

**HISTORICAL SAV DISTRIBUTION  
IN THE MOBILE BAY NATIONAL ESTUARY PROGRAM AREA AND  
RANKING ANALYSIS OF POTENTIAL SAV RESTORATION SITES**



Prepared for

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## EXECUTIVE SUMMARY

This report documents the GIS mapping effort that provides historic information on the distribution of submerged aquatic vegetation (SAV) in coastal Alabama, primarily in portions of Mobile County during October 1940 and Baldwin County during January 1955. This information contributes to the MBNEP living resources goal of identifying historic changes in the distribution of SAV in coastal Alabama. The acreage of SAV in the historic photography was compared with the 2002 MBNEP survey to assess distributional differences, and develop a priority list of potential SAV restoration sites for coastal Alabama.

Historic aerial photography was digitized and georeferenced using Blue Marble Geographic Transformer version 5.1. Outlines of distinguishable SAV signatures in the aerial photography were digitized in a GIS environment, supplemented by visual examination of the photographic prints. ESRI polygon coverage of SAV beds was created in ArcView version 3.2.

The results of this investigation affirm previous reports of more widespread SAV in the MBNEP study area during the mid-20<sup>th</sup> Century. Overall acreage in 2002 was 44.5% of the acreage in 1940 (Table ES-1), including 691 fewer acres along the western shore of Mobile Bay, with most of the difference south of Dog River, and 268 fewer acres in Mississippi Sound. Overall acreage in 2002 was 11.7% of the acreage during January 1955 in Baldwin County. Along the eastern shore of Mobile Bay, 1955 SAV was mapped from north of Point Clear south to Bon Secour Bay, but this area had no mapped SAV for the 2002 survey. Similarly, extensive beds were mapped in Wolf Bay, Bay la Launch, Arnica Bay, and Perdido Bay in the 1955 photography that were not present in 2002. There were 328 fewer acres mapped in 2002 compared to same photographic area in the 1966 photography of the northeastern shore of Mobile Bay, a 71% decrease.

Table ES-1. Acreage of SAV in MBNEP study area locations common to historic aerial photosets and 2002 aerial photography.			
Photoset	Historic Acreage	2002 Acreage	Difference
Mobile County October 1940	1,924.6	855.8	-1,068.8
Baldwin County January 1955	1,495.4	175.5	-1,319.9
Baldwin County October 1966	461.9	133.9	-328.0

Despite the fact that changes in SAV distribution can reflect responses to natural coastal cycles and climatic processes, the prominent decline and apparently persistent disappearance in acreage since the 1940s and 1950s indicates that human activity has altered habitats capable of supporting SAV. The primary choices for restoration sites should be areas that previously supported SAV but have been impacted (Fonseca, 1990); however, some locations in the MBNEP area that once supported SAV have shown persistent absence of these resources over decadal scales, increasing the probability that restoration attempts in those areas will not succeed. Criteria for excluding certain areas as priority restoration areas are based in part on locations that have undergone physical

modifications that prevented them from supporting SAV, such as poor water quality and extensive shoreline development. Considering these exclusionary criteria, Table ES-2 lists priority restoration areas for the MBNEP study area with the greatest probability of success.

Table ES-2. Priority SAV restoration areas for the MBNEP study area	
Location	
Western Shore of Mobile Bay South of Dog River	
Mississippi Sound	
Eastern Shore of Mobile Bay North of Point Clear	
Eastern Shore of Mobile Bay South of Point Clear	
Wolf Bay/Arnica Bay/Bay La Launch	

All of the areas in Table ES-2 have substantially less SAV acreage at present compared to the past, and are not listed in an order that reflects priority of one area over another. Specific locations within each of the restoration areas should be analyzed on a site-by-site basis to assure appropriate water depth, sediment characteristics, and water quality prior to any restoration attempts.

## TABLE OF CONTENTS

<b>EXECUTIVE SUMMARY .....</b>	<b>i</b>
<b>1.0 INTRODUCTION .....</b>	<b>1</b>
1.1 MBNEP Background .....	1
1.2 Study Purpose and Objectives .....	1
1.3 Study Approach .....	1
<b>2.0 METHODS.....</b>	<b>2</b>
2.1 Project Area .....	2
2.2 Georeferencing of Historic Photographs .....	2
2.3 Creation of Polygonal and GIS Database .....	2
2.4 Quality Assurance and Control.....	4
2.5 Metadata.....	4
<b>3.0 RESULTS.....</b>	<b>7</b>
<b>4.0 LITERATURE CITED .....</b>	<b>13</b>

## LIST OF FIGURES

Figure 1. Photographic areas examined for historic SAV distribution in coastal Alabama.....	3
Figure 2. Aerial photography showing SAV on the western shore of Mobile Bay near the mouth of Dog River (top), and in Dog River (bottom) during October 1940.....	5
Figure 3. Aerial photography showing SAV near the mouth of Weeks Bay (top) and the northern shore of Arnica Bay (bottom) during January 1955 .....	6
Figure 4. Extent of SAV in 1940 compared to 2002 on the western shore of Mobile Bay near the mouth of Dog River, in Mobile County. ....	8
Figure 5. Extent of SAV in 1955 compared to 2002 in the area of Wolf Bay and Terry Cove, in Baldwin County. ....	10
Figure 6. Extent of SAV in 1966 compared to 2002 on the northeastern shore of Mobile Bay, in Baldwin County. ....	11

