Chandeleur Islands

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Background

The Chandeleur Islands (fig. 1) are the barrier remains of the Mississippi River's St. Bernard Delta. Coastal geological processes constantly alter this 72-km (45-mi) barrier island arc trend, and major geomorphological changes occur with the passage of tropical storms and hurricanes (Williams and others, 1997). These remote islands can be accessed only by boat or seaplane. With the exception of light tower navigation aids at the northern end (Hewes Point), they lack permanent structures. The islands were designated a national wildlife refuge in 1904 and became part of the National Wilderness Preservation System in 1975. This preservation has prevented direct, site-specific stressors from development that are found in many other populated areas. Seagrass meadows occur on shallow shoals in protected waters behind the northern islands. The distribution and abundance of Chandeleur seagrasses are almost entirely controlled by geological processes related to storms and barrier island dynamics. The fate of Louisiana seagrasses, therefore, is dependent upon the fate of this fragile island chain.

Scope of Area

The Chandeleur Island Chain consists of Chandeleur Island to the north followed by Curlew, Grand Gosier, and Breton Islands to the southwest and Freemason, North, and New Harbor Islands to the west (fig. 2). The northern end of the Chandeleur chain is 35 km (22 mi) south of Biloxi, Miss.; the southern end, Breton Island, is 25 km (16 mi) northeast of Venice, La. Chandeleur, Freemason, North, New Harbor, and a northern portion of Curlew Islands are in St. Bernard Parish, and the southwestern islands, a portion of Curlew, Grand Gosier, and Breton Islands are in Plaquemines Parish. Significant seagrass meadows are limited to Curlew Island and islands in the chain north of Curlew.

Methodology Employed To Determine and Document Current Status

Natural color, 1:24,000-scale aerial photography was acquired. The mapping protocol consisted of stereoscopic photointerpretation, cartographic transfer, and digitization in accordance with strict mapping standards and conventions. Other important aspects of the protocol included the development of a classification system, groundtruthing, quality control, and peer review. Land, water, and areas where seagrasses were present were included on the maps.

The information derived from the photography was subsequently transferred by using a zoom transfer scope onto a stable medium overlaying U.S. Geological Survey (USGS) 1:24,000-scale quadrangle base maps. The primary data sources were 1:24,000-scale natural color aerial photography flown by National Aeronautics and Space Administration. In those cases where the data were inadequate or incomplete, contemporary supplemental data were acquired from other sources and used to complete the photographic coverage.

The groundtruthing phase included the participation of field staff from the USGS National Wetlands Research Center. Draft maps were sent out to these agencies and staff for review and comments. All comments received were incorporated into the final maps prepared and delivered.

Studies of seagrass species occurrence, distribution, and abundance were conducted on field trips during 1999, 2000, and 2001 in conjunction with studies of Hurricane Georges' impact and recovery (Poirrier and Franze, 2001; Franze, 2002).

