Statewide Summary for Alabama

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Background

Natural Environment

The gulf coast of Alabama extends from the Mississippi State line eastward to the Florida State line, a distance of only 74 km (46 mi) (Alabama Coastal Area Board, 1980). The coastline, however, including the estuaries and inlets, covers a greater distance of 977 km (607 mi) (National Oceanic and Atmospheric Administration, 1997). Two large drainage basins empty into the northern Gulf of Mexico within coastal Alabama: the Perdido River basin and the Mobile River basin (fig. 1). The Perdido basin encompasses 3,238 km^2 (1,250 mi^2) located in Florida and Alabama (Special Grand Jury, 1999). The Mobile basin is the sixth largest drainage area in the United States and is the fourth largest river basin in terms of flow volume. The 111,370-km^2 (43,000-mi^2) Mobile basin encompasses parts of Tennessee, Georgia, Mississippi, and Alabama (Isphording and Flowers, 1990; Johnson and others, 2002) (fig. 1).

The coastal lowlands of Alabama, with gently undulating to flat topography, basically follow the shoreline along the Gulf of Mexico and Mobile, Perdido, and Bon Secour Bays (Sapp and Emplaincourt, 1975). The ecological environments and geomorphology consist of features such as wetlands (i.e., tidal marsh), two large peninsulas, a delta, lagoons, islands, and bays. The presence of a saline and/or fresh, high water table gives rise to the abundance of various wetland habitat types that are found within Alabama's coastal area. The largest bays of coastal Alabama include Mobile Bay, Perdido Bay, and Bon Secour Bay with the largest of these, Mobile Bay, being formed within a submerged river valley (Chermock, 1974). Some of Perdido Bay is in Florida, and there is a further discussion of seagrasses there in Perdido Bay in the Florida section of this report. Further, the Mississippi Sound estuary extends from southwestern Mobile Bay, behind the offshore barrier islands, crossing the State line and bordering the entire southern Mobile County and Mississippi coastlines (fig. 2); consequently, there is another discussion of seagrasses in Mississippi Sound in the Mississippi section of this report.

Alabama has two main peninsulas: (1) Fort Morgan Peninsula at the mouth of Mobile Bay, and (2) Perdido Key at the mouth of Perdido Bay. The Fort Morgan Peninsula is an elongated stretch of land extending westward from south Baldwin County and bounded by Bon Secour/Mobile Bay to the north and west and by the Gulf of Mexico to the south. Perdido Key is located at the southeastern extent of Baldwin County and is bounded to the north by Old River, to the west by Perdido Pass, and to the south by the Gulf of Mexico. Alabama has at least 10 coastal islands, and of these, Dauphin Island, defining the western mouth of Mobile Bay, is the largest.

The confluence of the Tombigbee and Alabama Rivers in north Mobile and Baldwin Counties forms the Mobile River. The Mobile, Tensaw, and Blakeley Rivers flow southward to Mobile Bay through the Mobile-Tensaw Delta. The alluvial-deltaic plain is located at the terminus of Mobile Bay, northward along the Mobile-Baldwin County line. Topographically, the Mobile-Tensaw Delta is flat and generally below 6 m (20 ft) in elevation. Additionally, other major coastal tributaries include Dog River and East Fowl River on the western side of Mobile Bay; the Blakeley, Fish, Magnolia, and Bon Secour Rivers on the eastern side of the Bay; West Fowl and Escatawpa Rivers discharging into Mississippi Sound; and the Perdido and Blackwater Rivers at the northern end of Perdido Bay.

Mean annual precipitation in the Mobile and the Perdido basins ranged from 135.6 cm/yr (53.4 inches) in Montgomery, Ala., to 162.6 cm/yr (64 inches) in Mobile, Ala., over the time period 1961–90 (National Oceanic and Atmospheric Administration, 1997). The Alabama area of the central gulf coast has one of the highest frequencies of hurricane landfalls in the United States. Tropical storms can vary the annual precipitation considerably (Hurricane Danny yielded 94 cm (37 inches) in 24 h in July 1997), causing tides and water movement that can redistribute bay bottom sediments and reconfigure shorelines (Schroeder and others, 1990). Conversely, droughts can reduce the precipitation dramatically, as in the case in 2000 when Mobile received an average of only 116.2 cm (45.7 inches) of precipitation (Coastal Weather Research Center, 2003).