## LIST OF TABLES

Table 1. Acreage of SAV in Mobile County locations common to both 1940 and 2002 aerial photography.....	7
Table 2. Acreage of SAV in Baldwin County locations common to both 1955 and 2002 aerial photography.....	7
Table 3. Acreage of SAV in Baldwin County locations common to both 1966 and 2002 aerial photography .....	9
Table 4. Priority SAV restoration areas for the MBNEP study area .....	12

## **1.0 INTRODUCTION**

The Mobile Bay National Estuary Program (MBNEP) funded the project entitled “Historical SAV Distributions in the MBNEP Area and Ranking Analysis of Potential SAV Restoration Sites” (MBNEP project # 417-025). This report documents the GIS mapping effort that provides information on the historic distribution of submerged aquatic vegetation (SAV), primarily in portions of Mobile County during October 1940 and Baldwin County during January 1955.

### **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. Habitat loss is a high priority area of environmental concern for the MBNEP, and previous SAV data were not adequate to assess the current status of this resource relative to its historic distribution in the MBNEP area.

### **1.2 Study Purpose and Objectives**

The environmental investigation 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 helps fulfill the MBNEP living resources priority to identify the historic distribution of SAV. The first step in the SAV Action Plan was production during 2002 of a map of major SAV concentrations of occurrence (Barry A. Vittor & Associates, Inc., 2004). The distribution of historic SAV analyzed in this report is compared with the 2002 MBNEP SAV survey in coastal Alabama to identify areas of major change, and as a guide to potential restoration. Future investigations will enhance the GIS database to facilitate more comprehensive analysis of historic changes in SAV occurrence in the MBNEP study area.

### **1.3 Study Approach**

Historic aerial photography was digitized and georeferenced. Outlines of distinguishable SAV signatures in the aerial photography were digitized in a GIS environment, supplemented by visual examination of the photographic prints. The distribution of SAV in the historic photography was compared with the 2002 MBNEP survey to assess differences and develop a priority list of potential SAV restoration sites for coastal Alabama.

## **2.0 METHODS**

### **2.1 Project Area**

Black and white aerial photographs from three separate photographic sets were used for this investigation (Figure 1), primarily flights over Mobile County (October 1940) and Baldwin County (January 1955). A small area of the northeastern shore of Mobile Bay from a pair of October 1966 aeriels was also included as part of the analysis. Historical photography used for SAV mapping in this investigation does not encompass the entire MBNEP area surveyed in 2002.

### **2.2 Georeferencing of Historic Photographs**

Black and white photographic prints housed at local Natural Resources Conservation Service offices in Mobile and Baldwin Counties were used for this investigation. Aerial photographs were visually inspected for potential SAV signatures. Useable photographs were scanned at 600 dots per inch (DPI) using a Microtek 9800 XL scanner, and saved as TIFF images.

Scanned photography was georeferenced using Blue Marble Geographic Transformer version 5.1. The projection used for georeferencing was Universal Transverse Mercator (UTM) Zone 16 North, North American Datum 1983 (NAD 83), and meters. Using digital orthophotographs acquired in 2002 for MBNEP SAV mapping (Barry A. Vittor & Associates, Inc., 2004), each historical aerial photograph was georeferenced using the Blue Marble Affine method. An Affine solution incorporates a single scale change, a rotation, and two translations to transform unknown coordinates from one arbitrary system (the historic photos) to coordinates in another system (the 2002 orthophotos), using values of known reference points. A minimum of three reference points were defined (on average 4-6 points were used) and unmasked in order to compute an Affine solution for each historic photograph. An XY residual error of less than 2 pixels and an East/North error of less than 2 meters were used for all the aerial photography. Residual error is the computed difference between observed source coordinates (2002 orthophotography) and calculated source coordinates (historic photography) resulting from transformation. Residual error vector of the geographic referencing is based on the selected control points and their respective locations within the image.

### **2.3 Creation of Polygonal and GIS Database**

ESRI polygon coverage of SAV beds was created in ArcView version 3.2. SAV polygons were digitally delineated on a computer screen display. In addition to the screen displays of the georeferenced photographs, analysts identified potential SAV signatures using the photographic prints. Overlapping photographs were used where possible for comparison when delineating areas of interest, to ensure accurate patch edges.