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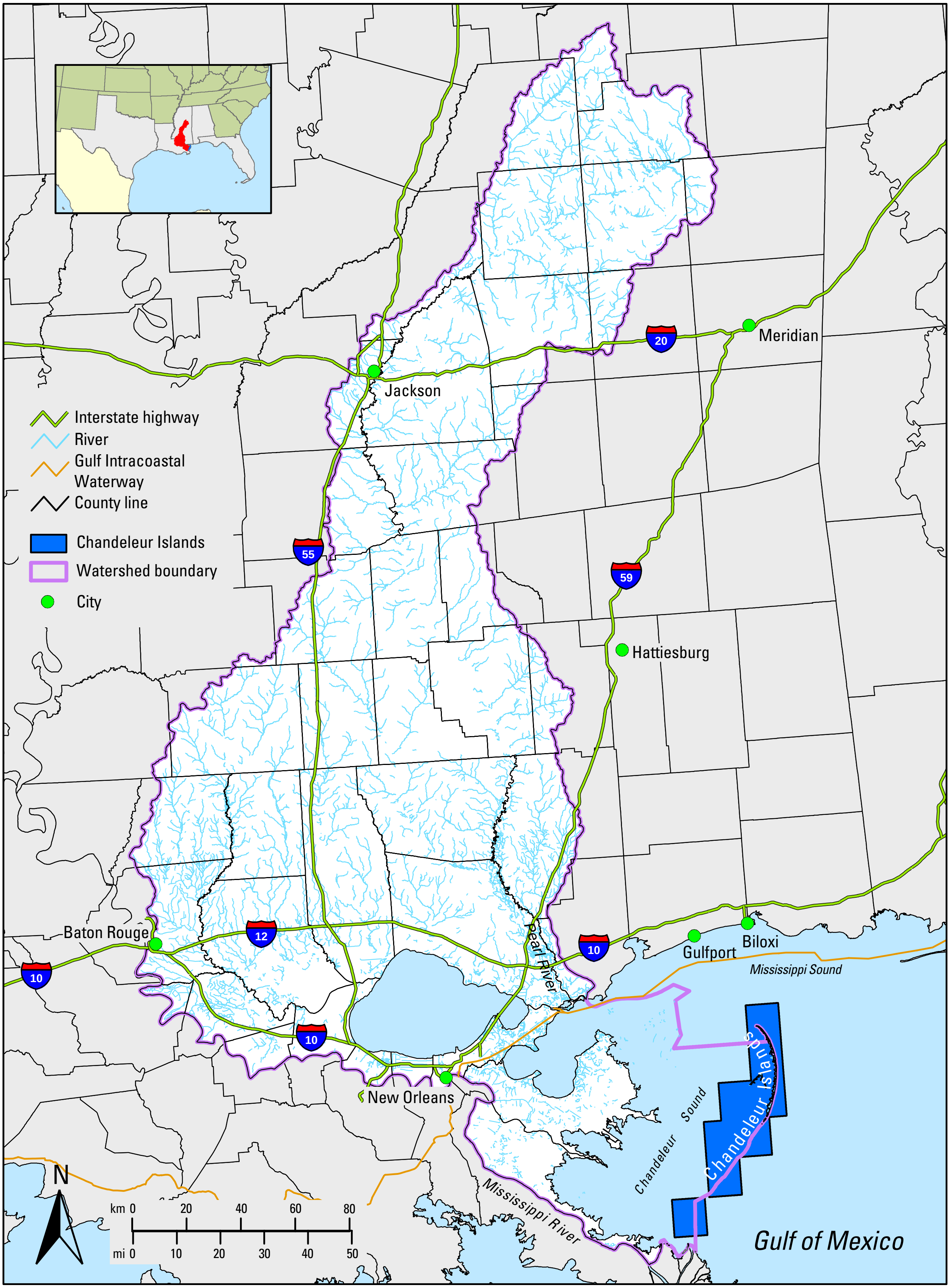

Figure 1. Watershed for Chandeleur Islands.

Methodology Employed To Analyze Historical Trends

Historical seagrass trends were analyzed by comparing changes in total areal coverage of habitat with seagrass present along a time sequence. Comparisons were made among data sums of seagrass coverage for April 1969 (fig. 3), October 1969 (fig. 4), April–June 1992 (fig. 5), and November–December 1995 (fig. 6). Maps of seagrass distribution for 1969, 1992, and 1995 were studied to determine the location of major changes of coverage. Methodology used for preparing maps can be found in appendix 1.

Status and Trends

Areal coverage of seagrasses (table 1) decreased by 1,708 ha (4,221 acres) (26.8%) between April and October 1969, increased by 1,868 ha (4,615 acres) (28.6%) from October 1969 to April–June 1992, and decreased by 2,025 ha (5,004 acres) (31%) from April–June 1992 to November–December 1995. It should be noted that April 1969 and October 1969 data were prepared to assess the changes associated with Hurricane Camille, which affected the islands in August 1969. Comparing October 1969 data with the 1992 data demonstrates how much the seagrass beds recovered after the hurricane.

Table 1. Seagrass areal coverage for the Chandeleur Sound shoals, Louisiana, from April and October 1969 and from April–June 1992 and November–December 1995.

Date	Hectares	Acres
April 1969	6,377	15,758
October 1969	4,669	11,537
April–June 1992	6,537	16,152
November–December 1995	4,512	11,149

Causes of Change

The northern Chandeleur Islands provide a relatively pristine seagrass habitat with few direct, site-specific, human-induced stressors (figs. 3, 4, 5, and 6). The distance of the northern islands—including Chandeleur, Freemason, North, New Harbor, and Curlew—of more than 35 km (22 mi) from Biloxi, Miss., and 60 km (37 mi) from the mouth of the Pearl River and the passes of Lake Pontchartrain in Louisiana protect them from pollution sources and other stressors. Nutrients and suspended solids from coastal discharges are probably assimilated in the Biloxi marsh system of Louisiana and the waters of Mississippi and Chandeleur Sounds and do not appear to have a major impact on the northern islands.

The southern Chandeleur chain, including Breton and Gosier Islands, are 15 km (9 mi) to 30 km (19 mi) from major passes of the Mississippi River. This chain does not support significant seagrass meadows (figs. 2, 3, and 4). Fresh water, plant nutrients, and turbidity from the Mississippi River may adversely affect seagrass development in the southern island chain. The lower Mississippi River-Gulf Outlet Channel is located between Breton and Gosier Islands. Increased turbidity from maintenance dredging may also adversely affect seagrasses. In addition, the southern islands are smaller and narrower and have a greater rate of retreat. Seagrasses are probably also limited by the constantly changing morphology of the southern islands.

