Damage, Resilience, and Recovery of Salt Marshes

Highlights

Florida marshes were largely resistant to storm damage from Hurricane Michael. Although marshes were subject to hurricane force winds and high inundation values, only 2% of coastal marshes in the study area were damaged.

During Hurricane Michael, damage was primarily due to deposition of vegetation or sediment onto the marsh grass.

Marsh recovery can be slow. Only 16% of damaged marshes had recovered six months after landfall.

Marshes on public land were more likely to recover quickly. They had recovered more six months after the storm than had marshes that were privately owned.

Marshes recovered more readily from vegetation loss than from other types of damage.

OVERVIEW

Damage and recovery assessments can provide crucial information about the health and resilience of ecosystems and coastal communities. Previous research studies have shown that marshes and coastal vegetation can protect against storm damages by reducing storm wave heights and surge. Therefore, understanding how marshes respond to major hurricanes is important for future coastal protection planning. Through field damage assessments, we evaluated the impacts of Hurricane Michael, which hit Florida in October 2018, on the marshes and shorelines along waterfront residences and public parks throughout the study regions. In addition, as large areas of marsh were difficult to assess on site, we completed damage and recovery assessments using high-resolution aerial imagery from Google Earth. Collectively, our approach provided a system-wide assessment as well as specific examples of the resistance and resilience of marshes in the Hurricane Michael region.

RESEARCH OBJECTIVES

1. Quantify and understand the damage Hurricane Michael caused to coastal marshes in Bay, Gulf, and Franklin Counties.
2. Assess the recovery of marshes six months after the hurricane and identify potential influences on recovery.
3. Provide information and insights into possible marsh recovery strategies, potentially increasing coastal resistance and resilience.

METHODS

Salt marshes were identified in Bay, Gulf, and Franklin Counties using the USFWS National Wetlands Inventory (Figure 1). Pre-storm and post-storm images were compared to identify seven types of marsh damage: deposition of sediment or marsh, human-made debris, fallen trees, lateral erosion, vegetation loss, conversion to open water, and channel cutting/widening. For parts of Gulf and Franklin Counties where aerial images from April 2019 were available, marsh cells identified as damaged were subsequently assessed for recovery (yes/no).

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FINDINGS

Marshes in Bay, Gulf, and Franklin Counties were largely undamaged by Hurricane Michael (98%), suggesting that the majority of marshes can withstand the effects of a Category 5 hurricane. However, for the 2% of marshes that were damaged, recovery was not swift.

Six months after the storm, only 16% or 310 km² of originally damaged marshes had recovered. Most of the damage was caused by deposition of sediment or vegetation (79.5% or 1,648 km²). Of this damage type, 14.6% (241 km²) of marshes recovered. Previous studies have shown that some deposition of sediment or vegetation may actually benefit marshes by increasing the total marsh elevation (Castagno et al. 2018), though too much deposition may cause irreparable vegetation loss. Post-storm removal of excessive deposition is a tangible, low-cost method to increase marsh recovery. Our findings suggest that marshes can be largely resistant to storm impacts but may not be particularly resilient once damaged, at least within the first six months of disturbance.

Given that marshes on public land recovered more rapidly, it is possible that the management techniques used on public lands improved marsh resilience after a storm. For instance, removing the thick layers of wrack buildup before they cause vegetation death may promote marsh resilience after future storms. As hurricanes intensify with the changing climate, ensuring marsh resilience and resistance will help provide coastal communities with natural barriers to storm damage.

	TOTAL MARSH (KM²)	DAMAGED MARSH (KM²)	PERCENTAGE DAMAGED
Bay County	56,130	991	1.8%
Gulf County	13,257	585	4.3%
Franklin County	103,872	1,795	1.7%
All Counties	173,259	3,371	1.9%

Table 1. Area of marsh damage by county.

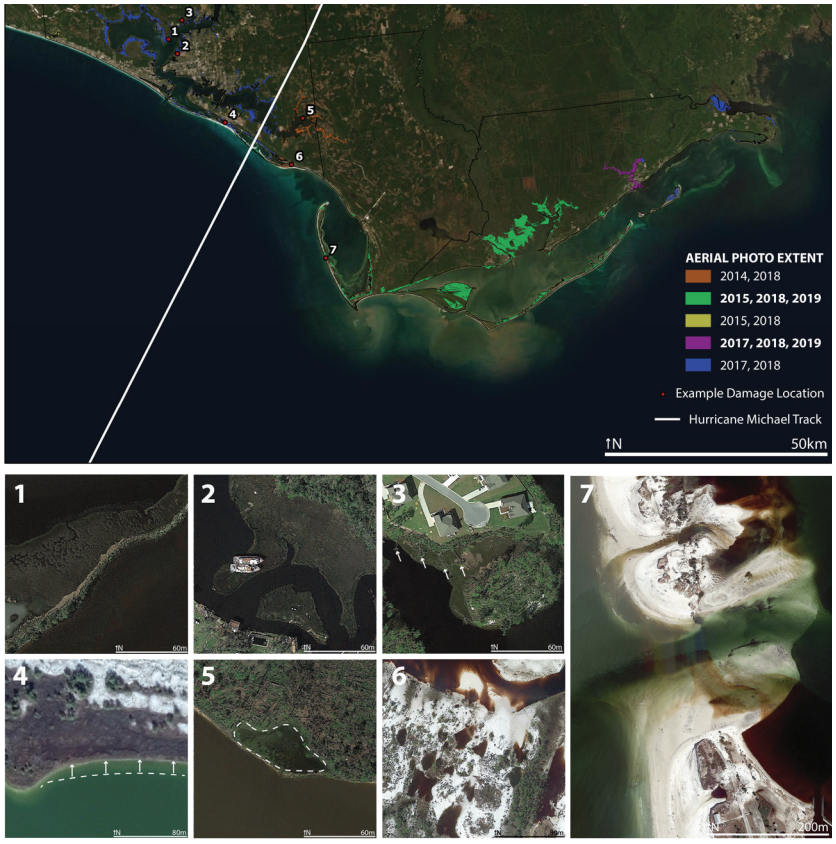

Figure 1. *Above*, extent of aerial imagery coverage on study marshes. All marshes have aerial imagery from October 2018, within 1-2 days of Hurricane Michael's landfall. Areas with bolded dates (green and purple) have aerial imagery from April 2019, six months after landfall, and were used to study the marsh recovery from damage. *Below*, examples of marsh damage from Hurricane Michael, locations indicated in the above map. Damage types include: 1) deposition of vegetation or sediment, 2) human-made debris, 3) fallen trees, 4) lateral erosion, 5) vegetation loss, 6) conversion to open water, and 7) channel cutting/widening.