With an average 1,756 m^3 (62,004 ft^3) per second of flow, upstream riverine inputs significantly influence water quality

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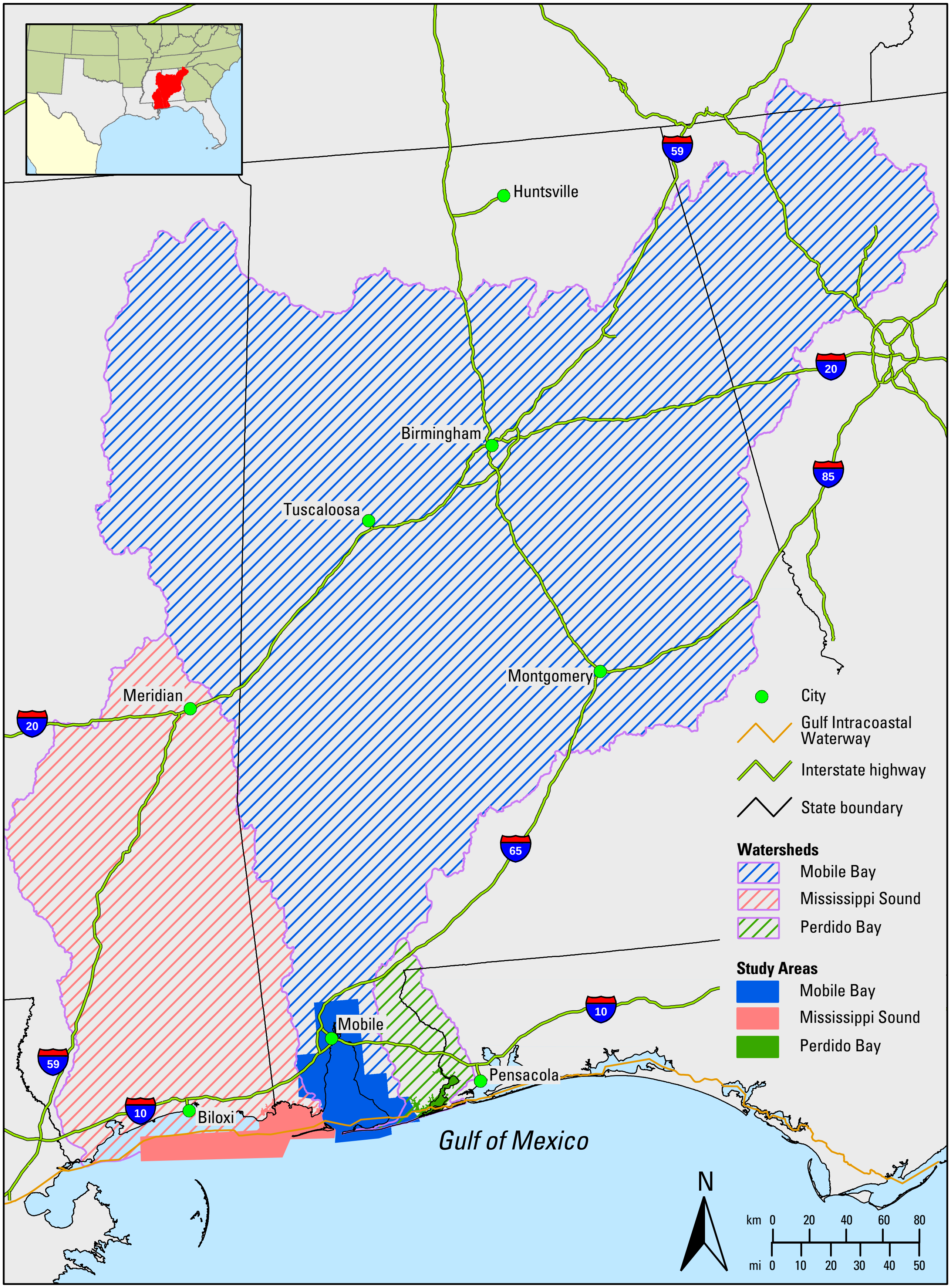

Figure 1. Watershed for coastal Alabama.

in Mobile Bay. Low upstream flows typically occur during late summer and early fall months when certain water-quality parameters (e.g., nutrient enrichment, salinity, dissolved oxygen levels) are most critical. During this time, coastal rainfall amounts and flow inputs from local sources may be more significant to the system (Baya and others, 1998).

