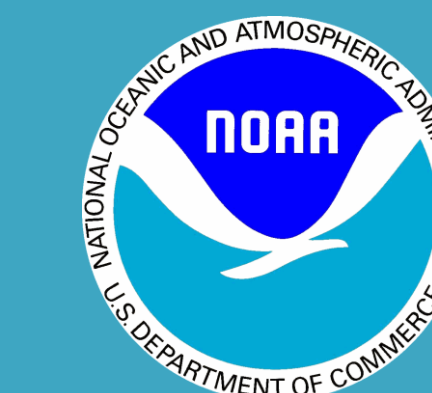
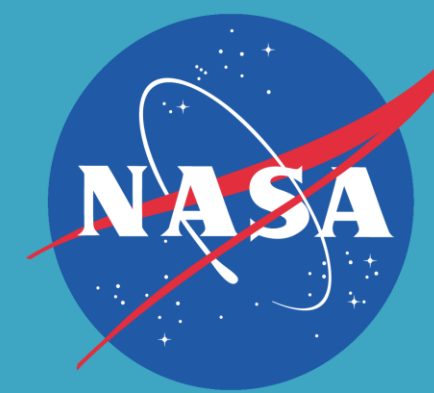


# Decadal-Scale Changes in Seagrass Coverage on the Mississippi Barrier Islands, Northern Gulf of Mexico



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## Background

Seagrass beds provide essential habitat for a wide variety of aquatic species and buffer subaqueous sediments from erosion (Green and Short, 2003; Larkum et al., 2006), yet they are in decline worldwide. Pressures on seagrass communities include reduction in water clarity, alteration of sediment migration via dredging and direct destruction from boating and commercial fishing (Green and Short, 2003; Orth et al., 2006). Mapping seagrass beds at high spatial resolution over time is important for distinguishing the effects of major disturbances from natural variation in seagrass coverage (Dekker, et al., 2005; Kendrick et al., 2000; Kirkman, 1996; Pasqualini et al., 2001).

The Mississippi barrier islands constitute a portion of the world's longest barrier island chain which extends along the U.S. Atlantic and Gulf of Mexico coasts (Pilkey, 2003). From west to east, these include Cat, West and East Ship, Horn and Petit Bois (Fig. 1). Since 1971, each of these islands except Cat has been largely protected, including a 1.6 km marine habitat buffer zone, from direct anthropogenic disturbance under stewardship of the Gulf Islands National Seashore, U.S. National Park Service. Prior to 1995, the island seagrass beds were subject to disturbance by shrimp trawling. Each of the islands has been impacted by numerous hurricanes, including severe impacts by Hurricane Camille (1969) and Hurricane Katrina (2005), and decreased steadily in land area since they were first mapped accurately ca. 1850 (Morton, 2008; Otvos and Carter, 2008).

