RESULTS

Habitat Mapping: Habitat data from 1956 to 1990 are not presently available to address goal 3 as written. However, for the purpose of this initial report, we feel that immediate pre-construction habitat maps show a deltaic growth rate consistent with our goal. The GIS analysis of the digital NWI habitat data, derived from photo-interpretation of the 1994, 1997 and 1998 aerial photography, yielded the results shown in Table 1, while Figure 6 illustrates the distribution of habitat types. Habitat classification data show that the percent of land in the project area increased from 6.5% to 11.2% to 14.8% in 1994, 1997, and 1998, respectively. From 1994 to 1997, land gain in the project area increased at a average rate of 34.3 acres per year (13.9 ha per year), and during the 1 year post-construction there was a land gain of 78.4 acres (31.7 ha) (about twice the rate than had been occurring immediate pre-construction). Of the 78.4 acres of new land, fresh marsh increased the least at 14.1 acres (5.7 ha), upland barren at 14.2 acres (5.7 ha), and wetland forested increased 50.1 acres (20.3 ha). From 1994 to 1997, fresh marsh was increasing at an annual rate of 24.9 acres (10.1 ha), while upland barren did not exist, and wetland forested was increasing at an annual rate of 9.4 acres (3.8 ha). These results indicate that the goal of creating 230 acres of delta-lobe islands suitable for the establishment of emergent marsh vegetation was not met. Instead, a majority of the dredge material disposal areas were constructed in habitats classified pre-construction as land, and the higher elevations comprised habitats more suitable for woody vegetation, or lacked various soil properties needed for their colonization (upland barren).

Table 1. National Wetlands Inventory habitat classes and acreages photo-interpreted from 1994, 1997 and 1998 aerial photography for the Atchafalaya Sediment Delivery (AT-02) project.

	Project Area (ac)		
Habitat Class	**1994**	**1997**	**1998**
Fresh Open Water	1251.9	849.7	660.2
Submerged Aquatics	0.0	643.3	864.8
Fresh Marsh	142.1	216.8	230.9
Beach/Bar/Flat	750.9	429.7	302.2
Wetland Forested	0.0	28.1	78.2
Upland Barren	0.0	0.0	14.2
Total	2181.6	2181.6	2181.4

Vegetation (Basic analysis): A species list for all sampling periods, as well as the mean percent cover of each species, is presented in Table 2. To better understand the importance, influence, or dominance of a species on both the AT-02 project area and the Rodney Island reference area, we calculated an importance value. An importance value (IV) is a relative number calculated using at least two vegetative characteristics. We used the formula: IV = (relative cover + relative frequency)/2. Each species earns an importance value ranging from 0 to 100. Using the number as an indicator, we can rank a species relative contribution to the vegetative community (Barbour *et al.* 1999) (Table 3, Figure 7).

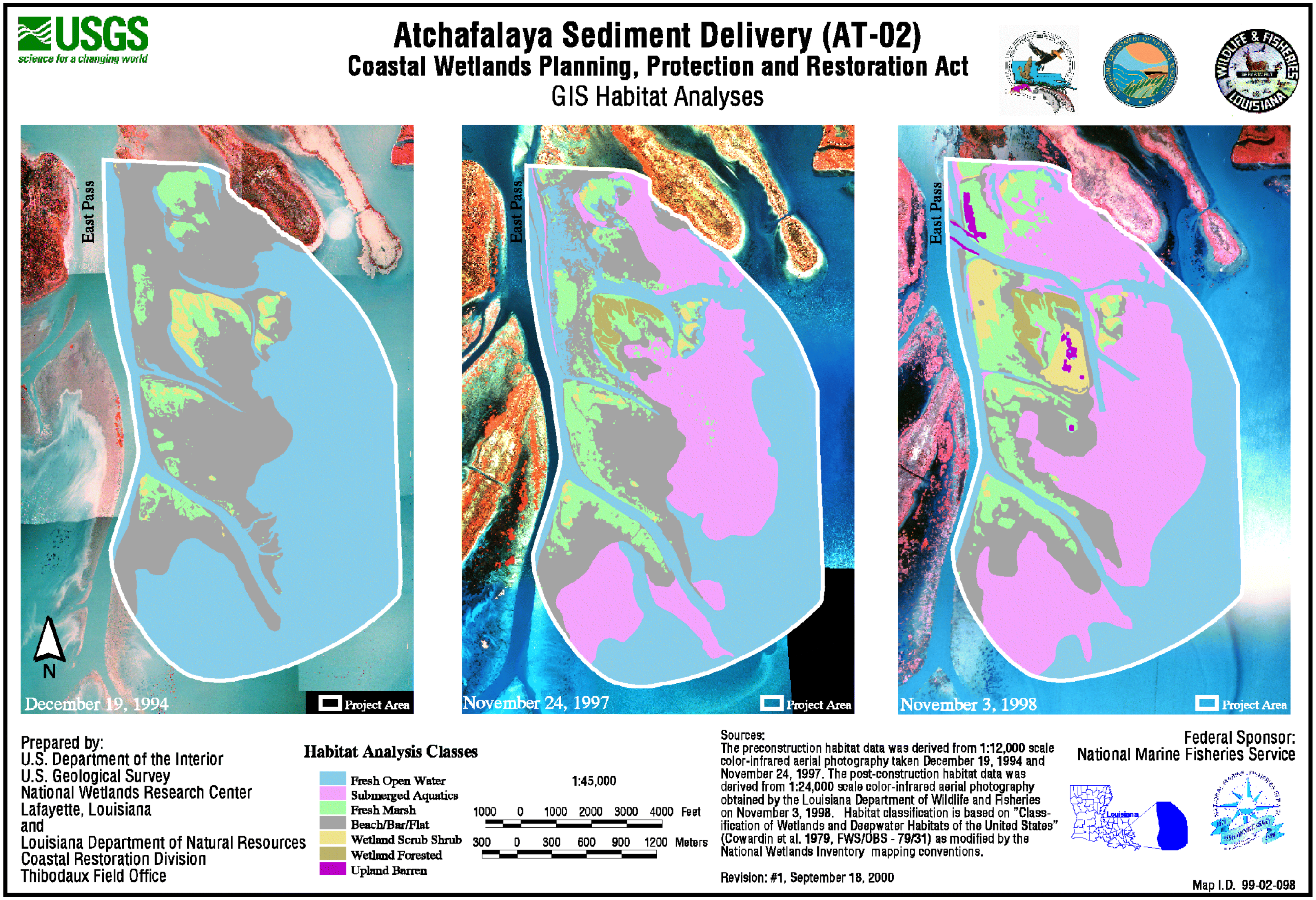

Figure 6. **Atchafalaya Sediment Delivery (AT-02) restoration project habitat analysis of pre-construction 1994 and 1997 and immediate post-construction aerial photography.**

Table 2. **Occurrence and mean percent cover of understory species on created dredge material islands at Atchafalaya Sediment Delivery (AT-02) in 1998 and Rodney Island in 1979, 1980, 1982, and 1998.**

	AT-02	Rodney Island			
Species	1998	1979	1980	1982	1998
Acnida sp.	-	-	0.1	-	0.1
Aeschynomene indica	3	-	15	39	-
Alternanthera philoxeroides	-	-	-	-	2
Amaranthus cannabinus	-	-	-	-	0.5
Ammania coccinea	-	0.1	3	9	-
Aster subulatis	-	-	-	0.1	2
Aster tenuifolius	-	-	0.1	0.1	-
Bacopa monnieri	-	-	2	-	-
Bidens sp.	-	-	-	0.1	-
Colocasia esculentus	19	-	-	5	16
Crinium americanum	-	-	-	-	0.1
Cyperus difformis	-	42	16	15	-
Cyperus odoratus	15	-	2	-	-
Cyperus surinamensis	3	-	-	-	-
Dicot seedling	-	2	1	-	-
Echinochloa walteri	-	-	0.1	2	-
Eclipta alba	-	-	0.1	0.1	-
Eichhornia crassipes	63	-	61	55	88
Eleocharis parvula	-	-	5	-	-
Eleocharis sp.	-	-	3	19	2
Heteranthera dubia	-	-	-	-	7
Hydrocotyle sp.	-	-	15	0.1	1
Juncus sp.	-	-	3	-	-
Juniperus virginiana	0.1	-	-	-	-
Justicia lanceolata	-	-	8	15	2
Justicia sp.	-	-	-	-	2
Leersia oryzoides	8	-	-	19	5
Leptochloa fascicularis	3	-	-	-	-
Leptochloa sp.	-	-	2	0.1	-
Ludwigia leptocarpa	28	-	1	0.1	13
Ludwigia peploides	11	-	0.1	0.1	3
Mikania scandens	-	-	-	2	5
Najas guadalupensis	-	-	-	15	-
Nelumbo lutea	-	-	-	-	11
Panicum sp.	-	-	8	8	-
Panicum virgatum	15	-	-	-	-
Paspalum distichum	3	-	-	-	-

Table 2. Continued.

