MAPPING OF SUBMERGED AQUATIC VEGETATION IN MOBILE BAY AND ADJACENT WATERS OF COASTAL ALABAMA IN 2002

Prepared for

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EXECUTIVE SUMMARY

This document is the technical report for the project providing mapping of submerged aquatic vegetation (SAV) for the Alabama Gulf Coast. This report documents the GIS mapping effort that provides detailed information on the distributions of SAV species in the Mobile Bay National Estuary Program (MBNEP) study area during 2002. This information fulfills the MBNEP living resources goal of identifying the current status of SAV resources in coastal Alabama. The project area encompassed the entire coastline of Alabama from its border with Mississippi to the Alabama/Florida border. The landward boundary was the Louisville and Nashville (L & N) Railroad north of Mobile Bay. An exception to the landward boundary was the streams and bays of the waterway north of the L&N Railroad commonly known as McReynolds Lake, formerly known as Negro Lake and The Basin.

Digital orthophotographs were created from true color aerial photography acquired July 19, 20, 22, and 31, 2002. Areas with SAV were visited in the field using prints of the aerial photography. The field effort included verifying SAV signatures on the aerial photographs and species identification at 295 locations, and QA/QC accuracy checks. Aerial photographs were observed in ArcView GIS and SAV habitat polygons were digitally delineated on a computer screen display. ESRI polygon coverage of SAV beds was created in ArcView version 3.2. Field location data were acquired at 31% of mapped polygons in freshwater portions of the study area, and at 23% of mapped polygons overall.

A total of 6,713.9 acres of SAV was mapped (Table ES-1), mostly (5,653.6 acres) classified as continuous (> 50%) coverage, with lesser amounts of patchy (10 to 50%) and scattered (< 10%) coverage (Table ES-2). Most of the total SAV acreage in the project area occurred in the lower delta, particularly in the Bridgehead Quadrangle (3,641.0 acres), followed by the Mobile (1,007.0 acres) and Hurricane (517.3 acres) Quadrangles. Other areas of substantial acreage included widgeon grass beds along the western shore of Mobile Bay and seagrasses, mostly shoal grass (*Halodule wrightii*), in northern Mississippi Sound and the Perdido Key area.

A total of sixteen vascular plant species representing ten taxonomic families was recorded during field surveys. Ubiquitous freshwater species were wild celery (*Vallisneria neotropicalis*), Eurasian watermilfoil (*Myriophyllum spicatum*), coon's tail (*Ceratophyllum demersum*), southern naiad (*Najas guadelupensis*), widgeon grass (*Ruppia maritima*), and water stargrass (*Heteranthera dubia*). The northern portion of the study area, the Mobile Delta, contained most of the overall acreage and identified SAV species. Wild celery accounted for the greatest acreage of freshwater SAV during the study, occurring in 1,005.7 acres in pure (categorical) stands and in beds mixed with other species that totaled 1,695.4 acres (Table ES-3). Other common freshwater species included coon's tail and Eurasian watermilfoil. Shoal grass comprised the greatest acreage of mapped SAV habitat type with 1,120.3 total acres.

EXECUTIVE SUMMARY (continued)

Invasive SAV species were common in the study area, particularly Eurasian watermilfoil. Watermilfoil occurred in pure (categorical) stands totaling 353.6 acres and was mixed with other species in an additional 2,440 acres. Another invasive species, hydrilla (*Hydrilla verticillata*), though less widespread than watermilfoil, was mixed with coon's tail in extensive beds (278.2 acres) along the shorelines of McReynolds Lake and its connecting rivers, in the northernmost portion of the study area.

Table ES-1. Total SAV acreage by U.S.G.S. 7.5-Minute Quadrangle[1].

QUADRANGLE	AL	FL	ACREAGE
Bridgehead	3,641.0		3,641.0
Chickasaw	26.9		26.9
Daphne	9.5		9.5
Grand Bay	296.4		296.4
Grand Bay SW	79.9		79.9
Gulf Shores	1.2		1.2
Hollinger's Island	126.7		126.7
Hurricane	517.3		517.3
Isle aux Herbes	87.6		87.6
Kreole	295.9		295.9
Mobile	1,007.0		1,007.0
Orange Beach	60.0	3.3	63.3
Perdido Bay	114.6	121.7	236.3
Petit Bois Pass	59.6		59.6
Pine Beach	0.1		0.1
The Basin	265.2		265.2
TOTAL ACREAGE			6,713.9

[1]Quadrangles not listed did not have mapped SAV

Table ES-2. Total SAV acreage by density category.

SAV DENSITY CATEGORY	ACREAGE
Continuous (> 50% Coverage)	5,653.6
Patchy (10 to 50% Coverage)	773.3
Scattered (< 10% Coverage)	287.0
TOTAL	6,713.9

EXECUTIVE SUMMARY (continued)

Table ES-3. Total acreage by habitat category[1].

SAV HABITAT CATEGORY	ACREAGE
Halodule wrightii	1,120.3
Vallisneria neotropicalis	1,005.7
Ceratophyllum demersum, Myriophyllum spicatum	990.6
Myriophyllum spicatum, Vallisneria neotropicalis	898.4
Najas guadelupensis	729.7
Myriophyllum spicatum	353.6
Ruppia maritima, Vallisneria neotropicalis	324.8
Ceratophyllum demersum, Hydrilla verticillata	278.2
Heteranthera dubia, Myriophyllum spicatum, Vallisneria neotropicalis	215.1
Ceratophyllum demersum, Heteranthera dubia	186.0
Ruppia maritima	142.0
Myriophyllum spicatum, Ruppia maritima, Vallisneria neotropicalis	96.6
Heteranthera dubia, Hydrilla verticillata	84.8
Myriophyllum spicatum, Ruppia maritima	79.4
Ceratophyllum demersum, Myriophyllum spicatum, Vallisneria neotropicalis	64.4
Ceratophyllum demersum, Heteranthera dubia, Myriophyllum spicatum, Vallisneria neotropicalis	57.4
Heteranthera dubia, Vallisneria neotropicalis	38.7
Ceratophyllum demersum, Myriophyllum spicatum, Najas guadelupensis	32.5
Heteranthera dubia	13.1
Myriophyllum heterophyllum, Egeria densa , Utricularia inflata	2.6
Thalassia testudinum	0.04

[1]Multiple species indicates co-dominance

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1.0 INTRODUCTION

The Mobile Bay National Estuary Program (MBNEP), National Oceanic and Atmospheric Administration, EPA Gulf of Mexico Program, and Alabama Department of Environmental Management funded the project entitled "Mapping of Submerged Aquatic Vegetation in Mobile Bay and Adjacent Waters of Coastal Alabama in 2002" (contract # DISL/NEP 2002-01). This report documents the GIS mapping effort that provides detailed information on the distributions of submerged aquatic vegetation (SAV) species in the MBNEP area during 2002.

1.1 MBNEP BACKGROUND

Mobile Bay was designated a National Estuary in 1995 through the National Estuary Program, which was established by the Clean Water Act of 1987. The charge of the MBNEP is to develop a blueprint for conserving the resources of the Mobile Bay estuary. The MBNEP has developed a Comprehensive Conservation and Management Plan (CCMP) to accomplish this conservation goal. The MBNEP CCMP identifies goals, objectives, and action plans aimed at rehabilitating and maintaining the various resources in the estuary. Habitat loss is a high priority area of environmental concern for the MBNEP, and previous SAV data in the MBNEP area were not adequate to assess the current status of this resource.

1.2 STUDY PURPOSE AND OBJECTIVES

The environmental survey documented by this report contributes to the fulfillment of the CCMP natural resource objective to preserve and restore SAV resources in the MBNEP area. The information in this report fulfills the MBNEP living resources priority to identify the current status of SAV resources. The first step in the SAV Action Plan is to produce a map of major SAV concentrations of occurrence for public distribution. The objective of this project was to gather accurate digital benthic habitat data within the project area. Future changes in SAV resources in the MBNEP area will be compared with the results of this investigation, which represents a baseline condition of SAV.

1.3 PROJECT AREA

The geographic focus of this MBNEP SAV mapping project was on near-shore estuarine and marine aquatic ecosystems in coastal Alabama (Figure 1-1). The project area encompassed the entire coastline of Alabama from its border with Mississippi to the Alabama/Florida border. The landward boundary was the Louisville and Nashville (L & N) Railroad north of Mobile Bay. An exception to this landward boundary was the streams and bays of the waterway north of the L&N Railroad commonly known as McReynolds Lake, formerly known as Negro Lake and The Basin. The project area included coastal areas outside of the MBNEP study boundary, such as Perdido Bay, and excluded the northernmost portions of the MBNEP area, including the northern portions of Mobile and Baldwin counties north of Interstate 65.

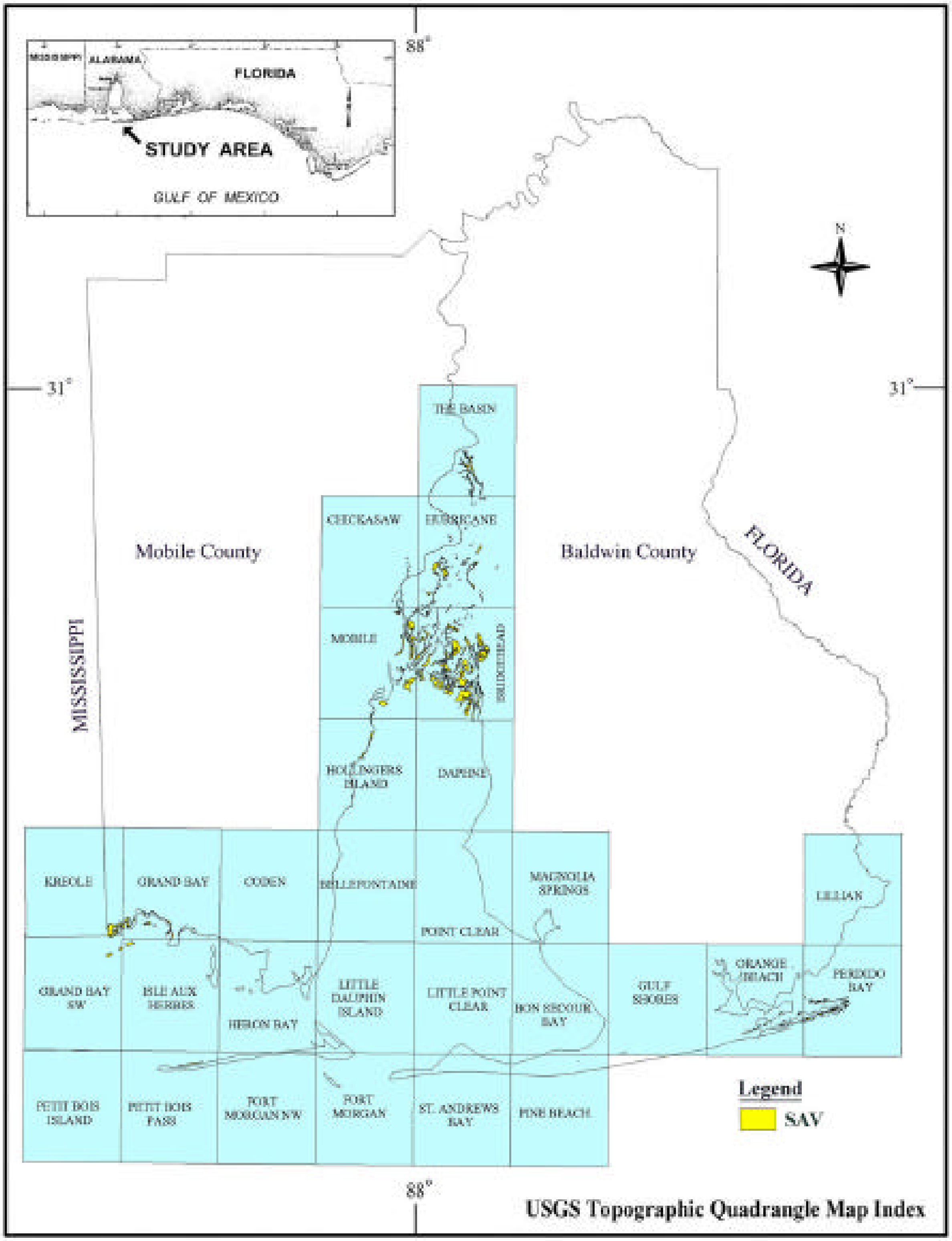

Figure 1-1. Study area for the 2002 survey of SAV in coastal Alabama.

1.4 STUDY APPROACH

In 1995 the U.S. Department of Commerce published benthic mapping methods in a document entitled *NOAA Coastal Change Analysis Program* (C-CAP). This NOAA document presented methods for carrying on the C-CAP objective of producing high-quality habitat data on a national basis, and provided detailed technical guidance for mapping benthic habitats, primarily SAV. This guidance was designed to facilitate production of data that meet the original C-CAP regional goals, while serving local coastal management needs. The C-CAP protocols outline habitat mapping through remote sensing, via acquisition of aerial photography, complemented by strategic ground truthing.

This digital mapping effort for SAV in the MBNEP area was conducted within the technical framework established by the C-CAP. The aerial mapping technology used for this study was airborne GPS (ABGPS) and an inertial measurement unit (IMU) to accurately position each photo center (principal point). The processed GPS/ABGPS/IMU data were used in an aerotriangulation procedure to produce a digital elevation model (DEM) surface for imagery rectification. The DEM removed imagery displacements inherent in the aerial photography, such as distortions resulting from camera tilt and ground relief, to create digital orthophotos with uniform scale and a high degree of accuracy.

Outlines of distinguishable SAV signatures were digitized in a GIS environment using the orthophotos as base maps. SAV signatures detected through visual assessment of the aerial photography were ground truthed to document habitat characteristics in the field. In addition to verifying the presence of SAV on the photos, field data on species composition were collected to provide detailed descriptions of the digitally mapped SAV.

2.0 HISTORIC SAV SURVEYS IN COASTAL ALABAMA

Historical SAV data are limited for coastal Alabama. Stout and Lelong (1981) utilized intensive ground surveys complemented by assessment of black and white aerial photography to map SAV in the most comprehensive prior investigation of the MBNEP area. Prior to Stout and Lelong (1981), few investigations of coastal Alabama SAV had been accomplished, and these studies were relatively limited in scope. Baldwin (1957) and Lueth (1963) provided distributions of SAV in the lower delta and northern portions of Mobile Bay for wildlife and waterfowl management planning. These surveys did not utilize aerial photography for grassbed boundary delineations and only rough estimates of SAV spatial coverage were produced. Plant inventories compiled by Baldwin (1957) and Lueth (1963) were not comprehensive.

Baldwin (1957) estimated that submerged aquatic vegetation covered 5,000 acres in Mobile Bay and 7,500 acres in the lower delta. He reported that the spatially dominant vegetation in Mobile Bay included southern naiad (*Najas guadalupensis*), wild celery (*Vallisneria americana*), horned pondweed (*Zannichellia palustris*), bushy pondweed (*Potamogeton pusillus*), and water stargrass (*Heteranthera dubia*). Based on surveys performed in the late 1940s, Lueth (1963) reported pondweeds (*Potamogeton* spp.), horned pondweed, wild celery, and southern naiad as abundant, with fanwort (*Cabomba caroliniana*), water stargrass, and watermilfoil (*Myriophyllum* sp.) locally abundant in the bays of the lower delta.

Based on a 1980 inventory, Stout and Lelong (1981) estimated the total acreage of SAV in coastal Alabama to be approximately 2,763 acres. SAV occurred at depths less than 6 ft, and community composition was significantly affected by salinity. At the time of their investigation, freshwater SAV comprised most of the overall acreage. Wild celery accounted for about 27% (741 acres) and milfoil accounted for 35% (958 acres) of the overall acreage (Stout and Lelong, 1981). SAV beds with these two species frequently included mixtures of several other species, including water stargrass, pondweeds, and southern naiad. A total of 19 freshwater species was inventoried from mixed beds of various species composition. SAV bed boundaries were mapped in a limited area north of the Highway 90 Causeway but no species information was provided (Stout and Lelong, 1981).

