ML3 ML4
Fundulus grandis	11	ML1 ML2 ML3 ML4
Fundulus jenkinsi	10	ML1 ML3 ML4 R1 R2
Farfantepenaeus aztecus	7	ML4 R2

Cluster analysis of lift net contents found 62% similarity among all stations. The SIMPER procedure identified the taxa accounting for the observed assemblage differences among and within the sample groups (Table 3-5). ML stations clustered at 78% average similarity, with relatively high abundances of grass shrimp and blue crabs. R stations grouped together at 68% similarity, with numerical dominants grass shrimp and white shrimp.

Table 3-5. Average abundance of nekton taxa accounting for at least 50% of within group similarity in lift nets. Numbers in bold represent the overall average similarity for each sample group. N = 3 for all stations.

Group	Stations	Taxonomic Name	Average Abundance	Average Similarity
A	ML1, ML2, ML3, ML4	*Palaemonetes* (LPIL)	4.11	34.65
		Callinectes sapidus	2.04	16.62
				78.27
B	R1, R2	*Palaemonetes* (LPIL)	3.43	27.41
		Litopenaeus setiferus	3.60	24.01
				67.56

3.3 Macroinfauna

A phylogenetic list of macroinfauna collected in hand cores and station taxa counts are presented in Appendix C. Table 3-6 presents macroinfauna community statistics. Station ML3 yielded 15 total taxa, followed by R1 (11 taxa), with means of 10.3 and 6.0, respectively. Station ML4 had a mean of 7.3 taxa per replicate. Station ML1 yielded 5 taxa, with a mean of 2.3 taxa per replicate.

Table 3-6. Macroinfaunal community statistics based on hand core contents at Mon Louis Island and reference survey stations.

Station	Total Number of Taxa	Mean Number of Taxa (Std. Dev.)	Mean Density (Individuals/m^2) (Std. Dev.)	Shannon Diversity (H')	Pielou Evenness (J')
ML1	5	2.3 (0.6)	1,097.0 (527.0)	0.93	0.58
ML2	6	4.0 (2.0)	6,033.8 (3,364.2)	0.79	0.44
ML3	15	10.3 (1.5)	3,375.5 (1,076.6)	2.25	0.83
ML4	9	7.3 (1.5)	3,122.4 (2,488.0)	1.99	0.91
R1	11	6.0 (4.6)	1,645.6 (1,207.5)	2.06	0.86
R2	6	2.7 (1.5)	717.3 (697.2)	1.51	0.84

Mean density was greatest at ML2 (6,033.8 individuals/m^2), while R2 had the lowest mean density (717.3 individuals/m^2) (Table 3-6). Diversity ranged from 2.25 at ML3 to 0.79 at ML2. Taxa evenness ranged from 0.91 at ML4 to 0.44 at ML2.

Table 3-7 lists the most abundant macroinfauna collected. Abundance was numerically dominated by polychaetes, especially *Laeonereis culveri*, which was collected at all six stations. Polychaete *Streblospio benedicti* was also collected at all stations. *Mediomastus* (LPIL) and *Capitella capitata* were collected at all four ML stations, but not at either R station (Table 3-7).

Cluster analysis of hand core contents found <50% similarity between ML and R stations. R1 and R2 did not cluster with each other or the ML stations, partly due to low individual abundance. The SIMPER procedure identified the taxa accounting for the observed assemblage differences among and within the hand core sample groups (Table 3-8).

Table 3-7. Most abundant macroinfauna collected in hand cores at Mon Louis Island and reference survey stations.		
Taxonomic Name	Total Count	Station Occurrence
Laeonereis culveri	159	ML1 ML2 ML3 ML4 R1 R2
Mediomastus (LPIL)	45	ML2 ML3 ML4 R1
Streblospio benedicti	42	ML1 ML2 ML3 ML4 R1 R2
Dicrotendipes (LPIL)	25	ML3 ML4
Naididae (LPIL)	20	ML1 ML2 ML3 ML4 R2
Polypedilum (LPIL)	16	ML3 ML4 R2
Capitella capitata	14	ML1 ML2 ML3 ML4
Polydora cornuta	14	ML3 R1
Hobsonia florida	12	ML3 ML4 R2

The ML3 and ML4 stations were characterized by polycheates *L. culveri*, and *S. benedicti*, and insect larvae *Dicrotendipes* (LPIL) and *Polypedilum* (LPIL). Stations ML1 and ML2 were characterized by polychaetes *L. culveri*, and *C. capitata* and oligochaete Naididae (LPIL) (Table 3-8).

Table 3-8. Average abundance of macroinfauna accounting for at least 50% of within group similarity. Numbers in bold represent average similarity for each sample group.				
Group	Stations	Taxonomic Name	Average Abundance	Average Similarity
C	ML3, ML4	*Dicrotendipes* (LPIL) *Streblospio benedicti* *Laeonereis culveri* *Polypedilum* (LPIL) *Capitella capitata*	1.64 1.81 1.60 1.22 0.91	13.66 13.08 12.45 8.33 7.19 **70.82**
D	ML1, ML2	*Laeonereis culveri* *Capitella capitata* *Naididae* (LPIL)	2.80 0.60 0.60	33.33 8.55 8.55 **55.24**

Epifauna quadrat data are presented in Appendix C. Stations R1 and R2 had numerous marsh periwinkles (*Littorina irrorata*) that were not present in the restoration site. The restoration area had many fiddler crab burrows, but generally not in vegetated areas near the ML stations.

