Tampa Bay and Saint Joseph Sound

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Background

Nearly 2 million people live in the Tampa Bay region, and the bay is the largest estuary in the State of Florida. The bay is home to the third largest port in the United States (in terms of domestic tonnage), and nearly 100,000 recreational boats are registered to owners in the counties surrounding the bay. Tampa Bay is also home to approximately 40,000 breeding pairs of shorebirds and over 100 bottlenose dolphins (*Tursiops truncatus*) (Tampa Bay National Estuary Program, 1996).

In the years following World War II, the human population in the Tampa Bay region increased at a rapid rate. Accompanying this population growth was a significant loss of native upland, intertidal, and subtidal plant communities. Perhaps half of the bay's seagrass meadows were lost between 1950 and 1982 because of combined impacts from dredge-and-fill activities and degraded water quality (Tampa Bay Estuary Program, 1996). The loss of seagrass acreage is thought to be at least partially responsible for declines in commercial and recreational fisheries for various species of finfish and shellfish.

In southwest Florida, seagrass meadows have been the focus of a significant amount of research on the relationships between pollutant loads, water quality, and seagrass health. In Tampa Bay, historical losses of seagrass coverage have been linked to both direct and indirect impacts (Lewis and others, 1991; Haddad, 1989; Lewis, 1989). In contrast, recent increases in seagrass coverage have been linked to improved water quality, which has in turn been linked to reductions in nitrogen loads caused by humans (Johansson, 1991; Avery, 1997; Johansson and Ries, 1997; Johansson and Greening, 2000). Recent improvements in the treatment and disposal of wastewater discharges by the city of Tampa, the city of St. Petersburg, and the city of Clearwater have been identified as major causes of improved water quality in the bay (Tampa Bay Estuary Program, 1996).

To the north and west of Tampa Bay are the areas of Clearwater Harbor and Saint Joseph Sound (fig. 1). While adjacent to Tampa Bay, Clearwater Harbor and Saint Joseph Sound have not yet benefited from a detailed examination of pollutant loads, water quality, and seagrass coverage as has Tampa Bay. Figure 1 shows the watershed for both Tampa Bay and the Saint Joseph Sound and Clearwater Harbor region.

Scope of Area

Tampa Bay is divided into seven bay segments: (1) Hillsborough Bay, (2) Old Tampa Bay, (3) Middle Tampa Bay, (4) Lower Tampa Bay, (5) Boca Ciega Bay, (6) Terra Ceia Bay, and (7) the Manatee River (fig. 2). These subareas have all been consistently included in seagrass mapping efforts dating back to the 1950s.

For Clearwater Harbor and Saint Joseph Sound, 1996 photography covered an area between The Narrows (27° 52.7' N. latitude) and Three Rooker Bar (28° 07.4' N. latitude). For 1999 and 2002 (the time period considered here), the area photographed was expanded northward up to Anclote Key (28° 10.7' N. latitude).

Methodology Employed To Determine and Document Current Status

Seagrass mapping efforts have played an important role in measuring the success, or lack thereof, made toward maintaining and expanding upon improvements to water quality in Tampa Bay and other estuaries. These mapping efforts are conducted on a typically biennial basis by the Southwest Florida Water Management District (SWFWMD) to fulfill its obligations under the Comprehensive Conservation and Management Plan created by the Tampa Bay National Estuary Program (1996). Seagrass maps are available for Tampa Bay for the years 1988 (fig. 3), 1990 (fig. 4), 1992 (fig. 5), 1994 (fig. 6), 1996 (fig. 7), 1999 (fig. 8), and 2002 (fig. 9). In addition, data from previous efforts are available for 1950 (Tampa Bay Regional Planning Council, 1986) and 1982 (Haddad, 1989) (see table 1). For Clearwater Harbor and Saint Joseph Sound, mapping efforts have been completed for the years 1996 and 1999 (figs. 7 and 8).

Seagrass maps were produced through multiple steps. First, aerial photography was obtained, usually in late fall to

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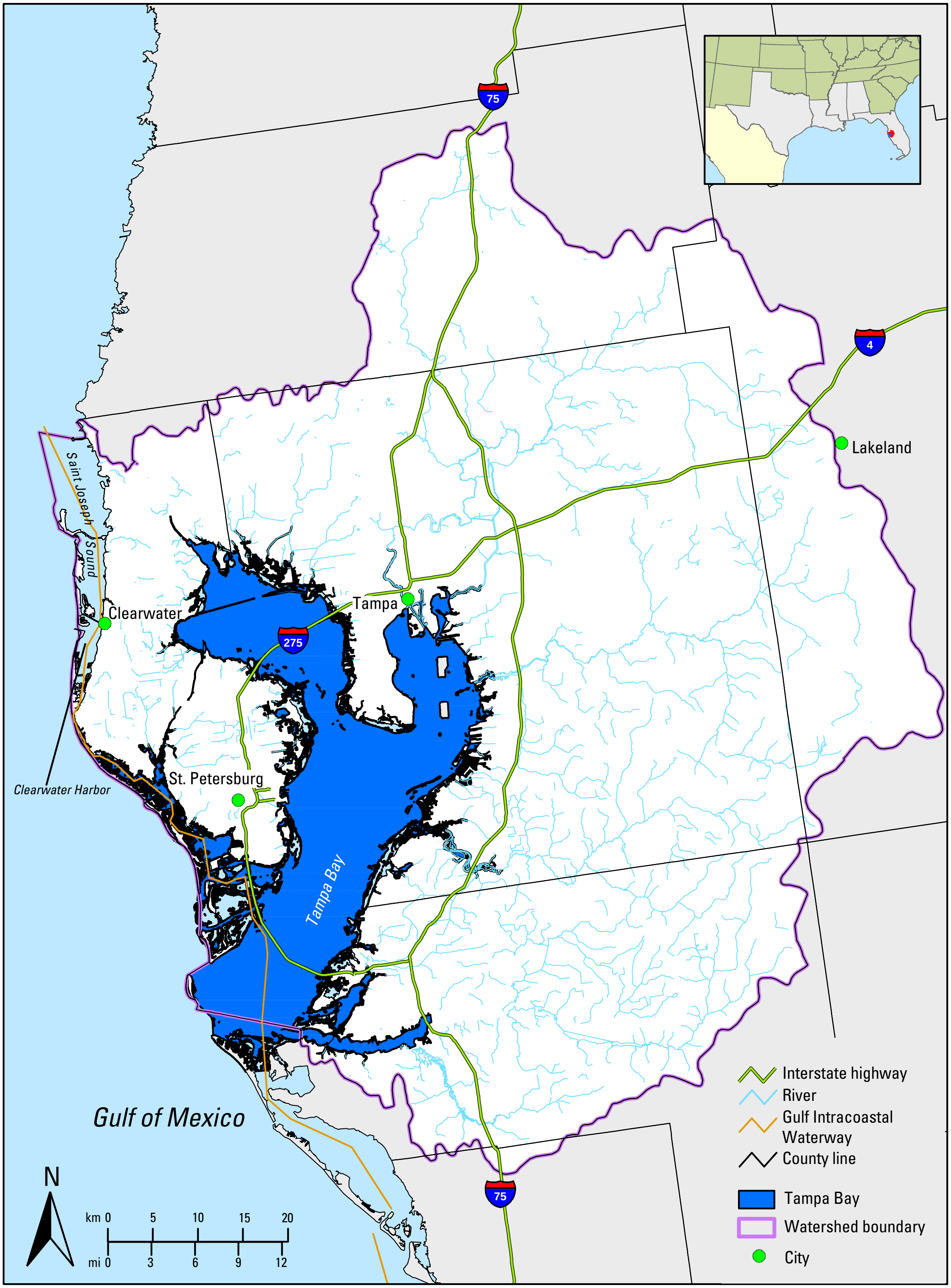

Figure 1. Watershed for Tampa Bay and Saint Joseph Sound.

early winter. This time of year is associated with both good water clarity and relatively high seagrass biomass.