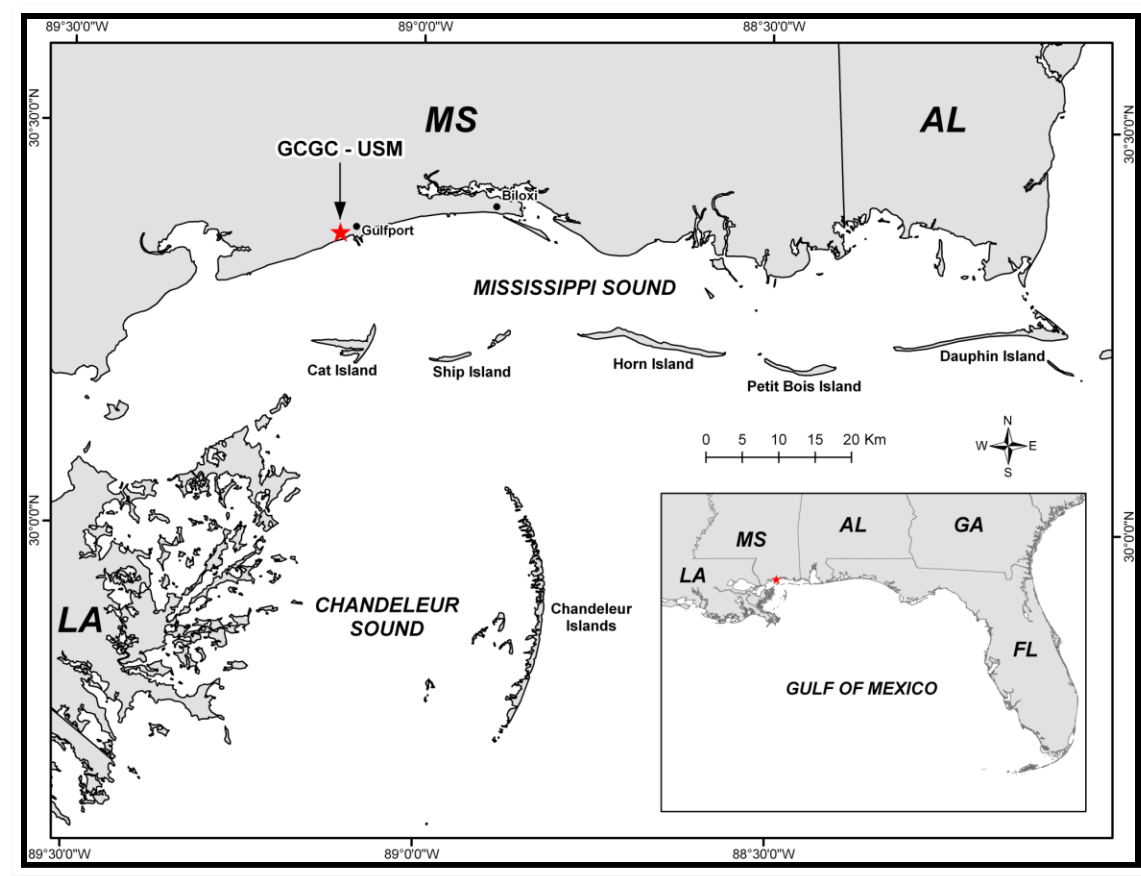


Figure 1. Map of the Mississippi barrier islands, northern Gulf of Mexico. The red star indicates the location of the USM Gulf Coast Geospatial Center.

Comparisons of earlier seagrass surveys (Eleuterius and Miller, 1976) with more recent studies (Moncrieff et al., 1998; Foster, 2005; Peneva et al., 2008) have raised concern that seagrass coverage on the Mississippi barriers may be declining. Eleuterius and Miller (1976) reported that in 1969, seagrass habitat on Horn Island totaled 2,253 ha. Moncrieff et al. (1998) reported a 1992 seagrass coverage of 215 ha, while Foster (2005) and Peneva et al. (2008) reported a 2003 coverage of approximately 100 ha. However, the extent to which this apparent decline might be explained by methodological differences among studies versus actual change in seagrass coverage has been unknown.

## Question

To what extent has the areal coverage of seagrass beds on the Mississippi barrier islands changed during the previous several decades?

## Goal

Analyze remotely-sensed data to quantitatively determine seagrass (predominantly *Halodule wrightii* Ascherson) coverage throughout the longest-possible time period for each of the Mississippi islands.

## Methods

Analyses were limited to imagery acquired during late summer through autumn, when seagrass canopies remained fully developed and water turbidity was low. The earliest dates of available imagery which met the autumn acquisition requirement were 1940 for Horn and Petit Bois Islands, 1963 for West and East Ship Islands and 2003 for Cat Island. The most recent imagery for each island was acquired in autumn, 2007. Seagrass beds were readily visible, in older black-and-white to color aerial photographs as well as in more recent multi-spectral imagery, contrasting against white sand bottom. To obtain maximum accuracy, individual seagrass beds were identified visually (ENVI v.4.2., ITT Visual

Information Systems, Boulder, CO). Total seagrass areal coverage for an island in a given year was determined by the sum of areas within polygons drawn manually around the perimeter of each seagrass bed seen in the image (Fig. 2).

## Results

- On Horn, the largest Mississippi island, seagrass coverage declined from 77 ha in 1940 to 19 ha in 1971 (Fig. 3). Coverage had returned to its 1952 value of 46 ha by 2003, and to its 1940 value by 2006, but declined again in 2007 to somewhat below the 1952 value.
- Seagrass coverage on Petit Bois, the most rapidly-migrating island, declined from 54 ha in 1940 to an approximately stable 8-19 ha from 1952 through 2007. Petit Bois was the only island for which decline in seagrass coverage corresponded with decline in island land area (Fig. 4).
- On the smallest island, East Ship, seagrass coverage remained nearly constant at 16-19 ha from 1963-2007 despite dramatic reductions in land area during Hurricanes Camille (1969) and Katrina (2005) (Morton, 2008; Otvos and Carter, 2008). On West Ship, coverage dropped to zero in 2003 but increased by 2007 to slightly exceed its 1975 value of 18 ha.
- Data for Cat Island extended only from 2003-2007. Seagrass coverage more than tripled during this period, from 22 ha in 2003 to 71 ha in 2007.