Large areas of the Alabama coastal zone support extensive beds of wild celery. Other common names for this species include tapegrass, channelgrass, and eel grass (Bent, 1925; Godfrey and Wooten, 1979; Wunderlin, 1998). This species probably represents the most important freshwater SAV species from a wildlife standpoint in the Mobile Bay area and the Southeast Coastal Plain. The importance of wild celery as a valuable food resource for waterfowl, particularly, the canvasback duck (*Aythya valisineria*) is well documented (*e.g.*, Bent, 1925; Korschgen and Green, 1988). Beds of wild celery also serve as vital nurseries for numerous animals, including blue crabs and redfish.

Historically, there has been some taxonomic confusion regarding the identity of the *Vallisneria* species found on the Gulf Coastal Plain of Alabama. Traditionally, most authors have considered the taxon in Alabama to be conspecific with the widespread *V. americana* which ranges throughout North and Central America (FNA, 2000). However, the local form has also been treated in the past as *V. neotropicalis* (Marie-Victorin, 1943; Haynes, 1980). The species name *V. neotropicalis* was first published by Marie-Victorin in 1943. Her work cited several morphological characters that separated the two forms, including a larger more robust growth habit in *V. neotropicalis*. Recent authors have tended not to recognize the taxa as a distinct species (e.g., Godfrey and Wooten, 1979; Lowden, 1982; Clewell, 1985; Wunderlin, 1998; FNA, 2000). The majority of these authors synonomize the name under *V. americana* without comment, but Lowden (Lowden, 1982) and FNA (2000) stated that the taxon known as *V. neotropicalis* simply represents an environmentally induced phenotype and is not worthy of nomenclatural recognition. Godfrey and Wooten (1979) offer a similar argument for not recognizing *V. neotropicalis* as a distinct taxon. However, Robert Haynes (personal communication) states that recent unpublished electrophoretic data indicates that *V. neotropicalis* is distinct from *V. americana* at the species level (see also Haynes, 1980). The Flora of Alabama Committee (unpublished data) is treating both taxa as full species in their upcoming Annotated Checklist of the Vascular Plants of Alabama. Preliminary data suggests that within the state, *Vallisneria neotropicalis* occurs on the Gulf Coast north to Shelby County, whereas *V. americana* has been documented only from the Tennessee River Valley in Northern Alabama, where it is abundant (Haynes, 1980).

Alabama's brackish and marine seagrass beds are comprised primarily of widgeon grass (*Ruppia maritima*) and shoal grass (*Halodule wrightii*), with minor and sporadic occurrences of turtle grass (*Thalassia testudinum*). Widgeon grass is a euryhaline species that is not considered a true marine seagrass because of its intolerance for seawater. Widgeon grass can undergo prominent year-to-year changes in abundance and distribution due to salinity fluctuations (Verhoeven, 1975). Stout and Lelong (1981) found that widgeon grass was the most ubiquitous species in the Mobile Bay area, though not the most abundant, occurring near bay mouths and tributary rivers, and in brackish waters of Mississippi Sound. Shoal grass was found to occur only in southern Perdido Bay and along the northern shore of the western end of Dauphin Island. Overall, widgeon grass covered 305 acres and shoal grass covered 656 acres in the 1980 survey of the project area (Stout and Lelong, 1981). Minor occurrences of turtle grass have been found among extensive beds of shoal grass in southern Perdido Bay (Stout and Lelong, 1981; Lelong, 1988).

Shoal grass and widgeon grass are pioneer species (den Hartog, 1970). In areas of early colonization, these species often occur in monotypic stands, unless or until later successional species, such as turtle grass, invade vegetated areas. Widgeon grass tolerates the greatest range of salinity compared with other SAV species, and, due to its high rates of seed production and dispersal (Silberhorn *et al*., 1996), is able to rapidly colonize suitable substrata. Shoal grass is a colonizer of disturbed areas where species such as turtle grass cannot grow. Of the marine seagrasses, shoal grass can withstand the widest range of temperatures and salinities, which contributes to its colonizing ability. Shoal grass can tolerate salinities as low as 5 parts per thousand (McMahon, 1968). In general, shoal grass and widgeon grass are inferior competitors with other seagrasses, and tend to occur in areas that are not suitable for other species (den Hartog, 1970).

Since the early inventories by Baldwin (1957) and Leuth (1963), changes have occurred in the spatial coverage, distribution, and species composition of SAV in coastal Alabama (Borom, 1975; Borom, 1979; Stout and Lelong, 1981). Overall, areal coverage of SAV in the MBNEP area has decreased over time, apparently due to dredging and filling operations, and from increased turbidity due to shoreline development (Stout and Lelong, 1981). The precise extent of these SAV losses is difficult to quantify, however, since early inventories (*e.g.*, Baldwin, 1957) were not sufficiently detailed to provide reliable comparisons. Based on comparison with early surveys, Borom (1979) concluded that SAV in the Mobile Bay and Delta had not only declined but had changed in species density, diversity, and distribution. Baldwin (1957) reported that extensive SAV once grew along the eastern shore of Mobile Bay between Daphne and Point Clear, particularly beds of wild celery. SAV along the eastern shore was much reduced by the late 1960s and almost completely gone in the 1970s (Borom, 1975). Stout and Lelong (1981) also noted that community diversity and species composition of SAV had declined, based on comparison with prior surveys, with single species beds apparently more common during their survey than in the past. Based on anecdotal evidence compiled from former residents and scientists, wild celery and widgeon grass beds once were extensive along both the eastern and western shore of Mobile Bay but had since disappeared from many of those areas by the time of Stout and Lelong's 1980 study. Since then, widgeon grass reestablished in some of these areas, particularly along the southwestern shoreline of the bay. Stout and Lelong (1981) found that widgeon grass accounted for 11% of all submerged vegetation in their study area and covered approximately 300 acres, mostly in pure stands. The spatial extent of shoal grass also has declined from past occurrences, particularly along the shores of Mobile Bay and in lower Perdido Bay (Stout and Lelong, 1981). Crance (1971) reported shoal grass in Portersville Bay, in northern Mississippi Sound, but this SAV had disappeared from this area by 1980, replaced by expansive widgeon grass beds (Stout and Lelong, 1981).

From 1940 to 1987, changes in the upper and middle parts of Perdido Bay consisted mainly of shifts in the locations of small shoal grass and widgeon grass meadows, with only minor changes in density (Handley, 1995). In the lower bay, some shifting of locations and changes in density occurred, and coverage of seagrasses declined from 1,201 acres in 1940-41 to 619 acres in 1987 (Handley, 1995).

Another major change since the 1950s has been the invasion of Eurasian watermilfoil (*Myriophyllum spicatum*), which was not noted in the inventory of Baldwin (1957). Since the 1950s and early 1960s, wild celery, which was abundant throughout the bays of the delta and along the eastern shore, has been gradually replaced by watermilfoil (Borom, 1979). Stout and Lelong (1981) found that watermilfoil had become the predominant species in Alabama's coastal waters, and suggested that its geographic extent would likely broaden through time. In a 1994 survey, watermilfoil was the most abundant submersed species in bays and creeks of the Mobile Delta (Zolczynski and Shearer 1997). Watermilfoil is considered a nuisance, due to detrimental impacts on native SAV and interference with public water uses. The Alabama Department of Conservation and Natural Resources (ADCNR) has an on-going watermilfoil control program consisting of herbicide treatments at strategic locations in the lower delta. In 2002, the Aquatic Plant Management Program of the ADCNR Division of Wildlife and Freshwater Fisheries treated approximately 25 to 30 acres in the lower delta through application of aquatic herbicides, in a program designed to eliminate milfoil in the treatment areas.

Hydrilla (*Hydrilla verticillata*) is another freshwater invasive SAV reported to be widespread in the Mobile Delta and northern portion of the Mobile Bay (Zolcynski, 1997). The strain that occurs in Alabama was imported to the United States in the early 1950s for use in aquariums. Hydrilla grows aggressively and forms thick mats in surface waters that block sunlight penetration to native plants below (van Dijk, 1985). Hydrilla can displace native vegetation such as wild celery and coontail (Rizzo *et al*., 1996).

3.0 METHODS

3.1 ORTHOPHOTOGRAPHY PRODUCTION

Aerial Photo Acquisition

Orthophotography was produced by Southeast Digital Mapping, L.L.C. of Mobile, Alabama. A Cessna T207 Skywagon aircraft was used for acquiring aerial photography on July 19, 20, and 22, 2002. Three Perdido Bay flight lines were reflown July 31 because of clouds during the original July 22 flight. Aerial photography was acquired at an elevation of 12,000 ft.

Aerial photography was acquired during optimal field conditions, concurrent with seasonal peak growth of SAV. Little turbidity was detectable in the photography for most of the study area. Climatic conditions included little wind and relatively cloudless conditions. Tidal stages (Mobile River at AL State Docks) during flights ranged from +1.1 to +1.7 ft. All flights were conducted during morning hours of appropriate sun angles (35 to 45˚).

WorldWide Mission Planning (WWMP) software was used to plan the aerial photography mission. A Computer-Controlled Navigation System (CCNS4) provided guidance for the aircraft and camera control. Aircraft position was controlled with the CCNS4 system and an on-board GPS flight navigation 2000A system by Trimble. A Zeiss RMK TOP 15 mapping camera acquired true color imagery with AGFA x100 film at 1:24,000 scale with 60% forward overlap and 30% sidelap. The TOP 15 camera was integrated with an airborne GPS unit (ABGPS) and an inertial measurement unit (IMU). The camera also was equipped with forward motion compensation (FMC) and Zeiss T-AS gyro-stabilized suspension mount to assure verticality of the optical axis. An airborne Leica 9500 unit GPS System captured one-second positional updates in order to record the position of each photo principal point and the time of firing of the camera shutter. The airborne 9500 GPS unit and the ground differential GPS unit recorded GPS satellite signals into Mb PCMCIA Type I data cards.

Camera orientations were recorded along the 377 miles of flight lines. The aircraft was equipped with the APPLANIX POS system mounted with the camera, utilizing an Inertial Measurement Unit (IMU) to enhance the aerotriangulation process by using the airborne GPS control to orient angles. The ABGPS and IMU systems provided horizontal position and the orientation parameters of the camera.

Photographic System Calibration

The Zeiss camera was calibrated September 06, 2000 and documented in USGS Camera Calibration Report No. OSL/2677. Noteworthy is the Area Weighted Average Resolution (AWAR) of 101 cycles/mm.

The ABGPS / IMU systems were previously boresight calibrated by a photographic flight February 15, 2002 over an area having 16 known high order ground survey points that were photo identifiable. A test aerotriangulation run was made on the trial run aerial photography to determine the quality of performance of the ABGPS / IMU systems. The ABGPS positional data and IMU orientation data were combined and post-processed for X,Y,Z output and subsequently compared with the test aerotriangulation X,Y,Z output. Any misalignments between the two data sets were calculated and calibrated adjustments to the IMU were made to refine the orientation angles. Upon completion of the mission, the GPS data was processed using differential software that combined the ground GPS survey phase measurements and the airborne GPS phase measurements.

Digital Scanners

USGS-approved Zeiss Photoscan photogrammetric scanners were used to scan roll-fed aerial photography negatives at 21 microns. Raw tif images of 0.504 m pixel size were produced.

GPS Photo Control Surveys

Twenty photo-identifiable GPS ground control points were established at strategic points along the perimeter and within the interior of the project area. Because most of the project area was water or featureless marsh, the majority of these were target panels placed at known GPS coordinates. The ground surveyed control points were further intensified in the aerotriangulation process by using the ABGPS / IMU principal point coordinates and generating photogrammetric control points.

Fully Analytical Aerotriangulation

Softcopy aerotriangulation was accomplished with ZI Imaging ISAT software. In the softcopy environment, mensuration was computer-aided by image matching techniques. The imaging software correlated digital imagery patches common to both frames of a stereomodel in order to generate photogrammetric control points. Numbers of patches to be correlated within each stereomodel were determined manually. Ground surveyed photo control points were visually identified and assigned coordinates furnished by ground surveyors. The ground control points served as the framework within which the generated photogrammetric control points were adjusted.

The aerotriangulation process generated control (pass points) for each frame to include tie points between adjacent flight lines. A total of 1,369 X,Y,Z control points was generated. Roll, pitch, and yaw values from the IMU were calibrated to X,Y,Z photo centers. The root mean square (RMS) errors of the final block adjustment to the ground survey control were as follows: X = 0.141 meters, Y = 0.073 meters, and Z = 0.04 meters. The root mean square errors of the photogrammmetric points were as follows:
x = 0.072 meters, y = 0.098 meters, Sigma Nought = 0.115 meters.

Orthophoto Workstation Instrumentation and Software

Dell workstations using ZI Imaging OrthoPro and I/RAS C software were used to produce orthophotos. The output of the aerotriangulation process was used to create a digital elevation model (DEM), or elevation surface, which removed imagery displacements in the production of the orthophotography. Each 9” x 9” photo frame was furnished as an ortho product with a final resampled pixel resolution of 0.61 meters.

3.2 SAV DATA DEVELOPMENT

Creation of Polygonal and GIS Database

SAV presence was determined through examination of the aerial photography. Two analysts identified potential SAV signatures using photographic prints and screen displays of the orthophotography.

Aerial photographs were observed in ArcView GIS and SAV habitat polygons were digitally delineated on a computer screen display. ESRI polygon coverage of SAV beds was created in ArcView version 3.2. Overlapping photographs were used for verification and comparison when delineating the areas of interest to ensure accurate patch edges. Boundaries of SAV beds were digitized on screen to automatically create preliminary vector line coverage. The minimum mapping unit (MMU) for this project was 0.03 hectares (0.1 acres). Once the line work was completed, polygon vector coverage was created using building, editing, cleaning, and labeling the polygonal line work.

Polygons were categorized for species composition based on qualitative field information. Habitat categories were determined based on visual assessment of apparent dominant species composition in the field. Species observed at field locations were assumed to be representative of the entire delineated area. The goal in developing SAV categories was to provide ecologically meaningful descriptions of species composition, balanced against overly broad categorization (*e.g.*, “freshwater SAV”) that would preclude any degree of future change detection. Polygons were visually assessed for vegetation density on a screen display and categorized as patchy (10 to 50% coverage) or scattered (less than 10% coverage) if SAV covered less than 50% of a polygon.

Field Validation

Field surveys were conducted to document habitat characteristics in areas containing SAV. Fourteen separate field excursions were conducted between July 23, 2002 and November 4, 2002. A few sites in the southern portion of the study area were visited during April 2003. Vessel navigation was accomplished mostly by dead reckoning using field prints of the aerial photography and U.S.G.S. 7.5-minute Quadrangle maps. A total of 295 locations were logged in the field using a Trimble Pro XR differential GPS unit, and followed common GPS practices. An elevation mask of 6 was used to avoid degraded signals from satellites. A Positional Dilution of Precision

(PDOP) threshold of 6, data logging at 2-second intervals, and real-time differential correction/post-processing of the field data collected data accurate to within 1 meter.

Development of the polygonal database included visiting areas with visible photographic signatures and determining whether SAV was present. Qualitative information on species composition was recorded at field points. SAV signatures on the aerial photographs provided clearly distinguishable bed boundaries in most cases; however, species composition could not be discerned by visual assessment of the photography. Field data of SAV species identifications were collected either by *in-situ* visual observation or taxonomic assessment of hand-collected (using oyster rake) specimens. SAV typically occurs at depths of six feet or less in the project area. Vouchered specimens were compared with specimens housed in the University of South Alabama herbarium collection in Mobile, AL, to verify species identification.