Coastal waters of Alabama are primarily under the influence of a daily astronomical tide with a mean range of only 0.4 m (1.3 ft), a maximum spring tide range of 0.8 m (2.6 ft), and a minimum neap tide range of less than 0.1 m (0.3 ft). The seasonal cycle of tides is low in winter and early summer and high in spring and late summer through fall. Winds and storms can significantly affect tide levels. The most recent estimate for sea-level change along the northern gulf coast is more than 1.8 mm (0.07 inches) a year or more than 0.18 m (0.59 ft) per century. Recorded salinity ranges are 0–35 ppt in the lower bay and 0–24 ppt in the upper bay. Vertical salinity differences as high as 10 to 15 ppt and 20 to 30 ppt have been observed in the northern and southern ends of the bay, respectively (Schroeder and others, 1990).

The unconsolidated alluvial sand, gravelly sands, and clays found along the Alabama coast, when combined with varying amounts of precipitation, cause dramatic effects on the turbidity of the shallow receiving waters in Mississippi Sound and Perdido and Mobile basins. An estimated 4.85 million Mg (5.35 million tons) of sediment annually enters the Mobile Bay estuary, with 33% deposited in the delta and 52% in the bay (the remainder being transported to the Gulf of Mexico and Mississippi Sound) (Isphording and others, 1996). During periods of high precipitation, visibility may be reduced to 15 cm (6 inches) or less (Sturm, personal observation, 2003). Conversely, during periods of drought, the turbidity can reach 5 nephelometric turbidity units (NTU) or more (Weeks Bay National Estuarine Research Reserve, 2003). Five NTUs is equivalent to 6.3 mg (0.0002 oz) total suspended solids/L (Lake Access, 2003). Jackson (2004) found that light attenuation averaged 142.5 cm (56 inches) on quiescent days while averaging only 55.0 cm (22 inches) on days when weather fronts passed through the area, thus increasing the quantity of suspended sediments and seston material in the water column. Lastly, winds and storms cause substantial increases in turbidity when they are greater than 24 kph (15 mph) since Mobile Bay is a shallow, wind-driven system.

Context of Human Influences

Alabama coastal systems have been subjected to increasing pressure from a variety of proliferating activities including commercial and recreational fishing, silviculture, oil and gas extraction and refining, shipping and navigation channel excavation, industrial construction and waste discharges, residential development, municipal waste treatment discharges and accidental spills, and nonpoint source runoff. Surveys in 1998 by the Mobile and Baldwin County offices of the Natural Resources Conservation Service (file reports, Mobile and Bay Minette offices, respectively) indicated that 45% of Mobile County and 32% of Baldwin County were developed (urban, agriculture, or pasture). Of the remainder, which was classified as "forested," an unreported portion was not natural habitat but managed for silviculture.

The Mobile metropolitan area (Mobile and Baldwin Counties) had a combined 2002 population of 551,578 (*http://cber.cba.ua.edu/edata/est_prj/alpop20002025.prn*, accessed May 18, 2004), a growth since 1990 of 51% for Baldwin County and 5.6% for Mobile County. Projections of additional growth from 2002 to 2025 of 63.6% and 10.9% for each county, respectively, result in an anticipated coastal population of 691,989 in 2025.

Current discharges of secondarily treated sanitary waste average 1.58 m^3/s (36,000,000 gallons per day) (Mobile Metropolitan Area Statistical Abstracts), but many areas are not served by waste treatment facilities; numbers of permits issued in 2003 for individual septic tanks were 1,619 for Mobile and 1,027 for Baldwin County (Mobile Bay Convention and Visitors Bureau, MBCVB Database, *http://www.southalabama.edu/mcob/cber/DB-port.htm*, accessed May 17, 2004). Aging sanitary waste collection systems and undersized treatment facilities have resulted in numerous large spills of raw sewerage in the last decade.

The Port of Mobile handled 35,587,125.4 Mg (39,227,431 tons) of cargo in 2003, with the principal coastal shipping route being the dredged and regularly maintained Mobile Ship Channel traversing Mobile Bay from north to south. Shallower draft shipping (barges) uses the depth-maintained Gulf Intracoastal Waterway through Mississippi Sound, crossing lower Mobile Bay and connecting to Perdido Bay by an artificial, excavated canal across Baldwin County. Coastal seafood landings were over 10,433 Mg (11,500 tons) in 2002, primarily delivered through dredged navigation channels into Bayou La Batre (off of Mississippi Sound) and the Bon Secour River in southeastern Mobile Bay (MBCVB Database, *http://www.southalabama.edu/mcob/cber/DB-port.htm*, accessed May 17, 2004).

