Appendix H
Submerged Aquatic Vegetation Report

MAPPING OF SUBMERGED AQUATIC VEGETATION IN 2010

MISSISSIPPI BARRIER ISLAND RESTORATION PROJECT

Prepared for

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EXECUTIVE SUMMARY

This is the technical report for the 2010 mapping of submerged aquatic vegetation (SAV) in Mississippi Sound, as part of the Mississippi Barrier Island Restoration project. The geographic focus of this project was the barrier island system off the mainland of coastal Mississippi. This report documents the digital mapping effort that provides detailed information on the distributions of SAV in the barrier island study area during 2010.

For this SAV mapping project a digital database was developed using aerial imagery and complementary surface-level verification. Digital orthophotographs were created from native aerial imagery acquired with a digital mapping camera. Aerial imagery was obtained July 22, 2010. An Airborne Global Positioning System (ABGPS) and inertial measurement unit (IMU) were used to accurately position each aerial photo center (principal point). Processed ABGPS/IMU data were used in an aerotriangulation procedure to produce a digital elevation model (DEM) surface for imagery rectification. Outlines of SAV signatures in the ortho imagery were digitized in a GIS environment. Digitized areas were field-verified to document habitat characteristics at the surface level.

As in previous surveys of the study area, SAV was mostly concentrated on the north side of the barrier islands. SAV was shoal grass (*Halodule wrightii*) at all locations. Overall, a total of 3,614 acres mapped. Bed densities were mostly patchy (< 50% coverage). SAV acreage by barrier island area was as follows:

Location	Density	Acreage
Cat Island	Continuous	178
Cat Island	Patchy	1,534
E Ship Island	Patchy	261
W Ship Island	Patchy	125
Horn Island	Patchy	974
Petit Bois Island	Patchy	541

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1.0 INTRODUCTION

This is the technical report for the 2010 mapping of submerged aquatic vegetation (SAV) in Mississippi Sound, as part of the Mississippi Barrier Island Restoration project. The geographic focus of this project was the barrier island system off the mainland of coastal Mississippi (Figure 1-1).

Figure 1. Study area for the 2010 survey of SAV near the Mississippi Barrier Islands.

For this SAV mapping project a digital database was developed using aerial imagery and complementary surface-level verification. In 1995 the U.S. Department of Commerce published benthic habitat mapping methods in a document entitled *NOAA Coastal Change Analysis Program* (C-CAP) (Dobson et al., 1995). The C-CAP is a nationally standardized database of land cover and land change information in coastal areas, developed using remotely sensed imagery. The C-CAP outlines methods and provides technical guidance for digital feature mapping. This project was conducted within the technical framework established by the C-CAP.

2.0 METHODS

2.1 ORTHOPHOTOGRAPHY PRODUCTION

Photo Science of St Petersburg, FL acquired the aerial imagery and produced the ortho imagery for this mapping project. The orthorectification process relied on digital aerial imagery, ground control/aerotriangulation data, and a digital elevation model (DEM).

The aerial mapping technology used was airborne Global Positioning System (ABGPS) and an inertial measurement unit (IMU) to accurately position each aerial 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 orthophotographs with uniform scale and a high degree of accuracy.

Digital Aerial Imagery

Aerial imagery was acquired July 22, 2010, using a Z/I Imaging Digital Mapping Camera (DMC). The DMC was equipped with eight (8) cameras heads, four (4) for panchromatic and one (1) each for red, blue, green and NIR (near-infrared).

A computerized flight-management system was utilized during imagery acquisition. GPS-supported aircraft navigation interfaced with the DMC control software. After initial flight planning, digitized mission data were fed into the flight-management system. The start and stop points of each flight line were processed by the aircraft's onboard navigation system.

Dual-frequency GPS observation data were collected on-board the aircraft at a one second epoch. Additionally, inertial data was collected at a rate of 0.005 seconds during all periods of flight. The midpoint of each photo exposure was precisely captured by the GPS receiver. All ABGPS and Inertial data was then post-processed using Applanix MMS version 5.2 software to provide accurate positional and rotation data of the camera for each exposure. Effectively, the three dimensional position (x, y, and z) of each

exposure was determined from the ABGPS data while the three-dimensional rotation (omega, phi, and kappa) of each exposure was determined from the inertial data.