The field strategy employed for the project was to visit as many locations as possible with visible SAV and record species present. This was imperative especially in the delta, where mixed beds were the rule. In many cases, different field points for the same polygon had different mixtures of species. Based on prior surveys and other informal observations, it was assumed that SAV in southern portions of the study area were monotypic in terms of species composition. This proved to be the case during the 2002 survey. The field effort was concentrated in freshwater portions of Mobile Bay and Delta because no assumptions could be made regarding species composition in those areas. There was no prescribed number of field points for any given SAV bed. Field location data were acquired at 31% of mapped polygons in the delta portion of the study area, and at 23% of mapped polygons overall.

In general, SAV signatures were clearly distinguishable in the photography (Figure 3-1). Ambiguous signatures included tree shadow, leaf litter, and bathymetric depressions near piers in the southern half of Perdido Bay. Non-SAV signatures were mostly distinguishable from SAV due to signature color and texture. Questionable areas were visited in the field to verify initial assumptions based on photographic signatures. There were few areas where SAV was found in the field but was not readily apparent in the photography because of occurrence in small, scattered patches. A field point was logged in these areas, which were then re-scrutinized in the photography and if detectable were delineated as “scattered” SAV.

Visual assessment of orthophotography did not detect SAV in several rivers in the project area, including Bay Minette Creek and Dog, Fowl, Fish, and Perdido Rivers, and their tributaries. Use of aerial photographs for remote delineation may have been problematic because SAV occurrence tends to be in narrow shoreline bands in these areas. Also, colored, or tannic, water may have affected ability to detect SAV in rivers using remote sensing. Total mapped SAV acreage likely represents less than the actual 2002 acreage in the MBNEP study area.

Figure 3-1. Aerial photography showing SAV in the Mobile Bay Delta (top) and Old River in Southern Baldwin County (bottom).

QA/QC

Polygons were reviewed visually using the aerial photography to check completeness and edges. Analysts consulted regarding questionable areas and reviewed the polygonal data set after completion. Interpreted photos were quality checked by two photo interpreters for attribute classification.

Field verification was performed by local scientists for areas where attribute 1:24,000 maps were checked by cartographic personnel for line and labelworks. Attribute accuracy was tested by manually comparing hard copy plots of the digital data with the source materials. When attributes could not be visually verified on plots they were interactively queried and verified on screen. In addition, the attributes were compared against a master set of valid attributes.

Horizontal accuracy was calculated using the National Standard for Spatial Data Accuracy (NSSDA) (LMIC, 1999), using a horizontal positional accuracy statistic. Edge points, lines, and known points were collected in the field using the Trimble Pro XR with beacon (differential with sub-meter accuracy). These points were projected on the completed delineated polygons and a set of 36 test points was selected from the polygon coverage. A separate independent data set (36 points) was selected from the collected field accuracy points. Measurements were then collected from corresponding data points from within each of the two data sets. A horizontal accuracy worksheet calculated the sum of the set of squared differences between the test data set coordinate values and the coordinate values of the independent data set. The average of the sum was calculated by dividing the sum by the number of test points being evaluated. Once the average was calculated the horizontal Root Mean Square Error (RMSE) was calculated by taking the square root of the average. This value is the circular error defined by the radius (CE90). The NSSDA statistic was determined by multiplying the RMSE by 1.7308, a value that represents the standard error of the mean at the 95 percent confidence level. The horizontal RMSE was 5.59 m, and the NSSDA tested was 9.68-m horizontal accuracy at 95% confidence level.

Production of the orthophotography was completed in November 2002, and the polygonal database was completed in May 2003. Comparison of the completed polygonal database, based on 2002 photography and field surveys, with 2003 field conditions was not attempted because of year-to-year variation of SAV species distribution in freshwater areas. Because of the timing of polygonal database development relative to biological seasonality, four additional field excursions beyond the scope of the project design were performed in the delta during September and October 2002. These additional field surveys further validated species composition in freshwater portions of the study area. Some field validation was performed in the southern portions of the study area in April 2003; however, compared to freshwater SAV, seagrass species composition and distribution are more stable from year to year.

Metadata

Metadata completed for the project meet Federal Geographic Data Committee (FGDC) standards and guidelines (FGDC, 1998). The objectives of FGDC standards are to provide a common set of terminology and definitions for the documentation of digital geospatial data. FGDC standards establish names of data elements and compound elements (groups of data elements) to be used for these purposes, the definitions of these compound elements and data elements, and information about the values that are to be provided for the data elements. Metadata were compiled after completion of the QA/QC, and are provided in Appendix A.

4.0 RESULTS AND DISCUSSION

Sixteen vascular plant species representing ten taxonomic families (Table 4-1) were recorded during field surveys. Most of the inventoried taxa typically occur in the study area as submerged plants. Beds of freshwater SAV were delineated throughout upper Mobile Bay north to the limit of the study area. Ubiquitous freshwater species were wild celery, Eurasian watermilfoil, coon's tail, southern naiad, widgeon grass, and water stargrass. Most beds contained varied mixtures of these and other SAV species. The northern portion of the study area, the Mobile Delta, contained most of the overall acreage and identified SAV species.

Table 4-1. SAV species identified during 2002 field surveys.

FAMILY	SPECIES	COMMON NAME
Ruppiaceae		
	Ruppia maritima L.	widgeon grass
Potamogetonaceae		
	Potamogeton nodusus Poir.	longleaf pondweed
	Potamogeton pusillus L.	bushy pondweed
Najadaceae		
	Najas guadelupensis (Spreng.) Magnus	southern naiad
Cymodoceaceae		
	Halodule wrightii Asch.	shoal grass
Hydrocharitaceae		
	Egeria densa Planch.	Brazilian waterweed
	Hydrilla verticillata (L.f.) Royle	hydrilla
	Thalassia testudinum Banks & Sol. ex J. König	turtle grass
	Vallisneria neotropicalis Marie-Victorin.	wild celery
Pontederiaceae		
	Heteranthera dubia (Jacq.) MacMill.	water stargrass
Cabombaceae		
	Cabomba caroliniana A. Gray	Carolina fanwort
Ceratophyllaceae		
	Ceratophyllum demersum L.	coon's tail
Haloragraceae		
	Myriophyllum heterophyllum Michx.	twoleaf milfoil
	Myriophyllum spicatum L.	Eurasian milfoil
Lentibulariaceae		
	Utricularia foliosa L.	leafy bladderwort
	Utricularia inflata Walter	swollen bladderwort

Enclosed embayments such as Bay Minette and Delmar Bay were dominated by watermilfoil and coon's tail. River edges in the delta supported mostly wild celery, water stargrass, watermilfoil, coon's tail, widgeon grass, and southern naiad. Wild celery accounted for the greatest acreage of freshwater SAV during the study, occurring in 1,005.7 acres in pure (categorical) stands (Table 4-2). Wild celery also was found in beds mixed with other species that totaled 1,695.4 acres. Figure 4-1 shows mapped areas of pure (categorical) wild celery beds in the lower delta, as well as field locations where this species was documented in the field. Other common freshwater species included coon's tail, which was mapped in mixed beds totaling 1,612.1 acres, and watermilfoil, which occurred in pure (categorical) stands totaling 353.6 acres and was mixed with other species in an additional 2,440 acres.

Table 4-2. Total acreage by habitat category[1].

SAV HABITAT CATEGORY	ACREAGE
Halodule wrightii	1,120.3
Vallisneria neotropicalis	1,005.7
Ceratophyllum demersum, Myriophyllum spicatum	990.6
Myriophyllum spicatum, Vallisneria neotropicalis	898.4
Najas guadelupensis	729.7
Myriophyllum spicatum	353.6
Ruppia maritima, Vallisneria neotropicalis	324.8
Ceratophyllum demersum, Hydrilla verticillata	278.2
Heteranthera dubia, Myriophyllum spicatum, Vallisneria neotropicalis	215.1
Ceratophyllum demersum, Heteranthera dubia	186.0
Ruppia maritima	142.0
Myriophyllum spicatum, Ruppia maritima, Vallisneria neotropicalis	96.6
Heteranthera dubia, Hydrilla verticillata	84.8
Myriophyllum spicatum, Ruppia maritima	79.4
Ceratophyllum demersum, Myriophyllum spicatum, Vallisneria neotropicalis	64.4
Ceratophyllum demersum, Heteranthera dubia, Myriophyllum spicatum, Vallisneria neotropicalis	57.4
Heteranthera dubia, Vallisneria neotropicalis	38.7
Ceratophyllum demersum, Myriophyllum spicatum, Najas guadelupensis	32.5
Heteranthera dubia	13.1
Myriophyllum heterophyllum, Egeria densa , Utricularia inflata	2.6
Thalassia testudinum	0.04

[1]Multiple species indicates co-dominance

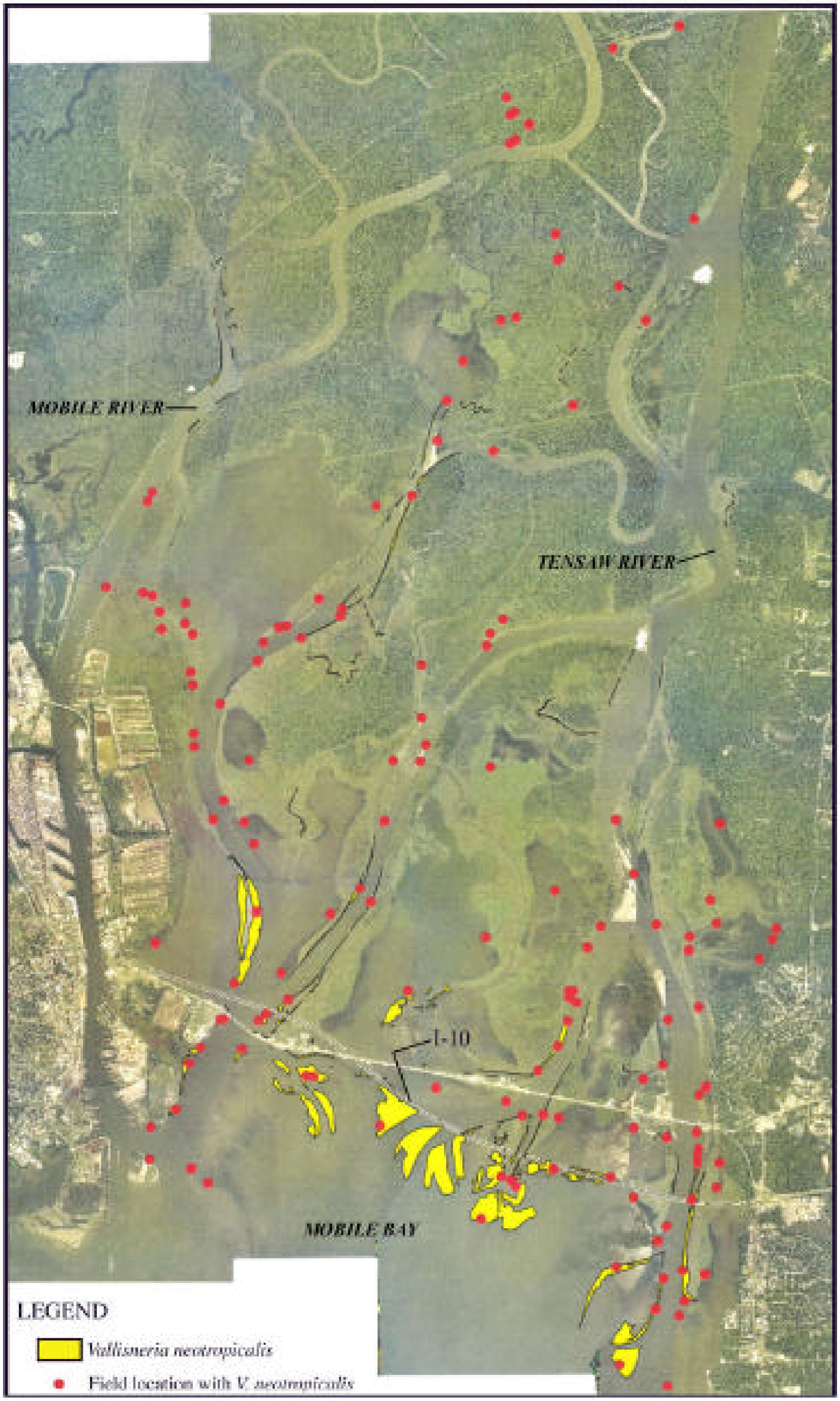

Figure 4-1. 2002 distribution of *Vallisneria neotropicalis* in the Mobile Bay Delta.

Eighty-four percent of the SAV acreage (5,653.6 acres) was mapped as continuous (> 50%) coverage, with lesser amounts of patchy (10 to 50%) and scattered (< 10%) coverage (Table 4-3).

Table 4-3. Total SAV acreage by density category.

SAV DENSITY CATEGORY	ACREAGE
Continuous (> 50% Coverage)	5,653.6
Patchy (10 to 50% Coverage)	773.3
Scattered (< 10% Coverage)	287.0
TOTAL	6,713.9

Most of the total SAV acreage in the project area occurred in the lower delta, particularly in the Bridgehead Quadrangle (Figure 4-2), followed by the Mobile and Hurricane Quadrangles. Other areas of substantial acreage included widgeon grass beds along the western shore of Mobile Bay and seagrasses in northern Mississippi Sound and the Perdido Key area (Figure 1-1). Total mapped SAV acreage by quadrangle map is summarized in Table 4-4.

Table 4-4. Total SAV acreage by U.S.G.S. 7.5-Minute Quadrangle[1].

QUADRANGLE	AL	FL	ACREAGE
Bridgehead	3,641.0		3,641.0
Chickasaw	26.9		26.9
Daphne	9.5		9.5
Grand Bay	296.4		296.4
Grand Bay SW	79.9		79.9
Gulf Shores	1.2		1.2
Hollinger's Island	126.7		126.7
Hurricane	517.3		517.3
Isle aux Herbes	87.6		87.6
Kreole	295.9		295.9
Mobile	1,007.0		1,007.0
Orange Beach	60.0	3.3	63.3
Perdido Bay	114.6	121.7	236.3
Petit Bois Pass	59.6		59.6
Pine Beach	0.1		0.1
The Basin	265.2		265.2
TOTAL ACREAGE			6,713.9

[1]Quadrangles not listed did not have mapped SAV

Aerial photographs were acquired during the approximate peak annual growth stages for SAV in the study area, according to Stout and Lelong (1981). By mid-July the occurrence of certain taxa typically recedes from springtime peaks. In particular, horned pondweed (*Zannichellia palustris*) was not encountered during field surveys from late July to mid-September, and this species is well-documented from the lower delta based