*HISTORICAL SAV DISTRIBUTION IN THE MOBILE BAY NATIONAL ESTUARY PROGRAM AREA  
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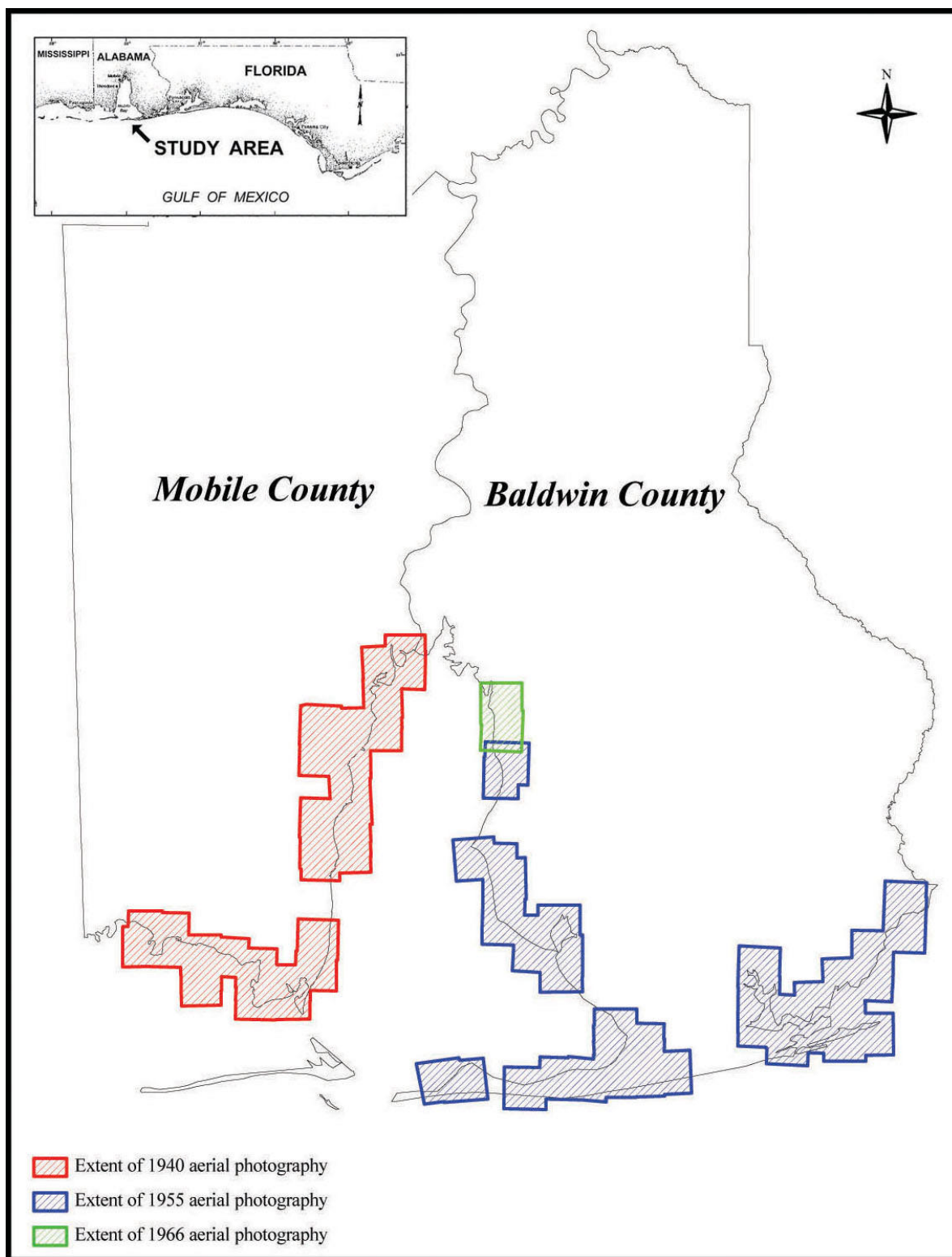


Figure 1. Photographic areas examined for historic SAV distribution in coastal Alabama.

## 2.4 Quality Assurance and Control

Historic photography was quality checked by two analysts for SAV signatures. The analysts consulted regarding questionable areas and reviewed the polygonal data sets after completion. The 2002 orthophotos were used in some instances to confirm questionable signatures. In particular, distinguishing SAV from emergent shoreline vegetation is problematic using black and white photography, and the 2002 color orthophotos were useful at some locations in the study area when analyzing vegetation signatures. The last major SAV study in the MBNEP area prior to 2002 (Stout and Lelong, 1981) also was reviewed during this investigation.

Some but not all SAV can be identified in less than optimal photography. NOAA C-CAP (*Coastal Change Analysis Program*) protocols were developed to assure that habitat mapping through remote sensing techniques is based on high quality photography. In addition to use of true color aerial photography, protocols include coordination with tide, appropriate map scale, sun angle, and time of year. None of these parameters are controllable when analyzing historic photography. Because no concurrent surface level information for signature verification can be made using historic photography, this investigation likely does not identify all the SAV in the photographic area for the timeframes examined, and may wrongly identify and delineate some signatures as SAV. Most of the historic photography used for this investigation had recognizable SAV (Figures 2-1 and 2-2), although some signatures in the photographic areas were delineated with a lower degree of confidence.