In 1997, Pickel and Douglass (1998) used historical aerial photographs (1955, 1974, and 1985), surveys, and video (1997) to investigate the impact of shoreline armoring around Mobile Bay.

Approximately 46,756 m (153,400 ft) of the shoreline was armored in 1997, leaving 110,368 m (362,100 ft) still unarmored. Armoring increased from 8% of the shoreline in 1955 to 30% in 1997, and the period of greatest increase was 1974–85. There was a complete loss of intertidal habitat in front of bulkheaded properties, and it was predicted that this hard stabilization of bay shorelines would lead to a decrease in intertidal habitat by converting horizontal beach recession into vertical erosion in the estuarine fringes (Pickel and Douglass, 1998).

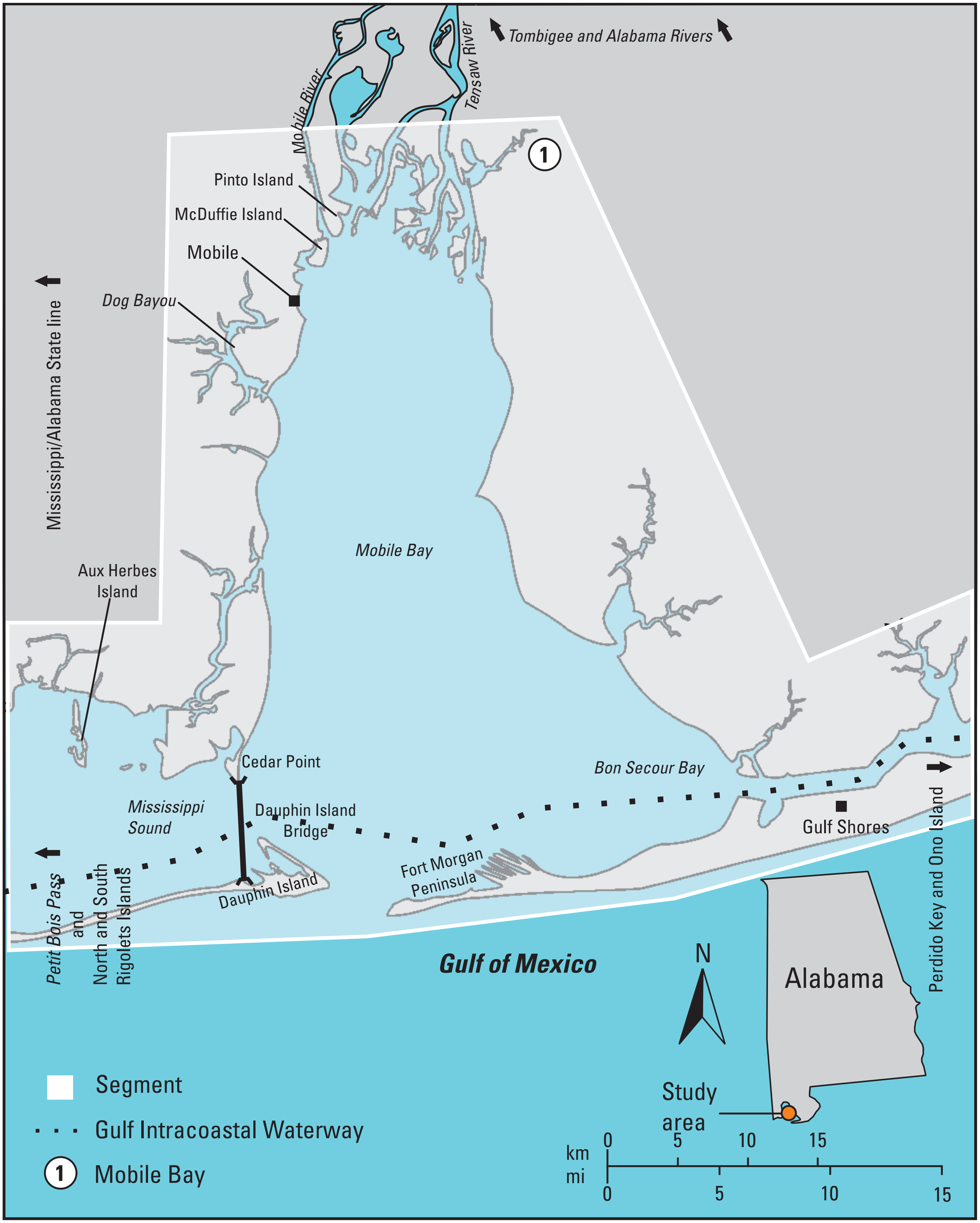

Figure 2. Scope of area for the Alabama summary.