3.4 Sediment Texture and Total Organic Carbon

Table 3-9 presents sediment texture and percent total organic carbon (TOC) data. ML stations had varying amounts of mud and sand, while R stations had mud and muddy sand mixed with gravel. There was a lower percent TOC at the ML stations compared to R stations.

Table 3-9. Sediment texture and % total organic carbon (TOC) at Mon Louis Island and reference survey stations.		
Station	Folk's Texture Description	% TOC
ML1	Muddy Sand	0.350
ML2	Muddy Sand	0.361
ML3	Sandy Mud	0.984
ML4	Sandy Mud	0.980
R1	Gravelly Muddy Sand	3.280
R2	Gravelly Mud	8.150

4.0 CONCLUSIONS

The planted marsh vegetation at Mon Louis Island has expanded its extent since the initial site planting and the September 2017 replanting of black needlerush (*Juncus roemerianus*). It is expected that plant coverage will continue to increase. Above ground plant biomass in created smooth cordgrass (*Spartina alterniflora*) marshes often reaches parity with natural marshes within one to two growing seasons after planting (Broome 1989, Matthews and Minello, 1994). Ecosystem function provided by the marsh will likewise converge with HGM reference conditions for good quality tidal wetlands as the percent vegetation coverage increases through time.

Nekton community composition at the restoration and reference stations was similar due to high numbers of grass shrimp, white shrimp, and blue crabs. The relative value of salt marsh habitats for juvenile fishery species appears to be primarily related to the amount of marsh/water interface and the elevation of the marsh surface (Minello et al., 1994; Whaley and Minello, 2002). The age of created salt marshes often is not an important characteristic governing nekton use (Minello and Webb, 1993; Able et al., 2008). Faunal response in many cases is more dependent on access to the shallow intertidal marsh surface and intertidal and subtidal creeks than on characteristics of the vegetated marsh (Able et al., 2008). In terms of use by transient nekton, the restored marsh appears to have achieved a substantial level of ecological function.

The occurrence of saltmarsh topminnow (*Fundulus jenkinsi*) at ML and R stations is notable. This species is classified by the Alabama Natural Heritage Program as an S1 species, defined as critically imperiled because of extreme rarity. In Alabama, saltmarsh topminnow populations are known to occur in the Grand Bay and Weeks Bay systems (Lopez et al., 2011).

Compared to natural systems, recently created salt marshes tend to have lower sediment organic content, lower densities of macroinfauna, and lower densities of nekton of the marsh surface (Matthews and Minello, 1994). Macroinfauna densities at the ML stations were comparable to R stations, with overall abundance dominated by polychaetes including *L. culveri*, *S. benedicti*, and *Mediomastus*. These taxa are common in northern Gulf estuaries.

There was low percent TOC at the restoration site stations. With continued annual vegetative growth, TOC accumulation at the Mon Louis Island marsh is expected to increase through time.

5.0 REFERENCES CITED

Able, K.W., T.M. Grothues, S.M. Hagan, M.E. Kimball, D.M. Nemerson and G.L. Taghon, 2008. Long-term response of fishes and other fauna to restoration of former salt hay farms: multiple measures of restoration success. Reviews in Fish Biology and Fisheries, 18: 65-97.

Bray J.R. and J.T. Curtis, 1957. An ordination of the upland forest communities of southern Wisconsin. Ecological Monographs, 27: 325-349.

Broome, S.W., 1989. Creation and restoration of tidal wetlands of the Southeastern United States, p. 37-72 *In* Kusler, J. A. and M. E. Kentula (ed.). Wetland creation and restoration: The status of the Science. Volume I: Regional overviews. EPA/600/3-89/038. U.S. Environ. Prot. Agency, Corvallis, OR.

Clarke, K.R. and R.N. Gorely, 2006. Primer v6: User Manual/Tutorial PRIMER-E. Plymouth, United Kingdom.

Ferguson, H.J. and C.F. Rakocinski, 2008. Tracking marsh restoration using macrobenthic metrics: implementing a functional approach. Wetlands Ecology and Management, 16:277-289.

Lopez, J.D., M.S. Peterson, J. Walker, G.L. Grammer, and M.S. Woodrey, 2011. Distribution, abundance, and habitat characterization of the saltmarsh topminnow, *Fundulus jenkinsi* (Everman 1892). Estuaries and Coasts, 34:148-158.

Matthews, G.A. and T.J. Minello, 1994. Technology and success in restoration, creation, and enhancement of *Spartina alterniflora* marshes in the United States. Volume 1 – Executive summary and annotated bibliography. NOAA Coastal Ocean Program Decision Analysis Series No. 2. NOAA Coastal Ocean Office, Silver Spring, MD.

Minello, T.J., R.J. Zimmerman, and R. Medina, 1994. The importance of edge for natant macrofauna in a created salt marsh. Wetlands, 14: 184-198.