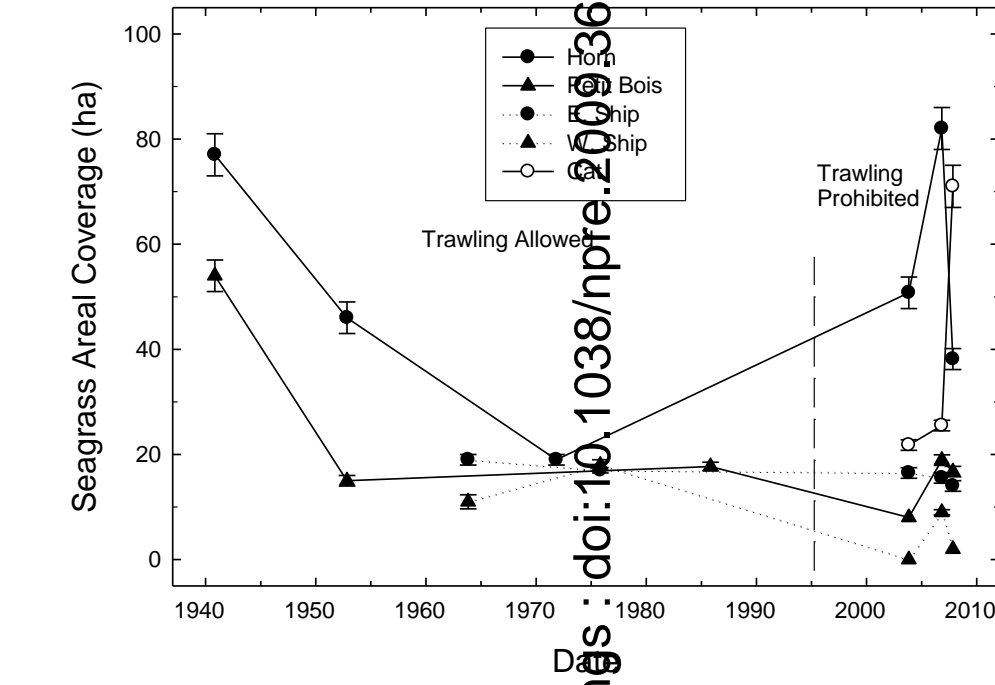


Figure 3. Decadal changes in seagrass coverage on the Mississippi barrier islands. Sampling error (bars) was estimated to be 5%.