Although the northern islands are subject to global environmental changes, the principal ecological drivers are natural coastal processes related to barrier island dynamics, abandoned river deltas, and damage from tropical storms and hurricanes (Williams and others, 1997). Some recovery through sediment deposition occurs after storms; however, land area of the Chandeleur Islands decreased from 3,462 ha (8,554 acres) to 1,215 ha (3,003 acres) (65%) between 1855 and 1999, with a 40% decrease (from 2,029 ha to 1,215 ha, or from 5,013 acres to 3,003 acres) from the passage of Hurricane Georges in 1998 (Penland and others, 2001). Other factors such as low water events, winter storms associated with frontal passages, wasting disease, coastal eutrophication, and damage from motorboat propellers may contribute to seagrass change. These factors do not, however, occur at spatial or temporal scales that would explain the rapid changes presented above, and if unabated, the human stressors would cause a steady decline not present in the previously mentioned data. The best explanation for these short-term, but major, decreases and increases is loss during storms and recovery after storms. The distribution and abundance of seagrass species are affected by storms, including winter storms, tropical storms, and hurricanes.

The 1,708-ha (4,221-acre) seagrass loss (26.8%) between April 1969 (fig. 3) and October 1969 (fig. 4) was the result of Hurricane Camille, which affected the islands in August 1969. The 1,868-ha (4,615-acre) increase (40%) from 1969 and 1992 (figs. 3 and 5) was probably caused by recovery from the effects of Camille. The islands were also impacted by hurricanes and other storms during this 13-yr period, however, and other cycles of increases and decreases may have occurred between 1969 and 1992 (figs. 3–5).

The limited data presented above are not sufficient to document the cause of the 2,025-ha (5,004-acre) decrease (31%) between April–June 1992 (fig. 5) and November–December 1995 (fig. 6). Seagrass meadows decreased in the western bays of Chandeleur and Curlew Islands and in the shoals near Freemason, North, and New Harbor Islands (figs. 5 and 6). Retreat of the Chandeleur Island meadow occurred at the northern and southern ends, in shallow water on the east side, and in deep water on the west side of shoals behind