	AT-02	Rodney Island			
Species	1998	1979	1980	1982	1998
Paspalum repens	15	-	-	-	-
Paspalum sp.	-	-	-	-	0.1
Phragmites australis	0.1	-	-	-	52
Phyla nodiflora	1	-	-	-	-
Pluchea sp.	-	-	-	0.1	-
Poaceae family (Grass)	-	0.1	2	-	-
Polygonum punctatum	2	-	-	-	-
Polygonum sp.	-	-	-	6	2
Sagittaria latifolia	32	10	11	13	17
Sagittaria platyphylla	-	26	2	8	3
Salix nigra	6	7	3	30	-
Scirpus americanus	14	-	15	9	19
Scirpus tabernaemontani	-	15	20	9	3
Sphenoclea zeylandica	-	-	5	15	-
Sunflower (Aster composite)	-	-	-	-	3
Taxodium distichum	-	-	0.1	-	-
Typha latifolia	38	3	63	62	32
Vallisneria americana	63	-	-	2	-
Vigna luteola	6	-	-	1	8
Zizaniopsis miliacea	-	-	-	-	42

Note: - indicates absence

Table 3. Species Importance Values[2] for Atchafalaya Sediment Delivery (AT-02) project and the Rodney Island reference area.

	AT-02	Rodney Island			
Species	1998	1979	1980	1982	1998
Acnida sp.	-	-	0	-	-
Aeschynomene indica	2	-	1	5	-
Alternanthera philoxeroides	-	-	-	-	3
Amaranthus cannabinus	-	-	-	-	1
Ammania coccinea	-	1	6	2	-
Aster subulatis	-	-	-	1	1
Aster tenuifolius	-	-	0	2	-
Bacopa monnieri	-	-	1	-	-
Bidens sp.	-	-	-	1	-
Colocasia esculenta	5	-	-	4	19

Table 3. Continued.

Species	AT-02	Rodney Island			
	1998	1979	1980	1982	1998
Crinium americanum	-	-	-	-	1
Cyperus difformis	-	33	15	1	-
Cyperus odoratus	1	-	1	-	-
Cyperus surinamensis	2	-	-	-	-
Dicot seedling	-	11	1	-	-
Echinochloa walteri	-	-	0	1	-
Eclipta alba	-	-	1	1	-
Eichhornia crassipes	20	-	20	13	6
Eleocharis parvula	-	-	2	-	-
Eleocharis sp.	-	-	1	3	1
Heteranthera dubia	-	-	-	-	3
Hydrocotyle sp.	-	-	1	1	1
Juncus sp.	-	-	1	-	-
Juniperus virginiana	1	-	-	-	-
Justicia lanceolata	-	-	1	2	-
Justicia sp.	-	-	-	-	3
Leersia oryzoides	5	-	-	3	6
Leptocloa fascicularis	1	-	-	-	-
Leptocloa sp.	-	-	3	1	-
Ludwigia leptocarpa	4	-	2	1	6
Ludwigia peploides	5	-	1	1	0
Mikania scandens	-	-	-	2	1
Najas guadalupensis	-	-	-	1	-
Nelumbo lutea	-	-	-	-	2
Panicum sp.	-	-	1	1	-
Panicum virgatum	2	-	-	-	-
Paspalum distichum	1	-	-	-	-
Paspalum repens	2	-	-	-	-
Paspalum sp.	-	-	-	-	0
Phragmites australis	1	-	-	-	3
Phyla nodiflora	3	-	-	-	-
Pluchea sp.	-	-	-	1	-
Poaceae family (Grass)	-	3	1	-	-
Polygonum punctatum	5	-	-	-	-
Polygonum sp.	-	-	-	2	5
Sagittaria latifolia	15	19	11	14	11
Sagittaria platyphylla	-	20	3	5	1
Salix nigra	6	5	1	4	2

Table 3. Continued.

Species	AT-02	Rodney Island			
	1998	1979	1980	1982	1998
Scirpus americanus	12	-	1	2	7
Scirpus tabernaemontani	-	5	7	5	0
Sunflower (Aster composite)	-	-	-	-	0
Sphenoclea zeylandica	-	-	2	2	-
Taxodium distichum	-	-	0	-	-
Typha latifolia	3	3	16	19	8
Vallisneria americana	4	-	-	1	-
Vigna luteola	3	-	-	3	5
Zizaniopsis miliacea	-	-	-	-	5

[2]Importance Value = (relative cover + relative frequency)/2

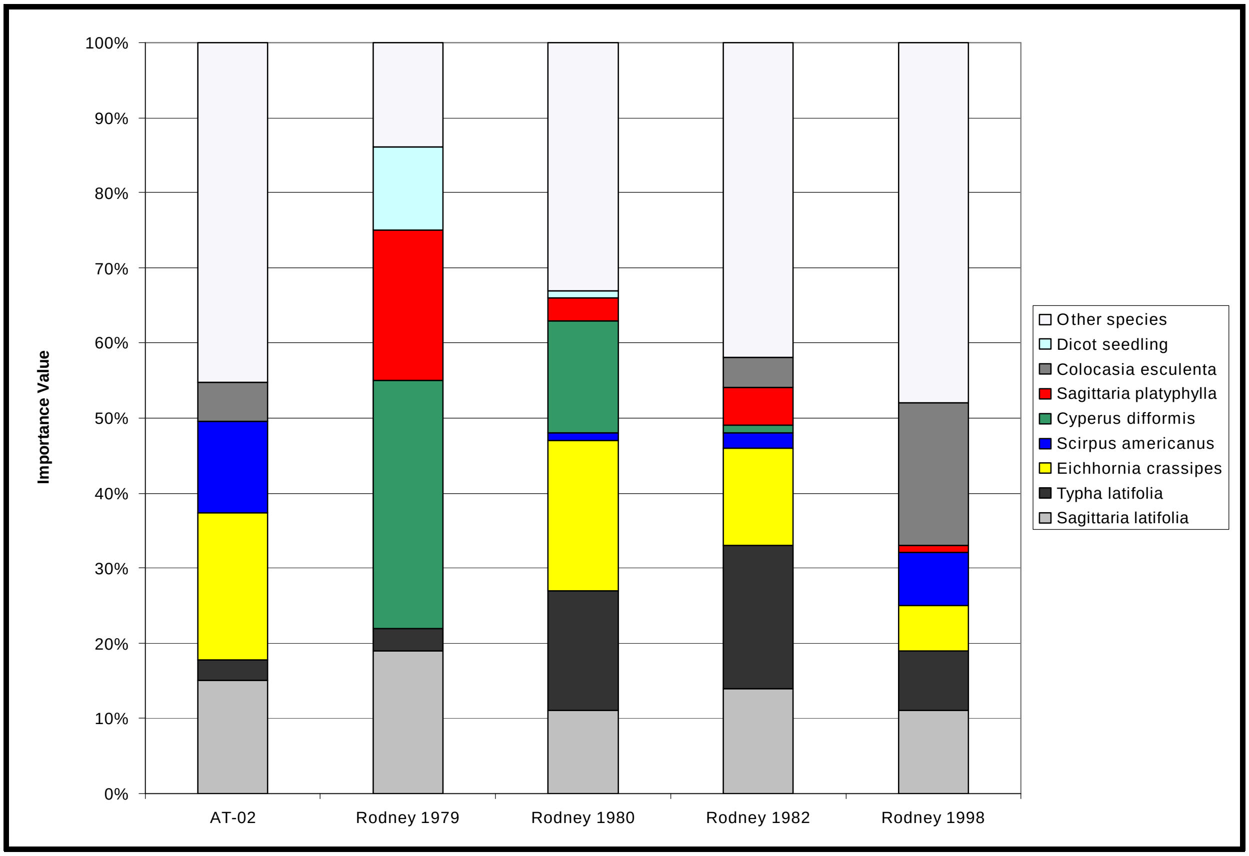

Figure 7. 1998 Importance Values of dominant species on Atchafalaya Sediment Delivery (AT-02) project areas and Rodney Island (reference).