Scope of Area

This report addresses seagrasses occurring throughout coastal Alabama, extending from the Mississippi State line eastward to the Florida State line and including all estuaries and drainage basins, as described below (fig. 2). Efforts have been made to include only those species considered seagrasses; however, because earlier reports included area totals for geographic areas with both freshwater aquatics and seagrasses, it was not always possible to separate the species (particulary in the lower delta and upper bay).

Only the portion of Mississippi Sound located in Alabama is included in this chapter. The Alabama portion of Mississippi Sound is bordered on the west by North and South Rigolets Islands and Petit Bois Pass west of Dauphin Island and by the Dauphin Island bridge on the east.

Only seagrasses in the portion of Perdido Bay located in Alabama are included in this chapter. The eastern border of coastal Alabama is defined along the coast by the State line splitting Perdido Bay down the center, snaking around the east end of Ono Island and crossing Perdido Key near its westward terminus.

The northern boundary of true seagrasses in coastal Alabama is defined by the salinity regime present during any given year. During years with normal rainfall, Interstate 10 and the Hwy 90/98 Causeway define the northernmost reaches of wigeon grass (*Ruppia maritima*). During drought years, however, wigeon grass may extend above the causeway into beds of submerged aquatic vegetation (SAV), which are almost exclusively freshwater aquatics.

Historical Documentation

Historical trends for seagrasses in Alabama have not been calculated. There have been few SAV surveys completed for coastal Alabama. Earliest studies by Baldwin (1957), Lueth (1963), and Beshears (1982) were limited surveys of distributions of SAV in the lower delta for wildlife and waterfowl management planning. Maps based on these data were not published. The Alabama Department of Conservation and Natural Resources conducted detailed surveys from 1987 to 1994, limited to SAV within the delta and the northern margins of Mobile Bay (Powell, 1979; Zolczynski and Eubanks, 1990; Zolczynski and Shearer, 1997). Other than occasional wigeon grass in the upper bay, seagrass beds were exclusively made up of submerged aquatic species and not seagrasses. Stout and Lelong (1981) used black and white photography, and Stout and others (1982) color-infrared aerial photography, combined with extensive ground surveys, to provide the first quantitative mapping of SAV area throughout coastal Alabama. Both SAV and seagrass species were included. Results were presented on hardcopy U.S. Geological Survey (USGS) 7.5' quadrangle maps but not digitized.

Statewide Status and Trends

Historical Surveys

No formalized studies of seagrass trends in coastal Alabama have been undertaken as of the writing of this report. Efforts are currently underway by the Mobile Bay National Estuary Program (MBNEP) to collect all available information to develop a historical estimate of SAV along the Alabama coast and to analyze trends for time periods where data are adequate.

Stout and Lelong (1981) found that wigeon grass was the most ubiquitous seagrass species in the Alabama coastal area, excluding the delta, though not the most abundant, occurring near bay mouths and tributary rivers and in brackish waters of Mississippi Sound. Shoal grass (*Halodule wrightii*) was found to occur only in southern Perdido Bay and along the northern shore of the western end of Dauphin Island. Overall, wigeon grass covered 123 ha (305 acres) and shoal grass covered 266 ha (656 acres) in the 1980 survey of the coastal area (Stout and Lelong, 1981). Minor occurrences of turtle grass (*Thalassia testudinum*) were found previously among extensive beds of shoal grass in southern Perdido Bay (Stout and Lelong, 1981; Lelong, 1988).

Overall, areal coverage of SAV in coastal Alabama has decreased over time, apparently because of dredging and filling operations and from increased turbidity caused by shoreline development (Stout and Lelong, 1981). 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 northeastern shore of Mobile Bay, particularly beds of water celery (*Vallisneria americana*). Seagrass bed coverage 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 more common during their survey than in the past.