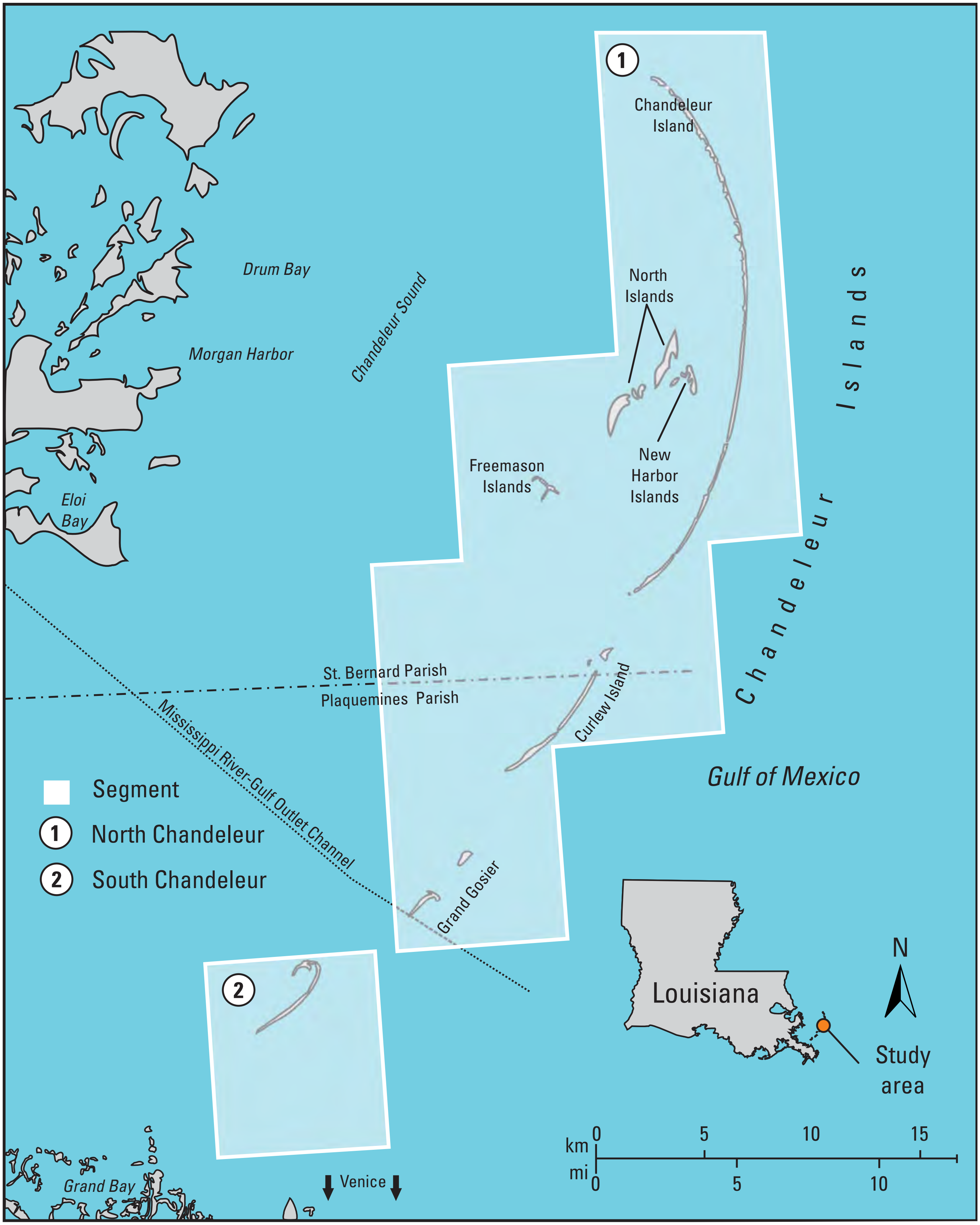

Figure 2. Scope of area for the Chandeleur Island seagrass vignette.

the island. There were no major changes in human-induced stressors at this remote site that could explain this widespread reduction. These changes may have been caused by erosion and turbidity from storms and hurricane and by seasonal differences in distribution and abundance.

Although there were no direct hurricane landings near the Chandeleur chain between 1992 and 1995, Hurricane Andrew hit the Louisiana coast in August 1992, and the 1995 hurricane season had three hurricanes, Allison, Erin, and Opal, in the eastern gulf, all of which affected seagrasses around the Chandeleurs to some extent. Opal was the most severe storm and was located south of Louisiana as it intensified and moved north across the Gulf of Mexico, but it shifted eastward before landfall in eastern Florida. Recovery from hurricane damage and subsequent meadow stability are also affected by severe winter storms and low water associated with frontal passages (Franze, 2002) and could have contributed to loss or affected the rate of recovery. Seasonal variation in seagrass coverage may have contributed to the differences between April–June 1992 and November–December 1995. Seagrass distribution in shallow water is limited by wave energy and low water events and in deep water by available light. Increased stress in these zones during winter may have decreased coverage of species that colonize shallow water in spring and summer and decrease during winter. The contribution of season to this decline, however, is probably minimal because coverage is generally high through November and early December, with major decreases occurring in late December, January, and February. The primary cause of this decline was probably hurricanes, particularly Hurricane Opal in October 1995.

Species Information

Turtle grass (*Thalassia testudinum*), manatee grass (*Syringodium filiforme*), shoal grass (*Halodule wrightii*), star grass (*Halophila engelmannii*), and wigeon grass (*Ruppia maritima*) have been reported by Hoese and Valentine (1972), Poirrier and Franze (2001), and Franze (2002). Data on the damage and recovery of Chandeleur Island seagrasses after the passage of Hurricane Georges in 1998 are presented in Moncreiff and others (1999), Poirrier and Franze (2001), and Franze (2002). Hurricane Georges caused numerous channel cuts through Chandeleur Island, and sediment deposition formed washover features. Seagrass damage was caused by erosion of meadows by channel flow and burial by washover features. When surveyed in 1999 (Franze, 2002), sites protected from hurricane damage were dominated by dense (100% coverage) turtle grass meadows. Exposed sites away from washover features were composed of turtle grass and manatee grass with some shoal grass. Star grass was present, but rare.

In the first year after Hurricane Georges, wigeon grass was associated with shoreline marshes, and shoal grass was present in shallow shoal areas. The channel cuts and sediment washover fans lacked vegetation. By 2001, colonization of the washover features by shoal grass and wigeon grass was widespread, but turtle grass and manatee grass colonization was patchy and appeared to be from buried root and shoot fragments (Franze, 2002). This pattern of disruption of mature turtle grass and manatee grass meadows by unvegetated washover features and gradual colonization of these features by shoal grass and wigeon grass observed after Hurricane Georges may be a regular pattern that occurs after major storms and hurricanes. There has been no change in species composition over time, but the relative abundance of wigeon grass and shoal grass may increase during recovery from major storms.