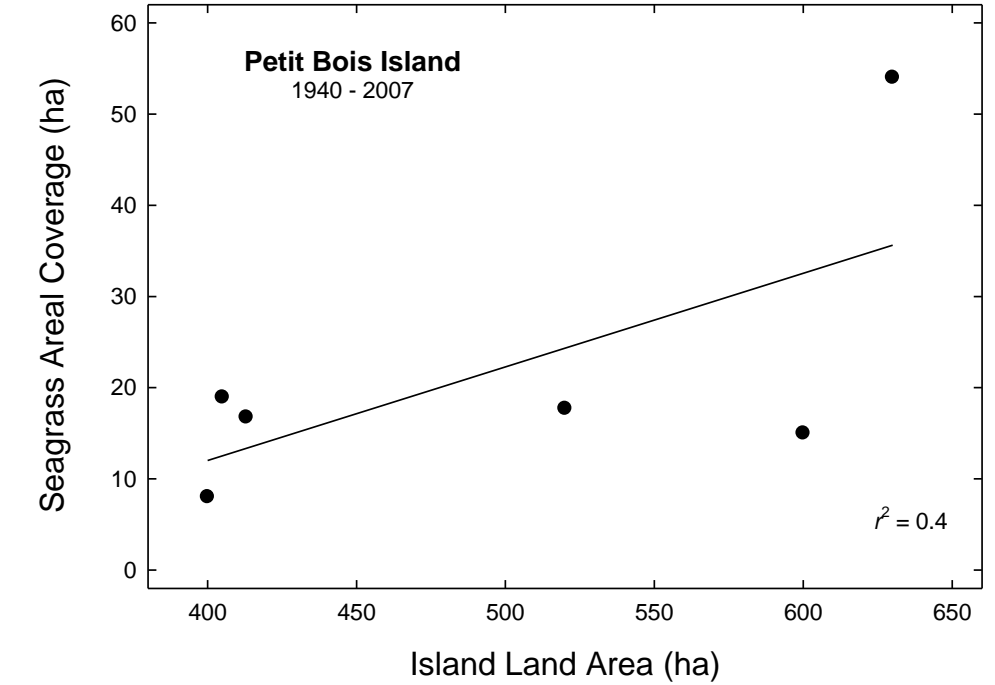


Figure 4. Relationship of seagrass bed areal coverage with the total land area of Petit Bois Island, 1940-2007.

## Conclusions

- Protection from trawling may have been a significant factor in the post-1995 recovery of seagrass on Horn, the largest of the Mississippi islands.
- The absence of a similar recovery on Petit Bois may be linked with its rapid westward migration in combination with a nearly 40% reduction in land area from 1940-2007.
- There was no discernible negative impact of Hurricane Camille or Hurricane Katrina on seagrass coverage.
- Methodological differences (e.g., mapping potential seagrass habitat rather than existing seagrass beds) are important in explaining the dramatic decline in seagrass coverage that is apparent when recent data are compared with results of earlier surveys.