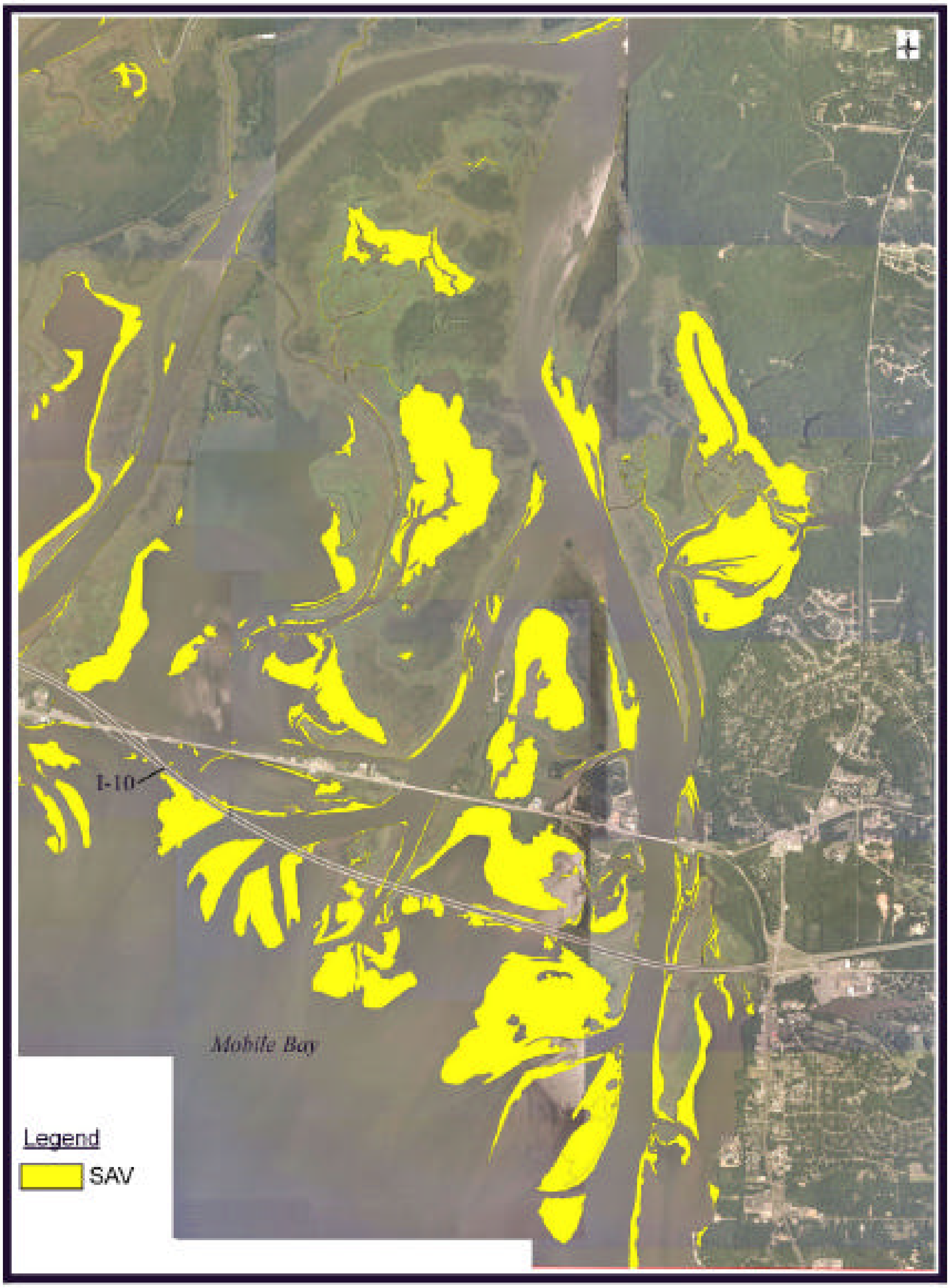

Figure 4-2. Distribution of SAV in the Bridgehead, AL Quadrangle during 2002.

on previous collections and inventory surveys (e.g., Lelong and Stout, 1981; Haynes, 1980; FNA, 2000). Horned pondweed typically flowers in early spring and then quickly dies back in late summer as water temperatures increase (Lelong and Stout, 1981). Spring surveys likely would have documented the presence of this species.

Numerous locations with occurrence of coon's tail (*Ceratophyllum*: Ceratophyllaceae) were mapped during this investigation. Two species of *Ceratophyllum* are currently known from the state: Coon's tail (*C. demersum*) and the spineless hornwort (*C. echinatum*). A third species, the prickly hornwort (*C. muricatum* ssp. *australe*) has been tentatively identified from Conecuh County, Alabama (FNA, unpublished data). Species separation typically requires detailed examination of mature fruits (Wunderlin, 1998; FNA, 1997). *Ceratophyllum* with reproductive structures were not encountered; therefore, all occurrences during the survey were assumed to be *C. demersum*, based on probable frequency of occurrence and habitat requirements. This species is the most frequently encountered species in the North American flora (FNA, 1997).

Much of the overall acreage of widgeon grass (*Ruppia maritima*) occurred in beds along the western shore of Mobile Bay (Figure 4-3). Some beds were relatively large, particularly near Brookley Field. Pure stands of widgeon grass primarily occurred south of Pinto Pass, where the Mobile River empties into Mobile Bay. Widgeon grass north of the Causeway occurred in beds mixed with wild celery, milfoil, water stargrass, and other freshwater species.

The 2002 distribution of widgeon grass differed from the last major survey of the study area. Chance (1971) reported shoal grass in Portersville Bay, in northern Mississippi Sound, but by 1980 it had been replaced by expansive areas of widgeon grass (Stout and Lelong, 1981). Widgeon grass also occurred in Little Lagoon and upper portions of Perdido Bay (Stout and Lelong 1981), but did not occur in these areas in 2002. Instead, Mississippi Sound and Little Lagoon supported shoal grass (*Halodule wrightii*) beds during the 2002 survey. Shoal grass distribution and acreage in the western portion of the study area has increased significantly since Stout and Lelong (1981) provided the last comprehensive survey of the project area. The study area had below average precipitation for at least two years prior to the 2002 mapping survey. Lower than average precipitation may have influenced seagrass colonization in the study area relative to prior surveys, particularly in northern Mississippi Sound. If future average levels of precipitation approach or exceed normal amounts, patterns of widgeon grass occurrence relative to shoal grass distribution may revert to patterns documented in prior surveys (e.g., Stout and Lelong, 1981) in the MBNEP study area.

Seagrasses were limited in distribution to the southern portion of the study area. Shoal grass comprised most of the acreage, particularly in Mississippi Sound (819.4 acres) and southern Perdido Bay (299.6 acres, including Florida waters) (Figure 4-4). In addition, relatively small patches occurred along the northern shoreline of the western end of Dauphin Island, and in Baldwin County in Little Lagoon, Bay la Launch, Arnica Bay, and Palmetto Creek. Shoal grass along the northern shoreline of Dauphin Island

Figure 4-3. Beds of widgeon grass (*Ruppia maritima*) along the western shoreline of Mobile Bay.

Figure 4-4. Distribution of shoalgrass (*Halodule wrightii*) during 2002 in the Perdido Key area of Alabama and Florida.

occurred in small, isolated patches that were included in a single polygon classified as scattered SAV. In Little Lagoon several small areas of shoal grass were identified and mapped, as well as a bed of turtle grass (*Thalassia testudinum*). Turtle grass was previously reported in the Perdido Key area mixed with shoal grass (Stout and Lelong, 1981; Lelong, 1988). Lelong (1988) observed turtle grass intermixed with shoal grass from the Old River in Baldwin County, but did not collect specimens. In subsequent conversations with Lelong (personal communication) he stated that given the species rarity in the state, no collections were made. A sample of turtle grass collected from Little Lagoon during the 2002 survey represents the first vouchered specimen of the species from Alabama waters.

Invasive SAV species were common in the study area, particularly Eurasian watermilfoil (*Myriophyllum spicatum*). Watermilfoil occurred in pure (categorical) stands totaling 353.6 acres and was mixed with other species in an additional 2,440 acres. Watermilfoil was frequently found in large beds mixed with coon's tail (Figure 4-5), particularly in several freshwater embayments in the delta. Watermilfoil was ubiquitous in the delta and northern Mobile Bay (Figure 4-6). Hydrilla (*Hydrilla verticillata*), another invasive SAV species, was documented in a few areas in the delta. Hydrilla was previously reported to be widespread in the Mobile Delta and northern portion of the Mobile Bay (Zolcynski 1997), but few field locations had this species (Figure 4-7).

Figure 4-5. Watermilfoil and coon's tail in Bay Minette.

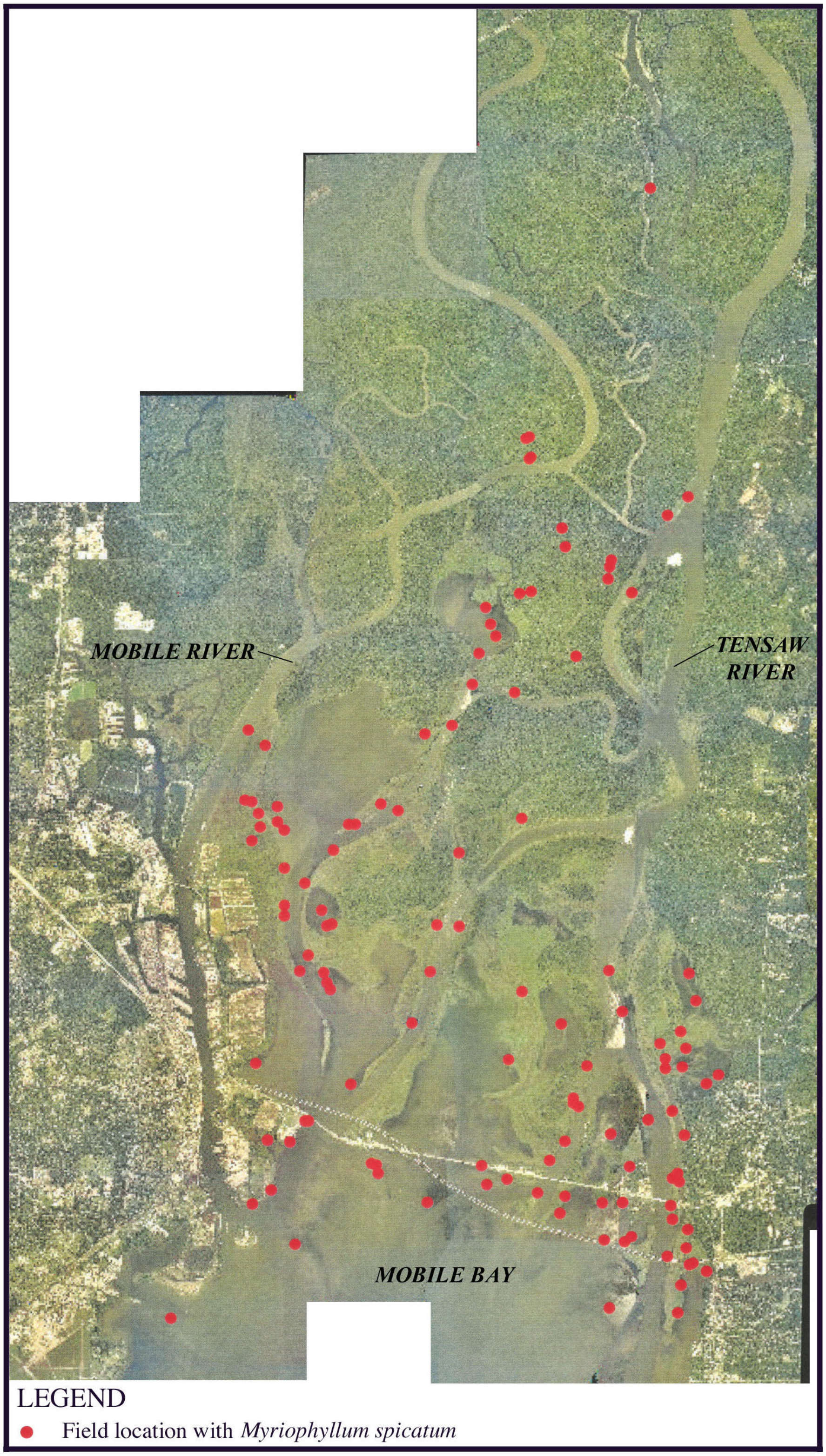

Figure 4-6. Field locations with Eurasian watermilfoil (*Myriophyllum spicatum*) in the Mobile Bay Delta during 2002.

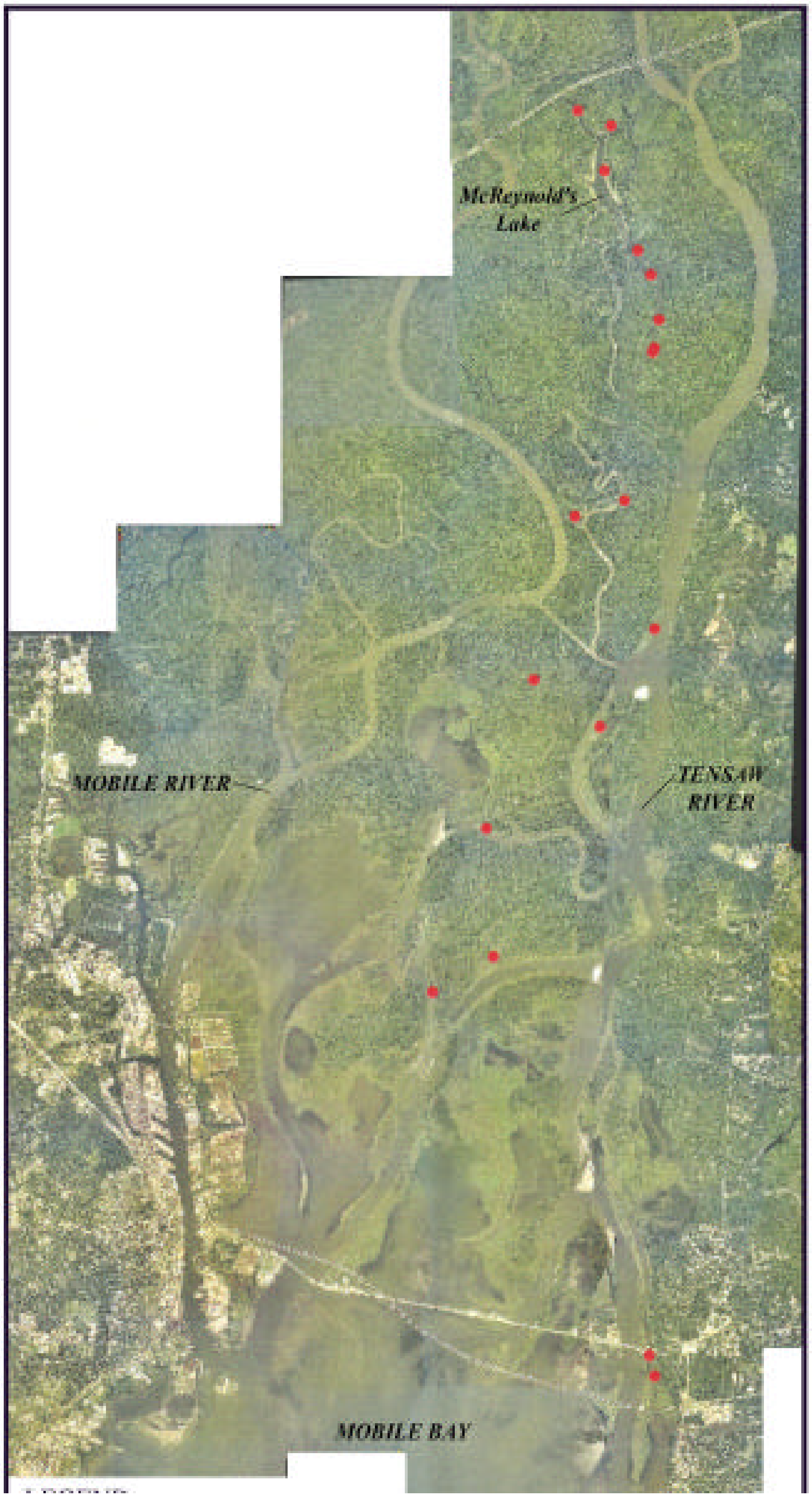

Figure 4-7. Field locations with hydrilla (*Hydrilla verticillata*) in the Mobile Bay Delta during 2002.

Stout and Lelong (1981) found that watermilfoil had become the predominant species in Alabama's coastal freshwater habitats, and suggested that its geographic extent would likely broaden through time. Comparisons between the 2002 distribution of watermilfoil and prior surveys are not reliable due to differences in mapping methods and habitat categorization, and insufficient detail in the earlier studies for areas north of Highway 90. Most of the acreage of hydrilla was in McReynolds Lake, located in the northernmost portion of the study area (Figure 4-8).