Monitoring for Seagrass Health

There is no established monitoring program to periodically evaluate the condition of the Chandeleur Islands seagrasses. Hoese and Valentine (1972) provided a species list along with general observations and comments on the effects of the passage of Hurricane Camille in 1969. Handley (1995) estimated the seagrass meadows to be about 6,000 ha (14,826 acres) based on 1989 aerial photographs. Michot and Chadwick (1994) investigated seagrasses as potential food for ducks. Poirrier and Franze (2001) and Franze (2002) studied damage and early stages of recovery from Hurricane Georges and the efficacy of transplanting to enhance recovery. Transplanting efforts were funded in part by the U.S. Environmental Protection Agency's Gulf of Mexico Program. Because the islands have few direct, human-induced stressors and because seagrass population dynamics are driven by storms and geological processes, the need to monitor seagrass health could be questioned. The relative health of Chandeleur seagrasses, however, is unknown and can be assessed only through monitoring. Healthy systems also need to be monitored because data on the productivity and population dynamics of meadows, not influenced by multiple human stressors, would be valuable in managing stressed meadows.

Mapping and Monitoring Needs

Future mapping and monitoring of Chandeleur seagrasses are needed to document storm effects and to determine the rate and mechanisms of natural recovery. Chandeleur Island seagrasses were severely damaged by Hurricane Georges in 1998, and additional studies are needed because recovery is a slow process. Barrier island landscape changes caused by storms provide a natural laboratory to observe the development of seagrass meadows on nonvegetated habitat. These efforts would provide information on colonization, species succession, and interactions between coastal geological processes and seagrass population dynamics. Seagrasses may play an important role in maintaining the

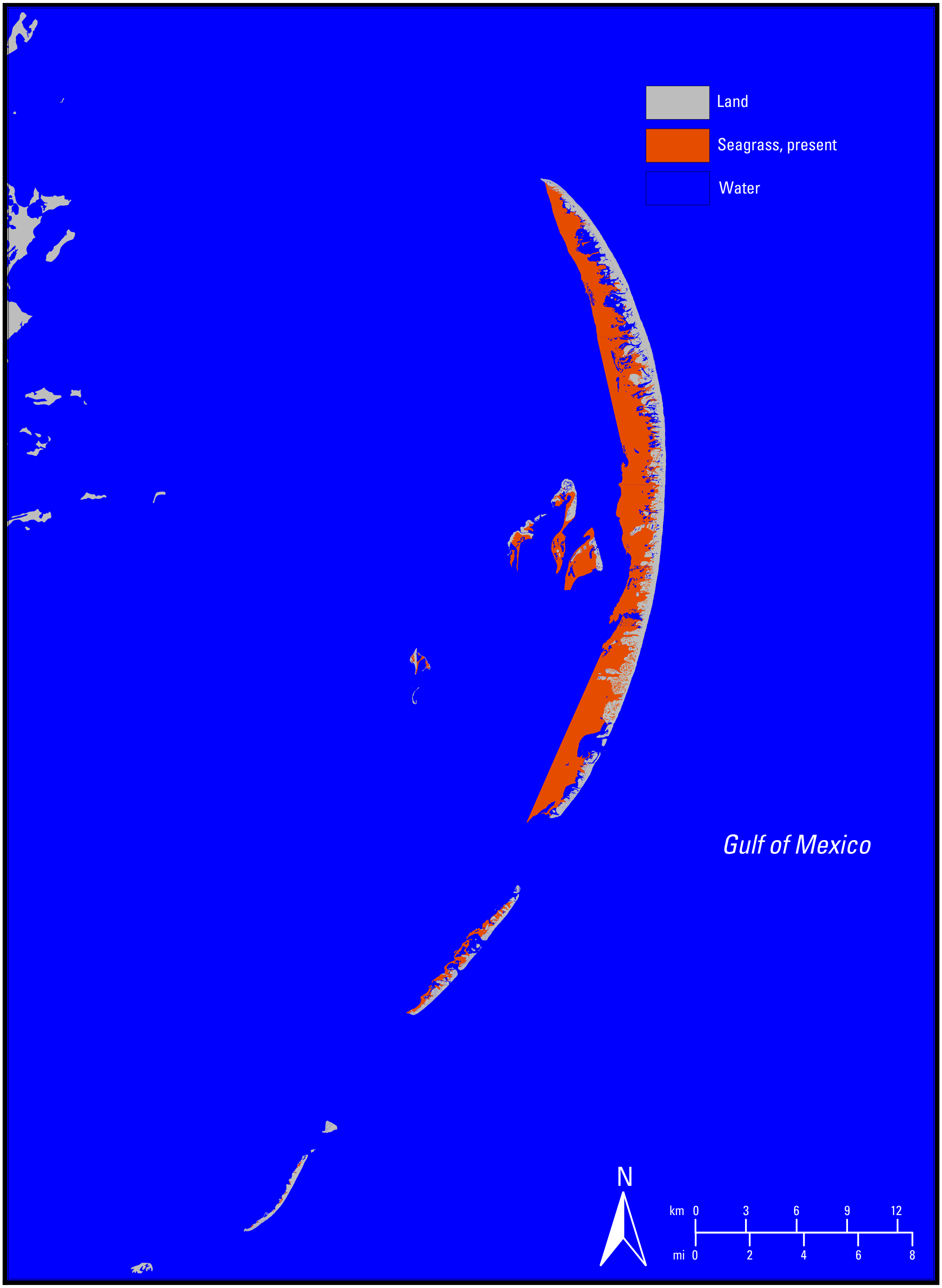

Figure 3. Distribution of seagrasses around the Chandeleur Islands, April 1969.