Second, photointerpretation efforts were conducted in the field to allow for the successful evaluation of distinct photographic signatures. Seagrass signatures are divided into two classes (continuous and patchy), with a minimum mapping unit of 0.2 ha (0.5 acres).

Third, polygons were integrated into an ArcInfo program. For some past efforts (i.e., 1988, 1990, 1992, 1994, and 1996; figs. 3–7), individual polygons were delineated onto Mylar® overlays, cartographically transferred by using a zoom transfer scope to U.S. Geological Survey quadrangles, and then digitally transferred to an ArcInfo database for further characterization. These techniques allowed for the seagrass maps to meet U.S. National Map Accuracy Standards for 1:24,000-scale maps. For 1999 and 2002 seagrass maps (figs. 8 and 9), the 1:12,000-scale U.S. National Map Accuracy Standards were met. While photography remained at a scale of 1:24,000, the higher positional accuracy standard required the use of tighter ground control and more sophisticated mapping techniques. Analytical stereo plotters were used for photointerpretation rather than traditional stereoscopes. This technique allowed for the production of a georeferenced digital file of the photointerpreted images without the need for additional photograph-to-map transfer. Rather than redrawing seagrass coverage polygons for each mapping year's efforts, the previous efforts' digital coverages were used as the baselines, and only the changes in seagrass coverage were mapped. Areas with no change between efforts were coincident with the earlier effort's coverage.

Fourth, hard copies of plots were made of photointerpreted seagrass coverage, and 60 randomly chosen points were identified for a classification accuracy assessment of the finished map. A hand-held Global Positioning System unit was used, along with the map and the latitude and longitude of the randomly located stations, to develop an unbiased determination of the map's classification accuracy. A 90% classification accuracy standard is required for these efforts, and 96% accuracy was achieved for 1999 efforts (i.e., 53 of 55 stations that could be visited had been accurately described on the maps).

Methodology Employed To Analyze Historical Trends

To determine seagrass coverage for historical conditions in Tampa Bay (table 1), the Tampa Bay Regional Planning Council (1986) used 1:24,000-scale, natural color aerial photographs. The resulting seagrass maps were digitized by the Florida Marine Research Institute, converted from raster to vector format, and horizontally georeferenced with available ground controls. This mapping effort met U.S. National Map Accuracy Standards for 1:24,000-scale maps. No groundtruthing was conducted concurrent with the photography for this time period. Coverage was simply classified as polygons with or without seagrass coverage; the classification system did not distinguish between patchy and continuous coverage.

Seagrass coverage estimates for 1982 were also available for Tampa Bay (table 1). These estimates are from a joint project between the U.S. Fish and Wildlife Service (USFWS) and the Florida Department of Environmental Protection. This effort digitized existing 1:24,000-scale natural color aerial photography that had been delineated according to the USFWS National Wetlands Inventory standard classification system. This mapping effort met U.S. National Map Accuracy Standards for 1:24,000-scale maps. As with the 1950 photography, a statistically relevant groundtruthing effort was not conducted concurrent with the acquisition of photography. The classification system did not distinguish between patchy and continuous coverage.

All historical mapping efforts are available in digital format through either the SWFWMD or the Tampa Bay National Estuary Program.

Status and Trends

Tampa Bay

Across the entire Tampa Bay study area, the majority of coverage is in the higher salinity portions of the lower bay, with the most extensive seagrass meadows being found in the vicinity of Fort Desoto County Park, just west of the northern end of the Sunshine Skyway. Extensive seagrass meadows are also found on the southeastern shore of Tampa Bay, from Anna Maria Island up to the Little Manatee River. Significant coverage is found in Old Tampa Bay, particularly in the eastern portion adjacent to Interbay Peninsula. Coverage in Hillsborough Bay is much less extensive than in other portions of the bay.

Tables 1 and 2 show the overall trend in seagrass coverage for Tampa Bay from 1950 to 2002. In 1950, seagrass meadows covered 16,350 ha (40,401 acres) of bay bottom. By 1982, that number had dropped to 8,763 ha (21,653 acres). From 1982 to 1996, acreage increased by 2,130 ha (5,263 acres) to 10,893 ha (26,917 acres) total. The average rate of increase between 1982 and 1996 was 152 ha (376 acres) per year. From 1988 to 1996, the average rate of increase was 184 ha (455 acres) per year. From 1996 to 1999, there was a decrease in coverage of 840 ha (2,076 acres) to 10,053 ha (24,841 acres) total. From 1999 to 2002, there was an increase in coverage of 501 ha (1,238 acres) to 10,554 ha (26,079 acres) total. Seagrass coverage in Tampa Bay in 2002 was 65% of the 1950 values.

For individual segments of the bay, table 1 can be used, in addition to the text below, to assess changes in coverage on a segment-by-segment basis over time.

Figure 2. Scope of area for the Tampa Bay and Saint Joseph Sound vignette.

Hillsborough Bay

In Hillsborough Bay, seagrass coverage dropped from 931 ha (2,301 acres) in 1950 to a complete absence in 1982. Coverage in 2002 was 194 ha (479 acres), a rate of increase of about 10 ha (25 acres) per year between 1982 and 2002. Seagrass coverage in Hillsborough Bay in 2002 was 21% of the 1950 values (table 1).

Old Tampa Bay

In Old Tampa Bay, seagrass coverage declined from 4,330 ha (10,700 acres) in 1950 to 2,026 ha (5,006 acres) in 1988. From 1988 to 1994, coverage increased at a rate of about 61 ha (151 acres) per year to 2,392 ha (5,911 acres) total. From 1994 to 1996, coverage decreased to 2,332 ha (5,762 acres), a 30 ha (74 acre) per year decline. From 1996 to 1999, coverage again decreased, this time to 1,779 ha (4,396 acres), a rate of decline of about 185 ha (457 acres) per year. Coverage in 2002 increased by 355 ha (877 acres) to 2,134 ha (5,273 acres) total. Seagrass coverage in Old Tampa Bay in 2002 was 49% of the 1950 values (table 1).

Middle Tampa Bay

In the middle Tampa Bay subarea, seagrass coverage declined from 3,885 ha (9,600 acres) in 1950 to 1,636 ha (4,043 acres) in 1982. From 1982 to 2002, seagrass coverage increased by 680 ha (1,680 acres), a 42% increase. Seagrass coverage in middle Tampa Bay in 2002 was 60% of the 1950 values (table 1).