Vegetation (Ordination): Ordinations were performed to detect patterns of vegetative colonization along environmental gradients (axes 1 and 2), if present. Graphs represent multi-dimensional correlations projected onto two dimensional axes. Additionally, the results will aid in the formulation of hypotheses about how vegetation will change or persist along gradients within the project area.

Within the Atchafalaya Sediment Delivery (AT-02) area in 1998, one growing season after creation, there was a clear separation of vegetation plots along axis 2. In the joint plot of Figure 8A, *Sagittaria latifolia* (arrowhead) dominates those plots in the lower left corner, while the plots in the upper quarters are influenced by two aquatic plants - *Eichhornia crassipes* (water hyacinth) and *Vallisneria americana* (water-celery). *E. crassipes* and *V. americana* grading to *Sagittaria latifolia* seemed a potential elevational gradient. However, when the elevation data were overlain on the species matrix to test for a correlation between elevation, percent cover, and an elevational/hydrologic gradient, we found it weaker ($r^2 = 0.205$) (Figure 9A) than that exhibited in 1980 and 1982 on the natural island ($r^2 = 0.313$ and 0.333). The weak correlation may be explained by the unexpected appearance of *E. crassipes* in plots of higher elevation -- AT02-16 and AT02-17 (0.78 and 0.79 ft, respectively).

As with the AT-02 project disposal areas, there is a clear separation of Rodney Island (1979) vegetation plots across axis 2 (Figure 8B). However, the species exhibiting strong trends across the axis are different than those on our created delta-lobe islands. In the joint plot of Figure 8B, *Sagittaria platyphylla* (delta duck potato; bottom right) is largely separated from a cluster influenced by *S. latifolia*, *Cyperus difformis*, and an unknown dicot seedling (upper left). *Sagittaria* spp. are aquatic to subaquatic, *C. difformis* is typically on muddy banks (Godfrey and Wooten 1979, 1981), and *S. nigra* was present at the head of the island. Though no elevation data were collected during this sampling period, we can use the above habitat descriptions and conceive an emerging crevasse-splay of low elevation.

In both 1980 and 1982 on Rodney Island (Figure 8C and 8D), separation of vegetation plots along either axis 1 or 2 was not as noticeable as in 1979. However, 4 species (*E. crassipes*, *C. difformis*, *Typha latifolia* (common cattail), and *S. latifolia*) exhibit strong trends (r^2 $ 0.2) across both axes in 1980, and all but *C. difformis* again exhibit strong trends in 1982. This again led us to consider the presence of an elevational gradient, so we overlaid the elevation data on the species matrix. The result was a negative correlation ($r^2 = 0.313$ and 0.333 in 1980 and 1982, respectively) between elevation and percent cover of the above species along axis 2 and 1 in 1980 and 1982, respectively (Figure 9B and 9C). This establishes a moderate elevational/hydrologic gradient across the natural crevasse-splay, though other environmental gradients influencing the distribution of species on Rodney Island during these sampling years were not determined.

We ran an ordination on the combined vegetation data from the first three sampling periods on Rodney Island (1979-1982) to detect early successional trends across a newly developed crevasse-splay. Our findings (Figure 8E) support those of Johnson *et al.* (1985) and Sasser and Fuller (1988), that being a dominant *S. nigra* community at the head of the island, a thinner cover of *S. nigra*

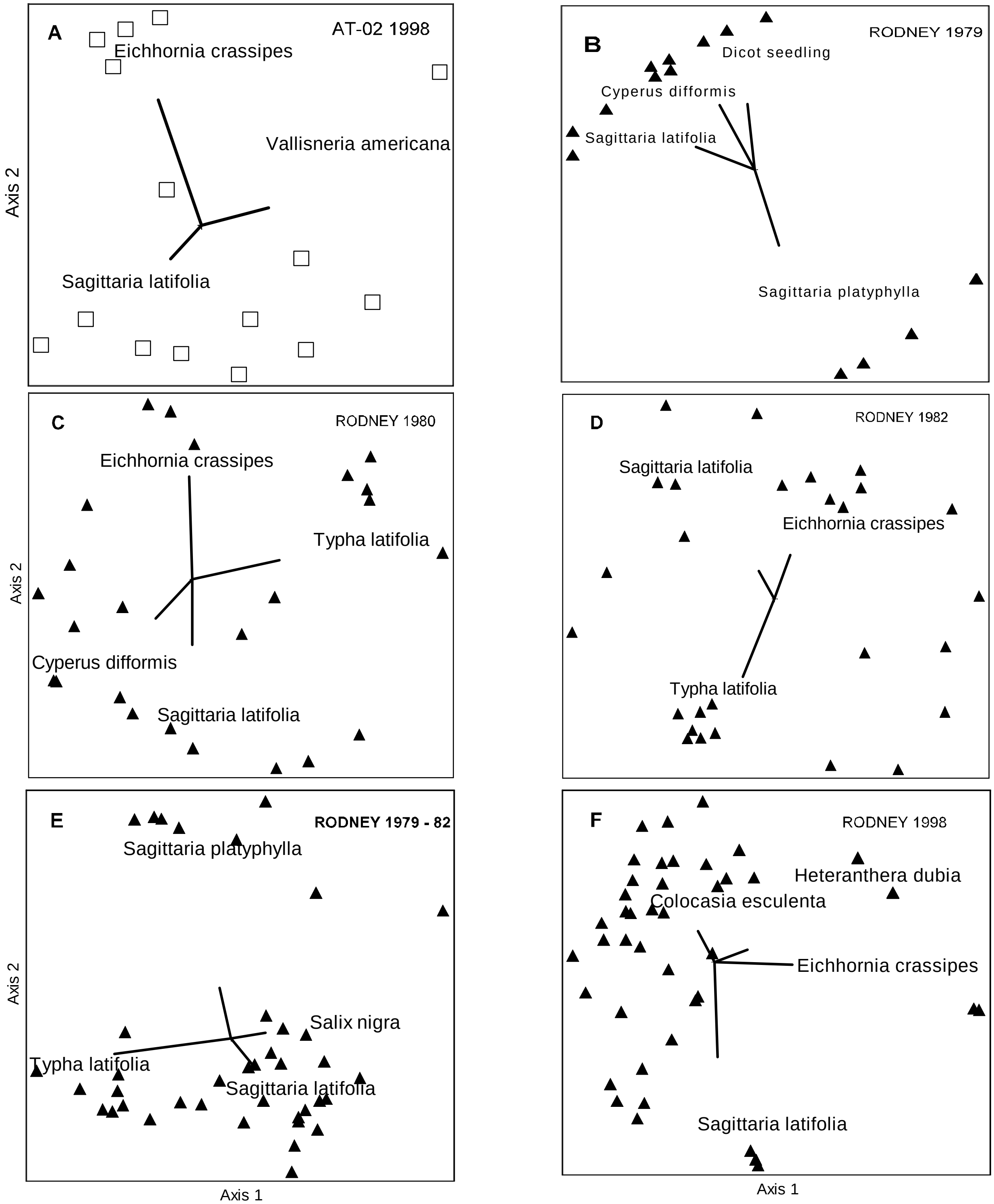

Figure 8A-F. **NMS ordination with joint plot (biplot) of vegetation percent cover. Labeled species exhibit strong trends along the axes ($r^2 > 0.20$). Symbols indicate the location of the vegetation plot: 9 = AT-02 and • = Rodney Island.**