Shafer, D.J, T.H. Roberts, M.S. Peterson and K. Schmid, 2007. A regional guidebook for applying the Hydrogeomorphic Approach to assessing the functions of tidal fringe wetlands along the Mississippi and Alabama Gulf Coast. U.S. Army Corps of Engineers, Engineer Research and Development Center, Vicksburg, MS.

Whaley, S.D. and T.J. Minello, 2002. The distribution of benthic infauna of a Texas salt marsh in relation to the marsh edge. Wetlands, 22:753–766.

Appendix A – Vegetation Data and Hydrogeomorphic Model Analysis

Figure A-1. Vegetation transect and quadrat placement at Mon Louis Island, Sept. 2018.

Plant Species List - September 2018 (**†** = non-native, invasive exotic**)**

ORDER PINALES

CUPRESSACEAE (CEDAR FAMILY)

Taxodium distichum (Linnaeus) L.C. Richard —BALD CYPRESS

ORDER ALISMATALES

CYMODOCEACEAE (MANATEEGRASS FAMILY)

Ruppia maritima Linnaeus —WIDGEON GRASS

JUNCAGINACEAE (ARROW GRASS FAMILY)

Triglochin striata Ruiz & Pavón —THREE-RIB ARROW GRASS

ORDER POALES

JUNCACEAE (RUSH FAMILY)

Juncus roemerianus Scheele —BLACK NEEDLE RUSH

CYPERACEAE (SEDGE FAMILY)

Bolboschoenus robustus (Pursh) J. Soják —STURDY BULRUSH

Cyperus polystachyos Rottbøll —MANY-SPIKE FLATSEDGE
Cyperus rotundus Linnaeus —PURPLE NUTGRASS **†**
Cyperus surinamensis Rottbøll —TROPICAL FLATSEDGE

Fimbristylis castanea (Michaux) Vahl —MARSH FRIMBY

Schoenoplectus pungens (Vahl) Palla —COMMON THREE SQUARE

POACEAE (GRASS FAMILY)

Digitaria ciliaris (Retzius) Köler —SOUTHERN CRABGRASS

Distichlis spicata (Linnaeus) Greene —SALT GRASS

Echinochloa walteri (Pursh) Heller —COAST COCKSPUR GRASS

Panicum repens Linnaeus —TORPEDO GRASS **†**

Paspalum vaginatum Swartz —SEASHORE PASPALUM

Phragmites mauritianus Kunth —MAURITIUS REED **†**

Spartina alterniflora (Loiseleur) P. M. Peterson & Saarela —SMOOTH CORDGRASS

Spatina patens (Roth) P. M. Peterson & Saarela —SALT MEADOW CORDGRASS

ORDER SAXIFRAGALES

HALORAGACEAE (MILFOIL FAMILY)

Myriophyllum spicatum Linnaeus —EURASIAN WATER MILFOIL †

ORDER FABALES

FABACEAE (LEGUME FAMILY)

Aeschynomene indica Linnaeus —INDIAN JOINT VETCH

Sesbania vesicaria (Jacquin) Elliott —BLADDERPOD

Strophostyles helvula (Linnaeus) Elliott —TRAILING FUZZY BEAN

Vigna luteola (Jacquin) Bentham —HAIRY-POD COW PEA

ORDER FAGALES

MYRICACEAE (BAYBERRY FAMILY)

Morella cerifera (Linnaeus) Small —WAX MYRTLE

ORDER MALPIGHIALES

EUPHORBIACEAE (SPURGE FAMILY)

Triadica sebifera (Linnaeus) Small —CHINESE TALLOWTREE †

ORDER CARYOPHYLLALES

POLYGONACEAE (BUCKWHEAT FAMILY)

Persicaria hydropiperoides (Michaux) Small —WATER PEPPER

AMARANTHACEAE (AMARANTH FAMILY)

Alternanthera philoxeroides (Martius) Grisebach —ALLIGATOR WEED †

Amaranthus australis (A. Gray) J.D. Sauer —SOUTHERN WATER HEMP

ORDER GENTIANALES

RUBIACEAE (MADDER FAMILY)

Hexasepalum teres (Walter) J.H. Kirkbride —POOR JOE

ORDER SOLANALES

CONVOLVULACEAE (MORNING-GLORY FAMILY)
Convolvulus limnophilus Greene —COASTAL PLAIN BINDWEED

ORDER LAMIALES

PLANTAGINACEAE (PLANTAIN FAMILY)
Bacopa monnieri (Linnaeus) Pennell —HERB OF GRACE

ORDER ASTERALES

ASTERACEAE (SUNFLOWER FAMILY)
Ambrosia artemisiifolia Linnaeus — ANNUAL RAGWEED

Baccharis halimifolia Linnaeus — GROUNDSEL TREE

Eupatorium capillifolium (Lamarck) Small — DOG FENNEL

Heterotheca subaxillaris (Lamarck) Britton & Rusby — CAMPHOR WEED

Iva frutescens Linnaeus —BIGLEAF SUMPWEED

Solidago mexicana (Linnaeus) Fernald —SOUTHERN SEASIDE GOLDENROD

Symphyotrichum tenuifolium (Linnaeus) Nesom —PERENNIAL SALT MARSH ASTER

ORDER APIALES

ARALIACEAE (GINSENG FAMILY)
Hydrocotyle bonariensis Lamarck —LARGE-LEAF PENNYWORT