Lower Tampa Bay

Relative to other areas of Tampa Bay, portions of the lower bay appear to exhibit a more optimistic picture of seagrass recovery. In lower Tampa Bay, seagrass coverage in 1950 was 2,469 ha (6,101 acres). Seagrass coverage in lower Tampa Bay in 2002 was 2,271 ha (5,612 acres), or 92% of the 1950 values (table 1).

Boca Ciega Bay

In Boca Ciega Bay, seagrass coverage declined from 4,371 ha (10,801 acres) in 1950 to 2,335 ha (5,770 acres) in 1982. From 1982 to 2002, seagrass coverage increased at a rate of 39 ha (96 acres) per year. Seagrass coverage in Boca Ciega Bay in 2002 was 3,105 ha (7,673 acres), or 71% of the 1950 values (table 1).

Terra Ceia Bay

In Terra Ceia Bay, seagrass coverage remained similar between 1950 and 1982 (283 ha (699 acres) and 304 ha (751 acres), respectively); however, 1988 coverage was 383 ha (946 acres), a 26% increase from 1982. In 2002, seagrass coverage in Terra Ceia Bay was 380 ha (939 acres), or 34% higher than in 1950 (table 1).

Manatee River

In the Manatee River, seagrass coverage declined between 1950 and 1982 (81 ha (200 acres) and 53 ha (131 acres), respectively); however, 1988 seagrass coverage was 140 ha (346 acres), a 165% increase from 1982. In 2002, seagrass coverage in the Manatee River was 154 ha (381 acres), or 91% higher than in 1950 (table 1).

Clearwater Harbor and Saint Joseph Sound

For Clearwater Harbor and Saint Joseph Sound, figure 9 shows the location of seagrass coverage in 2002. To the south, in Clearwater Harbor, seagrass coverage diminished compared to the wider areas of Saint Joseph Sound to the north. The deep edges of seagrass meadows extend farther offshore to the north, which seems to correspond to the perceived improvement in water quality in the northern portion of the mapped area. Unfortunately, water-quality monitoring programs are not nearly as well developed in Clearwater Harbor and Saint Joseph Sound as they are in Tampa Bay.

Between 1999 and 2002, seagrass coverage in Clearwater Harbor and Saint Joseph Sound decreased from 5,958 ha (14,722 acres) to 5,713 ha (14,117 acres), a decrease of 245 ha (605 acres). Seagrass coverage in Clearwater Harbor and Saint Joseph Sound in 2002 was 96% of the 1999 coverage.

Causes of Change

Historical losses of seagrass coverage in Tampa Bay (i.e., between 1950 and 1982; table 1) are thought to be due to direct and indirect impacts associated with rapid human population growth in the watershed in the post-World War II years (Tampa Bay Estuary Program, 1996). Direct-impact losses occurred because of dredge-and-fill activities associated with waterfront development for residential and commercial land uses. Indirect-impact losses are thought to be associated with increased point and nonpoint source nutrient loads that accompanied the population growth and urbanization of the watershed.

In contrast, the overall trend of increasing seagrass coverage in Tampa Bay from 1982 to 2002 is related to increases in water clarity during that same time period (Johansson, 1991; Johansson and Ries, 1997; Johansson and Greening, 2000). Increased water clarity, in turn, appears to be related to decreased phytoplankton populations (Johansson, 1991; Janicki and Wade, 1996). Finally, the reduction in phytoplankton levels is thought to be related to the approximately 61% decline in nitrogen loads coming into Tampa Bay between 1976 and 1992–94 (Tampa Bay Estuary Program, 1996).

Seagrass planting efforts appear to have played a minor role in bringing about the sustained increases in acreage in Tampa Bay, as most of the areas where seagrass increases have occurred are in parts of the bay where no transplanting efforts have been undertaken (Tomasko, personal observation). Also, seagrass transplanting efforts have usually been on the level of 1 ha of effort (usually less), whereas increases in seagrass coverage averaged 184 ha (455 acres) per year between 1988 and 1996 (figs. 3–7; table 1).

In Clearwater Harbor and Saint Joseph Sound, systemwide water-quality monitoring programs are just beginning, and information on trends in water quality is not yet available. Furthermore, watershed-level pollutant loading models for the watershed scale have yet to be derived for this region.

Monitoring for Seagrass Health

In addition to aerial photography for estimating seagrass acreage, a series of fixed transects has been established throughout Tampa Bay. A similar monitoring effort is underway in Clearwater Harbor and the southern portion of Saint Joseph Sound. Approximately 60 transects are placed throughout Tampa Bay, and they are revisited every October. At each transect, seagrass cover is estimated for each species by using the Braun-Blanquet method (for more information, see *http://chla.library.cornell.edu/cgi/t/text/text-idx?c=chla;idno=2917578*). Also, the maximum distance offshore where seagrasses are found is noted, as is the relative water depth at each station. Year-to-year comparisons are thus possible for examining trends in seagrass meadow composition for individual transects. Periodic reports on these findings are produced by the city of Tampa (e.g., Avery, 2000) and provide useful groundtruthed information on seagrass health throughout the bay.

The transect-based monitoring effort has provided information useful for interpreting and verifying results from seagrass mapping efforts. In Old Tampa Bay, where mapping efforts concluded that seagrass coverage declined by 24% between 1996 and 1999 (figs. 7 and 8; table 1), four of eight transects showed evidence of a shoreward migration of the offshore edge of the seagrass meadow between 1998 and 1999 (Avery, 2000). In Boca Ciega Bay, where seagrass coverage declined only 3% between 1996 and 1999 (table 1), only 1 of 10 transects showed a shoreward retreat of the offshore edge of the meadow between 1998 and 1999 (Avery, 2000).

Table 1. Seagrass coverage in hectares (acres) by year for segments of Tampa Bay.

[HB = Hillsborough Bay, OTB = Old Tampa Bay, MTB = Middle Tampa Bay, LTB = Lower Tampa Bay, BCB = Boca Ci ega Bay, TCB = Terra Ceia Bay, MR = Manatee River]

	1950	1982	1988	1990	1992	1994	1996	1999	2002
HB	931 (2,301)		3 (7)	19 (47)	19 (47)	59 (146)	78 (193)	78 (193)	194 (479)
OTB	4,330 (10,699)	2,405 (5,943)	2,026 (5,006)	2,251 (5,562)	2,378 (5,876)	2,392 (5,911)	2,332 (5,762)	1,779 (4,396)	2,134 (5,273)
MTB	3,885 (9,600)	1,636 (4,043)	2,106 (5,204)	2,148 (5,308)	2,133 (5,271)	2,337 (5,775)	2,242 (5,540)	2,282 (5,639)	2,316 (5,723)
LTB	2,469 (6,101)	2,030 (5,016)	2,232 (5,515)	2,486 (6,143)	2,526 (6,242)	2,511 (6,205)	2,582 (6,380)	2,366 (5,846)	2,271 (5,612)
BCB	4,371 (10,801)	2,335 (5,770)	2,533 (6,259)	2,754 (6,805)	2,813 (6,951)	2,880 (7,116)	3,116 (7,700)	3,021 (7,465)	3,105 (7,673)
TCB	283 (699)	304 (751)	383 (946)	405 (1,001)	406 (1,003)	404 (998)	394 (974)	376 (929)	380 (939)
MR	81 (200)	53 (131)	140 (346)	147 (363)	147 (363)	148 (366)	148 (366)	152 (376)	154 (381)
Total	16,350 (40,401)	8,763 (21,653)	9,423 (23,284)	10,209 (25,226)	10,422 (25,753)	10,732 (26,519)	10,893 (26,917)	10,053 (24,841)	10,554 (26,079)