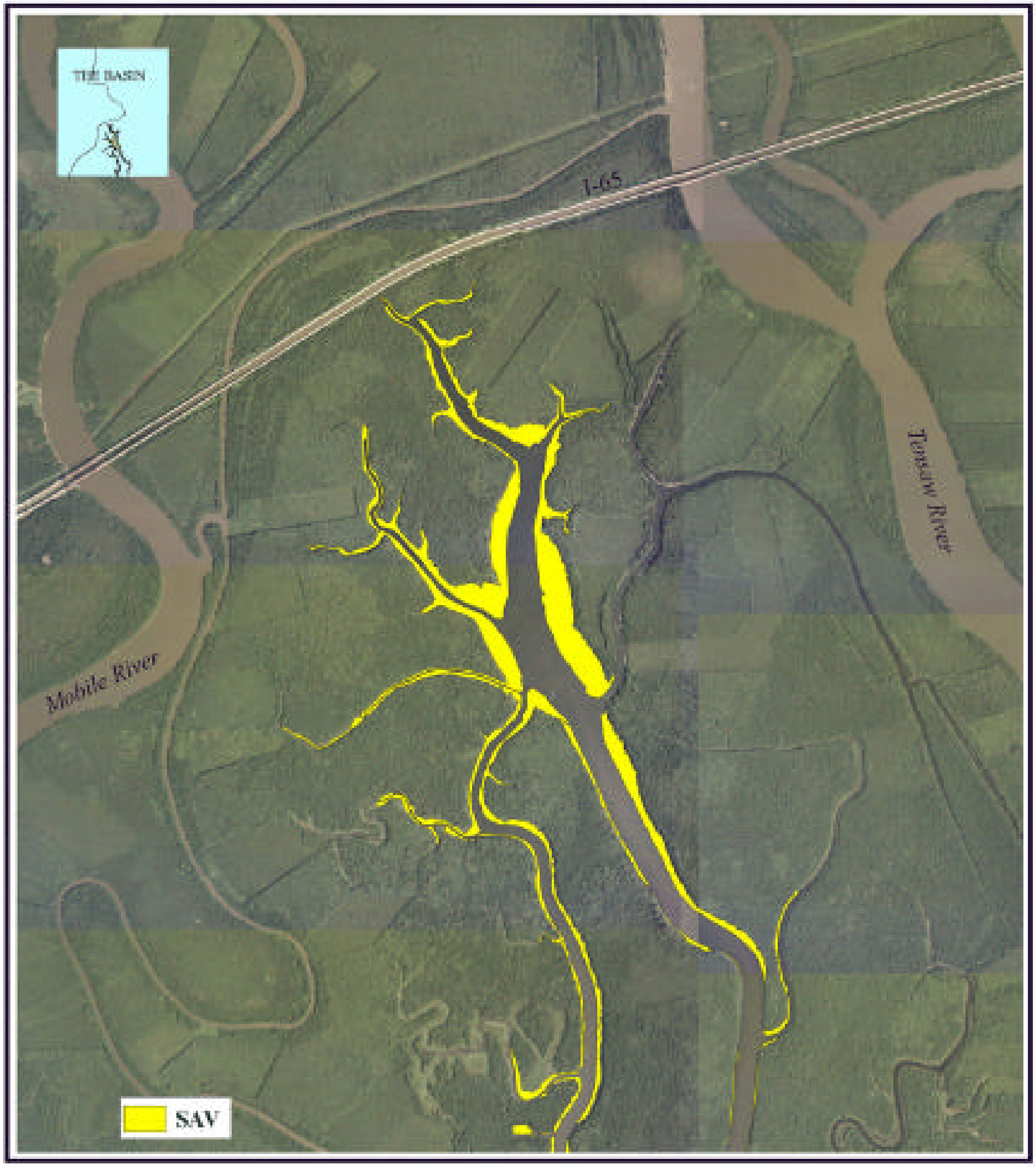

Figure 4-8. SAV in McReynolds Lake during 2002.

Hydrilla was mixed with coon's tail in extensive beds (278.2 acres total) along the shorelines of McReynolds Lake and its connecting rivers. SAV coverage in McReynolds Lake had thick algal cover. Several emergent plants occurred on the surface of the algal cover, including water spangle (*Salvinia minima*), a floating aquatic fern, mosquito fern (*Azolla caroliniana*), frog's bit (*Limnobium spongia*), and Cuban bulrush (*Oxycaryum cubense*) (Figure 4-9). Survey data were collected for these and other aquatic species, including the introduced water hyacinth (*Eichhornia crassipes*).

Figure 4-9. SAV in McReynolds Lake. Note the emergent plants on the surface (Inset: *Hydrilla verticillata*).

Locality data and baseline information on exotic species may be useful in determining the extent of species invasions, and potentially aid in future management decisions by identifying specific target areas of high infestation for control. However, general use of 2002 SAV survey data for future management and permit decisions is problematic due to the often-ephemeral nature of SAV species distribution and abundance. Users should exercise caution when attempting to apply these data to post-2002 conditions to specific field locations in the MBNEP study area.

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APPENDIX A – PROJECT METADATA

Submerged Aquatic Vegetation Polygons

Identification_Information:
  Citation:
    Citation_Information:
      Title: Submerged Aquatic Vegetation 2003
      Edition: Version 1.0
      Geospatial_Data_Presentation_Form: atlas
      Series_Information:
        Series_Name: Submerged Aquatic Vegetation
        Issue_Identification: Version 1.0
      Publication_Information:
        Publication_Place: Mobile, Alabama
        Publisher: Barry A. Vittor & Associates, Inc.
      Other_Citation_Details:
        Mobile Bay National Estuary Program
        Diana Sturm, Ph.D.
        Program Scientist
        4172 Commanders Drive
        Mobile, Alabama 36615
        (251) 431-6409
        (251) 431-6450
        dsturm@mobilebaynep.com
      Online_Linkage: None at this time.
      Larger_Work_Citation:

        Citation_Information:
          Series_Information:
          Publication_Information:
  Description:
    Abstract:
      This data set consists of digital data describing submerged aquatic vegetation beds in coastal Alabama, including Mississippi Sound (AL), Mobile Bay, Mobile Delta, Little Lagoon, Bay La Launch, Perdido Bay, and communicating tributaries thereof. The data set includes 296 orthophotographs, which were digitized at Southeast Digital Mapping, L.L.C from true color aerial photography acquired July 2002.
    Purpose:
      The intended use of this data set is to provide a comprehensive assessment of the distribution and extent of submerged aquatic vegetation along the Alabama Coast.
    Supplemental_Information:
      July 2002 through May 2003
      Photography Date July 17, 18, 19,

and 31, 2002
Time_Period_of_Content:
Time_Period_Information:
Single_Date/Time:
Range_of_Dates/Times:
Beginning_Date: July, 2002
Ending_Date: May, 2003
Multiple_Dates/Times:
Currentness_Reference: Publication Date
Status:
Progress: Complete
Maintenance_and_Update_Frequency: Annually
Spatial_Domain:
Bounding_Coordinates:
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Keywords:
Theme:
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Place_Keyword: Baldwin County
Place_Keyword: Mobile County
Place_Keyword: Perdido Bay
Place_Keyword_Thesaurus: USA
Place_Keyword: Alabama
Place_Keyword_Thesaurus: Florida
Place_Keyword: Panhandle
Stratum:
Temporal:
Temporal_Keyword_Thesaurus: 2003
Temporal_Keyword: May, 2003
Access_Constraints:
It is strongly recommended that this data be acquired directly from the distributor described above and not indirectly through other sources which may have changed the data in some way. The distributor makes no claims as to the data's suitability for other purposes.
Use_Constraints:
Acknowledgement of the Mobile Bay National Estuary

Program as a data source would be appreciated in products developed from these data, and such acknowledgment as is standard for citation and legal practices for data source is expected by users of this data. Sharing new data layers developed directly from these data would also be appreciated by Mobile Bay National Estuary Program staff. Users should be aware that comparison with other data sets for the same area from other time periods may be inaccurate due to inconsistencies resulting from changes in mapping conventions, data collection, environmental conditions, and
computer processes over time. The distributor shall not be liable for improper or incorrect use of this data, based on the description of appropriate/inappropriate uses described in this metadata document. These data are not legal documents and are not to be used as such.

Point_of_Contact:
  Contact_Information:
    Contact_Person_Primary:
    Contact_Organization_Primary:
      Contact_Organization: Mobile Bay National Estuary Program
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  Mobile, AL 36695
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  ArcView GIS Version 3.3
Cross_Reference:
  Citation_Information:
    Title: Submerged Aquatic Vegetation

Edition: Version 1.0
Geospatial_Data_Presentation_Form: atlas
Series_Information:
Series_Name: Submerged Aquatic Vegetation
Issue_Identification: Version 1.0
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Publication_Place: Mobile, Alabama
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Other_Citation_Details:
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Online_Linkage: None at this time.
Data_Quality_Information:
Attribute_Accuracy:
Attribute_Accuracy_Report:
Interpreted photos were quality checked by two photo interpreters for attribute classification. Field verification was performed by local scientists for areas where attribute 1:24,000 maps were checked by cartographic personnel for line and label works. The attribute accuracy was tested by manually comparing hard copy plots of the digital data with the source materials. When attributes could not be visually verified on plots they were interactively queried and verified on screen. In addition, the attributes were compared against a master set of valid attributes
Logical_Consistency_Report:
ArcGIS software was used to create and maintain topological relationships between features. There are no duplicate features, but coincident lines are maintained between data layers where appropriate. Polygonal features begin and end at the same point, contain no overshoots or undershoots, and contain a single label. Linear features are continuous where appropriate, i.e., dangling arcs are removed if they are not required.
Completeness_Report: Complete
Positional_Accuracy:
Horizontal_Positional_Accuracy:
Horizontal_Positional_Accuracy_Report:
The horizontal positional accuracy was tested by visual comparison of hard copy check plots to the source materials and verifying the location of the

data on-screen relative to other data layers in the same geographic area.
The spatial accuracy was measured using the Positional Accuracy Handbook,
by Minnesota Planning Land Management Information Center. The RMSE (CE90) is calculated by adding up the radius errors, averaging them and taking the square root. This gives a circular error defined by the radius. Using the
National Standard for Spatial Data Accuracy (NSSDA) is determined by multiplying the RMSE by 1.7308 (the value represents the standard error of the mean at the 95 percent confidence level). This measures and reports the positional accuracy of the features that are found within a geographic dataset
(Positional Accuracy Handbook, 1999). The horizontal RMSE (CE90) is 5.59m.
Using NSSDA the data set tested 9.68 m at a 95% accuracy rate

Quantitative_Horizontal_Positional_Accuracy_Assessment:
Horizontal_Positional_Accuracy_Value: The horizontal RMSE (CE90) is 5.59m. Using NSSDA the data set tested 9.68 m at a 95% accuracy rate
Horizontal_Positional_Accuracy_Explanation: QA/QC points were collected in the field and used to check the accuracy of the polygons.

Vertical_Positional_Accuracy:
Vertical_Positional_Accuracy_Report: Not applicable

Lineage:
Source_Information:
Source_Citation:
Citation_Information:
Originator: Southeast Digital Mapping, LLC(comp.)
Publication_Date: 20021111
Publication_Time: Unknown
Title: True Color Aerial Photography
Edition: Version 1.0
Geospatial_Data_Presentation_Form: remote-sensing image
Series_Information:
Publication_Information:
Publication_Place: Theodore, Alabama
Publisher: Southeast Digital Mapping, LLC
Larger_Work_Citation:
Citation_Information:
Series_Information:
Publication_Information:
Source_Scale_Denominator: 1:24,000
Type_of_Source_Media: disc
Source_Time_Period_of_Content:
Time_Period_Information:
Single_Date/Time:
Range_of_Dates/Times:
Multiple_Dates/Times:
Calendar_Date: July 17, 2002
Calendar_Date: July 18, 2002
Calendar_Date: July 19, 2002

Calendar_Date: July 31, 2002
Source_Currentness_Reference: Publication Date
Source_Citation_Abbreviation: NEP SAV Orthophotography
Source_Contribution:
Provided the ground base for the delineation of the submerged aquatic vegetation in the Mobile Bay area.
Process_Step:
Process_Description:
Aerial Photo Acquisition
A Cessna T207 Skywagon was used for acquiring aerial photography primarily on July 19,20,and 22, 2002. A flight log is included as Appendix A. Three Perdido Bay flight lines were reflown July 31 because of clouds during the original July 22 flight. Flights were conducted during morning hours of appropriate sun angles (35 to 45°). AGFA x100 true color film was used for the aerial photography.
A Zeiss RMK TOP 15 mapping camera acquired color 1:24,000 scale with 60% forward overlap and
30% sidelap. The TOP 15 camera was integrated with an airborne GPS unit (ABGPS) and an inertial measurement unit (IMU). WorldWide Mission Planning (WWMP) software was used to plan the aerial photography mission. A Computer-Controlled Navigation System (CCNS4) provided guidance for the aircraft and camera control. Aircraft position was controlled with the CCNS4 system and an on-board GPS flight navigation 2000A system by Trimble.
The TOP 15 camera was equipped with forward motion compensation (FMC) and Zeiss T-AS gyro-stabilized suspension mount to assure verticality of the optical axis.
An airborne Leica 9500 unit GPS System captured one-second positional updates in order to record the position of the photo principal point and the time of firing of the camera shutter.
Camera orientations were recorded along the flight lines.
The aircraft was equipped with the APPLANIX POS system mounted with the camera, utilizing an Inertial Measurement Unit (IMU to enhance the aerotriangulation process by using the airborne GPS control to orient angles. The ABGPS and IMU systems provided horizontal position and the orientation parameters of the camera.
Photographic System Calibration
The Zeiss TOP 15 camera, Serial no. 145843, Lens No. 145912 were calibrated September 06, 2000 as documented in the USGS Camera Calibration Report No. OSL/2677.
The ABGPS positional data and the IMU orientation data

were combined and post-processed for X,Y,Z output and subsequently compared with the test aerotriangulation X,Y,Z output. Any misalignments between the two data sets were calculated and calibrated adjustments to the IMU were made to refine the orientation angles. Upon completion of the mission, the GPS data was processed using differential software that combined the ground GPS survey phase measurements and the airborne GPS phase measurements.

Digital Scanners

The SDM Team used a USGS-approved Zeiss Photoscan photogrammetric scanner to scan roll-fed aerial photography negatives at 21 microns to produce raw tif images of 0.504 m pixel size.

GPS Photo Control Surveys

Twenty photo identifiable GPS ground control points were established at strategic points along the perimeter and within the interior of the project area. The ground surveyed control points were further intensified in the aerotriangulation process by using the ABGPS / IMU principal point coordinates and generating photogrammetric control points.

Fully Analytical Aerotriangulation

Softcopy aerotriangulation was accomplished with ZI Imaging ISAT software. In the softcopy environment, mensuration was computer-aided by image matching techniques. The imaging software correlated digital imagery patches common to both frames of a stereomodel in order to generate photogrammetric control points. The number of patches within each stereomodel to be correlated was manually determined. The ground control points served as the framework within which the generated photogrammetric control points were adjusted.

The aerotriangulation process generated control (pass points) for each frame to include tie points between adjacent flight lines. A total of 1,369 X,Y,Z control points was generated. The root mean square (RMS) errors of the final block adjustment to the ground survey control were as 0.04 meters. The root mean square errors of the 0.072 meters, 0.115 meters. The output of the aerotriangulation process was

used to create a digital elevation model (DEM. Each 9" x 9" photo frame was furnished as an ortho product with a final resampled pixel resolution of 0.61 meters.

