Annual Report Summary

Period Covered by the Report: 4/5/2001-4/5/2002
Date of Report: 3/30/2002
Title: Osmolytes and Their Role as Antioxidants in the Salt Marsh Macrophyte *Spartina alterniflora*
Investigators: Ronald P. Kiene, and Joseph D. Husband
Institution: The University of South Alabama
Research Category: Estuarine Studies
Project Period: 4/5/2001-4/5/2002

Objective(s) of the Research Project: To test the hypothesis that the osmolyte DMSP (dimethylsulfoniopropionate) functions as an antioxidant in *S. alterniflora,* conferring resistance to oxidative stress caused by environmental factors, including salinity, nitrogen limitation and iron limitation.

Progress Summary/Accomplishments: Work done during the 2001-2002 funding cycle has verified that DMSP oxidation products are indeed higher in tissues experiencing increased levels of oxidative stress relative to less stressed tissues. Preliminary data suggest higher concentration of DMSP oxidation products in the spring and summer when insolation and photosynthetic activity are at a maximum. Perhaps the most exciting finding over the past year has been that *S. alterniflora* plants experiencing increased levels of oxidative stress due to natural stressors (most pathologies ultimately are manifested as runaway oxidative stress) as well as those experiencing increased levels of stress due to the application of the herbicide paraquat (methylviologen) show increased synthesis of DMSP as well an in increase in the oxidation products of DMSP. These findings may indicate that *S. alterniflora* has the capacity to rapidly synthesize DMSP upon the onset of oxidative stress.

S. alterniflora is native to the east and gulf coasts of North America, but it has recently invaded various estuaries on the west coast. While valued on the east coast for its ability to stabilize shorelines and as a major source of organic matter and habitat, on the west coast *S. alterniflora* is considered an unwelcome invader. There is also growing evidence that *S. alterniflora* is hybridizing with the native west coast species *S. foliosa* providing a further threat to the ecological balance in west coast marshes. On the European side of the Atlantic, *S. alterniflora* has crossed with the native species, *S. maritima*, producing the successful hybrid *S. anglica*. Given the ability of *S. alterniflora* and its con-generics to dominate some ecosystems, and its apparent ability to invade new areas and cross with closely related species, we need to understand what makes this species so successful in colonizing euryhaline coastal margins. What specific adaptation(s) allows *S. alterniflora* to dominate under the harsh conditions prevailing in estuaries where the stressors include variable salinity, aerial desiccation, high light exposure, soil/sediment anoxia, sulfide, and anthropogenic pollutants? We believe the high concentration of DMSP in *S. alterniflora* may help explain this dominance.

Publications/Presentations: There have been no presentations or publications resulting from this work as of yet.

Future Activities: We will continue to measure seasonal patterns of DMSP and it oxidation products throughout the 2002-2003 funding cycle. We will carry out tests using antibiotics and antifungal agents to evaluate whether leaf microbes might be involved in these transformations. In addition we will investigate the hypothesis that the high concentrations of DMSP found in *S. alterniflora* confer increased resistance to oxidative stress for this species. To test whether DMSP provides *S. alterniflora* with greater resistance to oxidative stress (relative to the non-DMSP containing congener *S. patens*) time series measurements will be made of oxidative stress in paraquat treated *S. alterniflora* and *S. patens* in parallel with measurements of the concentration of DMSP and its oxidation products in *S. alterniflora.* A PAM-Fluorometer will be used to assess in situ oxidative stress in the paraquat treated plants.

Supplemental Keywords: Dimethyl sulfide, Dimethyl sulfoxide, DMS, DMSO, invasive species, Methane sulfonic acid, MSA, OH radical, Radical oxygen species, ROS, Salt marsh

Relevant Web Sites: A project web site will be created this year.

Acknowledgments and disclaimers

This research has been supported by a grant from the U.S. Environmental Protection Agency's Science to Achieve Results (STAR) program and is being carried out at the Dauphin Island Sea Lab, Dauphin Island, Alabama.

Although the research described in the article has been funded wholly or in part by the U.S. Environmental Protection Agency's STAR program, it has not been subjected to any EPA review and therefore does not necessarily reflect the views of the Agency, and no official endorsement should be inferred.