Species Information

Besides estimating acreage, the transect-based monitoring effort also allows for determination of the species composition of seagrass meadows throughout Tampa Bay. It was found that shoal grass (*Halodule wrightii*) was distributed throughout the bay, whereas wigeon grass (*Ruppia maritima*) was only encountered at transects located in Hillsborough Bay and Old Tampa Bay. Manatee grass (*Syringodium filiforme*) and turtle grass (*Thalassia testudinum*) were found in all portions of Tampa Bay except Hillsborough Bay (although Avery (2000) encountered turtle grass along a transect at Wolf Branch, on the border between Hillsborough Bay and Middle Tampa Bay). Star grass (*Halophila engelmannii*) was found along transects in lower Tampa Bay and Old Tampa Bay. In an earlier assessment, Lewis and Phillips (1980) found turtle grass and shoal grass to be equally abundant throughout the bay, with manatee grass and wigeon grass in lesser amounts. The least commonly encountered seagrass species was star grass.

In Clearwater Harbor, only shoal grass and turtle grass were encountered along the monitored transects (Avery, 2000). In the southern portion of Saint Joseph Sound, shoal grass, turtle grass, and manatee grass were all encountered.

Restoration and Enhancement Opportunities

Restoration and enhancement efforts for seagrasses in Tampa Bay are focused on implementation of a nitrogen-management strategy developed by the partners in the Tampa Bay Estuary Program. Efforts to reduce seagrass scarring by boat propellers have also been important elements in limited, but heavily impacted, areas of the bay, as summarized here.

The Tampa Bay Nitrogen Management Strategy

In 1990, Tampa Bay was accepted into the U.S. Environmental Protection Agency's National Estuary Program (TBNEP). The TBNEP, a partnership that includes three regulatory agencies and six local governments, has built on the resource-based approach initiated by earlier bay management efforts. Further, TBNEP has developed water-quality models (Zarbock and others, 1994; Janicki and Wade, 1996; Martin and others, 1996; Zarbock and others, 1996; Morrison and others, 1997; Wang and others, 1999) to quantify linkages between nitrogen loadings and bay water quality, as well as models that link loadings and water quality to seagrass goals (Squires and others, 1996; Janicki and Wade, 1996; Johansson and Greening, 2000).

The establishment of clearly defined and measurable goals is crucial for a successful resource management effort. In 1996, the TBNEP adopted a baywide minimum seagrass goal of 15,379 ha (38,002 acres). This goal represented 95% of the estimated 1950 seagrass cover (minus the nonrestorable areas) and included the protection of the existing 10,053 ha (24,841 acres) plus the restoration of an additional 5,325 ha (13,158 acres) (Tampa Bay National Estuary Program, 1996).

Recent research indicates that the deep edges of turtle grass meadows, the primary seagrass species for which nitrogen-loading targets are being set, correspond to the depth at which 20.5% of subsurface irradiance (the light that penetrates the water surface) reaches the bay bottom on an average annual basis (Dixon and Leverone, 1995). Water clarity and light penetration in Tampa Bay are affected by a number of factors such as phytoplankton biomass, nonphytoplankton turbidity, and water color. Janicki and Wade (1996) used regression analyses, based on long-term data provided by the Environmental Protection Commission of Hillsborough County, to develop an empirical model describing water-clarity variations in the four largest bay segments. Results of the modeling effort indicated that, on a baywide basis, variation in chlorophyll a concentration is the major factor affecting variation in average annual water clarity. The empirical regression model was used to estimate chlorophyll a concentrations necessary to maintain water clarity needed for seagrass growth for each major bay subarea. The adopted targets of average annual chlorophyll a (which are specific to each segment: 8.5 µg/L for Old Tampa Bay, 13.2 µg/L for Hillsborough Bay, 7.4 µg/L for middle Tampa Bay, and 4.6 µg/L for Lower Tampa Bay) are easily measured and tracked through time and are used as intermediate measures for assessing success in maintaining water-quality requirements necessary to meet the long-term seagrass goal (Johansson and Greening, 2000; Tomasko and others, 2005).

Water-quality conditions in 1992–94 appeared to allow an annual average of more than 20.5% of subsurface irradiance to reach target depths (i.e., the depths to which seagrasses grew in 1950). Thus, a management strategy based on maintaining the 1992–94 nitrogen-loading rates should be adequate to achieve the seagrass restoration goals. This maintenance approach, combined with careful monitoring of water quality

Table 2. Tampa Bay seagrass coverage from 1950 to 2002.

Year	Hectares	Acres
1950	16,350	40,401
1982	8,763	21,653
1988	9,423	23,284
1990	10,209	25,226
1992	10,422	25,753
1994	10,732	26,519
1996	10,893	26,917
1999	10,053	24,841
2002	10,554	26,079