Source_Used_Citation_Abbreviation: Orthophotography

Process_Date: 20020800

Process_Contact:
Contact_Information:
Contact_Person_Primary:
Contact_Organization_Primary:
Contact_Organization: Southeast Digital Mapping, LLC
Contact_Address:
Address_Type: mailing and physical address
Address:
5821 Range Line Road
Suite 101
City: Theodore
State_or_Province: Alabama
Postal_Code: 36582
Country: USA
Contact_Voice_Telephone: (251) 443-6979
Contact_Facsimile_Telephone: (251) 443-6970
Contact_Instructions:
Please contact the following for information and questions
Mobile Bay National Estuary Program
Diana Sturm, Ph.D.
Program Scientist
4172 Commanders Drive
Mobile
Alabama
36615
USA
(251) 431-6409
(251) 431-6450
dsturm@mobilebaynep.com
Spatial_Data_Organization_Information:
Direct_Spatial_Reference_Method: Raster
Raster_Object_Information:
Raster_Object_Type: Pixel
Spatial_Reference_Information:
Horizontal_Coordinate_System_Definition:
Planar:
Grid_Coordinate_System:
Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:
UTM_Zone_Number: 16 North
Transverse_Mercator:
Scale_Factor_at_Central_Meridian: 0.99960000
Longitude_of_Central_Meridian: -087.000000
Latitude_of_Projection_Origin: +00.000000
False_Easting: 500000.00
False_Northing: 0.00

Universal_Polar_Stereographic:
Polar_Stereographic:
State_Plane_Coordinate_System:
Lambert_Conformal_Conic:
Transverse_Mercator:
Oblique_Mercator:
Oblique_Line_Point:
Polyconic:
ARC_Coordinate_System:
Equirectangular:
Azimuthal_Equidistant:
Planar_Coordinate_Information:
Planar_Coordinate_Encoding_Method: coordinate pair
Coordinate_Representation:
Distance_and_Bearing_Representation:
Planar_Distance_Units: Meters
Geodetic_Model:
Horizontal_Datum_Name: North American Datum of 1983
Ellipsoid_Name: Clarke 1866
Vertical_Coordinate_System_Definition:
Altitude_System_Definition:
Altitude_Datum_Name: National Geodetic Vertical Datum of 1929
Altitude_Distance_Units: Meters
Depth_System_Definition:
Entity_and_Attribute_Information:
Detailed_Description:
Entity_Type:
Entity_Type_Label: Species (Broad)
Entity_Type_Definition: SAV species found in the study area
Entity_Type_Definition_Source: Numerous Sources
Attribute:
Attribute_Label: Area
Attribute_Definition:
The perimeter of the SAV polygons. Generated using the
Xtools extension.
Attribute_Definition_Source: Xtools Extension
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: Area
Enumerated_Domain_Value_Definition: Area of selected SAV polygon
Enumerated_Domain_Value_Definition_Source: Calculated using Xtools
Attribute_Units_of_Measure: Meters
Beginning_Date_of_Attribute_Values: 20020600
Ending_Date_of_Attribute_Values: 20020600
Attribute_Value_Accuracy_Information:
Attribute:

Attribute_Label: Perimeter
Attribute_Definition:
The perimeter of the SAV polygons. Generated using the
Xtools
extension.
Attribute_Definition_Source: Xtools Extension
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: Perimeter
Enumerated_Domain_Value_Definition: Perimeter of selected SAV polygon
Enumerated_Domain_Value_Definition_Source: Calculated using Xtools
Attribute_Units_of_Measure: Meters
Beginning_Date_of_Attribute_Values: 20020600
Ending_Date_of_Attribute_Values: 20020600
Attribute_Value_Accuracy_Information:
Attribute:
Attribute_Label: Acres
Attribute_Definition:
The acreage of the SAV polygons. Generated using the
Xtools extension.
Attribute_Definition_Source: Xtools Extension
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: Acres
Enumerated_Domain_Value_Definition: Acres of selected SAV polygon
Enumerated_Domain_Value_Definition_Source: Calculated using Xtools
Beginning_Date_of_Attribute_Values: June, 2002
Ending_Date_of_Attribute_Values: June, 2002
Attribute_Value_Accuracy_Information:
Attribute:
Attribute_Label: Groundtruth
Attribute_Definition:
Attribute column states whether or not a groundtruth point
was taken in the SAV polygon.
Attribute_Definition_Source: Field Notes
Attribute_Domain_Values:
Unrepresentable_Domain: Yes or No
Attribute_Units_of_Measure: Yes or No
Beginning_Date_of_Attribute_Values: June, 2002
Ending_Date_of_Attribute_Values: October, 2002
Attribute_Value_Accuracy_Information:
Attribute:
Attribute_Label: Gt_point
Attribute_Definition:
Attribute column states what groundtruth point
corresponds with that SAV polygon.

Attribute_Definition_Source: Field Notes
Attribute_Domain_Values:
Range_Domain:
Range_Domain_Minimum: 0
Range_Domain_Maximum: 250
Attribute_Units_of_Measure: Number
Beginning_Date_of_Attribute_Values: June, 2002
Ending_Date_of_Attribute_Values: October, 2002
Attribute_Value_Accuracy_Information:
Attribute:
Attribute_Label: Species1
Attribute_Definition:
The first SAV species observed during field verification.
Unique Two Letter Codes for SAV Taxa.
SPECIES CODE
Cabomba caroliniana CC
Ceratophyllum demersum CD
Egeria densa ED
Halodule wrightii HW
Heteranthera dubia HD
Hydrilla verticillata HV
Myriophyllum heterophyllum MH
Myriophyllum spicatum MS
Najas guadelupensis NG
Potamogeton nodosus PN
Potamogeton pusilus PP
Ruppia maritima RM
Thalassia testudinum TT
Utricularia foliosa UF
Utricularia inflata UI
Vallisneria neotropicalis VN
Attribute_Definition_Source: Species were assigned a unique two letter code based on the first letter of the genus and the first letter of the specific epithet.
Attribute_Domain_Values:
Codeset_Domain:
Codeset_Name: SAV Code set- listed in Definition
Codeset_Source: Mobile Bay National Estuary Program
Beginning_Date_of_Attribute_Values: June, 2002
Ending_Date_of_Attribute_Values: June, 2002
Attribute_Value_Accuracy_Information:
Attribute:
Attribute_Label: Broad
Attribute_Definition:
Surveys for beds of submerged aquatic vegetation (SAV) were conducted on the Alabama Gulf Coast during the summer and fall months of 2002 in an effort to provide

baseline inventory data on the status of biologically
important species of native aquatic plants occurring within
the coastal regions of Mobile and Baldwin Counties.
Invasive, non-native taxa such as Hydrilla (Hydrilla verticillata:
Hydrocharitaceae) and Eurasian milfoil (Myriophyllum spicatum: Haloragraceae)
were also targeted to determine the extent of infestation
within the study area. Areas covered within the two-county
region include Mobile Bay, the lower Mobile and Tensaw
River Delta and adjoining waters along the immediate coast
of Alabama. Aerial photography was flown during a
two-week period in July 2002 by Southeastern Digital
Mapping Inc. (SDM). The resulting images
were then digital rectified and converted into digital
orthoquads. Examination of aerial
photography was used to identify specific areas of SAV. A
total of 295 ground-truthing points were visited in the
field to verify the presence of SAV and to determine
species composition. A total of sixteen vascular plant species
representing ten taxonomic families were recorded during
the survey of the Alabama Gulf Coast. In addition, data was also collected for
several other aquatic and wetland species, which although typically
occur as free floating or emergent, include many non-native
and invasive taxa.
SPECIES-CODE
Cabomba caroliniana-CC
Ceratophyllum demersum-CD
Egeria densa-ED
Halodule wrightii-HW
Heteranthera dubia-HD
Hydrilla verticillata-HV
Myriophyllum heterophyllum-MH
Myriophyllum spicatum-MS
Najas guadelupensis-NG
Potamogeton nodosus-PN
Potamogeton pusilus-PP
Ruppia maritima-RM
Thalassia testudinum-TT
Utricularia foliosa-UF
Utricularia inflata-UI
Vallisneria neotropicalis-VN
Attribute_Definition_Source: Species were assigned a unique two letter code based on the first letter of the genus and the first letter of the specific epithet.
Attribute_Domain_Values:
Codeset_Domain:
Codeset_Name: SAV Code set- listed in Definition
Codeset_Source: Mobile Bay National Estuary Program

Beginning_Date_of_Attribute_Values: June, 2002
Ending_Date_of_Attribute_Values: October, 2002
Attribute_Value_Accuracy_Information:
Attribute:
Attribute_Label: Comments 1 & 2
Attribute_Definition: Additional comments made and noted in the field notes.
Attribute_Definition_Source: Field Notes
Attribute_Domain_Values:
Unrepresentable_Domain: Notes
Beginning_Date_of_Attribute_Values: June, 2002
Ending_Date_of_Attribute_Values: June, 2002
Attribute_Value_Accuracy_Information:
Overview_Description:
Entity_and_Attribute_Overview:
Surveys for beds of submerged aquatic vegetation (SAV) were conducted on the Alabama Gulf Coast during the summer and fall months of 2002 in an effort to provide baseline inventory data on the status of biologically important species of native aquatic plants occurring within the coastal regions of Mobile and Baldwin Counties. Areas covered within the two-county region include Mobile Bay, the lower Mobile and Tensaw River Delta and adjoining waters along the immediate coast of Alabama. Field surveys were used throughout the SAV mapping program to verify the accuracy of the aerial data and to document more detailed habitat characteristics in areas containing SAV. This mapping program will provide a basis for identification of future changes from the 2002 distribution and types of SAV resources within the Mobile estuary.
Entity_and_Attribute_Detail_Citation: Submerged Aquatic Vegetation
Distribution_Information:
Distributor:
Contact_Information:
Contact_Person_Primary:
Contact_Organization_Primary:
Contact_Organization: Mobile Bay National Estuary Program
Contact_Person: Diana Sturm, Ph.D.
Contact_Position: Program Scientist
Contact_Address:
Address_Type: mailing and physical address
Address: 4172 Commanders Drive
City: Mobile
State_or_Province: AL
Postal_Code: 36615
Country: USA

Contact_Voice_Telephone: (251) 431-6409
Contact_Facsimile_Telephone: (251) 431-6450
Contact_Electronic_Mail_Address: dsturm@mobilebaynep.com
Hours_of_Service: 9:00 a.m. to 4:00 p.m. CST for phone calls.
Resource_Description: Submerged Aquatic Vegetation
Distribution_Liability:
It is strongly recommended that this data be acquired directly from the distributor described above and not indirectly through other sources which may have changed the data in some way. The distributor makes no claims as to the data's suitability for other purposes.
Standard_Order_Process:
Non-digital_Form:
Mobile Bay National Estuary Program
Diana Sturm, Ph.D.
Program Scientist
4172 Commanders Drive
Mobile, Alabama 36615
(251) 431-6409
(251) 431-6450
dsturm@mobilebaynep.com
Fees: No Fees associated if on the internet.
Custom_Order_Process: No custom ordering processes.
Available_Time_Period:
Time_Period_Information:
Single_Date/Time:
Range_of_Dates/Times:
Multiple_Dates/Times:
Metadata_Reference_Information:
Metadata_Date: 20030500
Metadata_Review_Date: May, 2003
Metadata_Contact:
Contact_Information:
Contact_Person_Primary:
Contact_Organization_Primary:
Contact_Organization: Mobile Bay National Estuary Program
Contact_Person: Diana Sturm, Ph.D.
Contact_Position: Program Scientist
Contact_Address:
Address_Type: mailing and physical address
Address: 4172 Commanders Drive
City: Mobile
State_or_Province: AL
Postal_Code: 36615
Country: USA
Contact_Voice_Telephone: (251) 431-6409

Contact_Facsimile_Telephone: (251) 431-6450
Contact_Electronic_Mail_Address: dsturm@mobilebaynep.com
Hours_of_Service: 8:00 a.m. to 4:00 p.m. Monday Through Friday
Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata_Standard_Version: 1.0
Metadata_Access_Constraints:
Acknowledgement of the Mobile Bay National Estuary Program as the metadata source would be appreciated. Please cite the original metadata when using portions of the record to create a similar record of slightly altered data, such as reprojection.
Metadata_Use_Constraints:
Acknowledgement of the Mobile Bay National Estuary Program as the metadata source would be appreciated. Please cite the original metadata when using portions of the record to create a similar record of slightly altered data, such as reprojection.
Metadata_Security_Information:

APPENDIX B – FIELD NOTES

POINT	DATE	SPECIES	NOTES
1	7/23/02	*Vallisneria neotropicalis**	
2	7/23/02	*Vallisneria neotropicalis*	
3	7/23/02	*Vallisneria neotropicalis*	
4	8/14/02	*Vallisneria neotropicalis*	South of bayway; patchy
5	8/14/02	*Vallisneria neotropicalis*	Larger size bed than above
6	8/14/02	*Vallisneria neotropicalis, Myriophyllum spicatum†*	*Vallisneria* dominates/*Myriophyllum* minor
7	8/14/02	*Heteranthera dubia, Myriophyllum spicatum, Najas guadelupensis, Vallisneria neotropicalis, Salvinia minima†*	
8	8/14/02	*Vallisneria neotropicalis, Myriophyllum spicatum*	*Vallisneria* dominates/*Myriophyllum* minor
9	8/14/02	*Vallisneria neotropicalis*	
10	8/14/02	*Vallisneria neotropicalis*	Extensive bed. Clear water depths to 3 feet.
11	8/14/02	*Vallisneria neotropicalis, Ruppia maritima*	End of extensive *Vallisneria* bed to north. *Ruppia* picks up although sparse.
12	8/14/02	*Vallisneria neotropicalis*	Extensive
13	8/14/02	*Vallisneria neotropicalis, Ruppia maritima*	Mixture of the two species. *Ruppia* collected.
14	8/14/02	*Vallisneria neotropicalis*	Monotypic stand. Northern edge bordering channel
15	8/14/02	*Vallisneria neotropicalis*	Continuation of Point 11 (south)
16	8/14/02	*Vallisneria neotropicalis*	
17	8/14/02	*Vallisneria neotropicalis*	
18	8/14/02	*Vallisneria neotropicalis*	
19	8/14/02	*Vallisneria neotropicalis*	GPS point offset somewhat.
20	8/14/02	*Vallisneria neotropicalis*	
21	8/14/02	*Najas guadelupensis, Vallisneria neotropicalis*	Mix of the two species. Specimen taken of *Najas*
22	8/14/02	*Vallisneria neotropicalis*	
23	8/14/02	*Vallisneria neotropicalis, Myriophyllum spicatum*	Battleship. *Vallisneria* dominant. Edge of *Vallisneria*
24	81/14/02	*Vallisneria neotropicalis, Myriophyllum spicatum*	
25	8/14/02	*Vallisneria neotropicalis, Myriophyllum spicatum*	*Vallisneria* mixed with scattered *Myriophyllum*
26	8/14/02	*Vallisneria neotropicalis*	
27	8/14/02	*Vallisneria neotropicalis, Myriophyllum spicatum*	*Myriophyllum* minor component
28	8/14/02	*Vallisneria neotropicalis, Ruppia maritima*	*Vallisneria* to north, *Ruppia* to south
29	8/14/02	*Ruppia maritima*	
30	8/14/02	*Ruppia maritima*	
31	8/14/02	*Vallisneria neotropicalis, Ruppia maritima, Myriophyllum spicatum*	*Myriophyllum* a minor component
32	8/14/02	*Vallisneria neotropicalis, Myriophyllum spicatum, Ruppia maritima, Najas guadelupensis*	
33	8/14/02	*Myriophyllum spicatum, Najas gaudelupensis*	
34	8/14/02	*Vallisneria neotropicalis, Myriophyllum spicatum*	*Myriophyllum* a minor component
35	8/14/02	*Najas gaudelupensis, Myriophyllum spicatum, Vallisneria neotropicalis*	Thick algal cover, mixed with *Najas*
36	8/14/02	*Vallisneria neotropicalis*	
37	8/16/02	*Heteranthera dubia, Vallisneria neotropicalis, Myriophyllum spicatum †, Najas guadelupensis, Salvinia minima †*	*Myriophyllum* a minor component
38	8/16/02	*Vallisneria neotropicalis, Heteranthera dubia*	*Vallisneria* dominates
39	8/16/02	*Heteranthera dubia, Myriophyllum spicatum, Ceratophyllum demersum, Vallisneria neotropicalis, Salvinia minima*	Patchy. *Heteranthera* dominates. *Myriophyllum* a minor component. *Vallisneria* on outer edge in deeper water. Thick algal cover on surface.