An Applanix (Ontario, Canada) POS/AV-DG IMU system was used during all photo collection to measure the position of the camera perspective center and orientation angles of each photograph at the midpoint of exposure, to an accuracy of 5-10 cm and 20-30 arc seconds, respectively. During imagery acquisition the aircraft flew at 27,000 feet AMT to render a native pixel resolution of 1 meter for the entire study area. The Applanix Inertial Measurement Unit (IMU) ensured that tip, tilt, and swing of the camera for each frame was less than 3 degrees. Resolution loss due to blurring was avoided by a forward image motion compensation (FMC) system. Image motion did not exceed 0.002 inches. Each individual frame was formatted for 60% endlap and 30% sidelap.

Positional Accuracy

Airborne Global Positioning System (ABGPS) coordinates were automatically collected for the principal point for each photographic frame during imagery acquisition. The ABGPS/IMU recorded the position and orientation of the camera platform during all flight missions. Exact measurements obtained from the ABGPS and IMU provided positional accuracy of the resultant imagery suitable to support generation of ortho imagery.

Orthorectification

A 30-m DEM provided by the USGS was used for the orthorectification process. Cubic convolution re-sampling was used during the rectification process. The rectification methodology sharpened the edges of linear features and sampled 16 of the closest pixels and performed a weighted adjustment.

Orthophotos were produced as individual rectified image frames. Color balancing was performed on the digital images to provide a consistent tone, brightness and contrast throughout the project area. Digital orthophotos are projected to North American Datum of 1983, Universal Transverse Mercator (UTM) Zone Number 16 North, and meters. A low-resolution mosaic was created in a MrSID format.

2.2 SAV DATA DEVELOPMENT

Creation of Polygonal and GIS Database

The ortho imagery was observed in ArcView GIS, and SAV boundaries were digitally delineated on a computer screen display. ESRI polygon coverage was created in ArcView version 9.3. Once the preliminary line work was completed, polygon vector coverage was created using building, editing, cleaning, and labeling the polygonal line work. Overlapping photographs were used for verification and comparison when delineating areas of interest. The minimum mapping unit (MMU) for this project was 0.03 hectares (0.1 acres). Polygons were visually assessed for vegetation density on a

screen display and categorized as continuous (>50%) or patchy (<50%) coverage. SAV signatures were distinguishable in the photography for most of the study area (Figure 2).

Field Surveys

Field surveys were conducted to document SAV presence and habitat characteristics. Ambiguous signatures in the imagery included submerged objects and bathymetric depressions. Questionable areas were visited in the field to verify assumptions regarding identification of photographic signatures. Locations of interest identified through review of the aerial imagery were pre-plotted in GPS to aid navigation. Field verification surveys were conducted on the following dates:

West Ship Island - August 2, 2010
Cat Island and East Ship Island - September 28, 2010
Horn Island and Petit Bois Island - October 8, 2010

Field locations were logged 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 positional data accurate to within 1 meter. Data were collected at a total of 40 field points.

QA/QC

Two analysts identified potential SAV signatures using a screen display. Analysts visually reviewed the polygons superimposed on the digital imagery to check completeness and edges. Analysts consulted regarding questionable areas, and the entire polygonal data set was reviewed after completion.