Based on anecdotal evidence compiled from former residents and scientists, water celery and wigeon grass beds once were extensive along both the eastern and western shores of Mobile Bay but had disappeared from many of those areas by the time of Stout and Lelong's 1980 study. Since then, wigeon grass has become reestablished in some of these areas, particularly along the southwestern shoreline of the bay. Stout and Lelong (1981) found that wigeon grass accounted for 11% of all submerged vegetation in their study area and covered approximately 121 ha (300 acres), mostly in pure stands. The spatial extent of shoal grass had also 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 northern Mississippi Sound, but this seagrass had disappeared from this area by 1980, replaced by expansive wigeon 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 meadows of shoal grass and wigeon grass, 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 486 ha (1,201 acres) in 1940–41 to 251 ha (619 acres) in 1987 (Handley, 1995).

Results of area estimates from previous studies vary and include freshwater SAV as well as seagrass species (Vittor and Associates, 2004) (table 1). Differences may also be due to variations in geographic coverage of each study and different methods of estimation.

Table 1. Distribution of submerged aquatic vegetation in coastal Alabama from previous studies.

Source	Area	Hectares	Acres
Baldwin (1957)	Mobile Bay	2,024	5,000
	Delta	3,036	7,500
	Total	5,060	12,500
Stout and Lelong (1981)	Nondelta	1,118	2,763
Stout and others (1982)	Delta	1,496	3,696

Methodology Employed To Determine and Document Current Status

The most recent assessment of seagrass status in coastal Alabama was conducted in 2002 (Vittor and Associates, 2004) for the MBNEP. This mapping effort followed protocols established by the National Oceanic and Atmospheric Administration (NOAA) Coastal Change Analysis Program (C-CAP) (1995; *http://www.csc.noaa.gov/crs/lca/pdf/protocol.pdf*). Digital orthophotographs were created from true color aerial photography acquired July 19, 20, 22, and 31, 2002. Images were rectified by using a digital elevation model surface produced by aerotriangulation from an airborne geographic positioning system and inertial measurement unit data. Areas on the images with apparent SAV signatures were subsequently visited in the field with prints of the aerial photography used for locating the sites. The field effort included verifying SAV signatures on the aerial photographs and species identification at 295 locations for quality control and accuracy checks. Field location data were acquired at 31% of mapped polygons in freshwater portions of the study area and at 23% of mapped polygons overall. Aerial photographs were observed in the ArcView geographic information system (GIS), and SAV habitat polygons were digitally delineated on a computer screen display (fig. 3). Polygon coverage of SAV beds was created in ArcView version 3.2.

Table 2. Seagrass coverage in coastal Alabama by species, 2002 (Vittor and Associates, 2004).

Species	Hectares	Acres
Shoal grass (*Halodule wrightii*)	424	1,048
Turtle grass (*Thalassia testudinum*)	0.02	0.05
Wigeon grass (*Ruppia maritima*) (alone)	58	142
Wigeon grass (mixed with other freshwater species)	203	501
Total seagrass	684	1,691

Current Status and Changes

Vittor and Associates (2004) found shoal grass to be the dominant seagrass species in coastal Alabama during 2002. Overall, 684 ha (1,690 acres) of seagrass habitat were mapped (table 2). Greatest coverage by all species occurred in the delta and Mobile Bay, and the lowest acreage was in Perdido Bay (table 2).

Seagrasses were limited in distribution to the southern portion of the study area. Shoal grass made up most of the acreage, particularly in Mississippi Sound (332 ha, or 819 acres) and southern Perdido Bay (121 ha, or 300 acres), including Florida waters (table 3). In addition, relatively

Table 3. Geographic distribution of all submerged aquatic vegetation species in coastal Alabama, 2002 (Vittor and Associates, 2004).

Area	Hectares	Acres
Mobile Bay and Delta (freshwater submerged aquatic vegetation and wigeon grass (*Ruppia maritima*))	2,264	5,593
Mississippi Sound (seagrasses)	331	819
Perdido Bay (seagrasses)	95	234