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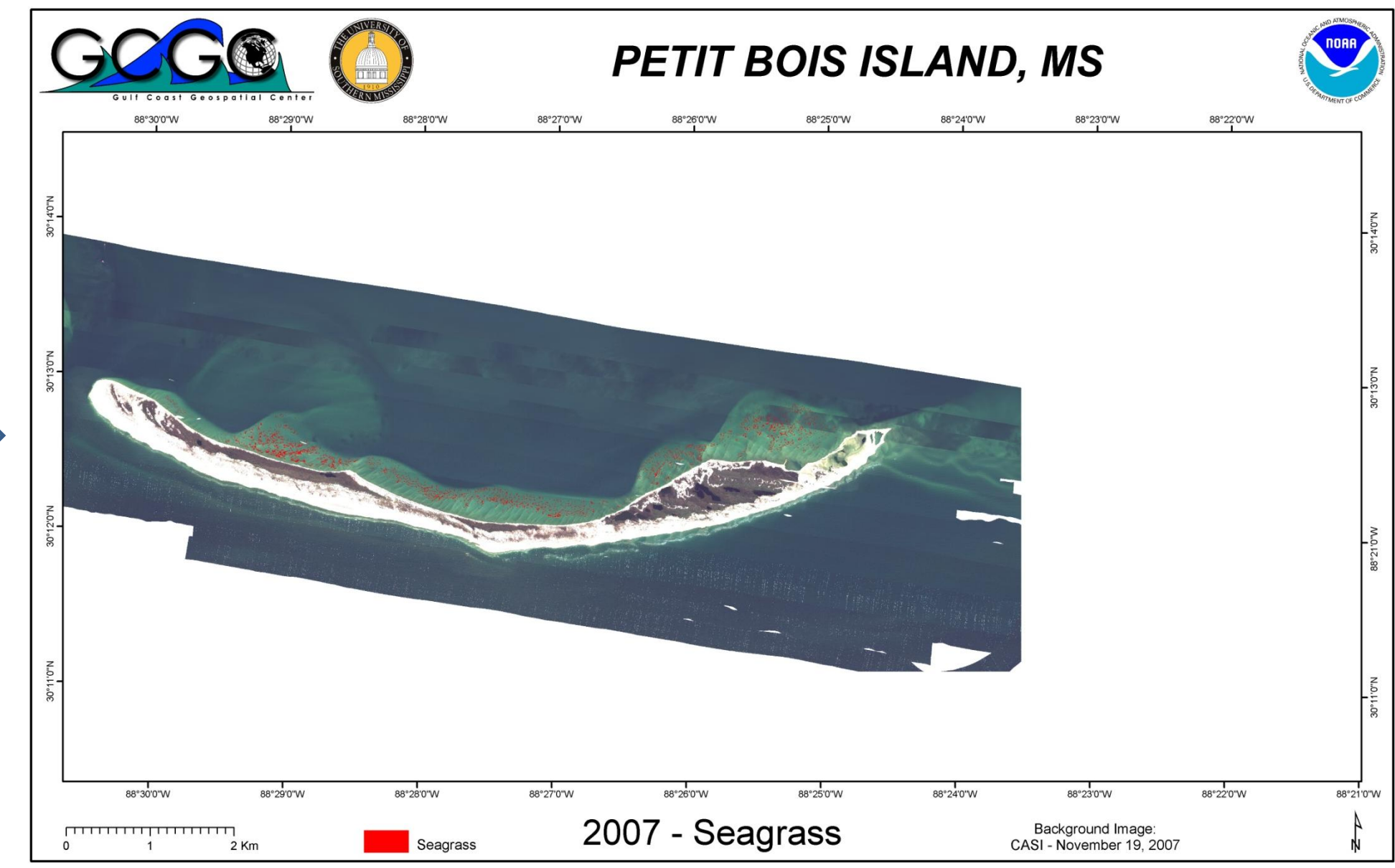
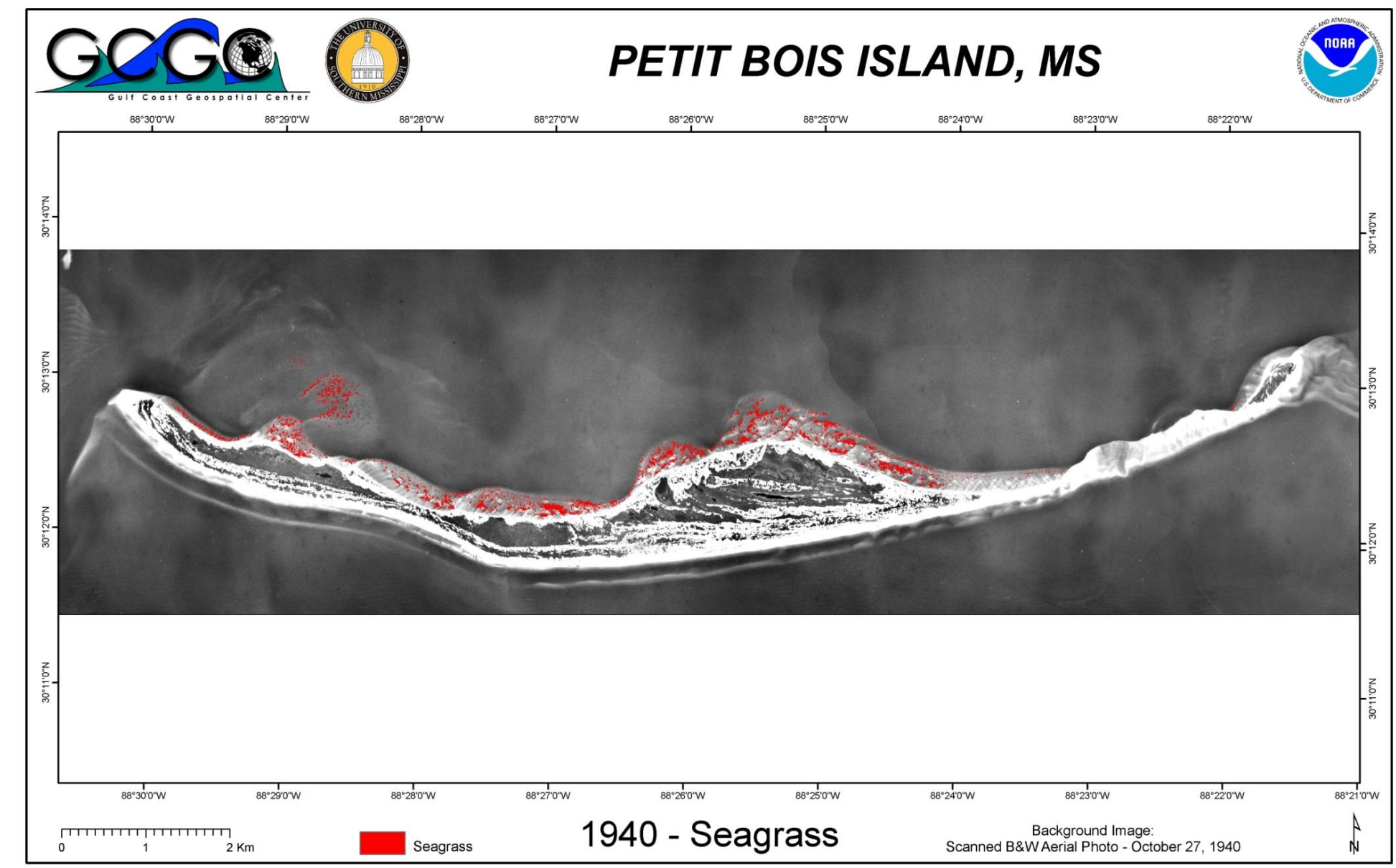
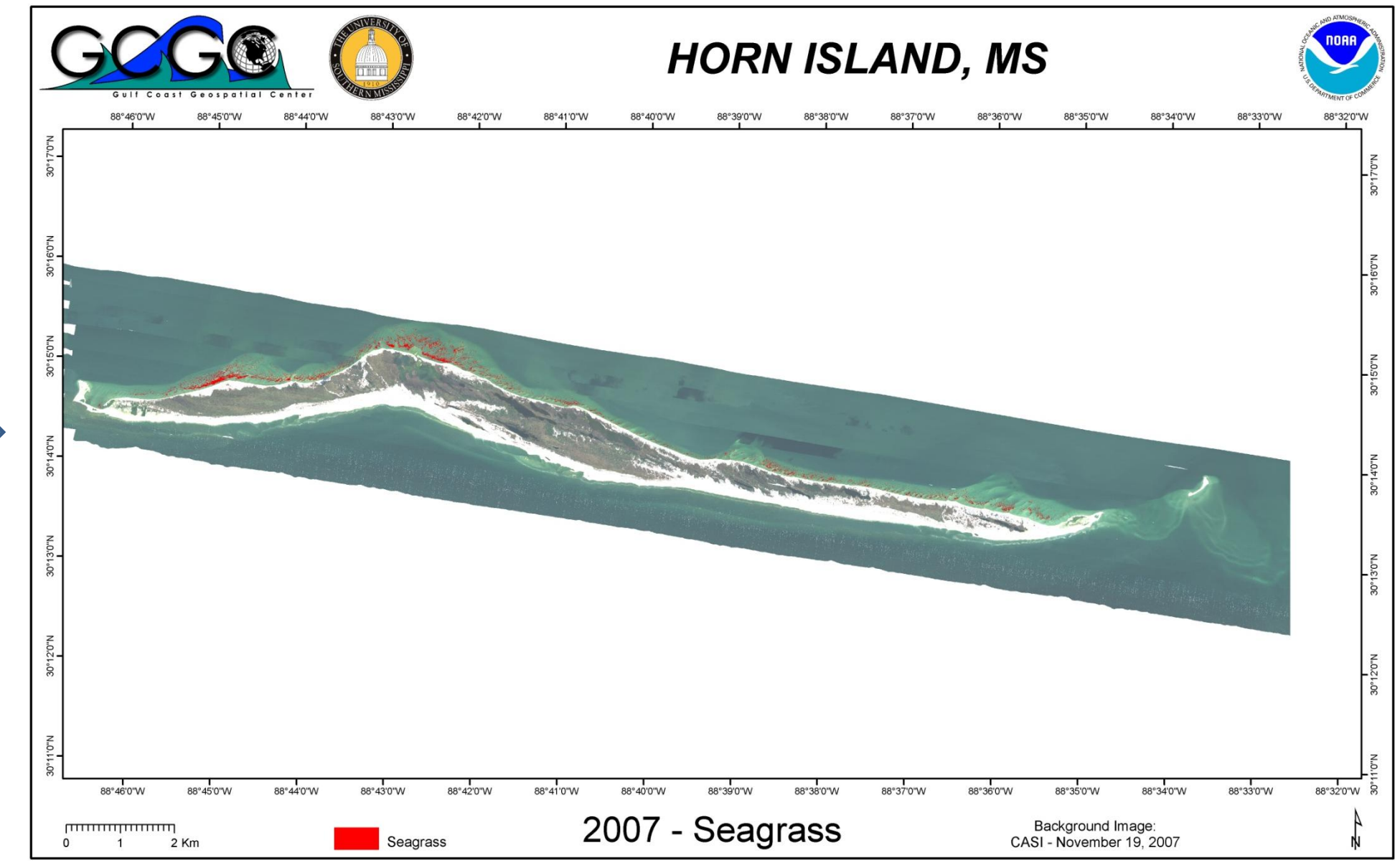
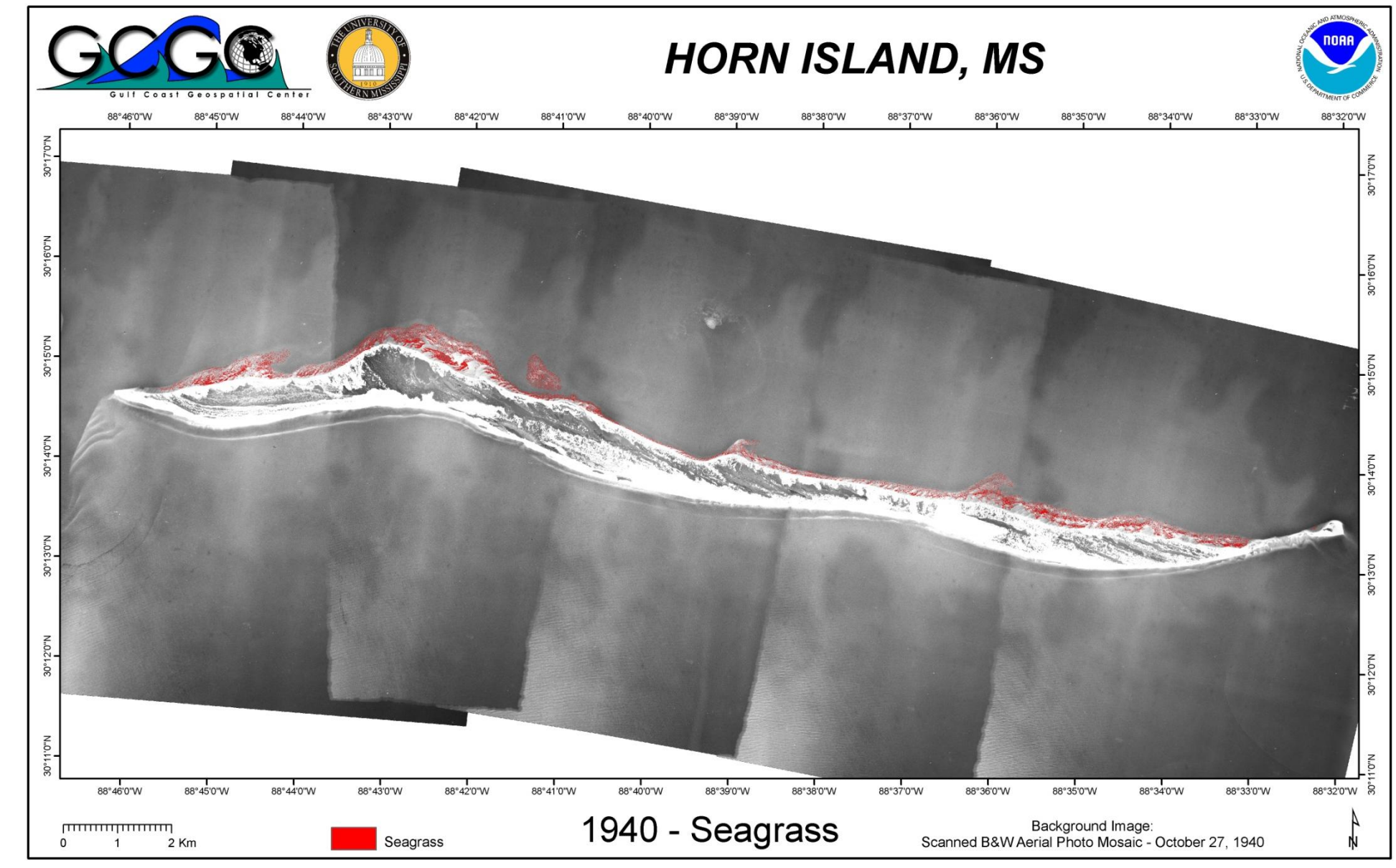


Figure 2. Seagrass maps developed from mosaics of 1940 and 2007 vertical aerial imagery. Various types of image data were used in the study, ranging from digitized black-and-white photographs (e.g., 1940) to hyperspectral imagery (2007 data, CASI 570 nm band). Where spectral data were available, seagrass mapping was based solely on the use of green-band data (Peneva et al., 2008).