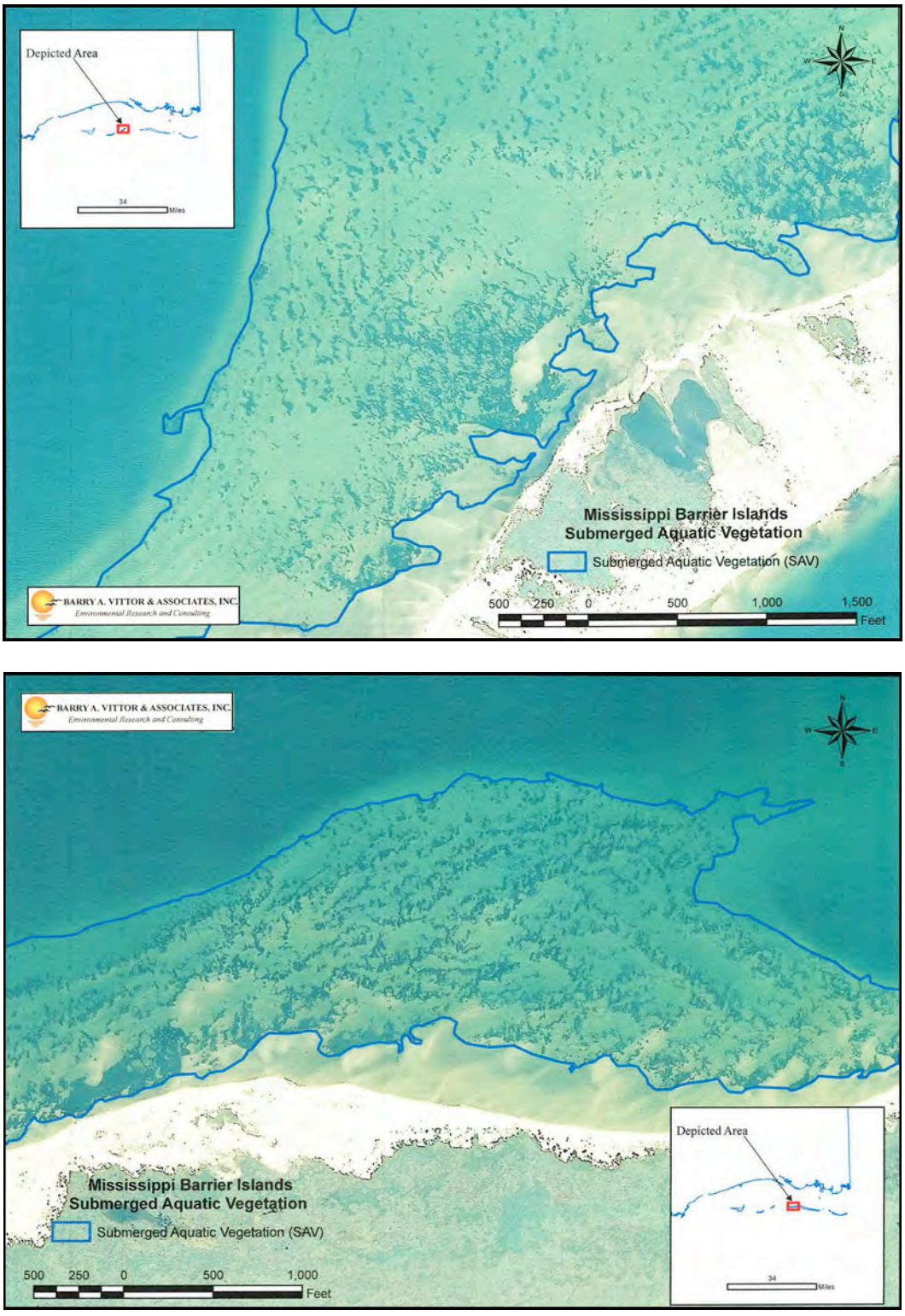

Figure 2. 2010 aerial imagery showing shoal grass on the northern side of East Ship Island (top) and Horn Island (bottom).

3.0 RESULTS

SAV was mostly concentrated on the north side of the barrier islands (Figures A-1; Appendix A). Figures A-2 through A-5 show the detailed distribution of shoal grass at each island. SAV acreage for each barrier island area was as follows:

Location	Density	Acreage
Cat Island	Continuous	178
Cat Island	Patchy	1,534
E Ship Island	Patchy	261
W Ship Island	Patchy	125
Horn Island	Patchy	974
Petit Bois Island	Patchy	541

Overall, a total of 3,614 acres mapped. SAV was shoal grass (*Halodule wrightii*) at all locations. Bed densities were mostly patchy (< 50% coverage), as shown in Figure 2-1. Cat Island had an area of continuous SAV (> 50% coverage) comprising 178 acres (Figure A-2; Appendix A). Previous studies have documented similar distributions near the Mississippi barrier islands (Eleuterius, 1973; Moncreiff et al., 1998), indicating some temporal stability of SAV occurrence on a decadal scale.

