Dr. Wade H. Elmer
Department of Plant Pathology and Ecology
The Connecticut Agricultural Experiment Station
123 Huntington Street, P. O. Box 1106
New Haven, CT 06504

Phone: (203) 974-8503
Fax: (203) 974-8502
Email: Wade.Elmer@ct.gov
Website: www.ct.gov/caes

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SUDDEN VEGETATION DIEBACK IN CONNECTICUT'S SALT MARSHES

What is Sudden Vegetation Dieback? Around the turn of the decade, wetland scientists from the Gulf of Mexico to Maine started to notice irregular, barren areas along the intertidal creeks in salt marshes where smooth cord grass (*Spartina alterniflora*) used to grow (Figure 1). In some sites, plants were observed to turn brown, die, and wash away leaving the resulting creek bank devoid of vegetation (Figure 2). Erosion then causes the barren peat to eventually slough off into the creek bank (Figure 3). This phenomenon was observed all along the Atlantic and Gulf coasts (Figure 4) and was first called Brown Marsh or Sudden Wetland Dieback. However, the name has been changed to Sudden Vegetation Dieback (SVD), since only the marsh grasses seemed to be affected. In Connecticut, SVD was observed in marshes from New Haven to New London (Figure 5). A key feature of SVD is that the plants do not grow back the next year.

Why care about salt marshes? Salt marshes are the most productive ecosystems in Connecticut. We know that a multitude of factors can cause a marsh to slowly expand, slowly shrink, slowly rise, and/or slowly sink. Most of these factors are understood. However, SVD is not understood. It is still unclear what causes it and when it actually began. In Connecticut, SVD was not believed to be caused by wrack deposition, fire, pollutants, ice rafting, or herbivory from geese, crabs, or snails. Until we decipher the underlying cause, our salt marshes remain vulnerable.

Figure 1. Sudden Vegetation Dieback along a tidal creek at Hammonasset Beach State Park, Madison, CT.

History of SVD in Connecticut. In 2002, Dr. Scott Warren of Connecticut College and Mr. Ron Rozsa of the Connecticut Department of Environmental Protection first noticed SVD in the tidal creeks along the south shore of Cape Cod. Examination of aerial photographs revealed the SVD had also been occurring in Connecticut's salt marshes along the Neck River and tributaries of Tom's Creek in Madison, and Pleasant Point marsh in Branford. Many of the sites at Hammonasset Beach State Park remain barren after 7 years, while in other areas of the park, recovery has occurred (Figure 6).

Figure 2. Declining *Spartina alterniflora* plants in a Sudden Vegetation Dieback site at Hammonasset Beach State Park, Madison, CT.

Figure 3. Erosion along the Neck River in Madison, CT (Courtesy of Peter Thiel).

Causes of SVD? We do not know the cause of SVD, but many hypotheses have been proposed. Several stressors have been associated with SVD sites along the Atlantic and Gulf coasts, but no underlying factor is common to them all. Drought, heavy metal

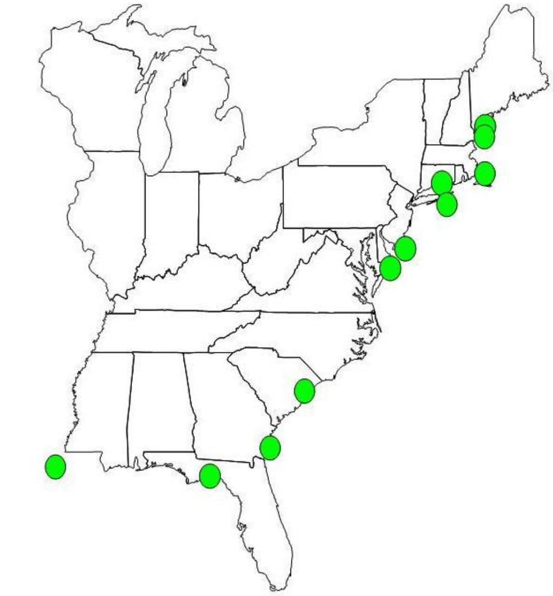

Figure 4. Sites along the Atlantic and Gulf coasts where Sudden Vegetation Dieback has been reported.

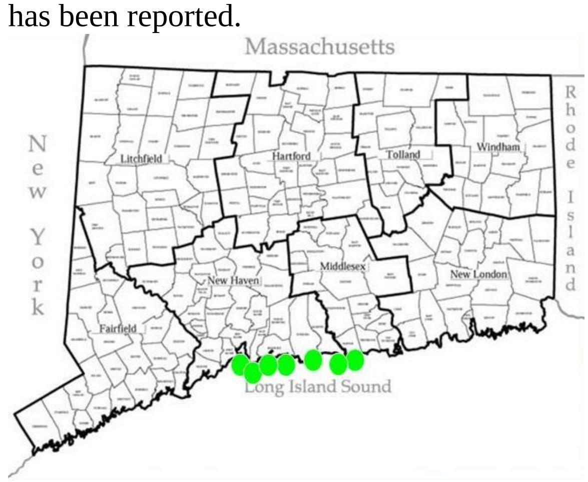

Figure 5. Sites along the Connecticut coast where Sudden Vegetation Dieback occurs.