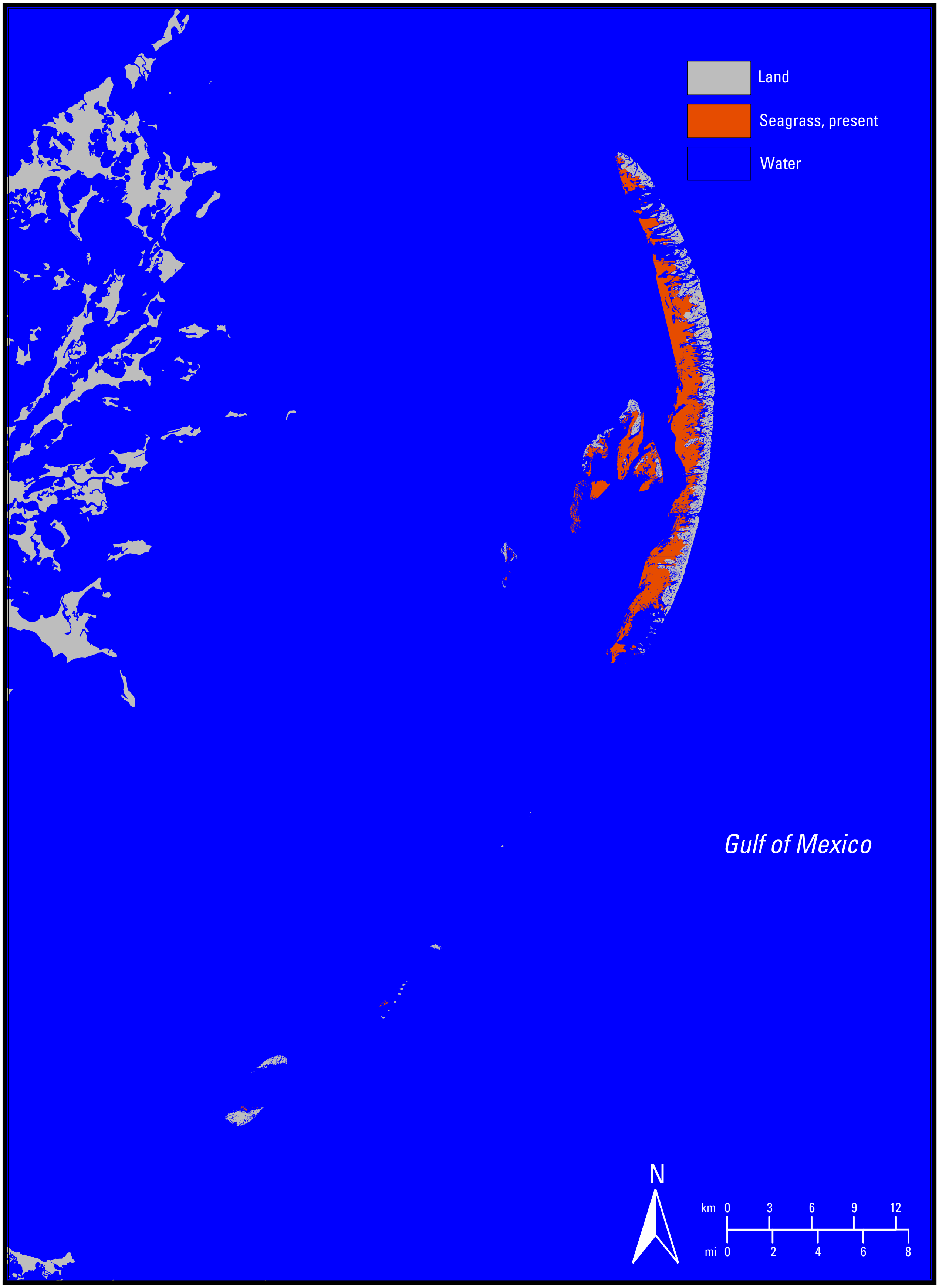

Figure 4. Distribution of seagrasses around the Chandeleur Islands, October 1969.