POINT	DATE	SPECIES	NOTES
40	8/16/02	*Heteranthera dubia, Myriophyllum spicatum, Vallisneria neotropicalis*	*Heteranthera* patchy. 1 patch of *Vallisneria*. Emergent Wild Rice (*Zizanopsis*) mixed in
41	8/16/02	*Vallisneria neotropicalis, Heteranthera dubia, Ceratophyllum demersum*	
42	8/16/02	*Vallisneria neotropicalis, Heteranthera dubia, Myriophyllum spicatum*	*Heteranthera* uncommon. Some *Myriophyllum* further north.
43	8/16/02	Same species as above	Southern edge of point 6.
44	8/16/02	*Heteranthera dubia, Ceratophyllum demersum, Hydrilla verticillata* †*, Vallisneria neotropicalis, Najas guadelupensis*	
45	8/16/02	*Heteranthera dubia, Myriophyllum spicatum, Vallisneria neotropicalis*	Some Vallisneria mixed in.
46	8/16/02	*Heteranthera dubia, Myriophyllum spicatum, Vallisneria neotropicalis*	
47	8/16/02	*Vallisneria neotropicalis, Heteranthera dubia*	
48	8/16/02	*Vallisneria neotropicalis, Heteranthera dubia, Myriophyllum spicatum, Ceratophyllum demersum*	
49	8/16/02	*Vallisneria neotropicalis, Heteranthera dubia*	*Heteranthera* minor component.
50	8/16/02	*Myriophyllum spicatum, Heteranthera dubia*	*Myriophyllum* abundant. *Heteranthera minor*. Thick algal cover on surface.
51	8/16/02	No Plants	Deep water along edge
52	8/16/02	*Vallisneria neotropicalis, Myriophyllum spicatum, Heteranthera dubia, Najas guadelupensis*	
53	8/23/02	*Vallisneria neotropicalis* Myriophyllum spicatum* †*, Ruppia maritima*	Mixture
54	8/23/02	*Myriophyllum spicatum,Ceratophyllum demersum, Najas guadelupensis, Vallisneria neotropicalis, Potamogeton pusillus*	
55	8/23/02	*Ruppia maritima, Myriophyllum spicatum, Vallisneria neotropicalis*	
56	8/23/02	*Vallisneria neotropicalis, Myriophyllum spicatum*	
57	8/23/02	*Vallisneria neotropicalis, Myriophyllum spicatum*	*Vallisneria dominates*, but some *Myriophyllum* present
58	8/23/02	*Vallisneria neotropicalis*	Same as above. Only 1 individual of *Myriophyllum* observed.
59	8/23/02	*Vallisneria neotropicalis*	
60	8/23/02	*Vallisneria neotropicalis, Myriophyllum spicatum*	Only 1 *Myriophyllum* observed
61	8/23/02	*Vallisneria neotropicalis*	
62	8/23/02	*Vallisneria neotropicalis, Ruppia maritima, Myriophyllum spicatum*	
63	8/23/02	*Vallisneria neotropicalis, Ruppia maritima, Myriophyllum spicatum*	*Myriophyllum* sparse
64	8/23/02	*Vallisneria neotropicalis, Myriophyllum spicatum, Ceratophyllum demersum*	1 individual of *Ceratophyllum* observed
65	8/23/02	*Vallisneria neotropicalis, Ruppia maritima*	
66	8/23/02	*Vallisneria neotropicalis, Ruppia maritima, Myriophyllum spicatum*	*Myriophyllum* scattered
67	8/23/02	*Vallisneria neotropicalis, Myriophyllum spicatum*	
68	8/23/02	*Vallisneria neotropicalis, Myriophyllum spicatum, Najas guadelupensis*	

POINT	DATE	SPECIES	NOTES
69	8/23/02	*Vallisneria neotropicalis, Myriophyllum spicatum, Najas guadelupensis*	Patchy
70	8/23/02	*Vallisneria neotropicalis, Ruppia maritima, Myriophyllum spicatum*	
71	8/23/02	*Myriophyllum spicatum, Ceratophyllum demersum*	
72	8/23/02	*Vallisneria neotropicalis, Myriophyllum spicatum*	
73	8/23/02	*Myriophyllum spicatum, Ceratophyllum demersum*	
74	8/23/02	*Vallisneria neotropicalis, Myriophyllum spicatum*	Patchy
75	8/23/02	*Myriophyllum spicatum, Vallisneria neotropicalis*	
76	8/23/02	*Myriophyllum spicatum, Najas guadelupensis*	
77	8/23/02	*Vallisneria neotropicalis, Myriophyllum spicatum*	
78	8/23/02	*Vallisneria neotropicalis, Najas guadelupensis*	
79	8/23/02	*Vallisneria neotropicalis, Myriophyllum spicatum*	
80	8/23/02	*Heteranthera dubia, Najas guadelupensis, Hydrilla verticillata* †, *Ceratophyllum demersum, Vallisneria neotropicalis, Myriophyllum spicatum, Cabomba caroliniana, Salvinia minima* †	*Salvinia minima* floating on surface
81	8/23/02	*Vallisneria neotropicalis, Heteranthera dubia, Cabomba caroliniana, Potamogeton nodosus*	
82	8/23/02	*Potamogeton nodosus, Vallisneria neotropicalis*	
83	8/23/02	*Heteranthera dubia, Vallisneria neotropicalis, Myriophyllum spicatum, Hydrilla verticillata* †	
84	8/23/02	*Heteranthera dubia, Vallisneria neotropicalis, Potamogeton nodosus*	
85	8/23/02	*Heteranthera dubia, Vallisneria neotropicalis, Ceratophyllum demersum*	Intermixed with Wild Rice
86	8/23/02	*Heteranthera dubia, Ceratophyllum demersum*	
87	8/23/02	*Heteranthera dubia, Ceratophyllum demersum, Najas guadelupensis*	
88	8/23/02	*Heteranthera dubia, Vallisneria neotropicalis, Ceratophyllum demersum*	
89	8/23/02	*Heteranthera dubia, Ceratophyllum demersum*	
90	8/23/02	*Heteranthera dubia, Myriophyllum spicatum, Ceratophyllum demersum*	
91	8/23/02	*Heteranthera dubia*	Dominant
92	8/23/02	*Potamogeton nodusus, Heteranthera dubia Vallisneria neotropicalis, Myriophyllum spicatum*	
93	8/23/02	*Vallisneria neotropicalis, Myriophyllum spicatum, Heteranthera dubia*	*Heteranthera* a minor component
94	8/23/02	*Vallisneria neotropicalis, Myriophyllum spicatum, Heteranthera dubia*	*Vallisneria* frequent in deeper water. *Heteranthera dubia* dominants along shore.
95	8/23/02	*Vallisneria neotropicalis, Heteranthera dubia, Myriophyllum spicatum*	*Myriophyllum* occasional
96	8/23/02	*Vallisneria neotropicalis*	

POINT	DATE	SPECIES	NOTES
97	8/23/02	*Vallisneria neotropicalis*	
98	8/29/02	*Ceratophyllum demersum, Myriophyllum spicatum* †, *Najas guadelupensis, Ruppia maritima*	*Ruppia* scattered
99	8/29/02	UNVEGETATED	
100	8/29/02	*Myriophyllum spicatum, Vallisneria neotropicalis**, *Ceratophyllum demersum*	Majority is vegetated in milfoil. There is a scattered fringe on opposite bank that may not be mappable in size.
101	8/29/02	*Myriophyllum spicatum* , *Vallisneria neotropicalis*	*Vallisneria* and *Myriophyllum* hug west bank to south in scattered patches.
102	8/29/02	*Myriophyllum spicatum*	Southern edge of emergent marsh. Scattered milfoil
103	8/29/02	*Vallisneria neotropicalis, Ruppia maritima Myriophyllum spicatum*	Edge Point. 50/50 mix of Vallisneria and Ruppia. Scattered traces of *Myriophyllum*
104	8/29/02	*Vallisneria neotropicalis*	Offset point 60ft. Perhaps some *Ruppia* present.
105	8/29/02	*Vallisneria neotropicalis, Ruppia maritima*	
106	8/29/02	*Vallisneria neotropicalis, Myriophyllum spicatum*	*Myriophyllum* out from bank. *Vallisneria* closer in. scattered.
107	8/29/02	*Vallisneria neotropicalis, Myriophyllum spicatum*	Offset point 90 ft. Mostly *Vallisneria* with some milfoil.
108	8/29/02	*Vallisneria neotropicalis, Myriophyllum spicatum, Heteranthera dubia*	*Vallisneria* dominates. *Myriophyllum* a minor component. Only 1 *Heteranthera* observed.
109	8/29/02	*Vallisneria neotropicalis, Myriophyllum spicatum, Ceratophyllum demersum.*	Mostly Vallisneria with scattered milfoil. 1 *Ceratophyllum* observed.
110	8/29/02	*Myriophyllum spicatum, Ceratophyllum demersum, Heteranthera dubia*	Estimated 50/50 mix of *Myriophyllum* and *Ceratophyllum* . Heteranthera scattered.
111	8/29/02	*Vallisneria neotropicalis, Myriophyllum spicatum, Ceratophyllum demersum*	
112	8/29/02	*Ceratophyllum demersum, Myriophyllum spicatum, Heteranthera dubia, Najas guadelupensis*	Coontail dominant
113	8/29/02	*Vallisneria neotropicalis, Myriophyllum spicatum*	*Vallisneria* dominant. *Myriophyllum* scattered.
114	8/29/02	*Myriophyllum spicatum, Vallisneria neotropicalis*	Myriophyllum primarily dominating, but 50/50 mix in some spots.
115	8/29/02	*Vallisneria neotropicalis, Myriophyllum spicatum*	Experimental treatment area. Myriophyllum defoliated.
116	8/30/02	*Vallisneria neotropicalis** *Ceratophyllum demersum, Najas guadelupensis, Utricularia foliosa, Heteranthera dubia, Myriophyllum heterophyllum, Cabomba caroliniana, Myriophyllum spicatum* †	Mixture. *Nuphar lutea* with leaves floating on surface
117	8/30/02	*Vallisneria neotropicalis, Najas guadelupensis, Utricularia foliosa, Heteranthera dubia, Myriophyllum heterophyllum*	Similar to point 1 but no *Ceratophyllum demersum, Cabomba caroliniana,* or *Myriophyllum spicatum* observed.
118	8/30/02	*Ceratophyllum demersum, Najas guadelupensis, Vallisneria neotropicalis, Potamogeton pusillus, Myriophyllum spicatum*	Similar to point 1 but with *Ceratophyllum* dominant.
119	8/30/02	*Ceratophyllum demersum, Myriophyllum spicatum, Heteranthera dubia, Najas guadelupensis*	*Ceratophyllum demersum* and *Myriophyllum spicatum* dominant
120	8/30/02	*Ceratophyllum demersum, Myriophyllum spicatum*	Edge point*. Salvinia minima* † floating on the surface
121	8/30/02	*Myriophyllum spicatum, Najas guadelupensis Ceratophyllum demersum, Vallisneria neotropicalis*	*Myriophyllum spicatum* dominant. Scattered *Vallisneria*
122	8/30/02	*Ceratophyllum demersum, Myriophyllum spicatum*	Thick algal cover
123	8/30/02	*Vallisneria neotropicalis, Myriophyllum spicatum, Heteranthera dubia*	
124	8/30/02	*Vallisneria neotropicalis, Myriophyllum spicatum, Myriophyllum heterophyllum*	Only 1 *Myriophyllum heterophyllum* observed

POINT	DATE	SPECIES	NOTES
125	8/30/02	*Heteranthera dubia, Myriophyllum spicatum, Najas guadelupensis*	Primarily *Heteranthera* and *Myriophyllum* mixture
126	8/30/02	*Ceratophyllum demersum, Myriophyllum spicatum, Najas guadelupensis, Vallisneria neotropicalis*	*Ceratophyllum* and *Myriophyllum* spicatum dominant. *Vallisneria* scattered.
127	8/30/02	*Vallisneria neotropicalis, Myriophyllum spicatum*	*Vallisneria* on outer edge.
128	8/30/02	*Vallisneria neotropicalis, Myriophyllum spicatum, Ceratophyllum demersum, Heteranthera dubia, Utricularia foliosa*	*Vallisneria* on outer edge. *Salvinia minima* and *Eichhornia crassipes* † floating on surface
129	8/30/02	*Heteranthera dubia, Myriophyllum spicatum, Ceratophyllum demersum, Najas guadelupensis*	
130	8/30/02	*Heteranthera dubia, Vallisneria neotropicalis, Myriophyllum spicatum, Ceratophyllum demersum, Najas guadelupensis, Utricularia foliosa*	Nearly all *Heteranthera dubia* . Single individuals of *Ceratophyllum* and *Utricularia foliosa* observed. *Vallisneria* out toward channel in deeper water.
131	8/30/02	*Vallisneria neotropicalis, Myriophyllum spicatum, Heteranthera dubia, Ceratophyllum demersum*	Mostly *Vallisneria* and *Myriophyllum* . Only a small amount of *Ceratophyllum. Salvinia minima on surface*
132	8/30/02	*Vallisneria neotropicalis,Heteranthera dubia, Ceratophyllum demersum, Myriophyllum spicatum*	Mostly *Vallisneria* . *Myriophyllum* floating?
133	8/30/02	*Vallisneria neotropicalis*	
134	8/30/02	*Vallisneria neotropicalis, Heteranthera dubia, Myriophyllum spicatum*	*Myriophyllum* present in small amounts
135	8/30/02	*Vallisneria neotropicalis, Heteranthera dubia*	
136	8/30/02	*Vallisneria neotropicalis*	
137	8/30/02	*Ceratophyllum demersum, Hydrilla verticillata † Heteranthera dubia, Najas guadelupensis, Myriophyllum spicatum, Vallisneria neotropicalis*	Gravine Island. *Vallisneria* only near entrance to channel. Thick algal cover. Myriophyllum only in small amounts. Hydrilla mostly dominates along with Heteranthera.
138	9/5/02	*Heteranthera dubia, Ceratophyllum demersum, Myriophyllum spicatum †, Salvinia minima †*	Largely *Heteranthera dubia with* some *Ceratophyllum* , and *Myriophyllum spicatum* . *Salvinia* floating on surface. Thick algal cover present
139	9/5/02	*Vallisneria neotropicalis, Heteranthera dubia, Ceratophyllum demersum*	*Vallisneria* dominant with thick cover. *Ceratophyllum* and *Heteranthera* scattered
140	9/5/02	*Heteranthera dubia, Vallisneria neotropicalis, Myriophyllum spicatum*	*Heteranthera* dominant.
141	9/5/02	*Vallisneria neotropicalis*	
142	9/5/02	*Vallisneria neotropicalis*	
143	9/5/02	*Heteranthera dubia*	Scattered
144	9/5/02	NONVEGETATED	Deep channel with SAV on either side-same species as LINE1
145	9/5/02	*Ceratophyllum demersum, Heteranthera dubia, Hydrilla verticillata †*	*Ceratophyllum demersum* dominant, although may be floating(?) *Hydrilla* fragments floating on surface. *Heteranthera* scattered. Thick algal cover.
146	9/5/02	*Myriophyllum spicatum,Vallisneria neotropicalis, Heteranthera dubia, Ceratophyllum demersum, Hydrilla verticillata*	Mix of the the first three species listed, with perhaps *Myriophyllum* dominating. *Heteranthera* abundant on opposite side with large amounts of floating *Hydrilla*
147	9/5/02	*Heteranthera dubia*	
148	9/5/02	*Vallisneria neotropicalis, Ceratophyllum demersum, Myriophyllum spicatum,*	Mostly *Vallisneria* . Oppostie bank is the same.
149	9/5/02	*Heteranthera dubia, Ceratophyllum demersum, Myriophyllum spicatum*	*Heteranthera* dominant