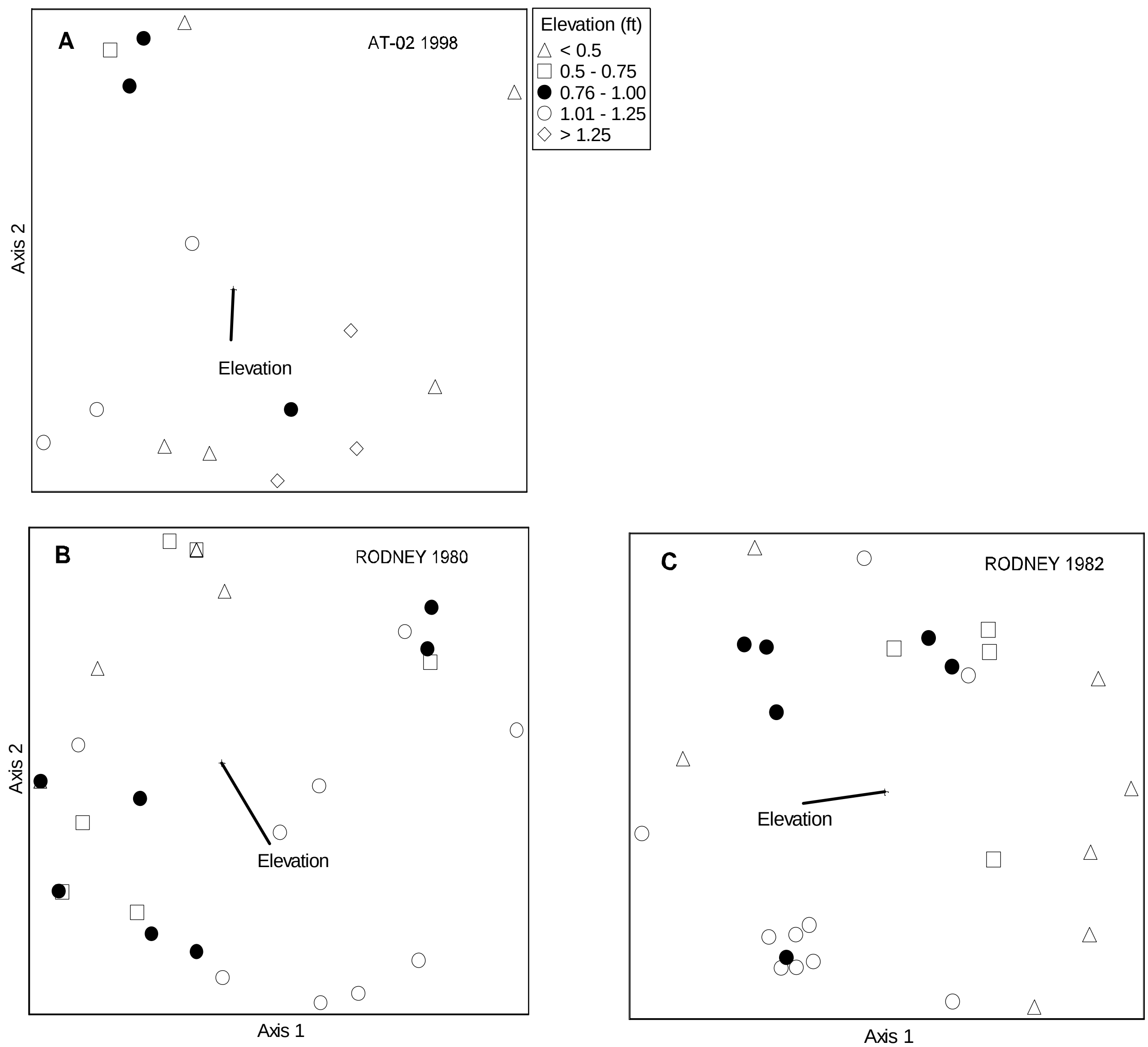

Figure 9A-C. NMS ordination with joint plot (biplot) of AT-02 1998 vegetation plots with recorded elevation. The correlation between elevation and vegetation percent cover is lower (r^2 = 0.205) than that found on the natural crevasse splay (9B and 9C) where r^2 = 0.313 and 0.333, respectively. In all graphs, however, a low to moderate elevational gradient is present.

with a fairly dense herbaceous understory of *Colocasia esculenta* (elephant ear), *Scirpus americanus* (bulrush), and others just downstream of the island head. Further downstream is a distinct *T. latifolia* community, and past that is a community comprised mainly of *S. latifolia* and *S. platyphylla*. Since the created delta-lobe islands were only 8 months old at the time of sampling, we lack the data to examine long-term successional trends. But, the above analysis and description provides a target successional community for this project and future projects in the area.

We were interested in any apparent successional trends that may exist on a delta crevasse-splay more than 20 years after its establishment, so we ran an ordination on the 1998 Rodney Island data. We found a majority of the vegetation plots clustered toward the left of the graph (Figure 8F) where *C. esculenta* and *S. latifolia* are exhibiting a positive (r^2 = 0.19) and negative trend (r^2 = 0.49), respectively, along axis 2. Within the cluster of plots *Polygonum punctatum* (dotted smartweed), *Eleocharis* sp. (spikesedge), *Leersia oryzoides* (rice cutgrass), and *T. latifolia* all exhibit clustering. Though not highly correlated with any known gradient at this time, they are part of various associations outlined by Johnson *et al*. (1985) and Shaffer *et al*. (1992). *Heteranthera dubia* (yellow mud plantain) and *E. crassipes* influence plots on the right side of the graph. *H. dubia* is a submersed plant, while *E. crassipes* is a floating herb (Godfrey and Wooten 1979), likely indicating that the area is at least periodically flooded. Due to the small plot size used (1 m^2), the dominant *S. nigra* community sampled near the head of the island in 1982 does not appear in this analysis of mature island vegetation. In 1998, there were no live *S. nigra* rooted in the plots, however, there was approximately 40% overstory shading three plots at the head of the island (G. Holm, LSU/CEI, pers. comm). When LSU/CEI personnel increased the plot size to 9 m^2, the plots recorded 51-75% *S. nigra* cover.

There were apparent differences in understory vegetation composition between the natural and created islands when comparing the 1998-created island (AT-02) to natural island data collected on Rodney Island by LSU/CEI in 1979, 1980, 1982, and 1998.

When we compared the AT-02 1998 vegetation data to the Rodney Island 1979 data, the plots show a visible separation between created and naturally-formed islands along axis 2 (Figure 10A) where *C. difformis*, *S. latifolia*, *V. americana* and *E. crassipes* exhibit strong trends (r^2 > 0.20). *C. difformis*, as was mentioned in the 1979 Rodney Island analysis above, is an early colonizer of emerging crevasse-splays, and is largely contrasted in this comparison between islands. The AT-02 islands have a minimal *C. difformis* component, and therefore, differ at the time of establishment due to frequency and high cover value of *S. latifolia* in the created understory. *E. crassipes* and *V. americana* exhibit strong trends across axes 2 and 1, respectively, and cause a scattering effect of plots with these species as a component.

When comparing the same project data to the Rodney Island 1980 data, the understory vegetation plots show a pronounced separation between island types across axis 1 (Figure 10B). In this graph, the natural crevasse-splay occupies the left half while created crevasse-splays occupy the right. Again, at this time of early island establishment, *C. difformis* is a frequent component in the natural splay understory. Additionally, the frequency of *T. latifolia* has increased in the Rodney Island plots and is exhibiting influence in plot separation. The high frequency of *S. americanus* and *V. americana* on the created islands is exhibiting a strong influence and contributes toward separating the plots to the right of the graph.