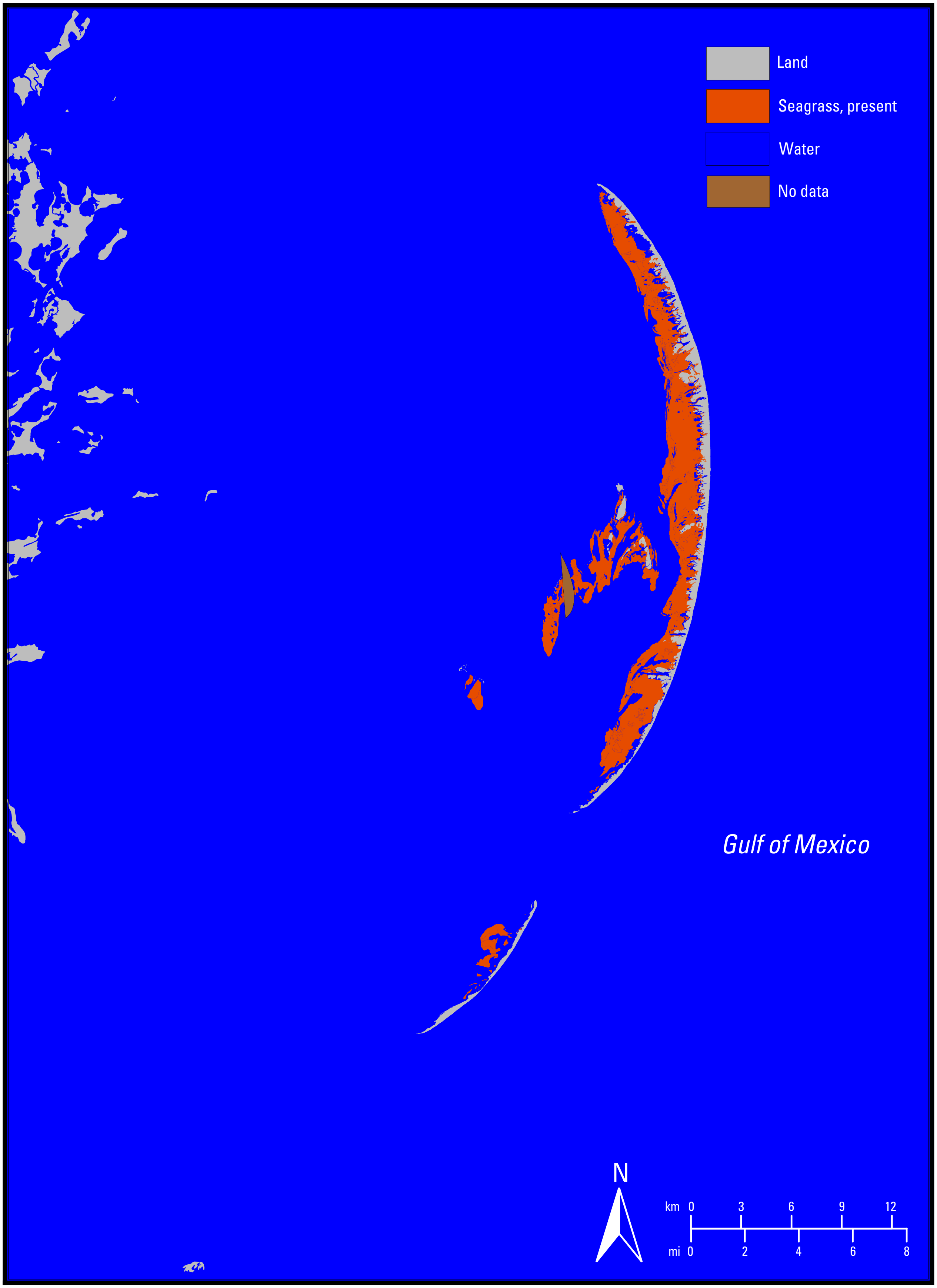

Figure 5. Distribution of seagrasses around the Chandeleur Islands, 1992.