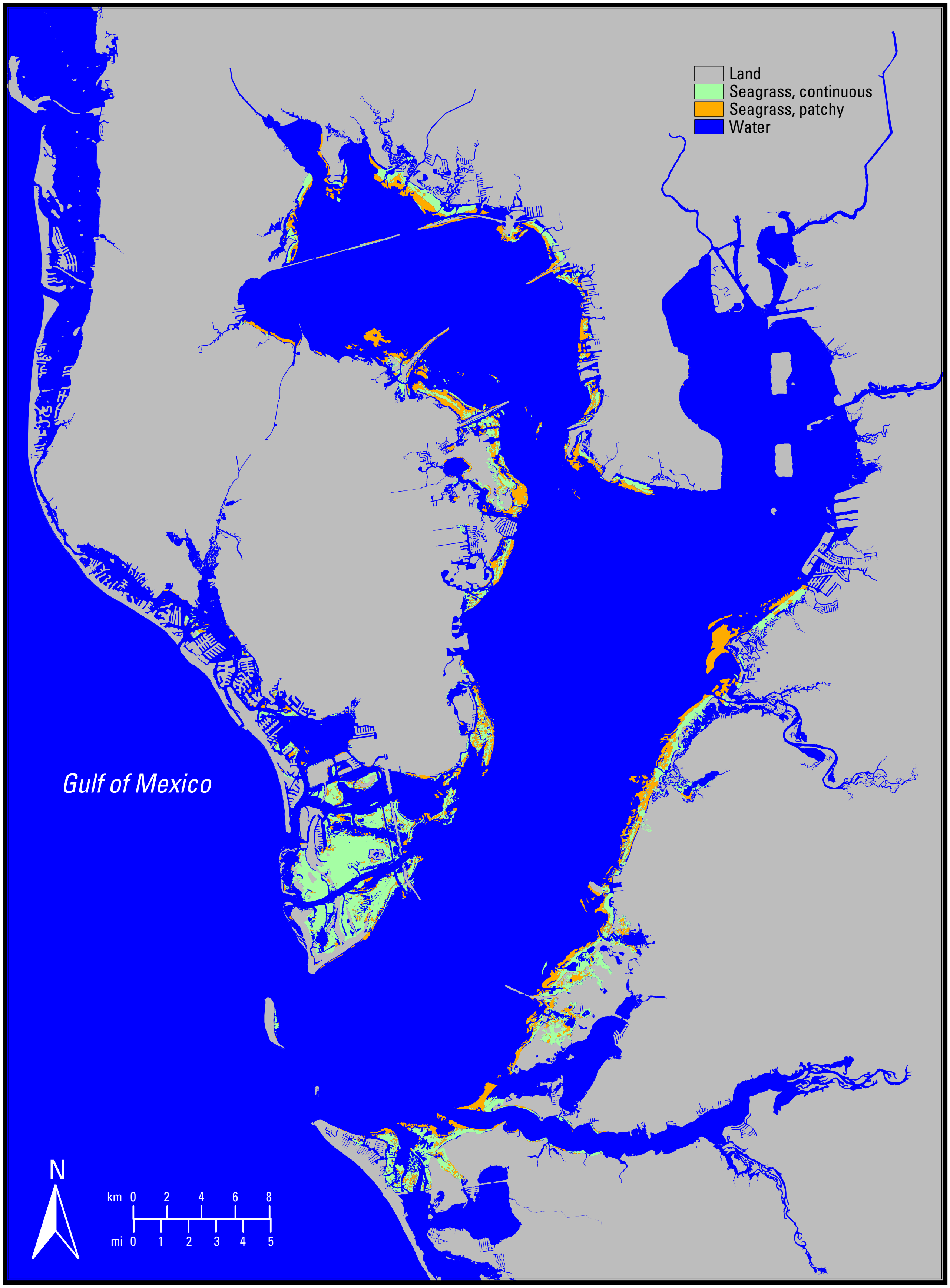

Figure 3. Distribution of seagrass in Tampa Bay, 1988.

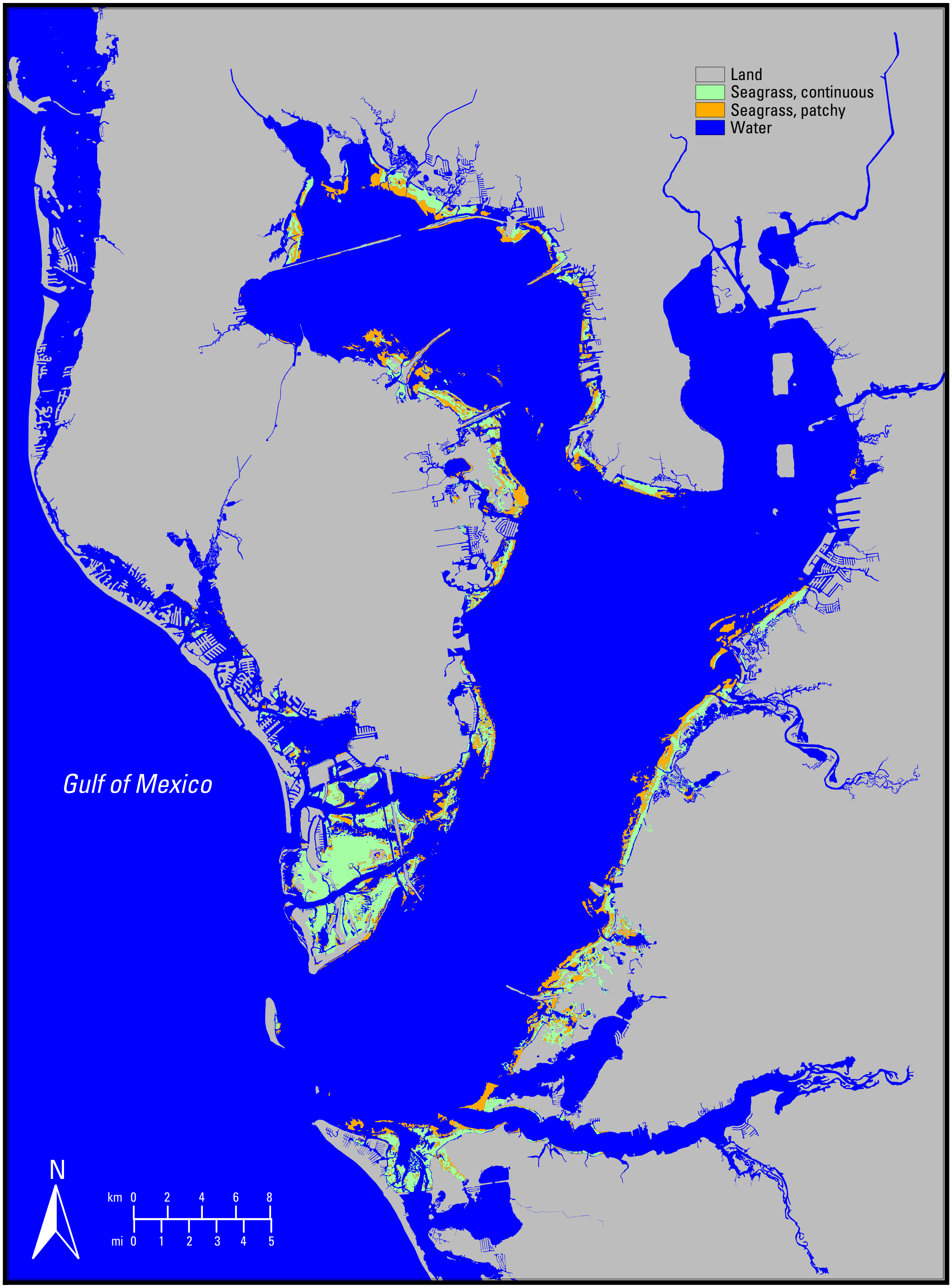

Figure 4. Distribution of seagrass in Tampa Bay, 1990.