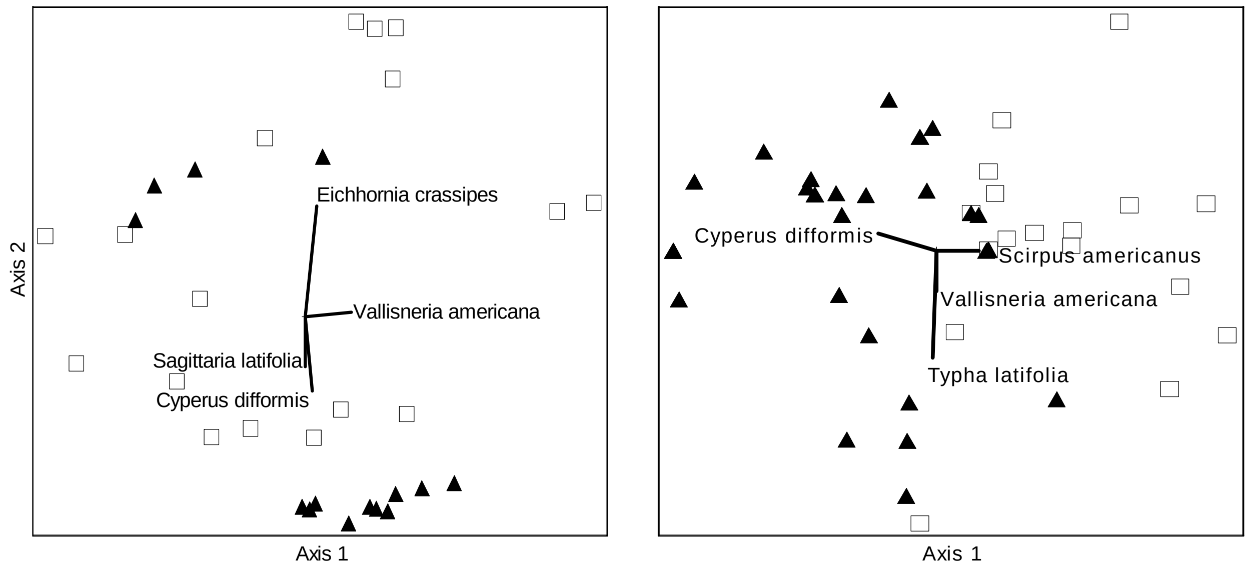

Figure 10A-B. NMS ordination of AT-02 (9, delta lobe island) and Rodney Island (• , natural crevasse-splay) vegetation communities. Top: Plots are separated by type (natural vs. created) along axis 2. Higher frequency and percent cover of *Cyperus difformis* and *Sagittaria latifolia* causes the greatest contrasts. Bottom: Plots are clearly separated by type along axis 1. Differences arise due to the presence and frequency of *Cyperus difformis* in the natural plots and *Scirpus americana* in the created plots.

In the comparison against the Rodney 1982 data (Figure 11A), *C. difformis* no longer exhibits a trend across either axes, and the distinct separation of island types across axis 1 (just mentioned) is slightly diminished. This is caused by the increased presence and cover of *T. latifolia* and *S. platyphylla*.

By 1982, *T. latifolia* emerged as a steady component in the natural crevasse-splay understory, while *S. platyphylla* (a frequent species in the natural crevasse-splay understory but not present in the created crevasse-splay understory) automatically created differences between plots toward the center of the graph. A slight clustering of plots occurs toward the bottom of figure 11A due to the presence of *S. latifolia*. The overlap of created and natural crevasse-splay occurred when a vegetation plot (created or natural) contained *S. latifolia* and had a Braun-Blanquet rank of 2; that is between 6 and 25% cover or a median of 15.

Lastly, we compared the created-island data collected on AT-02 disposal areas in 1998 to that collected on Rodney Island in 1998. Vegetation plot composition differed by crevasse-splay (created versus natural) as shown by the strong grouping of vegetation plots on the naturally-formed island toward the lower right of the graph (Figure 11B). These plots are strongly influenced by *C. esculenta*, whereas *S. americanus* and *S. latifolia* separate the created crevasse-splay plots. As stated previously, the *S. nigra* component on the island is missing due to plot size, but largely contributes to the vegetative composition at the island head. If this were present in the analysis, the vegetative gradient would likely be different (graphically).

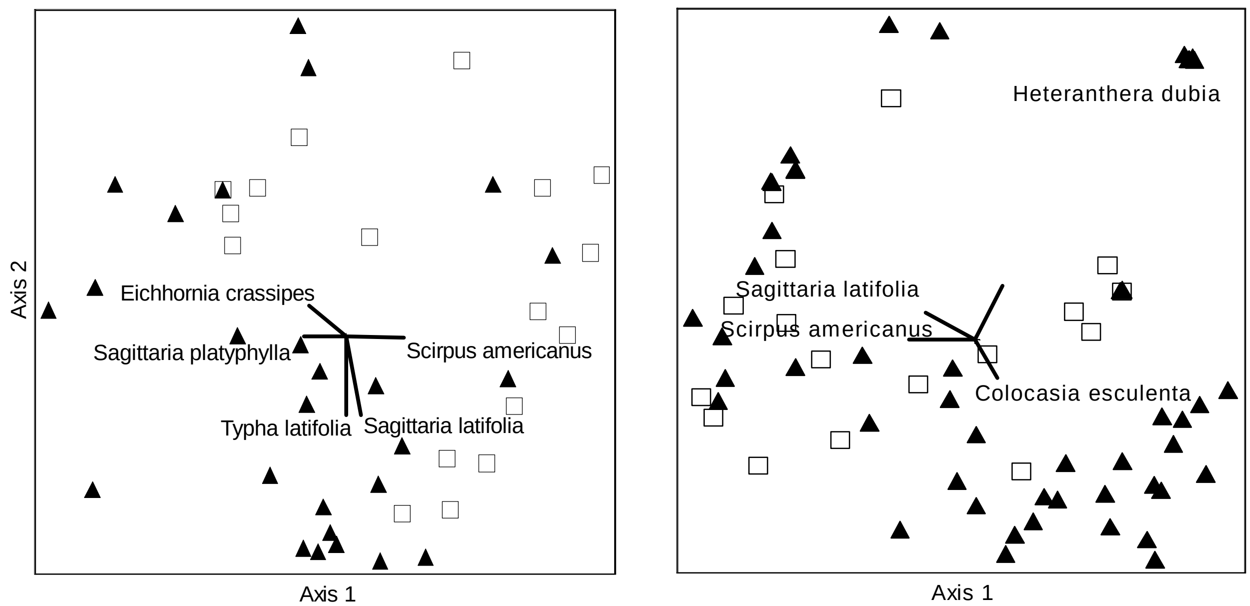

Figure 11A-B. NMS ordination of AT-02 (9, delta lobe island) and Rodney Island (• , natural crevasse-splay) vegetation communities. Top: Plot separation is slightly diminished compared to that seen in 1980, but the presence of *Sagittaria platyphylla* exclusively on the naturally created splay causes clustering toward the bottom left. Additionally, *Typha latifolia* continues to exhibit strong trends along axis 2; quite possibly the result of nearly 75% more cover on the natural splays. Bottom: The separation of vegetation plots (bottom right corner) along axes 1 and 2 was due to the strong influence of *Colocasia esculenta* and a suite of other species, such as *Polygonum punctatum*, *Eleocharis* sp. and *Typha latifolia* on the natural splay.

SAV: The comparison of Castille Pass and Natal Channel sampling areas indicated similar total frequencies of occurrence at 61% and 70%, respectively, but differed in the number of species (Table 4). Natal area transects had a greater number of species (n=7) than the Castille transects (n=5). *V. americana* and Alga spp. had the highest frequency of occurrence in the project area, at 44% and 35%, respectively (Table 5, Figure 12). *H. dubia*, *V. americana*, *Potamogeton* spp. (pondweed) and *Ceratophyllum demersum* (coontail) occurred most frequently in the reference area, with frequency of occurrence of 47%, 42%, 36% and 30%, respectively (Figure 12). The project area had a total of 8 species with a mean species richness of 1.00 per plot, while the reference area also had a total of 8 species, but a mean species richness of 2.00 per plot. Differences in species richness and frequency of occurrence may be associated with differences in average water levels.

The project area was sampled in the morning and the reference area in the afternoon. Tide data for Atchafalaya Bay at Eugene Island indicates low tide occurred in the morning and high tide in the afternoon (Figure 5). The water level difference was approximately 1 ft (0.3 m) between morning and afternoon, therefore, those depths recorded in the afternoon have been changed relative to the 10:00 am water level. Water depths along transects in the reference area were significantly lower than those in the project areas ($p = 0.0205$). The reference area depth averaged 10.67 in (27.1 cm) while the project area depth averaged 15.39 in (39.1 cm) (Table 4). Water depths were not

Table 4. Submerged aquatic vegetation (SAV) total percent frequency of occurrence, species richness and average depth (cm) for project and reference areas.

Variable	Castille Pass	Natal Channel	Total Project Area	Reference Area
Total Frequency of Occurrence	61.00	70.00	66.00	96.00
Species Richness	0.98	1.03	1.00	2.00
Average Depth (cm)	41.62	36.26	39.10	27.09
# of species	5	7	6	8

Table 5. Submerged aquatic vegetation (SAV) species percent frequency of occurrence in project and reference areas. Project area data presented as Castille Pass transects, Natal Channel transects and Total Project Area transects.