4.0 REFERENCES CITED

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Eleuterius, L.N., 1973. Phase II: The distribution of certain submerged plants in Mississippi Sound and adjacent waters. Pp. 191-197, In J.Y. Christmas (ed.), Cooperative Gulf of Mexico Inventory and Study, Mississippi. Gulf Coast Research Laboratory, Ocean Springs, MS.

Moncreiff, C.A., T.A. Randall, and J.D. Caldwell, 1998. Mapping of Seagrass Resources in Mississippi Sound. Gulf Coast Research Laboratory, University of Southern Mississippi, Ocean Springs, MS. 41 pp.

APPENDIX A – SAV DISTRIBUTION MAPS

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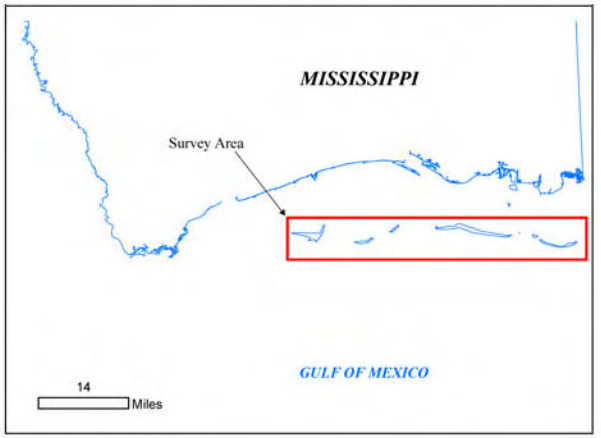
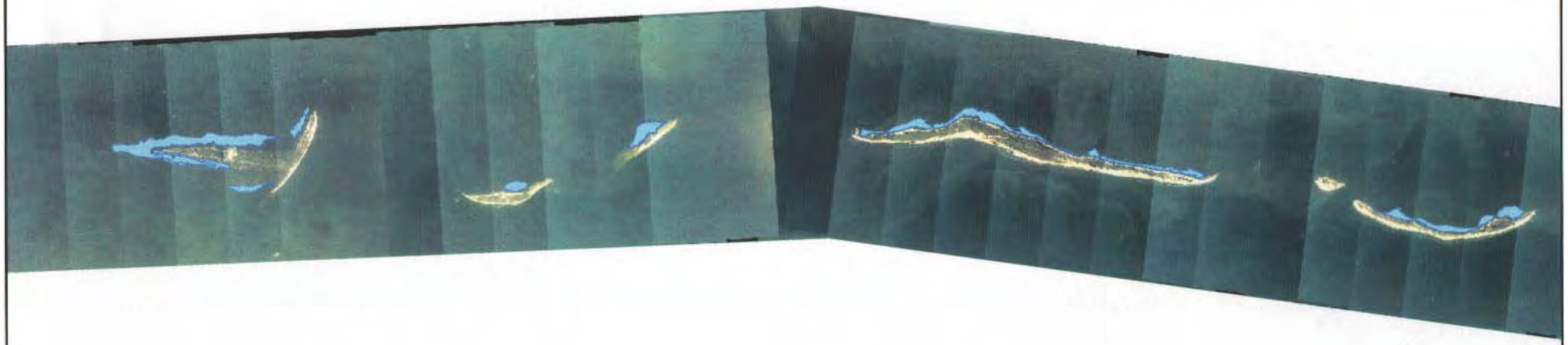
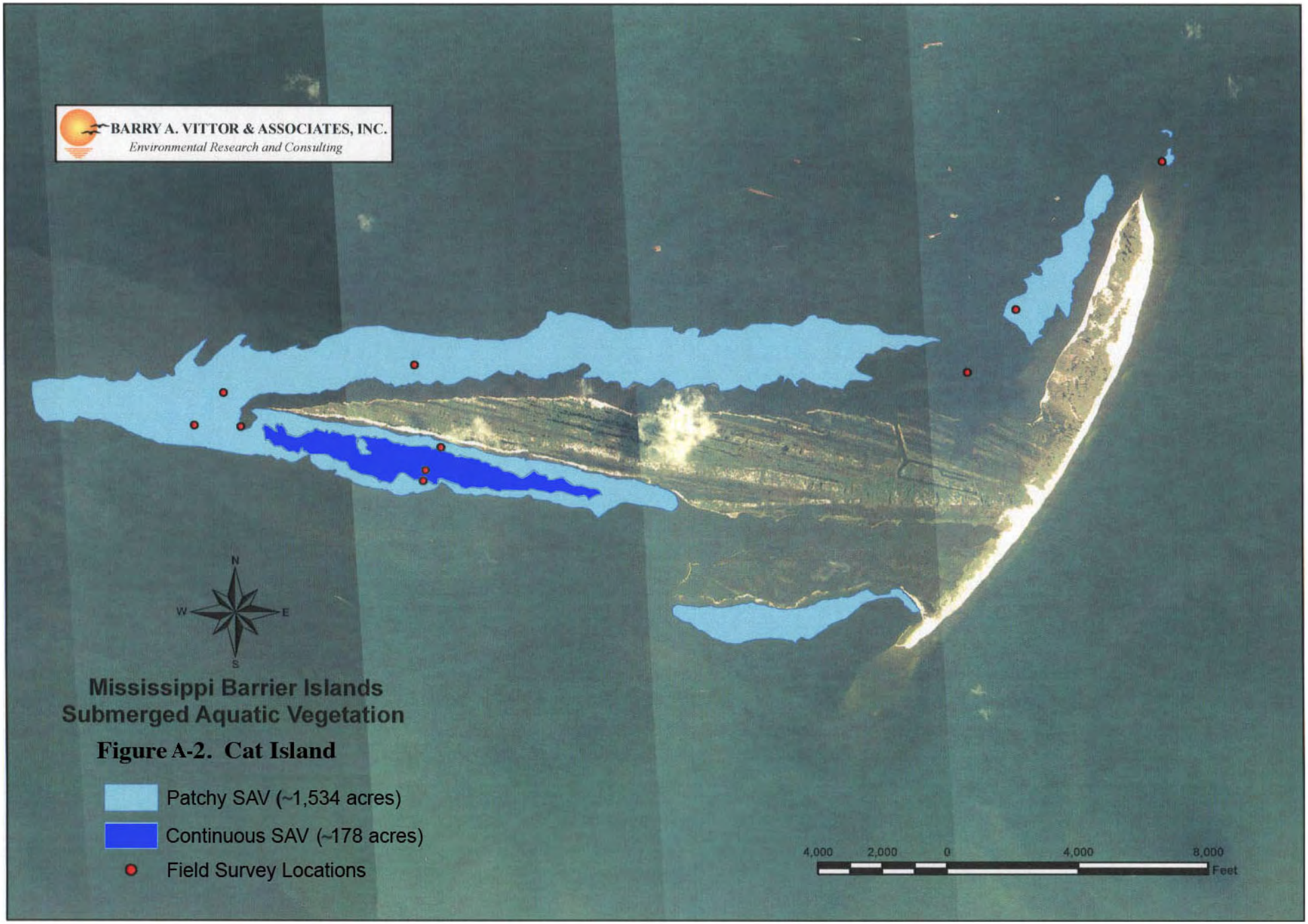