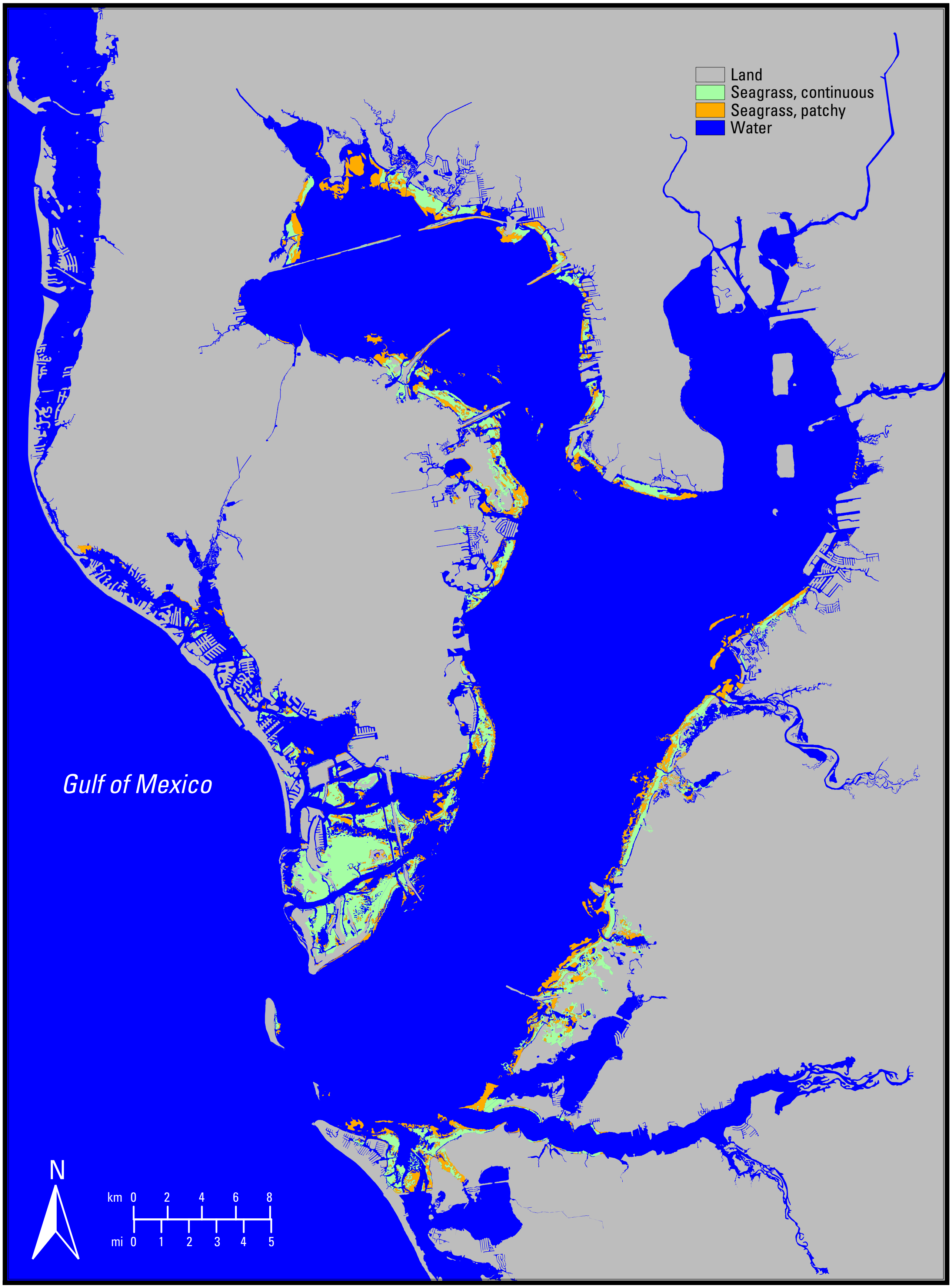

Figure 5. Distribution of seagrass in Tampa Bay, 1992.

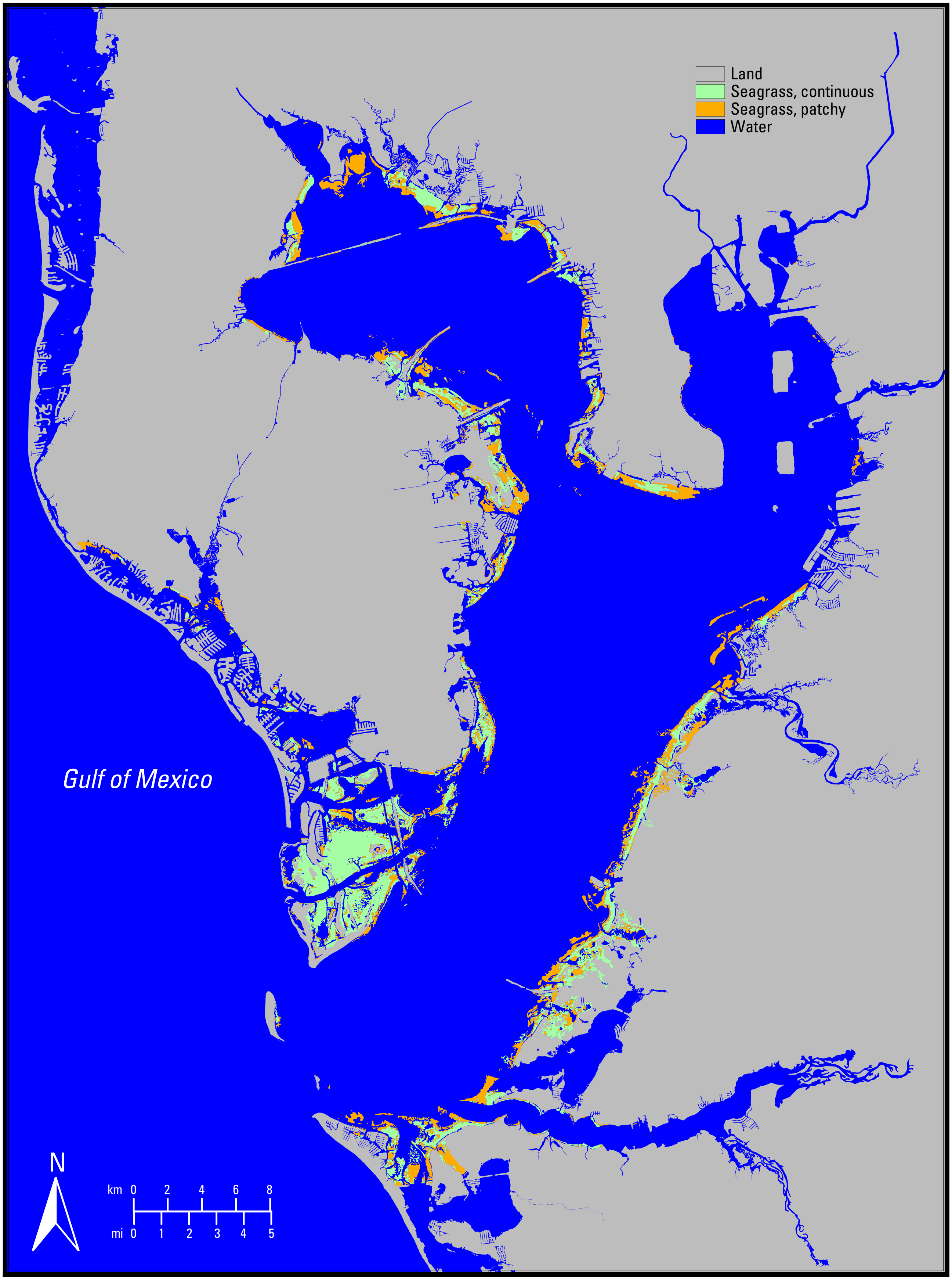

Figure 6. Distribution of seagrass in Tampa Bay, 1994.