## 2.5 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.



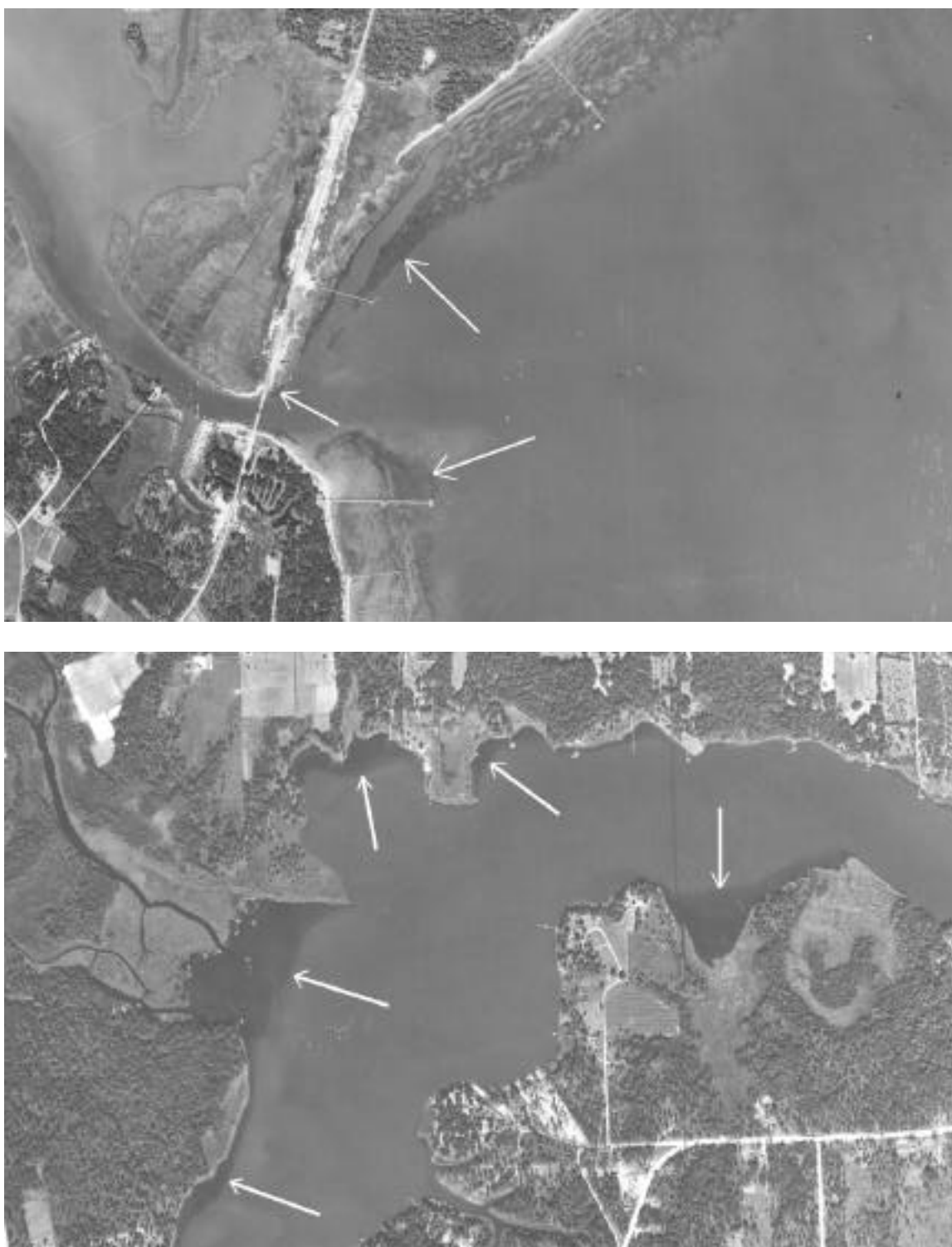


Figure 2. Aerial photography showing SAV on the western shore of Mobile Bay near the mouth of Dog River (top), and in Dog River (bottom) during October 1940.