Figure 6. Marsh recovery at one site at Hammonasset Beach State Park. Left photo shows a Sudden Vegetation Dieback site in 2006. Right photo shows the regrowth of *Spartina alterniflora* (Courtesy of P. Thiel).

toxicity, acid soils, extreme salinity, plant pathogens, crabs, and geese have been implicated. A combination of several stressors may have occurred and predisposed the plants to attack by pests. Although it is difficult to determine what caused SVD, at present, there is evidence to suggest that plant pathogens and herbivores are impacting these SVD sites and may be hindering regrowth.

Plant pathogens. We have identified a new species of a pathogenic group of fungi called *Fusarium* and it has been found in all SVD sites (Figure 7). Greenhouse tests with healthy *S. alterniflora* plants showed that the species is virulent, but it is unlikely able to kill a healthy plant (Figure 8). The fungus probably lives as an epiphyte (an organism that grows on or in a plant in a nonparasitic relationship) on *S. alterniflora* until a stress triggers the fungus to become a destructive pathogen.

Figure 7. New *Fusarium* sp. found associated with declining *Spartina alterniflora* plants. Left photo shows the macroconidia (spores) of the species. Right photo shows the thick-walled spores called chlamydospores.

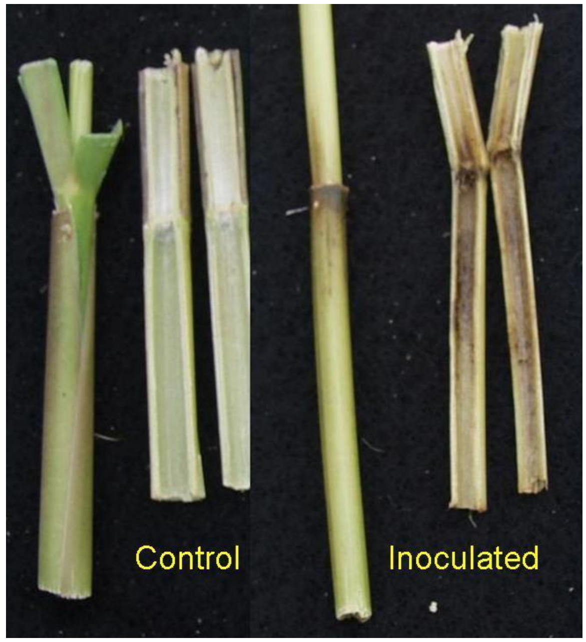

Figure 8. Pathogenicity tests on *Spartina alterniflora*. Left photo shows *Spartina alterniflora* stems following inoculation with a sterile needle (control). Right photo shows the internal symptoms following inoculation with the *Fusarium* sp.

In addition, root-knot nematodes were found to be associated with *S. alterniflora* plants in SVD sites (Figure 9). Root-knot nematodes are microscopic worms that cause root galls and stunting. In 2006, Dr. James A. LaMondia of The Connecticut Agricultural Experiment Station, identified a unique root-knot nematode on *S. alterniflora* plants in SVD sites. The interaction of *Fusarium* pathogens and the root-knot nematodes was examined under controlled conditions, and we found that they caused more damage on *S. alterniflora* together than alone.

Herbivores. The main herbivores in Connecticut's salt marshes are crabs and geese. Damage caused by geese grazing is considered to be temporary and does not appear to cause lasting harm to the rhizomes. The purple marsh crab (*Sesarma reticulatum*) is also a resident species in salt marshes and can graze on *S. alterniflora* foliage and possibly the roots (Figure 10). Surveys at Hammonasset Beach State Park have found the purple marsh crab in the SVD sites.

Figure 9. Root-knot nematodes on *Spartina alterniflora.* Left photo shows a root system where the roots have terminated in galls. Right photo shows a close-up of the root gall. The adult male nematode can be seen as a thin, red worm; the female is visible as the large egg-filled mass in the center of the gall (Courtesy of Jim LaMondia).

Figure 10. Purple marsh crabs. Clockwise from upper left: the purple marsh crab, *Sesarma reticulatum;* students helping to monitor crab activity at Hammonasset Beach State Park; purple marsh crabs feeding on *Spartina alterniflora* transplants in captivity (Courtesy of Peter Thiel).

Feeding studies with purple marsh crabs found they could survive in captivity for over six months on an exclusive diet of *S. alterniflora*. As with the plant pathogenic fungi and nematodes, it is not clear whether the purple marsh crab could cause an SVD event. However, the impact of the purple marsh crab along with other potential crab species deserves attention, since they do hinder the ability of *S. alterniflora* to recolonize these SVD sites.

Conclusion. SVD remains a significant threat to Long Island Sound, and the Atlantic and Gulf marsh systems. The cause is still unclear. Although recovery appears to occur in some SVD areas, other sites remain devoid of vegetation. Many factors have been associated with SVD sites, but in Connecticut, plant pathogens and herbivores appear to be the only biotic stressors that have been associated with SVD sites. Continual monitoring along with experimentation *in situ* and in the greenhouse may provide more evidence to decipher the cause of SVD in Connecticut.

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