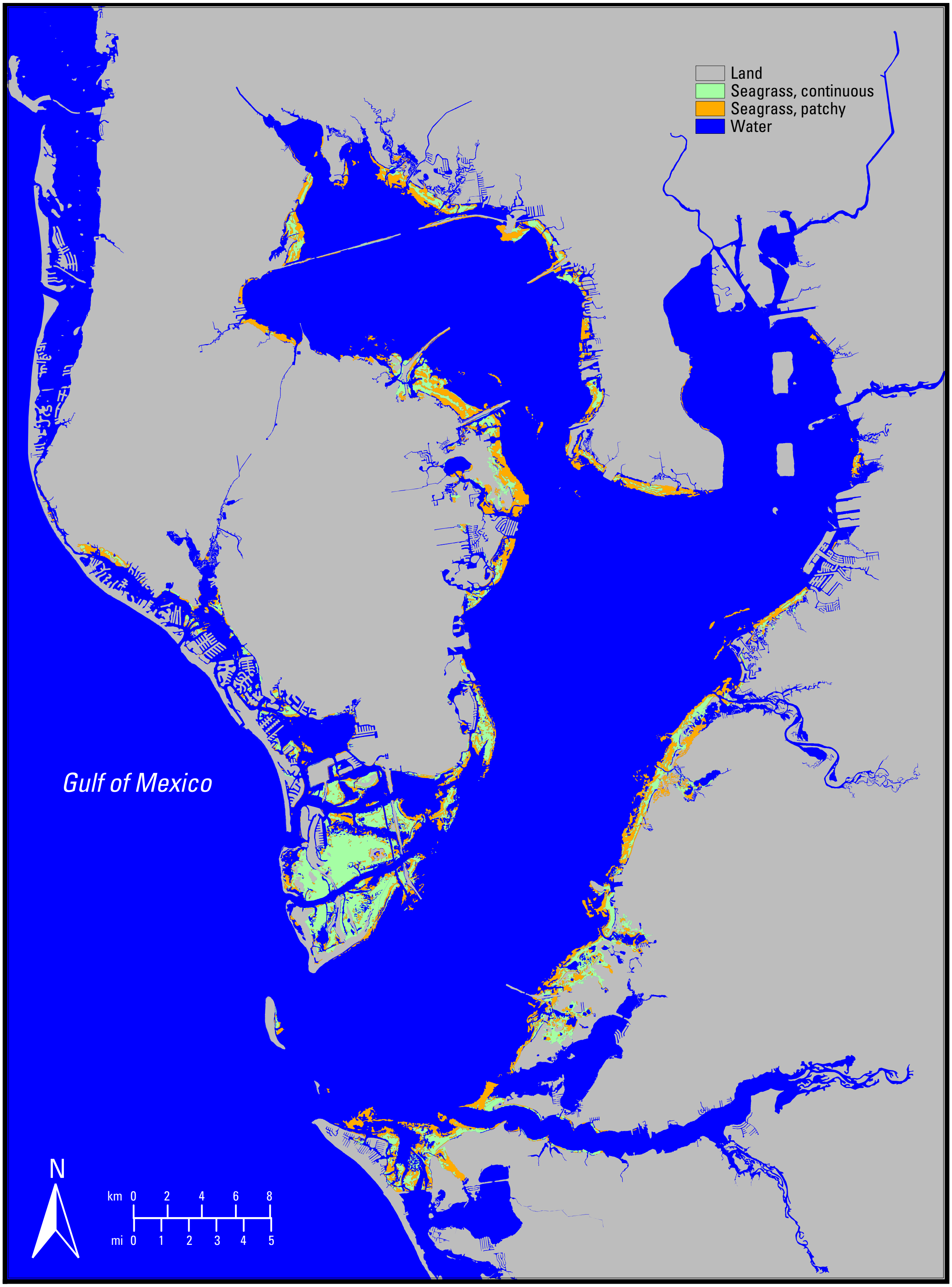

Figure 7. Distribution of seagrass in Tampa Bay, 1996.

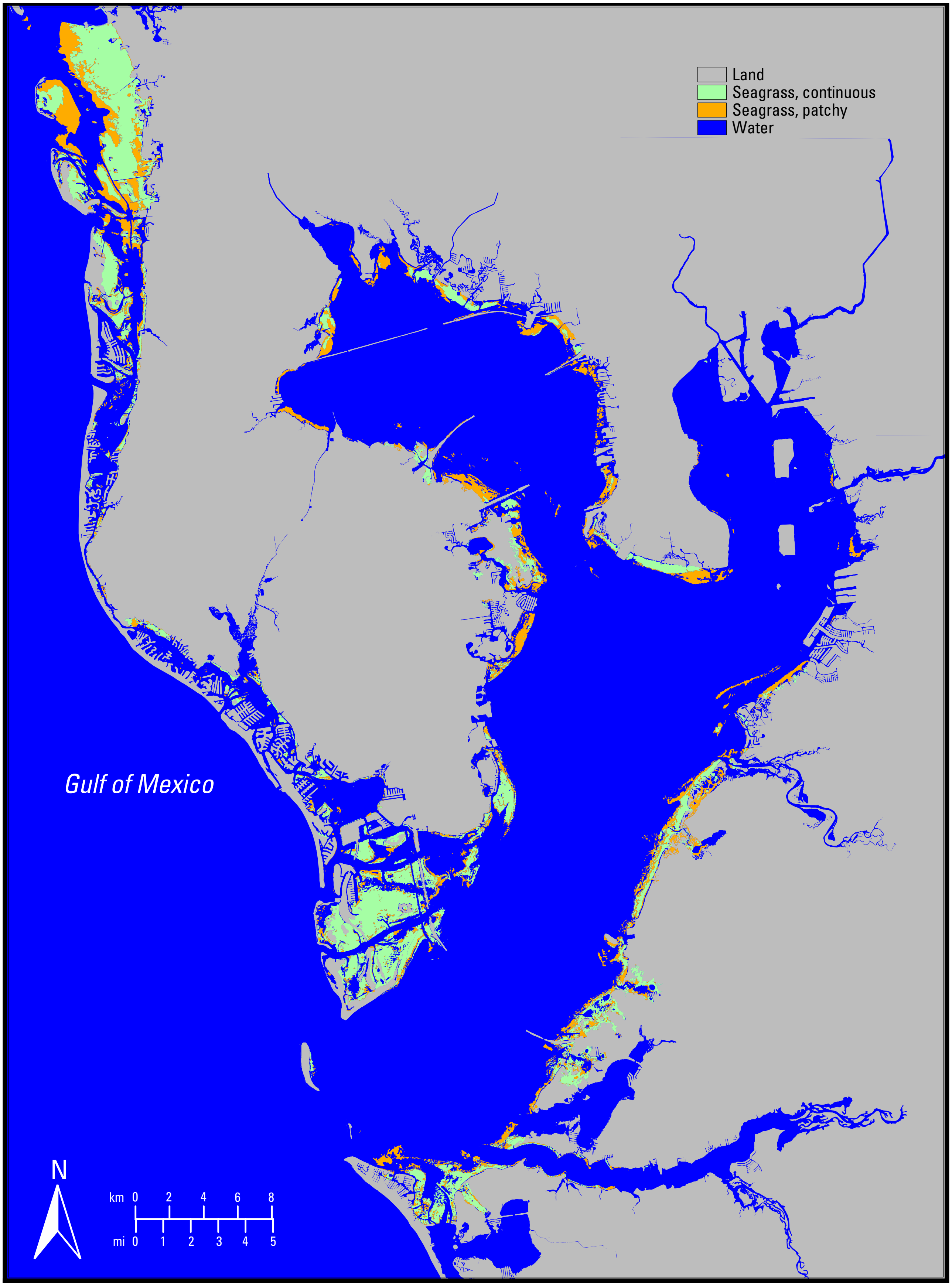

Figure 8. Distribution of seagrass in Tampa Bay, 1999.