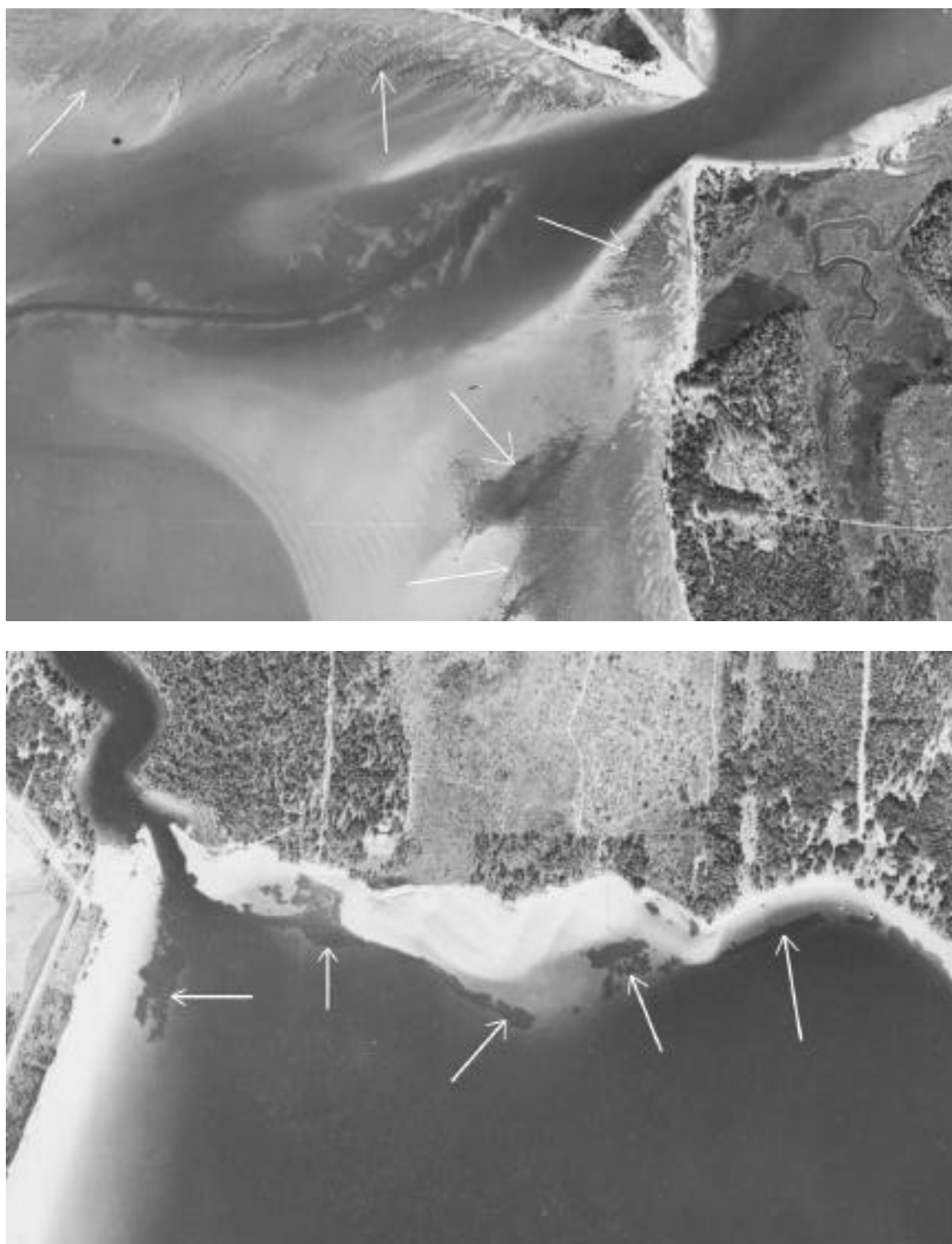


Figure 3. Aerial photography showing SAV near the mouth of Weeks Bay (top) and the northern shore of Arnica Bay (bottom) during January 1955.

### 3.0 RESULTS

#### Mobile County 1940

Table 1 presents SAV acreage during October 1940 in Mobile County compared to 2002 in the same photographic area. Overall acreage in 2002 was 44.5% of the acreage in 1940, including 691 fewer acres along the western shore of Mobile Bay, with most of this difference south of Dog River, and 268 fewer acres in Mississippi Sound. One example of change is shown in Figure 4, which presents the extent of SAV in 1940 compared to 2002 on the western shore of Mobile Bay, near the mouth of Dog River. There were 109.6 acres mapped in Dog River for 1940 compared to a complete absence of mapped SAV in 2002 for the same area (Table 1).

Table 1. Acreage of SAV in Mobile County locations common to both 1940 and 2002 aerial photography.			
Location	1940 Ac	2002 Ac	Difference
Western Shore North of Dog River	887.2	679.3	-207.9
Western Shore South of Dog River	508.0	24.9	-483.1
Dog River	109.6	0	-109.6
Mississippi Sound	419.8	151.6	-268.2
Total	1,924.6	855.8	-1,068.8

#### Baldwin County 1955

Table 2 presents SAV acreage during January 1955 in Baldwin County compared to 2002 in the same photographic area. Overall acreage in 2002 was 11.7% of the acreage in 1955. Except for Little Lagoon, all areas within in the 1955 photographic area had more acreage than the same areas during 2002 (Table 2).

Table 2. Acreage of SAV in Baldwin County locations common to both 1955 and 2002 aerial photography.			
Location	1955 Ac	2002 Ac	Difference
Eastern Shore North of Point Clear	1.6	0	-1.6
Eastern Shore South of Point Clear <sup>1</sup>	695.5	0	-695.5
Little Lagoon	0	1.3	+1.3
Wolf Bay/Arnica Bay/Bay La Launch	153.1	0.2	-152.9
Perdido Bay North of Bear Point	70.4	0.3	-70.1
Perdido Bay South of Bear Point <sup>2</sup>	574.8	173.7	-401.1
Total	1,495.4	175.5	-1,319.9

<sup>1</sup> Includes Weeks Bay, Bon Secour, and Fort Morgan Peninsula

<sup>2</sup> Includes Cotton Bayou, Terry Cove, Perdido Pass, Old River, and St. John's Bayou