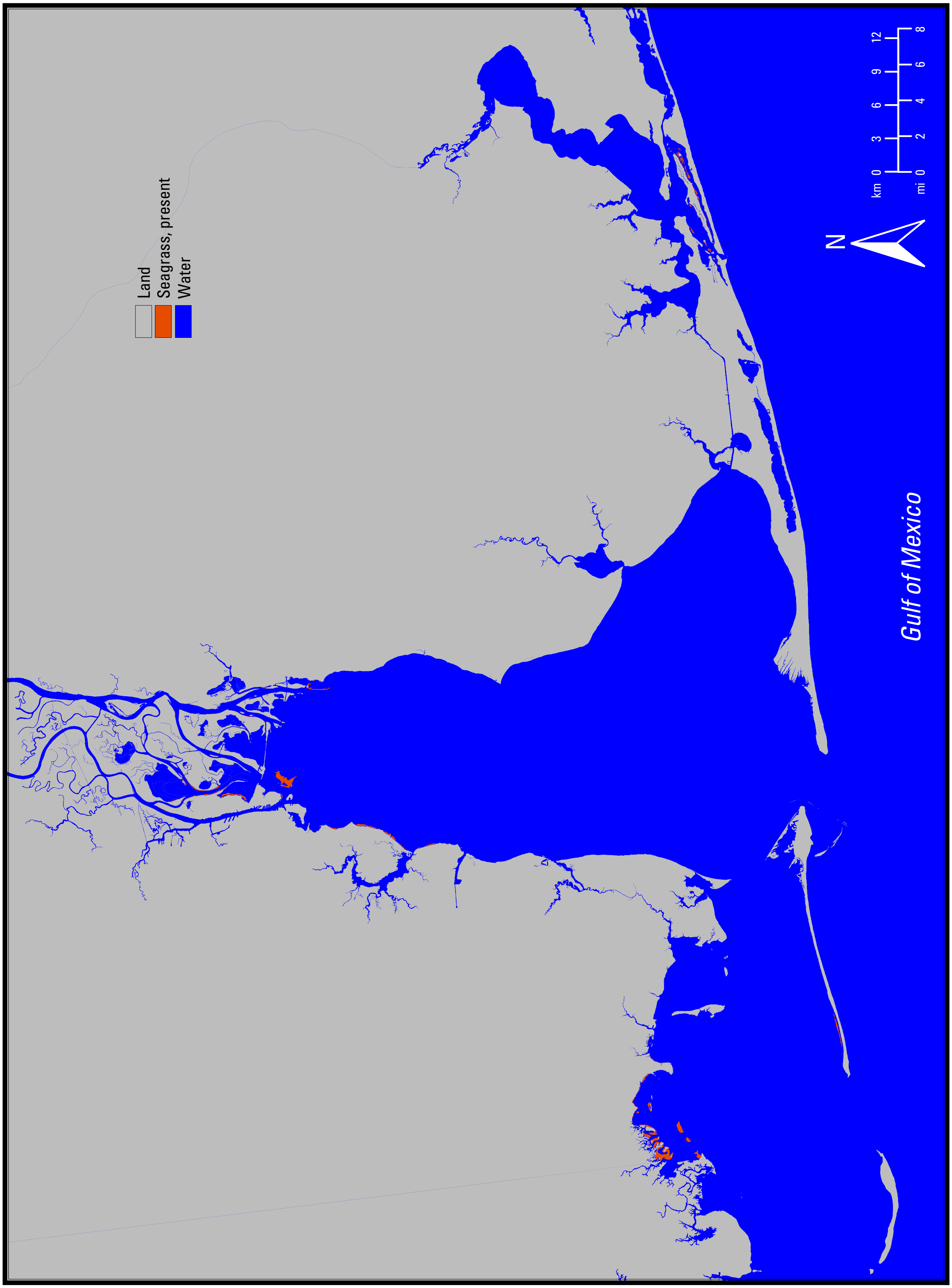

Figure 3. Distribution of seagrass along coastal Alabama, 2002.

small patches occurred along the northern shoreline of the western end of Dauphin Island and in Baldwin County in Little Lagoon and southwestern Perdido Bay tributaries. Shoal grass along the northern shoreline of Dauphin Island 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. 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 (oral commun., 2003), 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.

Much of the overall area of wigeon grass occurred in beds along the western shore of Mobile Bay (Vittor and Associates, 2004). Some beds were relatively large, particularly along the northwestern shores of the bay. Pure stands of wigeon grass primarily occurred south of Pinto Pass, where the Mobile River empties into Mobile Bay. Wigeon grass north of the Hwy 90/98 Causeway occurred in beds mixed with water celery, Eurasian watermilfoil (*Myriophyllum spicatum*), water stargrass (*Heteranthera dubia*), and other freshwater species.

The 2002 distribution of wigeon grass (Vittor and Associates, 2004) differed from the last major survey of the study area. Crance (1971) reported shoal grass in northern Mississippi Sound, but by 1980 it had been replaced by expansive areas of wigeon grass (Stout and Lelong, 1981). Wigeon 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 beds at the time of the 2002 survey. Shoal grass distribution and area in the western portion of the study area had 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 2 yr prior to the 2002 mapping survey of Vittor and Associates. 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 wigeon grass occurrence relative to shoal grass distribution may revert to patterns documented in prior surveys (e.g., Stout and Lelong, 1981) of the study area.