Species	Castille Pass	Natal Channel	Total Project Area	Reference Area
Vallisneria americana	36	53	44	42
Alga spp.	45	25	35	9
Potamogeton sp.	11	14	12	36
Heteranthera dubia	5	8	6	47
Ceratophyllum demersum	0	2	1	30
Ruppia maritima	1	1	1	0
Hydrilla sp.	0	1	0	23
Najas guadalupensis	0	0	0	9
Myriophyllum spicatum	0	0	0	5
Unvegetated	39	30	34	4

significantly different between Castille Pass area transects and Natal Channel area transects ($p = 0.86$). Castille Pass area average depth was 16.39 in (41.6 cm) and Natal Channel area average depth was 14.28 in (36.3 cm) (Table 4).

Topography/Bathymetry: Area and elevation statistics for the Natal and Castille dredge and disposal areas are presented in Table 6. The Natal disposal areas range in size from 39.0 acres (15.78 ha) (Natal DA4) to 71.8 acres (29.06 ha) (Natal DA2). The Castille disposal area is 70.6 acres (28.57 ha). Mean elevations in the Natal disposal areas increased on average by more than 1 ft (0.30 m) while mean elevation at the Castille disposal area increased by 0.37 ft (0.112 m). At the end of construction the Natal disposal areas were 1.5 - 2.0 ft higher on average than the Castille disposal area.

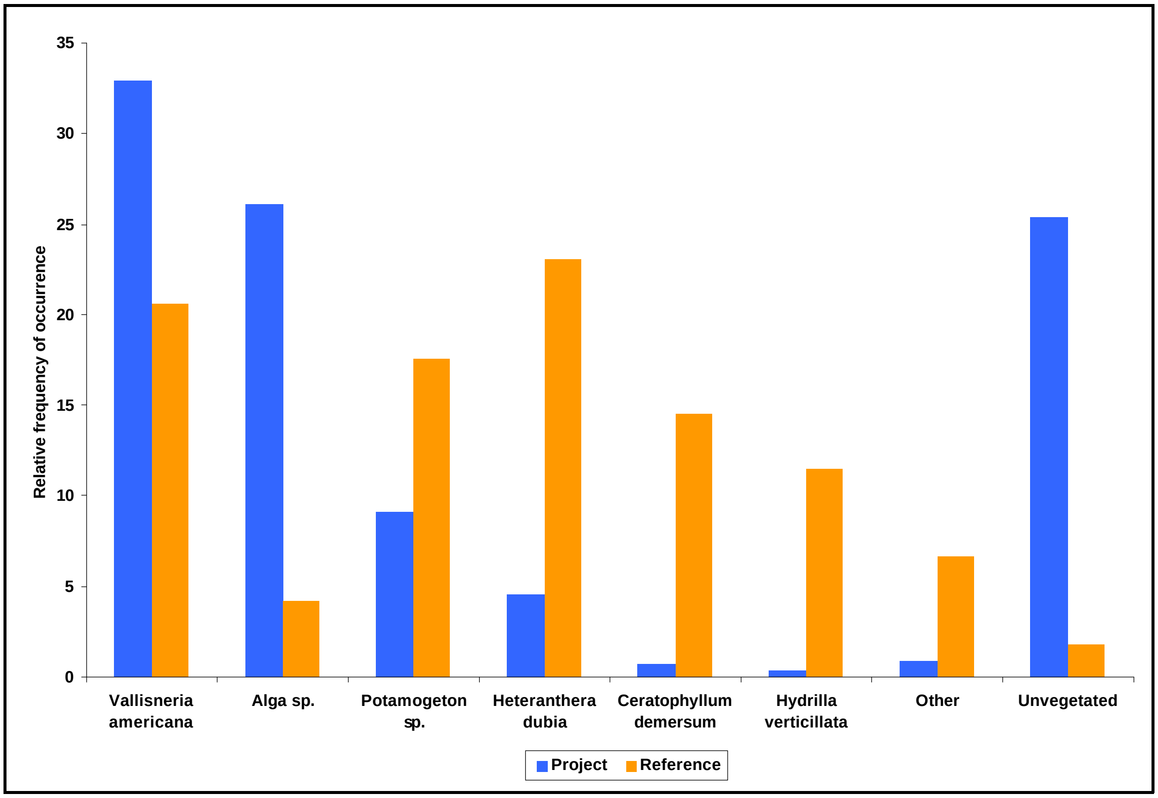

Figure 12. **1998 SAV frequency of occurrence for Atchafalaya Sediment Delivery (AT-02) project and reference area.**

Table 6. Area and elevation statistics for the Natal and Castille dredge and disposal areas.

		Elevation (ft)					
		Mean		Minimum		Maximum	
Location	Size (ac)	Pre	Post	Pre	Post	Pre	Post
Castille DA	70.6	-0.67	-0.30	-1.70	-3.62	0.49	2.00
Natal DA1	46.0	-0.20	1.18	-1.39	-0.82	0.46	3.87
Natal DA2	71.8	0.04	1.47	-1.30	-5.18	0.68	4.48
Natal DA3	45.1	-0.17	1.13	-0.78	-1.83	0.88	3.00
Natal DA4	39.0	-0.42	0.72	-1.09	-0.77	0.30	2.17
Natal Channel Dredge	70.6	-0.92	-9.07	-11.65	-13.12	1.29	0.37
Castille Channel Dredge	ND	ND	ND	ND	ND	ND	ND

Note: ND indicates no data.

Natal Channel was dredged to an average elevation of -9 ft (NGVD), with a minimum elevation occurring at -13 ft. Figure 13 illustrates elevation changes along the Natal and Castille dredge and disposal areas. Elevation increases of more than 1 ft (0.30 m) occurred over 73% of Natal DA1 (34 acres, 13.76 ha); 67% of Natal DA2 (48 acres, 19.42 ha); 68% of Natal DA3 (31 acres, 12.55 ha); 53% of Natal DA4 (21 acres, 8.50 ha); and 8% of Castille DA (5 acres, 2.02 ha). Increases in elevation less than 1 ft were measured on 75% of Castille DA.

Volume changes along the dredge and disposal areas are presented in Table 7. Approximately 428,000 yd^3 (327,229.5 m^3) of dredge spoil were pumped into the Natal disposal areas. This quantity accounts for nearly 75% of the material dredged from Natal Channel 572,000 yd^3 (437,325.4 m^3). The remaining 25% of the dredge spoil probably flowed into areas that were not covered by the pre- and post-construction surveys, which differed in size and coverage. Along the Castille disposal area, approximately 42,000 yd^3 (32,111.3 m^3) of dredge material were pumped into the area, which was about 93% less than that pumped into the Natal disposal areas.

Table 7. Atchafalaya Sediment Delivery (AT-02) restoration project volume changes.

Site	Volume Change (yd^3)
Castille Pass Disposal Area	42,472
Natal Channel Disposal Area 1	102,114
Natal Channel Disposal Area 2	165,752
Natal Channel Disposal Area 3	88,602
Natal Channel Disposal Area 4	71,512
Natal Channel	-571,796
Castille Pass[1]	ND

[1] - Elevation data not provided to LDNR Biological Monitoring Section.