Average percent cover of plants in quadrats - September 2018

Species	Average Cover	No. of Quadrats	% Occurrence
Aeschynomene indica	0.30%	2	1.8
Ambrosia artemisiifolia	< 0.1%	2	1.8
Baccharis halimifolia	< 0.1%	3	2.7
Bacopa monnieri	< 0.1%	1	0.9
Bolboschoenus robustus	0.30%	3	2.7
Cyperus rotundus	< 0.1%	2	1.8
Digitaria ciliaris	0.10%	2	1.8
Distichlis spicata	0.60%	5	4.5
Eupatorium capillifolium	< 0.1%	1	0.9
Fimbristylis castanea	< 0.1%	1	0.9
Heterotheca subaxillaris	0.20%	2	1.8
Hexasepalum teres	< 0.1%	1	0.9
Hydrocotyle bonariensis	0.10%	2	1.8
Juncus roemerianus	1.00%	15	13.4
Myriophyllum spicatum	0.50%	2	1.8
Panicum repens	0.30%	4	3.6
Paspalum vaginatum	0.80%	4	3.6
Phragmites mauritianus	0.70%	16	14.3
Schoenoplectus pungens	0.20%	3	2.7
Spartina alterniflora	27.80%	64	57.1
Spartina patens	6.20%	36	32.1
Strophostyles helvula	0.10%	2	1.8
Symphyotrichum tenuifolium	0.10%	1	0.9
Taxodium distichum	< 0.1%	3	2.7
Vigna luteola	< 0.1%	1	0.9

Hydrogeomorphic (HGM) Model Analysis

Background

The Hydrogeomorphic (HGM) Approach is a collection of concepts and methods that uses mathematically derived indices to assess the capacity of a wetland to perform specific ecological, geochemical, and hydrological functions in comparison to similar wetlands within a geographic region. The HGM approach was originally developed to be used within the framework of the Federal Section 404 regulatory program permit review process to evaluate project alternatives, minimize project impacts, and determine compensatory mitigation requirements (Smith et al., 1995). Additional applications include the planning design and monitoring of habitat restoration projects outside the context of the Section 404 program.

The development of the HGM approach involves: 1) classification of wetlands within a defined region; 2) development of functional assessment models and indices, and 3) development and application of assessment protocols. The advantage of the HGM approach is that an individual site may be assessed for a suite of functions or a subset of functions, as determined by project management objectives. HGM is a rapid-assessment procedure designed to be implemented in a relatively short period of time at minimal expense (Shafer et al., 2007).

Classification

HGM classifies wetlands based on three separate criteria; geomorphic setting, water source, and hydrodynamics (Brinson, 1993). The classification criteria are used to group wetlands into five basic geomorphic classes at a continental scale (depressional, flat, slope, riverine and fringe wetlands). Flats can be further subdivided into organic and mineral flats, and fringe wetlands into lacustrine and tidal fringe. At a finer geographic scale, the three classification criteria are applied to identify regional wetland subclasses, which typically corresponds to existing, commonly recognized wetland types; for example oligohaline salt marsh along the Gulf of Mexico coastline (Shafer and Yozzo, 1998).

Reference Wetlands

In HGM, reference wetlands are sites selected to represent the variability that occurs within a regional wetland subclass. The reference domain is the geographic area represented by the reference wetlands. Ideally, the reference domain will mirror the geographic area encompassed by the regional wetland subclass; however, constraints on time, personnel, and fiscal resources, as well as agency jurisdictional boundaries often limit the size of a regional reference domain.

Reference wetlands establish the range and variability of conditions expressed by HGM model variables and provide data needed to calibrate HGM assessment models. Reference wetlands exhibiting the highest sustainable level of function across a suite of observed or documented functions are referred to as reference standard wetlands. When a model variable is within the range of conditions observed in reference standard wetlands a variable sub-index value of 1.0 is assigned. As the condition deviates from that observed in reference standard wetlands, the variable sub-index is assigned based on the observed relationship between model variable condition and functional capacity (on a scale of 0.0 to 1.0).

Assessment Protocol

The HGM assessment protocol is a series of tasks that allow the user to assess the functions of a particular wetland using the functional indices presented in a published Regional Guidebook. The first task in an HGM assessment is characterization, which involves describing the wetland and it's surrounding landscape, describing the proposed project and it's potential impacts, and identifying the wetland assessment areas (WAAs). The second task is collection of field data for model variables. The final task is analysis, which involves calculation of functional indices and units.

Models and Indices

An HGM assessment model is a simple representation of a wetland function. It defines the relationship among one or more wetland characteristics or processes (variables). Functional capacity is the ability of the wetland to perform a function relative the level of performance observed or measured in reference standard wetlands.