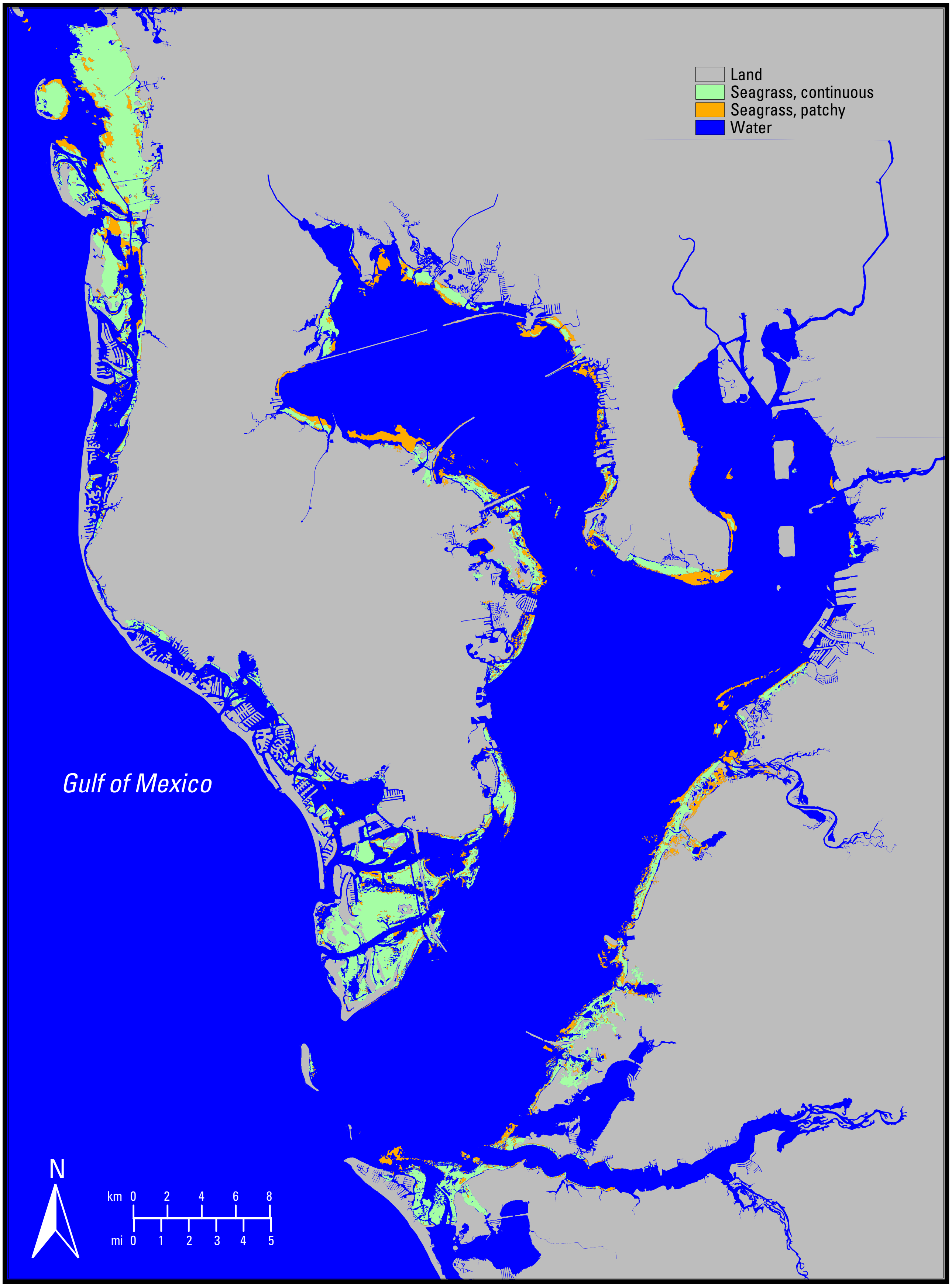

Figure 9. Distribution of seagrass in Tampa Bay, 2002.

and seagrass extent, was adopted by the TBNEP partnership in 1996 as its initial nitrogen-load management strategy.

A successful adherence to the maintenance nitrogen-loading strategy, however, may be hindered by the projected population growth in the watershed. A 20% increase in population and a subsequent 7% increase in annual nitrogen load are anticipated by the year 2010 (Zarbock and others, 1996). Therefore, if the projected loading increase (a total of 17 tons (~15 Mg) per year) is not prevented or precluded by watershed management actions, the maintenance nitrogen-load management strategy will not be achieved.

In 1996 local government, agency, and private industry partners formed a nitrogen management consortium to develop a plan to accomplish the nitrogen-reduction goal (17 tons (~15 Mg) per year) needed to meet long-term water-quality conditions necessary for seagrass restoration to historical levels. A nitrogen management action plan developed by the public and private partners in the consortium combined for each bay subarea all local government, agency, and private industry projects that will contribute to meeting the 5-yr nitrogen-management goal (Tampa Bay Estuary Program, 1998b). A total of 134 tons (~122 Mg) per year reduction in nitrogen loading to Tampa Bay was expected by the end of 2000, which exceeds the 1995–99 reduction goal by 60%.

Reduction of Seagrass Scarring

Fort Desoto Seagrass Protection Efforts

Assessments by the Florida Department of Environmental Protection and the Florida Marine Research Institute indicate that there is moderate to severe scarring in nearly 30% of the total seagrass coverage in Tampa Bay, some of the worst rates in the State. In response to these findings, and following the work of a coalition of regulatory and citizen advisory groups, Pinellas County adopted a seagrass protection ordinance in 1992 for the seagrass beds around Fort Desoto County Park, near the mouth of Tampa Bay (Stowers and others, 2000). Results of a 5-yr assessment indicated that, following placement of signage in the management area, the rate of increase of new scars was significantly reduced in both the caution zone and the exclusion zone as compared with the control (no signage) area (Stowers and others, 2000). The placement of signs, coupled with full-time, on-water presence of law enforcement officers in shallow draft boats, has reduced the rate of scarring (Jake Stowers, pers. commun.).

Cockroach Bay Seagrass Management

In addition to the governmental and private industry initiatives to manage nitrogen loadings to Tampa Bay, several efforts by citizens have contributed to the restoration and protection of seagrass. For example, when Hillsborough County proposed closing the area to boats and other restrictions in the Cockroach Bay Aquatic Preserve because of the extensive propeller scarring of seagrass in that area, local citizens and fishers organized in 1995 as “C-BUG” (Cockroach Bay Users Group) and proposed alternative, nonregulatory ways for protecting the seagrass from further propeller scarring. Hillsborough County agreed to allow C-BUG a 3-yr trial period for their strong protectionary approaches through education and voluntary slow speeds. C-BUG projects have included development and distribution of educational material to encourage the boating public to take responsibility for its actions. It has posted educational signs at public boat ramps in Cockroach Bay and placed 25 seagrass-area marker buoys at the deep edges of the seagrass meadows. Further, C-BUG has developed and placed a unique “stoplight” tidal gage to alert boaters of the tidal water level in relation to the seagrass. Recent monitoring of the Cockroach Bay area has indicated that several seagrass areas that were previously heavily scarred are recovering (Ehringer, 1998, 2000).

To date, results from these two seagrass management approaches support a similar conclusion: signage, education, and on-water presence appear to be just as effective in reducing rates of new scarring as is closure. This conclusion, if it continues to hold in these and other areas, is an important finding for seagrass management.

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