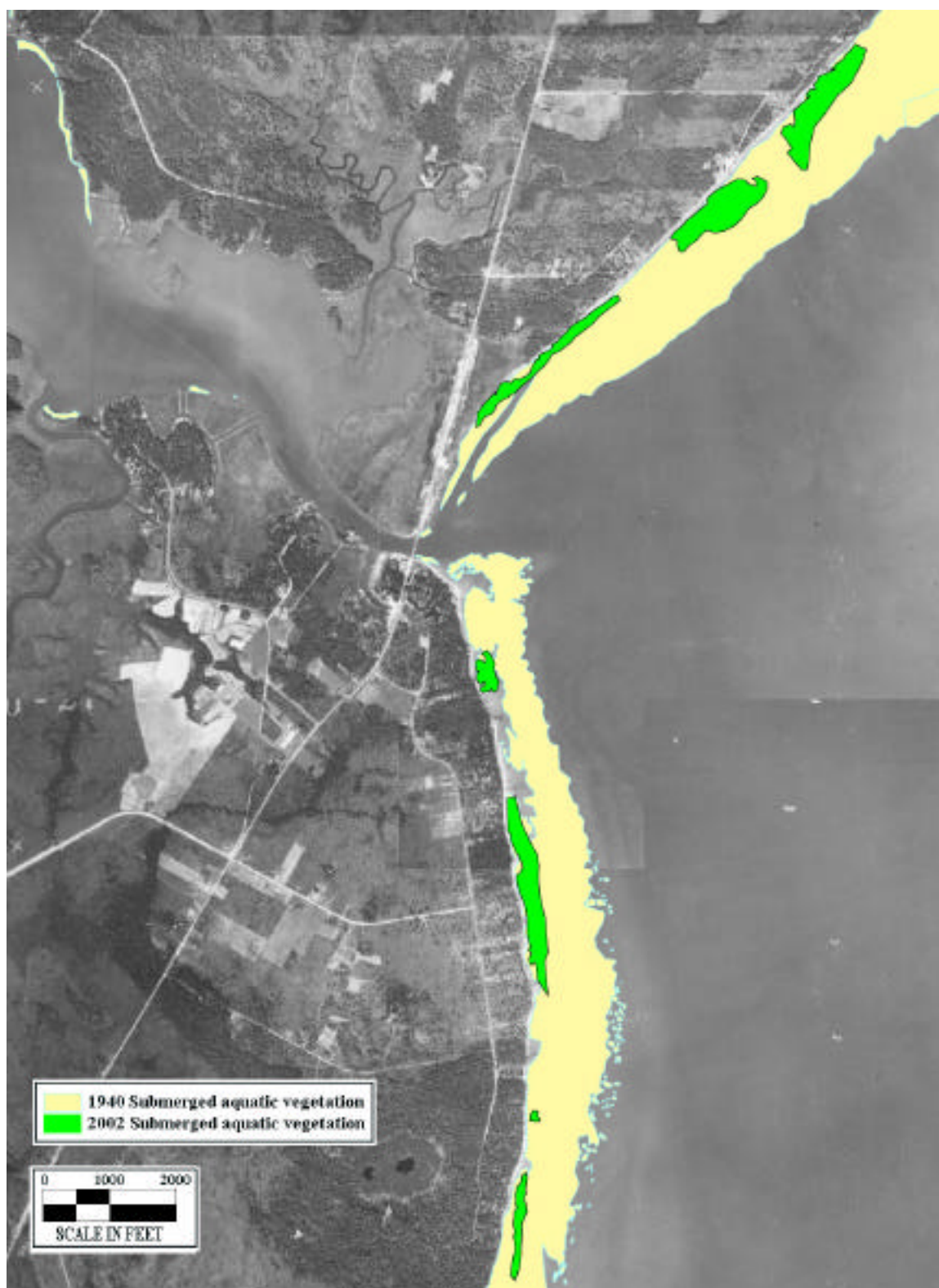


Figure 4. Extent of SAV in 1940 compared to 2002 on the western shore of Mobile Bay near the mouth of Dog River, in Mobile County.

Along the eastern shore of Mobile Bay, 1955 SAV was mapped from north of Point Clear south to Bon Secour Bay. No SAV was mapped in this area for the 2002 survey. Similarly, extensive beds were mapped in Wolf Bay, Bay la Launch, Arnica Bay, and Perdido Bay that were not present in 2002 (Figure 5). In the Perdido Key area extending from Cotton Bayou to the Alabama-Florida line, there were nearly 400 fewer acres in 2002 compared to 1955.

### Baldwin County 1966

Table 3 presents SAV acreage during October 1966 in Baldwin County compared to 2002 in the same photographic area. There were 328 fewer acres mapped in 2002 compared to the 1966 photography, a 71% decrease.

Table 3. Acreage of SAV in Baldwin County locations common to both 1966 and 2002 aerial photography.			
Location	1966 Ac	2002 Ac	Difference
Eastern Shore North of Point Clear	461.9	133.9	-328.0

### Priority Restoration Areas

The results of this investigation affirm previous reports of more widespread SAV in the MBNEP study area. Baldwin (1957) reported that extensive SAV grew along the eastern shore of Mobile Bay between Daphne and Point Clear, particularly beds of wild celery (*Vallisneria*). Borum (1975) subsequently noted that SAV along the eastern shore was much reduced by the late 1960s and almost completely gone in the 1970s. Stout and Lelong (1981) reported anecdotal evidence compiled from former residents and scientists that wild celery and widgeon grass (*Ruppia*) beds once were extensive along both the eastern and western shores of Mobile Bay. They found that SAV had since disappeared from many of those areas by the time of their 1980 study. The spatial extent of shoal grass (*Halodule*) has declined from past occurrences, particularly along the shores of Mobile Bay and in lower Perdido Bay (Stout and Lelong, 1981; Handley, 1995).