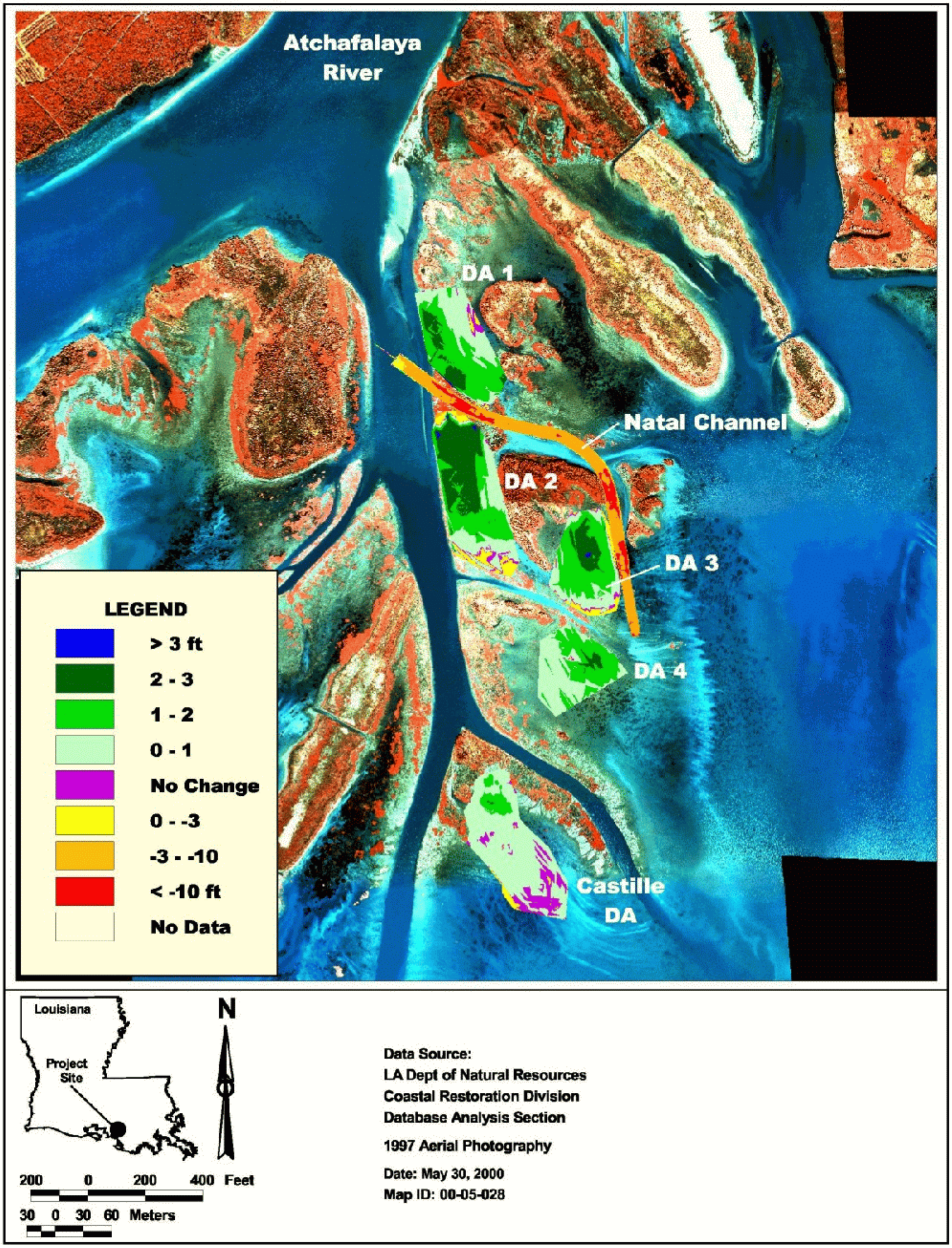

Figure 13. Elevation changes along Natal Channel and the five disposal areas resulting from the dredging operations at Atchafalaya Sediment Delivery (AT-02) project.

DISCUSSION

Land:water calculations using the post-construction habitat mapping data indicate increased delta growth. In one year (1997-1998), the project area gained 78.4 acres (31.7 ha) of land: 14.1 acres (5.7 ha) of fresh marsh, 50.1 acres (20.3 ha) of wetland forested, and 14.2 acres (5.7 ha) of upland barren. However, with only one year of post-construction data it would be misleading to either indicate or assume that the area would continue to build at a rate of 78 acres per year (31.6 ha per year). Therefore, we were unable at this time to fully address our goal of increasing subaerial delta growth in the project area to that measured from historical photography since 1956.

Habitat changes between the immediate pre- and post-construction periods were evident. In the long-term (1978-1997), fresh marsh within the project boundaries increased at a rate of 6.66 acres per year (2.7 ha per year) (U.S.G.S. 2000). Compared to this average, the yearly growth rate nearly doubled after project construction. But, when comparing the 14.1 acres (5.7 ha) of emergent marsh created by the project (1998) to the short-term natural creation of 24.9 acres per year (1994-1997), the average annual growth rate of emergent marsh decreased by nearly 50%. In any case, whether we use short- or long-term means, we lack a significant amount of post-construction data for a definitive comparison. Additionally, the short-term growth rate of emergent marsh seems high when compared to the long-term. An early assumption is that dredge material from a containment area up-river flowed into, and settled in, the project area. The USACE regularly conducts dredging of the Atchafalaya River and it is plausible that the above scenario could occur.

Depending on the data source, wetland forested habitat increased anywhere from 500% to 5000% due to project construction; again a preliminary comparison between short- and long-term means. The habitat mapping and terrestrial survey data make it apparent that, during project construction, dredge material was placed on portions of the islands already classified as land. The deposition of dredge material from Castille and Natal Channels increased elevations of the disposal areas, on average, about 0.37 ft (Castille DA) and 1 ft (Natal DA 1 - 4). At least 53% of each Natal disposal area experienced elevation changes of greater than 1 foot, while only 8% of the Castille disposal area had elevation changes of this magnitude. This was due to Natal disposal areas receiving approximately 2,120 yd^3/acre of dredge material, and Castille disposal area receiving approximately 602 yd^3/acre. The reduced amount was likely not caused by a lack of dredged material, but because the disposal area lacked a containment dike. Dredge material was allowed to flow freely and, therefore, sediment may have been immediately carried past the disposal site and project area. The average elevation of the Castille disposal area was 1.5 - 2.0 ft lower than the average elevation of the Natal disposal areas. The increased elevation, in most cases, would facilitate a change from herbaceous species to a community primarily dominated by *S. nigra*.

While *Salix* associations are not uncommon on a naturally created island, their distribution is typically limited to the upstream head of the island (Johnson *et al.* 1985, Sasser and Fuller 1988). This is a point of importance since the distribution of *Salix* may considerably influence the vegetative patterns of other species on the island. On natural islands, the *S. nigra* near the head of the island (also the highest portion) slows flood waters and therefore serves two important functions: 1) it continues the island building process by slowing flood water and allowing sediments to drop out of suspension, therefore, increasing island elevation and size, and 2) offers downstream communities protection from fast-moving floodwaters, and dominant and specific vegetative patterns emerge as a result (Johnson *et al.* 1985, Shaffer *et al.* 1992). On our created islands, especially Natal disposal areas #2 and #3, the *Salix* association occupied approximately 50 acres (20.23 ha), and was not limited to the head of the island. Since the limited extent of *S. nigra* as well as elevation and sediment particle size affect plant distribution on natural delta islands (Johnson *et al.* 1985), the abundance of *Salix* across the two disposal areas may have permanently altered the path of vegetative succession.

The challenge of studying succession and successional communities has long existed (Gauch 1982). Issues to contend with are biotic and abiotic disturbances, plots in varying stages of succession due to constant land growth, successional pathways that do not always progress forward, the need for an extensive data set due to complex vegetation patterns, and the interpretation of findings from new areas (Gauch 1982). The majority of work on early vegetative succession in the Atchafalaya Bay area was performed by Johnson *et al.* (1985) and Sasser and Fuller (1988), with the earliest known work by Montz (1975). The former have established the description that typifies an Atchafalaya Delta crevasse-splay: a dominant *S. nigra* community at the head of the island, a thinner cover of *S. nigra* with a fairly dense herbaceous understory of *C. esculenta*, *S. americanus*, and others just downstream of the island head, further downstream is a distinct *T. latifolia* community, and continuing downstream is a community comprised mainly of *S. latifolia* and *S. platyphylla*. Our analysis (Figure 7E) of the LSU/CEI Rodney Island data from 1979 - 1982 confirmed the above island description and supplied us with a goal for vegetative colonization on dredge-material islands.

Using the above description and comparing our project data to the LSU/CEI yearly data, we found that the vegetative communities on the constructed islands were not similar to those on the crevasse-splay of Rodney Island. Regardless of which LSU/CEI data set for Rodney Island we used for comparison, we always found a separation between the majority of vegetation plots on each island. We attributed the separation of natural versus dredge-material plots along axis 1 and/or 2 to the increased frequency of *C. difformis, T. latifolia, S. platyphylla,* and *C. esculenta* in the natural plots throughout the sequence of vegetation sampling by LSU/CEI. These species were identified by Shaffer *et al.* (1992) as key colonizing species at different successional stages during island development. The created islands at AT-02 have a higher frequency and cover of *S. americanus, S. latifolia,* and aquatic species such as *E. crassipes*.