Variables are combined mathematically in a functional assessment model to produce a functional capacity index (FCI). The mathematical expressions used vary, depending on the type of interaction to be represented (e.g. fully or partially compensatory, cumulative, limiting, controlling, etc.). A complete discussion of variable interactions and model development is presented in Smith and Wakeley (2001). FCIs are multiplied by the wetland assessment area (typically in hectares) to produce functional capacity units (FCUs), which represent the "currency" used to determine mitigation ratios within the context of the Federal Section 404 regulatory program.

Mississippi/Alabama HGM Guidebook

The methodology employed in the data collection and HGM assessment generally follows the protocol described in the Mississippi/Alabama HGM Guidebook (Schafer et al., 2007). http://el.erdc.usace.army.mil/wetlands/guidebooks.cfm)

METHODS

Field Data Collection

Field assessment of the Mon Louis Island site was conducted in September 2018. Transects were generally aligned perpendicular to the shoreline edge along the hydrologic gradient of decreasing elevation (following Schafer et al., 2007).

Vegetation metrics used in the HGM assessment were collected within meter-squared quadrats. Data recorded included the average height of vegetation (recorded in centimeters up to one meter), and the combined overall percent cover of native wetland vegetation occurring within the quadrat. Estimates of percent cover were made using cover class categories presented in **Table B-2** (modified from Schafer et al., 2007).

Table B-2. Cover classes and midpoint values for percent cover estimates in quadrats.

Class	Percent Cover Estimate	Midpoint Value Assigned
1	<1%	0.5%
2	1-5%	3.0%
3	6-25%	15.5%
4	26-50%	38%
5	51-75%	63%
6	76-95%	85.5%
7	96-99%	97.5%
8	>99%	99.5%

Desktop/GIS Assessment Variables

The HGM assessment procedure is twofold. First, site information is gathered and assessed in a GIS during the "desktop" component of the procedure. Wetland assessment areas (WAAs) are identified from maps and air photos (color infra-red is preferred, but high-quality true color air photos are acceptable, and were used in the current evaluations). A standardized scale is critical, and the methodology requires that all air photo work be conducted using a scale of 1:4800 (1 in. = 400 ft.). The following HGM variables were assessed during the desktop procedure:

V_{SIZE} (Wetland Patch Size): The size of the contiguous wetland patch within which the WAA occurs.

$V_{LANDUSE}$ (Adjacent Land Use): The proportion of the wetland perimeter occupied by various land use types.

V_{WIDTH} (Mean Marsh Width): The distance (m) that wind and vessel-generated waves must travel across intervening tidal fringe wetland (distance from the shoreline)

V_{EXPOSE} (Wave Energy Exposure): A qualitative classification of the potential for a wetland to attenuate wind and vessel-generated wave energy based on geomorphic setting and fetch distance – unitless.

V_{EDGE} (Aquatic Edge): The length (m) of vegetated tidally connected marsh/water interface or edge expressed as a proportion of total WAA area (ha).

V_{HYDRO} (Hydrologic Regime): The degree of alteration to the normal tidal hydrology typical of the subclass – unitless.

Field Assessment Variables

The HGM approach also incorporates site-specific information on vegetation metrics and habitat diversity collected in the field. The field assessments generated data on the following HGM variables:

V_{NHD} (Nekton Habitat Diversity): A measure of the heterogeneity of the site, based on comparison of the number of habitats actually present at a site relative to the number of possible habitats known to occur in the regional subclass.

V_{WHD} (Wildlife Habitat Diversity): A measure of the occurrence of habitat types known to support selected marsh-dependent wildlife species within the WAA.

V_{COVER} (Mean Percent Cover Emergent Marsh Vegetation):The mean total percent cover of native non-woody plant species with a wetland indicator status of OBL or FACW

V_{HEIGHT} (Vegetation Height): The most frequently occurring height of the plants within the tallest zone of the emergent marsh plant community.

V_{EXOTIC} (Percent Cover of Invasive or Exotic Species): The proportion of the site that is covered by non-native or invasive plant species.

V_{WOODY} (Percent Cover by Woody Plant Species): The proportion of the site that is covered by shrub-scrub or other woody plant species.

V_{WIS} (Wetland Indicator Status): The ratio of percent cover of FAC and FACU plants to the cover of emergent herbaceous wetland (OBL or FACW) plants.

Ecosystem Functions (FCIs and FCUs)

The data collected during the desktop and field assessments (i.e., the thirteen variables listed above) are combined using various mathematical expressions to estimate five ecosystem functions attributed to tidal fringe wetlands in the AL/MS Gulf coast reference domain (Schafer et al., 2007):

Wave Attenuation: Ability of a wetland to attenuate wind and vessel-generated wave energy based on geomorphic setting and fetch distance

Biogeochemical Cycling: The ability of a tidal wetland to receive, transform, and export various elements and compounds through natural biogeochemical processes.

Nekton Utilization: The potential utilization of a marsh by resident and seasonally occurring non-resident adult or juvenile fish and macrocrustacean species.

Provide Habitat for Tidal Marsh Dependant Wildlife: The capacity of a tidal marsh to provide critical life requisites to selected components of the vertebrate wildlife community.

Maintain Characteristic Plant Community Structure: The ability of a tidal marsh to support a native plant community of characteristic species composition and structure.