Despite the fact that changes in SAV distribution can reflect responses to natural coastal cycles and climatic processes, the prominent decline and apparently persistent disappearance in acreage since the 1940s and 1950s indicates that human activity has altered habitats capable of supporting SAV. The historic decrease in areal coverage of SAV apparently is due in large part to dredging and filling activities, shoreline development, vessel traffic, and water quality deterioration (Stout and Lelong, 1981). The primary choices for restoration sites should be areas that previously supported SAV but have been impacted (Fonseca, 1990); however, some locations in the MBNEP area that once supported SAV have shown persistent absence of these resources over decadal scales, increasing the probability that restoration attempts in those areas will not succeed.



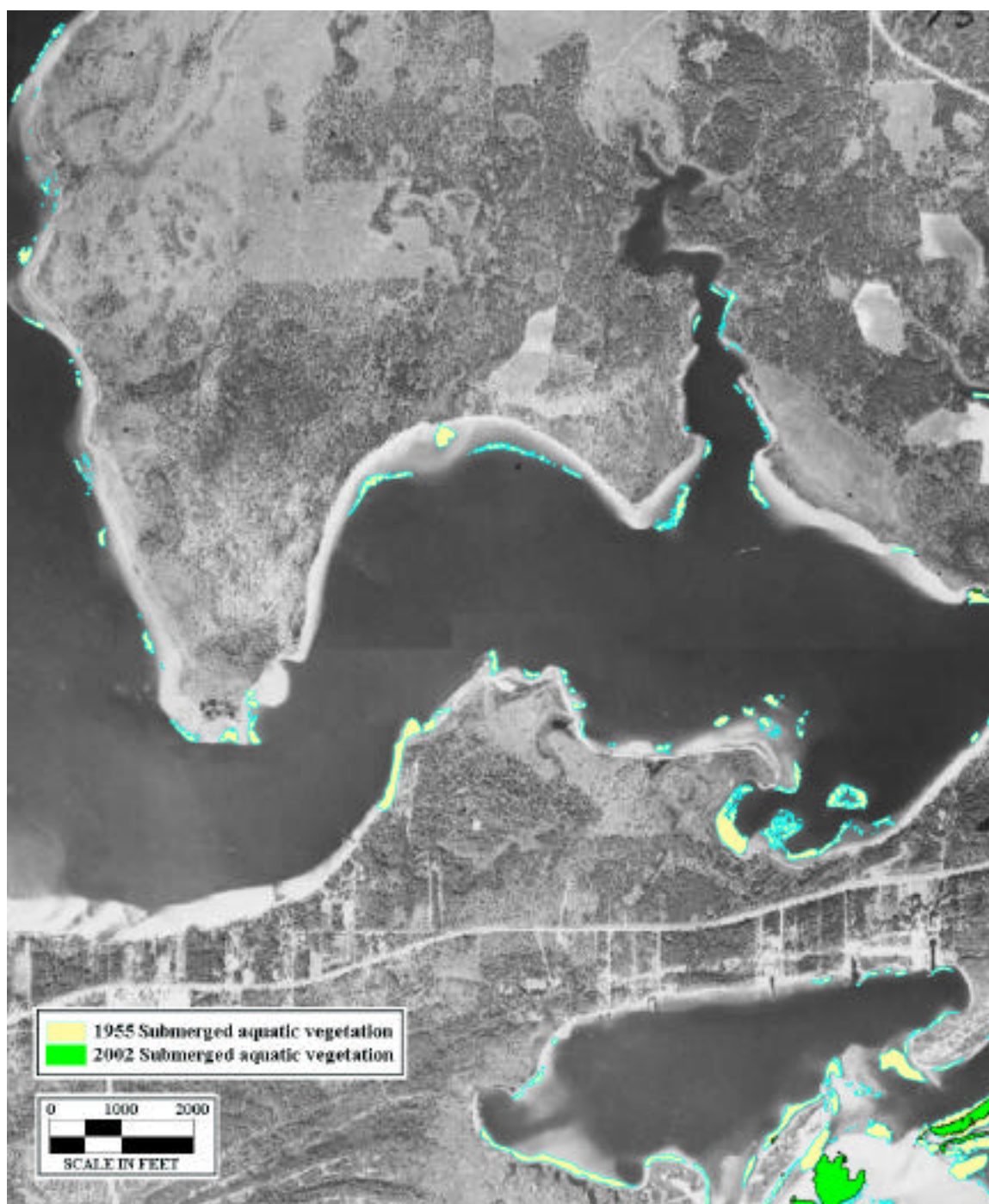


Figure 5. Extent of SAV in 1955 compared to 2002 in the area of Wolf Bay and Terry Cove, in Baldwin County