Though a noticeable separation of vegetation plots on the natural versus created islands is present on the ordination graphs, data are preliminary. In the created island vegetation plots, *S. latifolia* has an average cover of 32% while the naturally created island ranges from 10% to 17% from 1979 to 1998. Shaffer *et al.* (1992) found that *S. latifolia* was abundant in the earlier years of island establishment, but decreased to about 10% of its original cover by the 1986 sampling period due to either die-out or nutria (*Myocastor coypus*) herbivory. At that time, the majority of nutria damage on Rodney Island occurred at lower elevations, and those areas of higher elevation remained vegetated (Shaffer *et al.* 1992). The created islands, while having areas of low elevation, are largely higher in elevation. So, whether a similar decrease in *Sagittaria* frequency and cover will occur on the man-made islands is yet to be seen. While *S. latifolia* decreased in cover on natural islands over time, other species such as *C. esculentus* and *S. americanus* increased their cover (Shaffer *et al.* 1992). We found similar mean covers for *C. esculentus* and *S. americanus* on both the created and natural islands (1998). This may lead to thoughts of a successional advantage or similarity, but closer examination of each plot reveals that separation (in ordination space) occurred because the species on the created island were not a part of the vegetative associations found on the natural islands.

Lastly, this comparison was of an older, naturally established, crevasse-splay to one that was created only 8 months prior to vegetation sampling. The ordinations were performed to determine whether the created community gained a successional "head start" due to an already present seed source in the dredge material (of which the island was constructed). We found, however, that if the created island had a successional advantage, it was not equivalent to any year between 1979 and 1982 or to greater than 20 years (1998) of establishment, selection, and growth on the naturally-formed island. Therefore, based on available literature, data, graphical placement of the plots, and simple descriptive mathematics, it seems fair to say that the two types of islands are colonized by different vegetative communities.

The effect of this project on SAV are unclear. The habitat mapping data indicate an increase in submerged aquatic habitat of 221.5 acres (89.6 ha per year) from 1997 to 1998, but that is approximately the same annual increase as seen from 1994 to 1997 (214.2 acres per year) (86.7 ha per year). However, the differences in time periods needs to be considered, because the 1994 photography was taken in late December when herbivory from waterfowl could have influenced SAV coverage in habitat mapping (Sasser and Fuller 1988). Also, it should be noted that the habitat mapping category of submerged aquatics consists of a matrix composed of SAV and open water, as indicated by our SAV sampling data (Figure 12).

The goal of increasing frequency of occurrence of SAV in the project area cannot be answered at this time, due to no pre-construction SAV monitoring. SAV sampling data indicate that project and reference areas differ in the average total frequency of occurrence, at 66% and 96%, respectively (Table 4). Future SAV sampling along with habitat mapping should discern changes in SAV species, density, and aerial coverage.

CONCLUSIONS

Due to a lack of post-construction data, we were unable to address goals 3 and 4 at this time. These data are scheduled to be collected and future reports will address the goals. Goal 1 - increasing the distributary potential by increasing cross-sectional area and length of Natal Channel and Castille Pass - was assumed to have been met as a result of the dredging activities and chosen depths and widths. We can only make an assumption at this point because we lack immediate pre- and post-construction bathymetric surveys that encompass the channel past the point of dredging.

The only conclusion, at this time, is that project construction did not achieve its goal of creating approximately 230 acres (92 ha) of delta lobe islands suitable for emergent marsh vegetation through the beneficial use of dredged material. While the goal of creating emergent marsh was not met directly, the habitat mapping data did indicate wetland creation was approximately twice the rate of short-term pre-construction wetland gain. The habitat mapping showed that the created dredge material islands were wetland forested habitats dominated by *S. nigra*. Due to too few and/or small vegetation plots (18 across three disposal areas at 1 m^2), we were unable to quantify this, but ground observations support the findings. Additionally, due to inadequate sample size and other supporting data, we were unable to distinguish strong environmental gradients (if any) across the islands. The vegetation plots were sufficient to generate characterizations of the vegetative communities and perform comparisons of natural versus created island vegetation. The created areas contained different plant communities when compared to any time period in the development of the natural crevasse splay of Rodney Island.

The monitoring of vegetation over time, as well as elevation changes in the channel and on the created islands, should determine overall projects effects. To better evaluate this project, and other projects in the area, future analyses should attempt to assess or implement the following: 1) flooding frequency and inundation in each disposal area as a function of elevation in order to determine if sites are suitable for sustaining emergent marsh vegetation, 2) the effects of compaction and de-watering of newly deposited dredge spoil on marsh elevation, and 3) the use of a vegetation sampling protocol, such as that outlined by Peet *et al.* (1998) for use by the North Carolina Vegetation Survey, that is flexible enough to adequately sample and characterize both the understory and overstory communities.

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APPENDIX A

Habitat Mapping Classification System

Appendix A. National Wetlands Inventory (NWI) Classification System, habitat classes, codes and descriptions represented in the Atchafalaya Sediment Delivery (AT-02) project.

Habitat Class	NWI Code	Description
Fresh Open Water	R1UB	Riverine, Tidal, Unconsolidated Bottom
	R1AB4	Riverine, Tidal, Aquatic Bed, Floating Vascular
Submerged Aquatics	R1AB3	Riverine, Tidal, Aquatic Bed, Rooted Vascular
Fresh Marsh	PEM1	Palustrine, Emergent, Persistent
	PEM1s	Palustrine, Emergent, Persistent (spoil)
Beach/Bar/Flat	R1US	Riverine, Tidal, Unconsolidated Shore
	R2USs	Riverine, Lower Perennial, Unconsolidated Shore (spoil)
	PUS	Palustrine, Unconsolidated shore
Wetland Forested	PSS1	Palustrine, Scrub Shrub, Broad-Leaved Deciduous
	PSS1s	Palustrine, Scrub Shrub, Broad-Leaved Deciduous (spoil)
	PFO1	Palustrine, Forested, Broad-Leaved Deciduous
Upland Barren	• B	Upland, Unvegetated, Consolidated Shell (spoil)

APPENDIX B

Habitat Mapping Change Descriptions

Appendix B. Habitat changes over time in the Atchafalaya Sediment Delivery (AT-02) project.

Change Description	1994-1997 (Acres)	1997-1998 (Acres)
Fresh Open Water (no change)	748.2	589.0
Fresh Open Water to Fresh Marsh	3.7	32.5
Fresh Open Water to Beach/Bar/Flat	30.3	38.0
Fresh Open Water to Wetland Forested	0.1	11.8
Fresh Open Water to Submerged Aquatics	473.6	172.1
Fresh Open Water to Upland Barren	0.0	6.1
Fresh Marsh to Fresh Open Water	9.5	8.9
Fresh Marsh (no change)	106.5	132.1
Fresh Marsh to Beach/Bar/Flat	14.2	41.0
Fresh Marsh to Wetland Forested	8.4	26.0
Fresh Marsh to Submerged Aquatics	1.5	8.1
Fresh Marsh to Upland Barren	0.0	0.7
Beach/Bar/Flat to Fresh Open Water	91.5	14.5
Beach/Bar/Flat to Fresh Marsh	103.6	57.7
Beach/Bar/Flat (no change)	385.0	200.9
Beach/Bar/Flat to Wetland Forested	0.4	16.1
Beach/Bar/Flat to Submerged Aquatics	168.2	135.6
Beach/Bar/Flat to Upland Barren	0.0	4.9
Wetland Forested to Fresh Open Water	0.4	0.6
Wetland Forested to Fresh Marsh	2.9	4.0
Wetland Forested to Beach/Bar/Flat	0.1	0.3
Wetland Forested (no change)	33.2	36.5
Wetland Forested to Submerged Aquatics	0.0	0.7
Wetland Forested to Upland Barren	0.0	0.0
Submerged Aquatics to Fresh Open Water	0.0	47.2
Submerged Aquatics to Fresh Marsh	0.0	4.7
Submerged Aquatics to Beach/Bar/Flat	0.0	22.0
Submerged Aquatics to Wetland Forested	0.0	18.8
Submerged Aquatics (no change)	0.0	548.2
Submerged Aquatics to Upland Barren	0.0	2.4
TOTAL	2181.3	2181.4