Calculation of FCIs

A Microsoft Excel file provided by USACE-ERDC was used to facilitate data entry and to calculate FCIs for each of the functions assessed. Formulas used to calculate FCIs were:

Functional Capacity Equations	
Wave Energy Attenuation	$FCI = [(3V_{WIDTH} + V_{COVER}) / 4 \text{ X } V_{EXPOSE}]^{1/2}$
Biogeochemical Cycling	$FCI = [V_{HYDRO} \text{ X } V_{COVER} \text{ X } V_{LANDUSE}]^{1/3}$
Nekton Utilization Potential	$FCI = (V_{EDGE} + V_{HYDRO} + V_{NHD}) / 3$
Provide Habitat for Tidal Marsh Dependent Wildlife Species	$FCI = \left\{V_{SIZE} \times \left[\frac{(V_{HEIGHT} + V_{COVER})}{2}\right] \times \left[\frac{(V_{EDGE} + V_{WHD})}{2}\right]\right\}^{1/3}$
Maintain Plant Community Composition and Structure	$FCI = (\text{Minimum } (V_{COVER} \text{ or } V_{EXOTIC} \text{ or } V_{WIS} \text{ or } V_{WOODY})$

FCI and FCU Calculations for the Tidal Fringe HGM Regional Subclass

Project:	Mon Louis Island Restoration		
WAA		Area (ha):	1.95

Variable	Metric Value	Units	Subindex
V_{COVER}	37.4	%	0.200
V_{EDGE}	High	Qualitative	1.000
V_{EXPOSE}	Moderate	NA	0.600
V_{EXOTIC}	1.5	%	1.000
V_{HEIGHT}	92	cm	0.800
V_{HYDRO}	Minor	NA	0.750
$V_{LANDUSE}$	100%	%	1.000
V_{NHD}	7	EA	1.000
V_{SIZE}	1.95	ha	0.750
V_{WIS}	0.4	%	1.000
V_{WOODY}	0	%	1.000
V_{WHD}	4	EA	1.000
V_{WIDTH}	50.7	m	0.800

Function	Functional Capacity Index (FCI)	Functional Capacity Units (FCU)
Wave Energy Attenuation	0.62	1.218
Biogeochemical Cycling	0.53	1.036
Nekton Utilization Potential	0.92	1.788
Provide Habitat for Tidal Marsh Dependent Wildlife Species	0.72	1.406
Maintain Plant Community Composition and Structure	0.20	0.390
Overall Average	0.60	5.838

REFERENCES CITED

Brinson, M.M., 1993. A hydrogeomorphic classification for wetlands. Wetlands Research Program Technical Report WRP-DE-4, U.S. Army Corps of Engineers, Waterways Experiment Station, Vicksburg, MS.

Shafer, D.J., and D.J. Yozzo, 1998. National guidebook for application of hydrogeomorphic assessment to tidal fringe wetlands. Wetlands Research Program Technical Report WRP-DE-16, U.S. Army Corps of Engineers, Waterways Experiment Station, Vicksburg, MS.

Shafer, D.J, T.H. Roberts, M.S. Peterson and Keil Schmid, 2007. A regional guidebook for applying the Hydrogeomorphic Approach to assessing the functions of tidal fringe wetlands along the Mississippi and Alabama Gulf Coast. U.S. Army Corps of Engineers, Engineer Research and Development Center, Vicksburg, MS.

Smith, R.D. and J.S. Wakeley, 2001. Hydrogeomorphic Approach to assessing wetland functions: Guidelines for developing regional guidebooks. Chapter 4: Developing Assessment Models. Wetlands Research Program, U.S. Army Corps of Engineers, Engineer Research and Development Center, Vicksburg, MS. ERDC/EL TR-01-30.

Smith, R.D., A. Ammann, C. Bartoldus and M.M. Brinson, 1995. An approach for assessing wetland functions using hydrogeomorphic classification, reference wetlands, and functional indices. Wetlands Research Program Technical Report WRP-DE-9, U.S. Army Corps of Engineers, Waterways Experiment Station, Vicksburg, MS.

Appendix B – Nekton Data

Table B-1. Lift Net Taxa List

Class	Order	Family	Taxon Name
Malacostraca	Decapoda	Palaemonidae	*Palaemonetes* (LPIL)
Malacostraca	Decapoda	Penaeidae	*Farfantepenaeus aztecus*
Malacostraca	Decapoda	Penaeidae	*Litopenaeus setiferus*
Malacostraca	Decapoda	Sesarmidae	*Armases cinereum*
Malacostraca	Decapoda	Portunidae	*Callinectes sapidus*
Actinopterygii	Clupeiformes	Engraulidae	*Anchoa mitchilli*
Actinopterygii	Cyprinodontiformes	Cyprinodontidae	*Cyprinodon variegatus*
Actinopterygii	Cyprinodontiformes	Fundulidae	*Fundulus grandis*
Actinopterygii	Cyprinodontiformes	Fundulidae	*Fundulus jenkinsi*
Actinopterygii	Cyprinodontiformes	Fundulidae	*Fundulus majalis*
Actinopterygii	Cyprinodontiformes	Fundulidae	*Fundulus xenicus*
Actinopterygii	Cyprinodontiformes	Poeciliidae	*Gambusia affinis*
Actinopterygii	Cyprinodontiformes	Poecillidae	*Poecilia latipinna*
Actinopterygii	Perciformes	Gobiidae	*Ctenogobius shufeldti*
Actinopterygii	Perciformes	Gobiidae	*Evorthodus lyricus*
Actinopterygii	Perciformes	Mugilidae	*Mugil* (LPIL)
Actinopterygii	Perciformes	Sciaenidae	*Micropogonias undulatus*
Actinopterygii	Syngnathiformes	Syngnathidae	*Syngnathus* (LPIL)