POINT	DATE	SPECIES	NOTES
150	9/5/02	*Heteranthera dubia, Ceratophyllum demersum, Myriophyllum spicatum*	
151	9/5/02	NONVEGETATED	NONVEGETATED
152	9/5/02	*Najas guadelupensis*	Collected
153	9/5/02	*Myriophyllum spicatum*	Scattered
154	9/5/02	*Najas guadelupensis, Myriophyllum spicatum, Ceratophyllum demersum*	
155	9/5/02	*Vallisneria neotropicalis, Najas guadelupensis, Ceratophyllum demersum, Myriophyllum spicatum*	Sprigs of *Vallisneria*
156	9/5/02	*Vallisneria neotropicalis, Najas guadelupensis, Ruppia maritima, Myriophyllum spicatumMyriophyllum spicatum*	Mostly *Vallisneria* . *Ruppia* and *Myriophyllum* floating.
157	9/5/02	*Najas guadelupensis, Potamogeton pusillus*	
158	9/5/02	*Najas guadelupensis*	
159	9/5/02	*Najas guadelupensis, Ruppia maritima, Vallisneria neotropicalis*	*Najas* dominating. Single individuals of *Ruppia* and *Vallisneria* observed.
160	9/5/02	*Najas guadelupensis*	Mud flat with *Najas*
161	9/5/02	*Heteranthera dubia, Myriophyllum spicatum, Najas guadelupensis, Ceratophyllum demersum*	*Ceratophyllum* scattered
162	9/5/02	*Najas guadelupensis*	
163	9/5/02	*Najas guadelupensis, Myriophyllum spicatum, Vallisneria neotropicalis*	
164	9/5/02	*Myriophyllum spicatum, Ceratophyllum demersum*	Deep
165	9/5/02	*Najas guadelupensis*	
166	9/5/02	*Najas guadelupensis, Myriophyllum spicatum*	*Najas* dominates
167	9/5/02	*Vallisneria neotropicalis, Ceratophyllum demersum, Myriophyllum spicatum*	Along fringe of *Schoenoplectus californicus* near pier.
168	9/5/02	*Heteranthera dubia, Ceratophyllum demersum, Najas guadelupensis*	*Najas* dominant
169	9/5/02	*Heteranthera dubia, Myriophyllum spicatum, Najas guadelupensis*	South of boardwalk.
170	9/5/02	*Heteranthera dubia, Najas guadelupensis*	
171	9/5/02	*Heteranthera dubia, Najas guadelupensis*	
172	9/5/02	*Vallisneria neotropicalis, Myriophyllum spicatum, Ceratophyllum demersum, Potamogeton pusillus*	I-10 Bridge. 1 *Potamogeton* observed.
173	9/5/02	*Heteranthera dubia, Vallisneria neotropicalis, Ceratophyllum demersum, Najas guadelupensis*	
174	9/5/02	*Myriophyllum spicatum, Najas guadelupensis*	
175	9/5/02	*Najas guadelupensis, Myriophyllum spicatum, Ceratophyllum demersum*	Along *Typha* fringe
176	9/5/02	*Vallisneria neotropicalis, Ceratophyllum demersum, Potamogeton pusillus*	GPS point in wrong spot. Actual location is approximately 5-10 ft off concrete bulkhead.
177	9/5/02	*Myriophyllum spicatum, Najas guadelupensis, Ceratophyllum demersum*	
178	9/6/02	*Ceratophyllum demersum, Vallisneria neotropicalis**, *Myriophyllum spicatum* † *Heteranthera dubia, Najas guadelupensis, Nelumbo lutea* [E] , *Salvinia minima* ‡[F]	*Ceratophyllum* dominant. Large infestation of floating *Salvinina minima* † along west bank. Actual bed somewhat small. Large portion of signature most likely *Salvinia* bordering emergent *Nelumbo* marsh

POINT	DATE	SPECIES	NOTES
179	9/6/02	*Ceratophyllum demersum, Potamogeton nodosus, Myriophyllum spicatum, Hydrilla verticillata†*	Scattered patches of *Ceratophyllum*. Single individuals of *Myriophyllum* and *Hydrilla* observed
180	9/6/02	*Potamogeton nodosus, Heteranthera dubia*	50/50 mix
181	9/6/02	*Physostegia virginiana* (Terrestrial)	Terrestrial wetland plant collection #942.
182	9/6/02	*Heteranthera dubia, Ceratophyllum demersum, Hydrilla verticillata*, *Salvinia minima* [F], *Limnobium spongia* [F], *Eichhornia*	*Heteranthera dubia* dominant, but *Ceratophyllum* is abundant in deeper water. Perhaps a 50/50 mix. Similar on opposite bank. *Salvinia minima, Limnobium spongia, Eichhornia crassipes,* and *Azolla caroliniana*, floating on the surface. Also floating pieces of *Hydrilla*.
183	9/6/02	*Heteranthera dubia, Ceratophyllum demersum*	
184	9/6/02	*Heteranthera dubia, Ceratophyllum demersum*	
185	9/6/02	*Heteranthera dubia, Vallisneria neotropicalis, Ceratophyllum demersum, Hydrilla verticillata*	Floating pieces of *Hydrilla* on surface, along with *Salvinia minima*. Large bed of *Vallisneria* further in. *Ceratophyllum* scattered.
186	9/6/02	*Ceratophyllum demersum, Heteranthera dubia, Najas guadelupensis*	
187	9/6/02	NONVEGETATED	NONVEGETATED
188	9/6/02	*Vallisneria neotropicalis*	
189	9/6/02	*Vallisneria neotropicalis, Myriophyllum spicatum*	Scattered *Myriophyllum*
190	9/6/02	*Vallisneria neotropicalis, Myriophyllum spicatum, Heteranthera dubia*	Mostly *Vallisneria-Myriophyllum* mix with some *Heteranthera dubia*
191	9/6/02	*Vallisneria neotropicalis, Ceratophyllum demersum*	*Vallisneria* also on opposite bank.
192	9/6/02	*Vallisneria neotropicalis, Myriophyllum spicatum, Ceratophyllum demersum, Najas guadelupensis*	
193	9/6/02	*Vallisneria neotropicalis, Heteranthera dubia, Myriophyllum spicatum*	*Vallisneria* dominant. 1 *Myriophyllum spicatum* observed. River channel with submerged vegetation along sides. Some *Najas* present in small amounts.
194	9/6/02	*Ceratophyllum demersum, Najas guadelupensis, Heteranthera dubia, Vallisneria neotropicalis*	
195	9/6/02	Large floating mat of *Eichhornia, Ludwigia peploides*, and *Oycaryum cubense* †	Large floating mat of *Eichhornia, Ludwigia peploides*, and *Oycaryum cubense*
196	9/12/02	*Ceratophyllum demersum, Hydrilla verticillata* †	*Ceratophyllum* dominant with scattered individuals of *Hydrilla*. Widely dispersed beds along eastern bank leading up to Negro Lake but these small (non-mappable?). Associated with emergent *Nelumbo lutea*. Also, *Salvinia minima* †, *Oxycaryum cubense* †, *Limnobium spongia* and *Eichhornia crassipes* † floating on surface.
197	9/12/02	*Ceratophyllum demersum, Hydrilla verticillata*	North of Point 1. Same species as above.
198	9/12/02	*Ceratophyllum demersum, Hydrilla verticillata*	Hydrilla floating. Salvinia on surface with Nelumbo. Same species composition on opposite bank. Bed not visible on map(?)
199	9/12/02	*Ceratophyllum demersum, Hydrilla verticillata*	Same as previous 3 points. *Hydrilla* floating. No *Nelumbo*.
200	9/12/02	*Ceratophyllum demersum, Hydrilla verticillata*	Floating *Hydrilla.* Thick algal cover. *Salvinia minima, Azolla caroliniana, Limnobium spongia, Oxycaryum cubense* floating on the surface
201	9/12/02	*Ceratophyllum demersum, Hydrilla verticillata*	Thick algal cover. *Salvinia* and *Eichhornia* present.
202	9/12/02	*Ceratophyllum demersum, Hydrilla verticillata*	50/50 mix. Thick algal cover. *Nelumbo*, *Ludwigia peploides* ., some *Salvinia*, *Eichhornia*, and *Azolla.*
203	9/12/02	*Ceratophyllum demersum, Hydrilla verticillata*	Thick algal cover. *Hydrilla* floating. *Nelumbo* present. Scattered *Salvinia*, *Eichhornia*, and *Oxycaryum*. Osprey nest.
204	9/12/02	*Ceratophyllum demersum, Hydrilla verticillata*	Dense floating mat of vegetation. *Oxycaryum, Ludwigia peploides. Hydrilla* floating. *Salvinia* and *Azolla* present.
205	9/12/02	*Najas guadelupensis, Myriophyllum spicatum* †, *Vallisneria neotropicalis**, *Ceratophyllum demersum*	*Najas* and *Myriophyllum* dominant. *Vallisneria* scattered on periphery of bed.

POINT	DATE	SPECIES	NOTES
206	9/12/02	*Najas guadelupensis, Myriophyllum spicatum* †, *Vallisneria neotropicalis*, Ceratophyllum demersum*	
207	9/12/02	Omit	Omit
208	9/12/02	*Vallisneria neotropicalis, Myriophyllum spicatum, Najas guadelupensis*	
209	9/12/02	*Vallisneria neotropicalis, Myriophyllum spicatum, Ceratophyllum demersum, Heteranthera dubia, Cabomba caroliniana*	1 *Cabomba* observed
210	9/12/02	*Vallisneria neotropicalis, Myriophyllum spicatum, Ceratophyllum demersum*	
211	9/12/02	*Ceratophyllum demersum, Myriophyllum spicatum, Najas guadelupensis, Heteranthera dubia*	Mostly *Ceratophyllum* and *Myriophyllum*.
212	9/12/02	*Myriophyllum spicatum, Heteranthera dubia*	
213	9/12/02	*Myriophyllum spicatum, Vallisneria neotropicalis, Heteranthera dubia, Ceratophyllum demersum*	Mostly *Myriophyllum* and *Vallisneria*
214	9/12/02	*Vallisneria neotropicalis, Myriophyllum spicatum, Heteranthera dubia, Najas guadelupensis*	*Najas* scattered along bank
215	9/12/02	*Vallisneria neotropicalis, Ceratophyllum demersum, Heteranthera dubia, Najas guadelupensis, Hydrilla verticillata, Myriophyllum spicatum*	Primarily *Vallisneria* and *Ceratophyllum*. Only a few individuals of *Myriophyllum* observed near entrance of channel.
216	9/19/02	*Ruppia maritima*	Only a small amount of *Ruppia* detected. Large patch of *Myriophyllum spicatum* floating on surface, but not rooted (storm-washed?)
217	9/19/02	NONVEGETATED	Mud
218	9/19/02	*Myriophyllum spicatum* †, *Ruppia maritima, Najas guadelupensis, Vallisneria neotropicalis**	*Myriophyllum* and *Ruppia* dominant, with *Ruppia* becoming more abundant towards shore. Closer in *Najas* dominates in shallow water. Only a few individuals of *Vallisneria* observed
219	9/19/02	*Najas guadelupensis, Ruppia maritima, Myriophyllum spicatum*	*Myriophyllum* a minor component
220	9/19/02	*Vallisneria neotropicalis, Ruppia maritima*	
221	9/19/02	*Ruppia maritima*	sparse
222	9/19/02	*Myriophyllum spicatum*	
223	9/19/02	*Ruppia maritima*	Shell bottom with Oyster and *Rangia*
224	9/19/02	*Ruppia maritima*	Shell bottom
225	9/19/02	*Vallisneria neotropicalis*, *Ruppia maritima*, *Myriophyllum spicatum*	*Vallisneria/Ruppia* mix. Scattered *Myriophyllum* (minor component)
226	9/19/02	*Myriophyllum heterophyllum, Egeria densa, Utricularia inflata, Micranthemum umbrosum*	Along pier at public boat launch for Byrne's Lake. Mostly *Myriophyllum*, interspersed with *Egeria*. Normally emergent *Micranthemum* is instead completely submerged along water's edge.
227	10/1/02	*Halodule wrightii*	Sparse. Bed not located visually, but several ramets were pulled from bottom with rake
228	10/1/02	*Halodule wrightii*	Small bed
229	10/1/02	*Halodule wrightii*	1 small patch less than 60 square meters, but thick coverage
230	10/1/02	*Halodule wrightii*	Large thick bed. Plants brownish in coloration and appear to be dying-off?
231	10/17/02	*Halodule wrightii*	Florida side
232	10/17/02	*Halodule wrightii*	Near pier
233	10/17/02	*Halodule wrightii*	1 small patch less than 60 square meters/ East of larger patch
234	10/17/02	*Halodule wrightii*	Large patch
235	10/17/02	*Halodule wrightii*	
236	10/22/02	*Halodule wrightii*	Dauphin Island

POINT	DATE	SPECIES	NOTES
237	10/22/02	*Halodule wrightii*	Dauphin Island
238	10/22/02	*Halodule wrightii*	Dauphin Island
239	10/22/02	*Halodule wrightii*	Little Bay
240	10/22/02	*Halodule wrightii*	East side of Point aux Pines
241	10/22/02	*Halodule wrightii*	Big Island
242	10/22/02	*Halodule wrightii*	Long Island
243	10/22/02	*Halodule wrightii*	
244	10/22/02	*Halodule wrightii* , *Hypnea sp.*	Unknown algae (*Hypnea sp* .?) is a common associate
245	10/22/02	*Halodule wrightii, Hypnea sp.*	Sandy Bay (West side of Point aux Pines). Unknown algae (*Hypnea sp* .?) common associate
246	11/4/02	*Halodule wrightii*	
247	11/4/02	*Halodule wrightii*	
248	11/4/02	*Halodule wrightii*	
249	11/4/02	*Halodule wrightii*	
250	11/4/02	NONVEGETATED	
251	11/4/02	NONVEGETATED	
252	11/4/02	*Thalassia testudinum*	
253	11/4/02	*Halodule wrightii*	
254	11/4/02	NONVEGETATED	
255	11/4/02	*Halodule wrightii*	
256	11/4/02	NONVEGETATED	
257	11/4/02	NONVEGETATED	
258	11/4/02	NONVEGETATED	
259	11/4/02	NONVEGETATED	
260	11/4/02	NONVEGETATED	
261	11/14/02	NONVEGETATED	*Spartina*
262	11/14/02	NONVEGETATED	
263	11/14/02	NONVEGETATED	*Spartina*
264	11/14/02	NONVEGETATED	*Spartina*
265	11/14/02	NONVEGETATED	*Spartina*
266	11/14/02	NONVEGETATED	Beach
267	4/11/03	NONVEGETATED	
268	4/11/03	NONVEGETATED	Deep hole
269	4/11/03	NONVEGETATED	Bulkhead
270	4/11/03	*Halodule wrightii*	
271	4/11/03	*Halodule wrightii*	
272	4/11/03	*Halodule wrightii*	
273	4/11/03	NONVEGETATED	Boat slips, docks, piers, etc.
274	4/11/03	NONVEGETATED	Boat slips
275	4/11/03	*Halodule wrightii*	some algae mixed in
276	4/11/03	*Halodule wrightii*	
277	4/11/03	*Halodule wrightii*	
278	4/11/03	*Halodule wrightii*	
279	4/11/03	Emergent marsh	Emergent marsh
280	4/11/03	*Halodule wrightii*	
281	4/11/03	*Halodule wrightii*	
282	4/11/03	*Halodule wrightii*	small fringe mixed in with emergent marsh
283	4/11/03	*Halodule wrightii*	small fringe mixed in with emergent marsh

POINT	DATE	SPECIES	NOTES
284	4/11/03	*Halodule wrightii*	
285	4/11/03	*Halodule wrightii*	
286	4/11/03	*Halodule wrightii*	
287	4/11/03	*Halodule wrightii*	patchy
288	4/11/03	*Halodule wrightii*	some algae mixed in
289	4/11/03	*Halodule wrightii*	
290	4/17/03	NONVEGETATED	Emergent *Spartina* fringe, mud bottom
291	4/17/03	NONVEGETATED	Oyster shell
292	4/17/03	NONVEGETATED	Spartina
293	4/17/03	NONVEGETATED	*Spartina/Juncus* patch
294	4/17/03	NONVEGETATED	*Spartina*
295	4/17/03	NONVEGETATED	*Spartina*