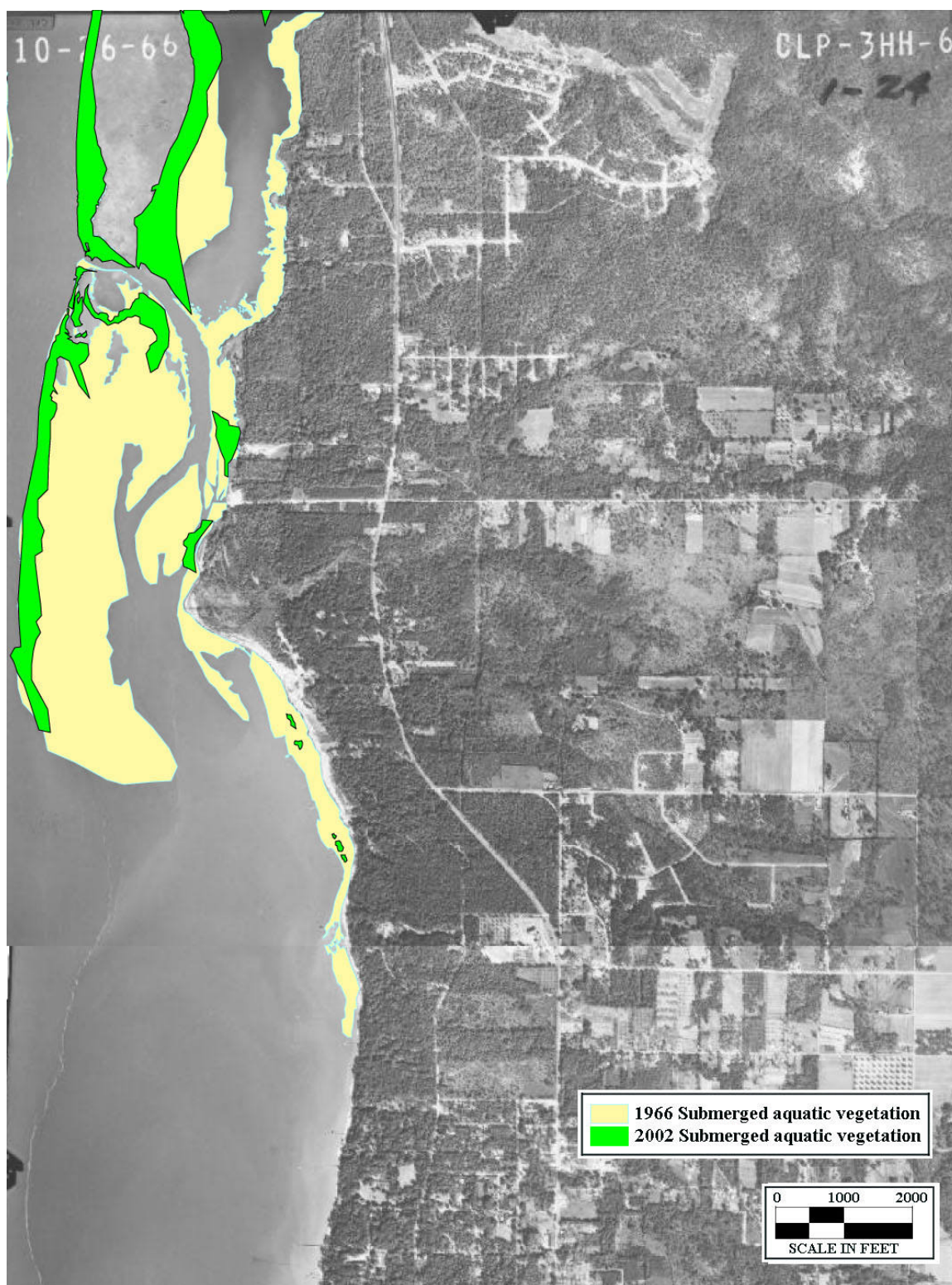


Figure 6. Extent of SAV in 1966 compared to 2002 on the northeastern shore of Mobile Bay, in Baldwin County.

Criteria for excluding certain areas as priority restoration areas are based in part on locations that have undergone physical modifications that prevented them from supporting SAV. For example, the southern Perdido Bay area in 1955 supported substantial SAV acreage compared to the 2002 survey (Barry A. Vittor & Associates, Inc., 2004), however most of the shoreline in the area is now developed with piers and bulkheads, and generally has a high level of vessel traffic. Other areas are documented as having poor water quality, in particular Dog River and northern Perdido Bay, and are not considered priority candidates for SAV restoration projects. Considering these exclusionary criteria, Table 4 lists priority restoration areas for the MBNEP study area with the greatest probability of success.

Table 4. Priority SAV restoration areas for the MBNEP study area	
Location	
Western Shore of Mobile Bay South of Dog River	
Mississippi Sound	
Eastern Shore of Mobile Bay North of Point Clear	
Eastern Shore of Mobile Bay South of Point Clear	
Wolf Bay/Arnica Bay/Bay La Launch	

All of the areas in Table 4 have substantially less SAV acreage than observed in the past, and are not listed in an order that reflects priority of one area over another. Specific locations within any of the restoration areas should be analyzed on a site-by-site basis to assure appropriate water depth, sediment characteristics, and water quality prior to any restoration attempts.



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