Mississippi Barrier Islands
Submerged Aquatic Vegetation

Figure A-1. Study Area

SAV (~3,614 acres)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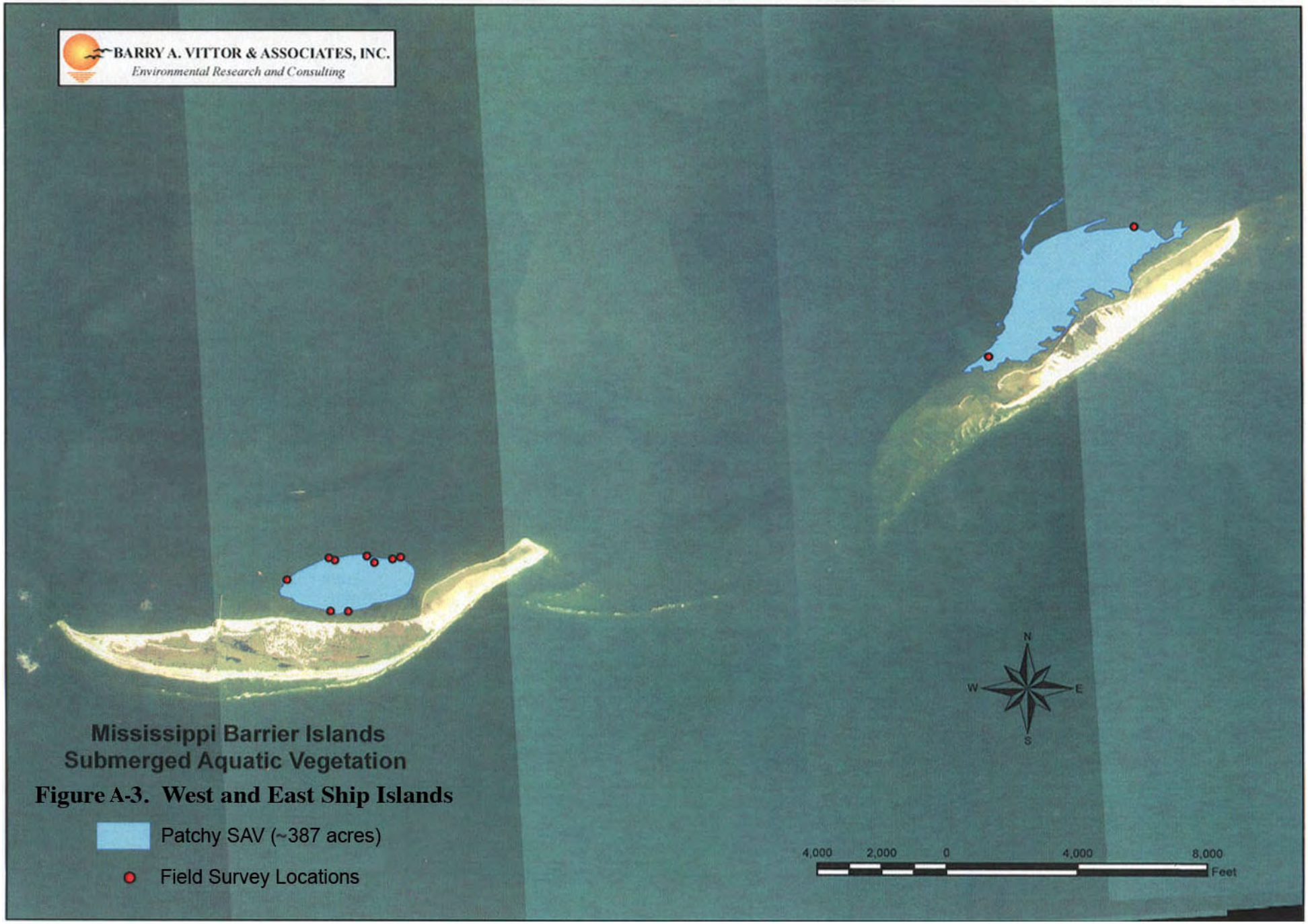
Environmental Research and Consulting
N
W
E
S
Mississippi Barrier Islands
Submerged Aquatic Vegetation
Figure A-2. Cat Island
Patchy SAV (~1,534 acres)
Continuous SAV (~178 acres)
Field Survey Locations
4,000
2,000
0
4,000
8,000
Feet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Mississippi Barrier Islands
Submerged Aquatic Vegetation
Figure A-3. West and East Ship Islands
Patchy SAV (~387 acres)
Field Survey Locations
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4,000
8,000
Feet


BARRY A. VITTOR & ASSOCIATES, INC.
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7,000 3,500 0 7,000 14,000
Feet
Mississippi Barrier Islands
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Figure A-4. Horn Island
Patchy SAV (~974 acres)
Field Survey Locations


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2,000
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4,000
8,000
Feet
Mississippi Barrier Islands
Submerged Aquatic Vegetation
Figure A-5. Petit Bois Island
Patchy SAV (~541 acres)
Field Survey Locations