[1]LPIL = lowest possible identification level

Table B-2. Lift Net Species Counts

Station ML1

Taxonomic Name	Rep 1	Rep 2	Rep 3	Total
Palaemonetes (LPIL)	165	26	61	252
Callinectes sapidus	11	3	6	20
Litopenaeus setiferus	11	2	4	17
Fundulus xenicus	0	1	5	6
Armases cinereum	3	0	1	4
Fundulus majalis	0	2	1	3
Fundulus grandis	1	0	1	2
Evorthodus lyricus	0	2	0	2
Fundulus jenkinsi	0	2	0	2
Poecilia latipinna	0	0	2	2
Gambusia affinis	1	0	0	1
Ctenogobius shufeldti	0	0	1	1
				312

Table B-2. Lift Net Data (Cont'd)

Station ML2

Taxonomic Name	Rep 1	Rep 2	Rep 3	Total
Palaemonetes (LPIL)	63	51	27	141
Callinectes sapidus	9	13	3	25
Litopenaeus setiferus	4	2	1	7
Armases cinereum	0	2	3	5
Fundulus grandis	2	1	1	4
Ctenogobius shufeldti	1	0	0	1
				183

Station ML3

Taxonomic Name	Rep 1	Rep 2	Rep 3	Total
Palaemonetes (LPIL)	93	69	55	217
Litopenaeus setiferus	11	4	6	21
Callinectes sapidus	5	3	5	13
Fundulus grandis	0	0	3	3
Fundulus jenkinsi	0	1	1	2
Armases cinereum	0	0	2	2
Cyprinodon variegatus	1	0	0	1
				259

Station ML4

Taxonomic Name	Rep 1	Rep 2	Rep 3	Total
Palaemonetes (LPIL)	52	25	56	133
Litopenaeus setiferus	10	24	39	73
Callinectes sapidus	6	5	13	24
Fundulus jenkinsi	1	0	3	4
Farfantepenaeus aztecus	1	2	0	3
Fundulus grandis	0	2	0	2
Armases cinereum	0	0	2	2
Fundulus xenicus	0	0	1	1
Evorthodus lyricus	0	0	1	1
				243

Table B-2. Lift Net Data (Cont'd)

Station R1

Taxonomic Name	Rep 1	Rep 2	Rep 3	Total
Palaemonetes (LPIL)	18	22	60	100
Anchoa mitchilli	78	0	0	78
Litopenaeus setiferus	1	37	14	52
Callinectes sapidus	2	1	3	6
Gambusia affinis	0	3	1	4
Fundulus jenkinsi	0	1	0	1
				241

Station R2

Taxonomic Name	Rep 1	Rep 2	Rep 3	Total
Litopenaeus setiferus	14	37	166	217
Palaemonetes (LPIL)	12	55	13	80
Callinectes sapidus	7	5	1	13
Farfantepenaeus aztecus	3	0	1	4
Mugil (LPIL)	0	3	0	3
Syngnathus (LPIL)	1	0	0	1
Gambusia affinis	0	1	0	1
Anchoa mitchilli	0	1	0	1
Fundulus jenkinsi	0	1	0	1
Micropogonias undulatus	0	1	0	1
				322

Appendix C – Macroinfaunal Data

Table C-1. Macroinfaunal Taxa List

Phylum	Class	Order	Family	Taxonomic Name
Annelida	Oligochaeta	Tubificida	Naididae	Naididae (LPIL)
Annelida	Polychaeta	Phyllodocida	Nereididae	*Laeonereis culveri*
Annelida	Polychaeta	Scolecida	Capitellidae	*Capitella capitata*
Annelida	Polychaeta	Scolecida	Capitellidae	*Mediomastus* (LPIL)
Annelida	Polychaeta	Spionida	Spionidae	*Polydora cornuta*
Annelida	Polychaeta	Spionida	Spionidae	*Streblospio benedicti*
Annelida	Polychaeta	Terebellida	Ampharetidae	*Hobsonia florida*
Arthropoda	Insecta	Diptera	Ceratopogonidae	Ceratopogonidae (LPIL)
Arthropoda	Insecta	Diptera	Chironomidae	*Dicrotendipes* (LPIL)
Arthropoda	Insecta	Diptera	Chironomidae	*Polypedilum* (LPIL)
Arthropoda	Insecta	Diptera	Dulichopodidae	*Rhaphium* (LPIL)
Arthropoda	Insecta	Diptera	Ephydridae	Ephydridae (LPIL)
Arthropoda	Malacostraca	Amphipoda	Aoridae	*Grandidierella bonnieroides*
Arthropoda	Malacostraca	Decapoda	Ocypodidae	*Uca* (LPIL)
Arthropoda	Malacostraca	Decapoda	Palaemonidae	*Palaemonetes pugio*
Arthropoda	Malacostraca	Decapoda	Xanthidae	*Rhithropanopeus harrisii*
Arthropoda	Malacostraca	Isopoda	Idoteidae	*Edotia triloba*
Arthropoda	Malacostraca	Isopoda	Munnidae	*Uromunna reynoldsi*
Arthropoda	Malacostraca	Tanaidacea	Leptocheliidae	*Hargeria rapax*
Mollusca	Bivalvia	Veneroida	Cyrenoididae	*Cyrenoida floridana*
Mollusca	Gastropoda	Heterostropha	Pyramidellidae	*Sayella* (LPIL)
Mollusca	Gastropoda	Neritopsina	Neritidae	*Neritina usnea*
Nemertea				Nemertea (LPIL)

