Salt Marsh Dieback in Georgia
Overview of Research Findings -2013

Since 2002, patches of dying vegetation have been observed in Georgia marshes, generally during periods of dry or drought conditions. These events, collectively referred to as salt marsh dieback, are characterized by the thinning and browning of marsh cordgrass (*Spartina alterniflora*) eventually leading to plant death. This is a concern because the salt marsh environment is extremely important in the life cycles of crabs, fish, and shrimp, and it also provides food for many wildlife species. In addition, salt marshes help prevent or lessen local flooding.

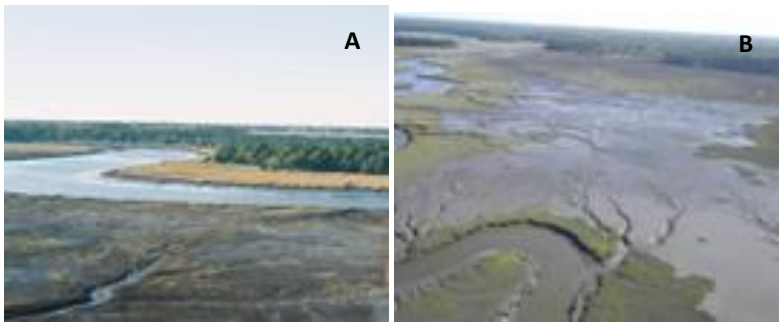

Fig. 1: Marsh dieback in Georgia: (A) Arial photograph of a marsh dieback area on the Jerico River in 2002 (Matt Ogburn); (B) Marsh dieback in Liberty County, 2011 (Jan Mackinnon).

The first incidence of salt marsh dieback occurred in 2002. At this time, reports of marsh areas with little or no live above-ground vegetation were received from all six of Georgia's coastal counties. Since that time, additional dieback episodes have been reported. In 2013 alone, marsh dieback has been reported in areas along the Jerico River, the St. Simon's Island causeway, and in Camden and Chatham Counties.

While no single cause has been found for salt marsh dieback, it appears that prolonged severe drought is the main factor that begins a chain of events leading to dead marsh sites. This update provides a summary of the ongoing research activities that are currently underway to address salt marsh dieback in Georgia and South Carolina.

Research findings

Association with drought: A number of studies have been conducted concerning the effect of drought conditions on salt marsh dieback.

- Soil samples collected in 2009 from a dieback area on Sapelo Island responded differently to periodic, severe and persistent, and no drought conditions in the laboratory. The researchers, who were from University of Georgia, suggest that ***1) by themselves, drought-induced changes in soil pH may not be sufficient to cause marsh dieback and 2) the geochemical changes brought about by drought could affect the release of metals such as iron***.
- Investigators from the GA DNR CRD, Savannah State University, and University of Georgia collected samples in 2011 from sites that were undergoing a dieback event. They found that ***although average metal concentrations were highest in dieback areas, none were high enough to be directly toxic to the plants***.
- Researchers from the University of South Carolina examined chemical and hydrological changes in marsh soil samples collected from a marsh that experienced dieback in 2001. They found that, ***while seasonal chemical changes did occur in the winter and spring, these changes did not coincide with the marsh dieback period***. The researchers concluded that ***a large salinity increase occurring over a short time period was the probable trigger for dieback in the study area***.

Insect damage: Two studies have shown that infestation by stem borer larvae may play a role in marsh dieback.

- A Savannah State University researcher found that ***the water-carrying vessels (xylem) of S. alterniflora stems damaged by stem borer larvae became clogged with a buildup of what were possibly heavy metals***. They suggest that drought-induced changes in pH may result in the ability of heavy metals to more easily move in marsh soil, leading to their accumulation in the xylem vessels. As the clogged vessels become unable to transport water, plant death follows.
- Investigators from the University of Wisconsin found that stem borer frequency was nearly three times higher in dieback areas compared to that found in healthy marshes on Sapelo Island. The researchers suggest that, ***while not a direct cause, stem borer infestation may worsen marsh dieback conditions.***

Plant stress: Early detection of disturbed areas before plants show visible signs of stress can be difficult. Several recent studies have looked at concentrations of metals and organic molecules in *S. alterniflora* as potential indicators of environmental stress.

- DMSP (short for dimethylsulfoniopropionate), is a chemical that is synthesized by *S. alterniflora* and thought to be converted to DMSO in response to stress. University of South Carolina researchers evaluated whether dieback conditions affect DMSP concentrations in *S. alterniflora*. ***In a healthy marsh site, lower levels of DMSP were observed in plants nearest the edge of a dieback area compared to those farthest away, suggesting that DMSP concentration responds to environmental conditions connected with salt marsh dieback.***
- A University of Georgia project examined the DMSO:DMSP ratio and metal content of *S. alterniflora* collected from areas affected by marsh dieback. The highest concentrations of 19 of the 20 metals evaluated were found in plants collected at edge and dieback areas. The study also found higher DMSO:DMSP ratios in leaves and stems collected from dieback sites compared to healthy areas. ***This study demonstrates that the DMSO:DMSP ratio and leaf metal concentrations can potentially provide an early indication of stress in S. alterniflora***.

Invertebrate abundance: Marsh invertebrate populations are also affected by dieback.

- A team of researchers from University of Georgia worked with colleagues in Louisiana to evaluate the effect that marsh dieback has on marsh organisms. They found that in Georgia marshes the abundance of all groups of organisms sampled, including snails and crabs, decreased in dieback as compared to healthy areas, and that their numbers increased along with *S. alterniflora* density. ***The study concluded that the presence of vegetation corresponded to increased soil moisture and better habitat for organisms***.

Marsh dieback recovery: Researchers are studying the recovery of areas affected by dieback.

- University of Florida researchers found that *S. alterniflora* transplanted into patches of marsh larger than 20 m^2 had faster recovery times than patches that were less than 1 m^2. Plants that were able to move into large dieback areas when there was plenty of rain were also able to survive through subsequent dry seasons, indicating that ***the size distribution of remnant marsh patches as well as the frequency and intensity of stressful events such as droughts affect the speed of recovery and the ability of marshes to withstand stress.***
- A seven-year study (2003-2009) of marsh recovery by the Georgia Coastal Research Council showed that recovery of large patches of marsh from dieback takes longer than seven years. ***Dieback areas had begun to recover in September 2004 in plots closest to the healthy marsh, but vegetation characteristics in the healthy and dieback marsh sites were still significantly different in 2009.***

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