

Final Report Executive Summary
ACES Project Summary: Part 1 Web Summary Report

Period Covered by the Report: 8/01/01 – 12/31/03
Date of Report: 12/31/03
EPA Agreement Number: R827072-01-1
Title: Influence of Invasive Plant Species in Determining Diversity of Aquatic Vegetation in the Mobile-Tensaw Delta
Investigators: Dr. Timothy Sherman and Dr. Anne Boettcher
Institution: University of South Alabama
Research Category: Small Grant for Exploratory Research
Project Period: 08/01/01-12/31/03

Objectives of the Research Project:

Introduction of non-indigenous species (NIS) is recognized as one of the leading causes of loss in biodiversity, second only to habitat loss (Walker and Steffen 1997, Wilcove *et al.* 1998). However, the identification of factors that lead to the establishment and persistence of these invaders has remained elusive (Lodge *et al.* 1998). The Mobile-Tensaw River Delta, an area rich in species diversity, has not escaped the advance of invasive species. Previous studies have shown that, in certain areas, non-indigenous aquatic plants can dominate in terms of both frequency and biomass (Nelson 1999). However, the impacts of these species on native plant assemblages and on plant-animal interactions in this system have not been examined previously. This work and a companion study entitled, “Role of Invasive species in Shaping Plant-Animal Interactions in the Mobile Delta” were designed to evaluate the role of introduced plant species in shaping plant-animal interactions and plant-plant interactions in an effort to elucidate the environmental impacts that NIS may have on the Delta system. The studies focused on NIS currently present in the system, with study sites located in waters surrounding Gravine Island, Baldwin County, AL. The primary objectives of the studies were to:

1. Develop a bio-inventory of native and non-indigenous aquatic plant species in the waters surrounding Gravine Island.
2. Gather data on physiological and growth parameters of dominant native and introduced aquatic plants.

Summary of findings:

The results that we present here are very similar to those present in our report for EPA R827072-02, because this is an expansion of that study.

Research

Data for the aquatic plant and macroinvertebrate bio-inventories have been collected and are being logged into the recently-created SQL database. The database will allow for rapid analyses of plant and animal abundance, diversity, and distribution. Preliminary analyses of plant distribution and abundance reveal several patterns. As expected, plant abundance follows seasonal changes in temperature, with peak abundance occurring during the summer season, decreasing with decreasing temperatures. During the first year of sampling the most common NIS were *Alternanthera philoxeroides* (alligator weed), *Eichhornia crassipes* (water hyacinth), and *Hydrilla verticillata* (Hydrilla). Interestingly, during the second year and third summer of

sampling, *H. verticillata* was the dominant NIS and *E. crassipes* was rarely detected. There were similar shifts in native species abundance. During the first year, *Zizaniopsis miliacea* (cut grass), *Potamogeton nodosus* (longleaf pondweed), and *Najas guadalupensis* (bushy pondweed) were dominant species at specific sites, but there was no common pattern across sites. However, during the second year and third summer, the dominant natives across sites were *Z. miliacea*, *N. guadalupensis*, and *Ceratophyllum demersum* (coontail).

Key native and invasive were monitored for their abilities to take up nitrate or ammonium from the water column. That work showed no clear difference between invasive and native species that would help to explain the ability of invasives to dominate a system. However, this was a small-scale exploratory study with low power and so further comparisons are warranted.

Ammonium uptake was common under field conditions, however, nitrate uptake was rarely observed. To address this anomaly, lab experiments were performed on native (*Vallisneria americana* and *Najas guadalupensis*) and a key invasive (*Hydrilla verticillata*) species to examine Nitrate Reductase (NR) is the enzyme responsible for catalyzing the first step in nitrate assimilation. NR is considered the limiting step in the nitrate assimilation pathway. While NR regulation is fairly well understood in terrestrial vascular plants, considerably less is known about the control of activity of NR in aquatic macrophytes. Our results revealed no enzyme activity for *H. verticillata* when grown in the presence of nitrate, a condition that normally induces NR activity in other aquatic plants. Under similar conditions, both native species possess low, but detectable activity. The enzyme activity in all of these species is much lower than that found in terrestrial vascular plants. It is possible the ammonium derived from photorespiration is responsible for this low activity. Experiments were conducted under conditions, which should decrease photorespiration. This work suggests that that this may be partially responsible for the low NR activity found in this species.

Literature Cited

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- Nelson, D.H. 1999. Population ecology of the Alabama red belly turtle (*Pseudemys alabamensis*)—vegetation, diet, clutch size. *Final report to Department of Conservation and Natural Resources*, December 1999.
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- Wilcove, D.S., D. Rothstein, J. Dubow, A. Phillips, and E. Losos. 1998. Quantifying threats to imperiled species in the United States. *Bioscience* 48: 607-615.
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Education

Several undergraduates (Stanislaus Arbaczauskas, Adrienne Berg, Darren Barrett, Lonnie Driskell, Matthew Dawson, Stacie Fairley, Savvas Michaelades, Heather Norman, and Anna Penton) have been supported by and/or have conducted directed research projects associated with this project. This has provided these students hands-on research experience in both the laboratory and the field. One of the undergraduates supported in the first year of funding, Anna Penton, joined us as a graduate student. Her research focuses on the factors influencing the macroinvertebrate distributions, however, she has assisted with all components of the research and is currently working with the database. A second student, Stan Arbaczauskas, is using the

research skills he gained in his job as an environmental consultant. Two graduate students from the Department of Computer and Information Science help us to create the SQL database.

Publications/Presentations:

Penton, A., J. Valentine, J. McClintock, C. Amsler, T. Sherman, and A. Boettcher. 2002. Role of invasive species in shaping plant-animal interactions in the delta. Oral presentation, ACES Scientific Advisory Committee Meeting. Dauphin Island Sea Lab, Dauphin Island, AL. May 2002.

Fairley, S. and T. D. Sherman 2001 "Regulation of Nitrate Reductase Activity by Environmental Factors." Poster presentation at the Second Annual Tuskegee Undergraduate Research Conference, held on November 18, 2001. Ms. Fairley won second place in poster presentation.

Fairley, S. and T. D. Sherman 2001 "Regulation of Nitrate Reductase Activity by Environmental Factors." Poster presentation the Annual Biomedical Research Conference for Minority Students(ABRCMS) was held in Orlando on October 29 - November 4, 2001.

Supplemental Keywords:

Estuary, ecology, ecological effects, indicators, habitat, surveys, south central

Relevant Websites:

<http://aquatl.ifas.ufl.edu/>

<http://www.invasivespecies.gov/>

Acknowledgements and Disclaimers:

This research has been supported by a grant from the U.S. Environmental Protection Agency's Science to Achieve Results (STAR) program, through the Alabama Center for Estuarine Studies. 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. In addition to the STAR program, the investigators would like to thank the University of South Alabama Department of Biological Sciences and College of Arts and Sciences, and the Department of Public Health Services' Bridges to a Baccalaureate Degree program for support of this research. We would like to thank Dr. John McCreadie for assistance with macroinvertebrate identifications and statistical analyses, Dr. Allen Tubbs, Dr. Brian Axsmith, and Dr. Judy Stout for assistance with plant identifications, and the numerous volunteers who have assisted with field collections including Emily Boone, Blake Golden, William Turner, Joshua Meyer, Jim Parker, Jack O'Brien, and Charlyn Partridge.