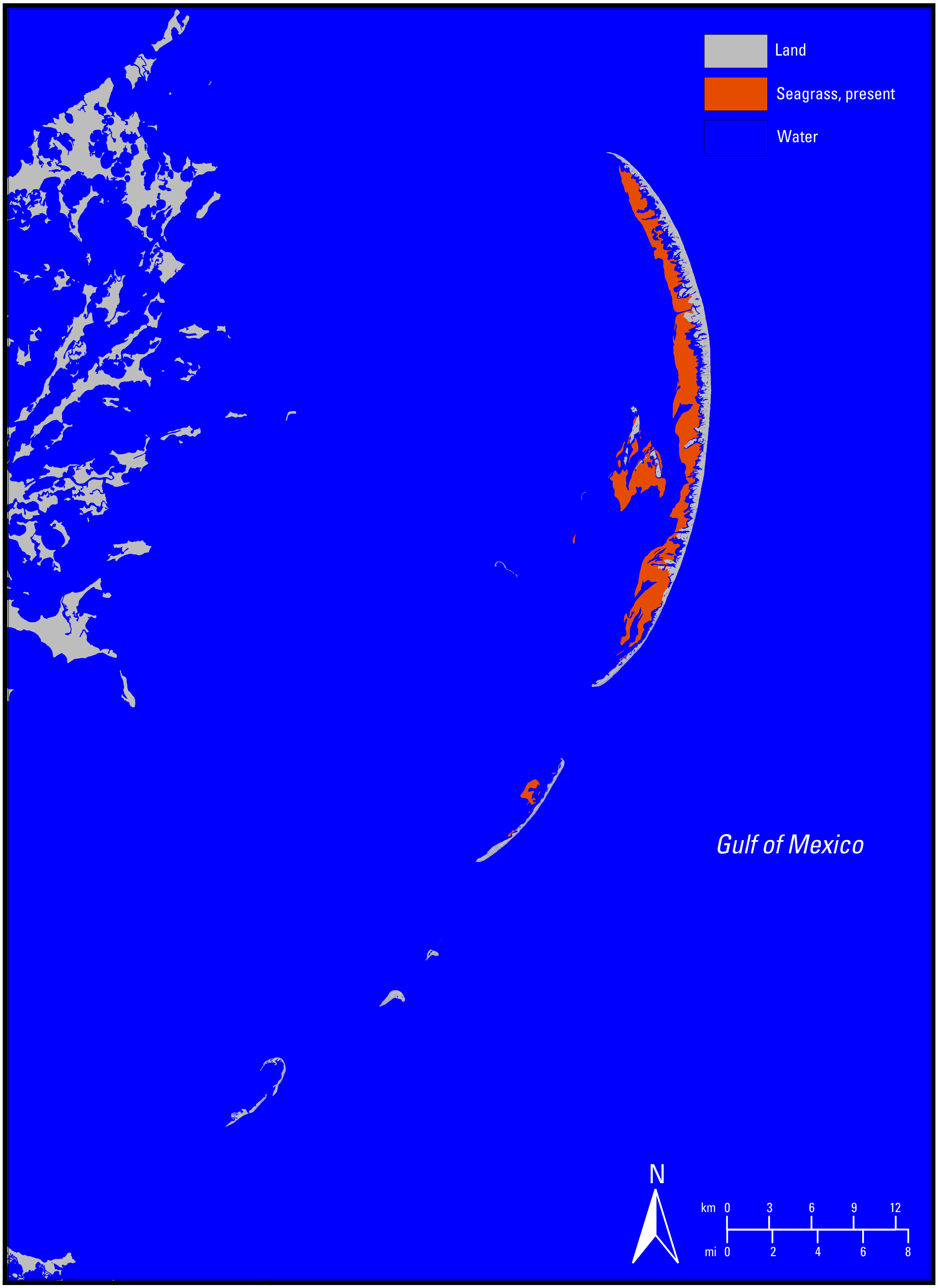

Figure 6. Distribution of seagrasses around the Chandeleur Islands, 1995.

integrity of the Chandeleur Islands and reducing the rate of island regression. Monitoring aspects of basic seagrass biology such as seasonal patterns, biomass, flowering, and epiphyte growth at a reference site relatively free from human-induced stressors would provide a standard for assessing the health of seagrasses at stressed sites in the Gulf of Mexico. Chandeleur seagrasses need to be mapped regularly to document damage and recovery from storms, certainly every 5 yr.

Restoration and Enhancement Opportunities

Changes in seagrass coverage are mainly driven by the long-term regression of the Chandeleur Island chain because of the deterioration of the St. Bernard Delta and direct seagrass loss from erosion and deposition from the passage of tropical storms and hurricanes. Additionally, the island chain has experienced increased damages to seagrasses over the past decades associated with boating. The persistence of Chandeleur seagrasses is dependent upon the calm, shallow bays provided by islands in the chain; furthermore, seagrasses may be important in stabilizing shoals on the bay side of the islands. These stable shoals provide a platform for the slow shoreward movement of islands. Loss of these shoals would hasten regression and island loss and result in loss of seagrass habitat.

Recovery from hurricane damage appears to be a slow process (Franze, 2002). Barrier island regression and community disruption by hurricanes are natural processes and appear to drive the Chandeleur seagrass community structure, which is the only true seagrass community in Louisiana. Outside stressors, however, could interrupt community resiliency and cause long-term seagrass and island loss. Considering the importance of these islands to geological and biological integrity of coastal Louisiana, it is prudent to obtain a better understanding of processes involved in seagrass recovery after hurricane damage to obtain effective ways to enhance recovery. Small-scale enhancement and restoration projects may not have a major effect on maintaining this large coastal system, but they do provide a knowledge base for effective large-scale projects if they are needed in the future. Louisiana does not have a seagrass monitoring or maintenance plan. Because of the importance of seagrasses to the integrity of the Chandeleur Island chain, seagrass monitoring, management, and restoration plans need to be developed and included in efforts to restore coastal Louisiana.

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