Causes of Change

Change in seagrass area has occurred in coastal Alabama, but as of this date, there has been no investigation into the specific causes of change along coastal Alabama. Some general, probable causes for decreased seagrass coverage include tropical storm activity and turbidity in coastal waters. Tropical storms are frequent along the northern Gulf of Mexico coast. At least one tropical storm or hurricane will strike the Alabama coast every 2 yr. These storms vary dramatically in strength and resulting damage caused to the shorelines. In addition, land development is increasing in the Mobile Basin watershed and along the entire Alabama coast. Repeated, significantly large spills of raw and incompletely treated sewerage from municipal treatment facilities have probably affected seagrass beds in adjacent waters. Land development and agricultural activities within the drainage basins can cause increased amounts of sediments and nutrients to enter the waterways, thereby increasing turbidity of the water and reducing the amount of sunlight available to plants. Historical and continuing dredging to maintain navigation channels introduces periodic events of increased turbidity resulting in short-term reduction in light availability, which may affect seagrass health and/or distribution. In addition, changes in hydrology related to construction of a dredged material island and depth alterations may have indirect impacts on seagrass bed viability.

Seagrass Health

As of this date, no investigation has been made into the health of collective seagrass beds or individual species in coastal Alabama.

Species Information

Alabama's brackish and marine seagrass beds are composed primarily of wigeon grass and shoal grass, with minor and sporadic occurrences of turtle grass. Wigeon grass is a euryhaline species that is not considered to be a true marine seagrass because of its intolerance for full seawater. Shoal grass and wigeon 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.

Although it does not tolerate full seawater, wigeon grass tolerates the greatest range of salinity compared with other SAV species, and because of its high rates of seed production and dispersal (Silberhorn and others, 1996), it is able to rapidly colonize suitable substrata. Wigeon grass can undergo prominent year-to-year changes in abundance and distribution that are due to salinity fluctuations (Verhoeven, 1975).

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, an ability which contributes to its colonizing ability. Shoal grass can tolerate salinities as low as 5 ppt (McMahon, 1968). As salinities increase in summer and fall or during drought years, shoal grass increases in abundance and may replace wigeon grass (Stutes, 2000; Heck and others, 2001). In general, shoal grass and wigeon grass are inferior competitors with other seagrasses and tend to occur in areas that are not suitable for other species (den Hartog, 1970). During years of drought, wigeon grass has been found in the delta north of Interstate 10 and the Hwy 90/98 Causeway and along the southeastern shore of the bay.

Monitoring, Restoration, and Enhancement Opportunities

There is currently no established monitoring program in Alabama for SAV. The 2002 survey (Vittor and Associates, 2004) was the first comprehensive coastal Alabama survey using standardized methods for image acquisition, rectification, mapping, and digitization. Digital comparisons to earlier comprehensive surveys (Stout and Lelong, 1981; Stout and others, 1982) have not been performed but are planned for 2004–05. As funding allows, future surveys will be planned to occur every 5 yr (David Yeager, MBNEP, oral commun.). Monitoring in coastal Alabama is coincidentally biased towards years with low precipitation. For example, if the most recent survey had been scheduled for 2003, the aerial photography would not have been flown because of the high precipitation and resulting high turbidity.

Mobile Bay has been a designated a U.S. Environmental Protection Agency National Estuary since 1995. The MBNEP Comprehensive Conservation and Management Plan (CCMP) contains a series of action items designed to monitor, protect, restore, and enhance SAV (Mobile Bay National Estuary Program, 2002): the SAV is one of five priority habitats identified and is addressed by action items to “protect or restore SAV habitats within the Mobile Bay estuary” with the goal to “maintain existing native SAVs at 2001 levels and increase acreage by 3% … by 2006.” Tasks completed to date include the 2002 mapping project, implementation of regulations restricting shrimp trawling in or near seagrass beds, and a pilot volunteer SAV gardening program to produce transplant materials, including wigeon grass, for restoration projects. Additional CCMP action items with indirect, anticipated positive effects on seagrasses include improving monitoring of living resources, reducing nutrient loading into coastal waters, restoring shorelines, management plans for nuisance species, comprehensive land-use planning, and reduction of shoreline erosion.

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