[1]LPIL = Lowest practical identification level

Table C-2. Macroinfaunal Station Data

Station ML1

Taxonomic Name	Rep 1	Rep 2	Rep 3	Total
Laeonereis culveri	11	8	0	19
Capitella capitata	0	1	2	3
Naididae (LPIL)	0	0	2	2
Streblospio benedicti	1	0	0	1
Uca (LPIL)	0	1	0	1
				Total 26

Table C-2. Macroinfaunal Station Data (Cont'd)

Station ML2

Taxonomic Name	Rep 1	Rep 2	Rep 3	Total
Laeonereis culveri	42	50	16	108
Mediomastus (LPIL)	19	5	1	25
Streblospio benedicti	0	4	0	4
Naididae (LPIL)	2	1	0	3
Capitella capitata	1	1	0	2
Cyrenoida floridana	0	1	0	1
				Total 143

Station ML3

Taxonomic Name	Rep 1	Rep 2	Rep 3	Total
Streblospio benedicti	11	2	8	21
Dicrotendipes (LPIL)	3	8	2	13
Laeonereis culveri	5	1	4	10
Polypedilum (LPIL)	2	1	7	10
Naididae (LPIL)	3	0	2	5
Capitella capitata	4	1	0	5
Polydora cornuta	1	1	1	3
Hobsonia florida	2	0	1	3
Mediomastus (LPIL)	1	0	1	2
Ceratopogonidae (LPIL)	1	1	0	2
Uca (LPIL)	0	1	1	2
Rhaphium (LPIL)	0	1	0	1
Ephydridae (LPIL)	0	0	1	1
Palaemonetes pugio	0	0	1	1
Uromunna reynoldsi	0	0	1	1
				Total 80

Station ML4

Taxonomic Name	Rep 1	Rep 2	Rep 3	Total
Mediomastus (LPIL)	1	11	4	16
Laeonereis culveri	0	9	5	14
Dicrotendipes (LPIL)	3	6	3	12
Streblospio benedicti	2	8	1	11
Hobsonia florida	1	6	1	8
Polypedilum (LPIL)	2	3	0	5
Capitella capitata	1	1	2	4
Naididae (LPIL)	0	2	1	3
Grandidierella bonnieroides	0	1	0	1
				Total 74

Table C-2. Macroinfaunal Station Data (Cont'd)

Station R1

Taxonomic Name	Rep 1	Rep 2	Rep 3	Total
Polydora cornuta	2	0	9	11
Neritina usnea	5	1	2	8
Hargeria rapax	0	0	5	5
Laeonereis culveri	0	3	1	4
Edotia triloba	0	2	1	3
Mediomastus (LPIL)	0	1	1	2
Streblospio benedicti	0	1	1	2
Grandidierella bonnieroides	0	0	1	1
Rhithropanopeus harrisii	0	0	1	1
Sayella (LPIL)	0	0	1	1
Nemertea (LPIL)	0	0	1	1
				Total 39

Station R2

Taxonomic Name	Rep 1	Rep 2	Rep 3	Total
Naididae (LPIL)	6	1	0	7
Laeonereis culveri	2	0	2	4
Streblospio benedicti	3	0	0	3
Hobsonia florida	0	1	0	1
Polypedilum (LPIL)	0	1	0	1
Edotia triloba	1	0	0	1
				Total 17

Table C-3. Quadrat Data

Station ML1

Taxonomic Name	Common Name	N1-1	N1-2	N1-3	Total
		0	0	0	0

Station ML2

Taxonomic Name	Common Name	N2-1	N2-2	N2-3	Total
		0	0	0	0

Station ML3

Taxonomic Name	Common Name	S-1	S-2	S-3	Total
Uca (LPIL)	Fiddler crab	0	0	1	1

Station ML4

Taxonomic Name	Common Name	R1-1	R1-2	R1-3	Total
		0	0	0	0

Table C-3. Quadrat Data (Cont'd)

Station R1

Taxonomic Name	Common Name	R2-1	R2-2	R2-3	Total
Littorina irrorata	Marsh periwinkle	0	4	2	6

Station R2

Taxonomic Name	Common Name	R2-1	R2-2	R2-3	Total
Littorina irrorata	Marsh periwinkle	10	5	14	29