

Final Report Executive Summary
ACES Project Summary: Part 2 Final Technical Report

Period Covered by the Report: 12/31/01 – 12/31/03
Date of Report: 12/31/03
EPA Agreement Number: R827072-02
Title: Role of Invasive Species in Shaping Plant-Animal Interactions in the Mobile Delta
Investigators: Dr. Anne Boettcher, Dr. Timothy Sherman, and Dr. John Valentine
Institution: University of South Alabama and Dauphin Island Sea Lab
Research Category: Small Grant for Exploratory Research
Project Period: 06/01/00-12/31/03

Background and Objectives:

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 study and a companion study entitled, "Influence of Invasive Plant Species in Determining Diversity of Aquatic Vegetation in the Mobile-Tensaw River 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 (Figure 1). 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. Develop a bio-inventory of the most common macroinvertebrates found on and around dominant native and introduced aquatic plants in the waters surrounding Gravine Island.
3. Create a SQL relational database of plant spatial and temporal distribution and abiotic parameters for the study sites.

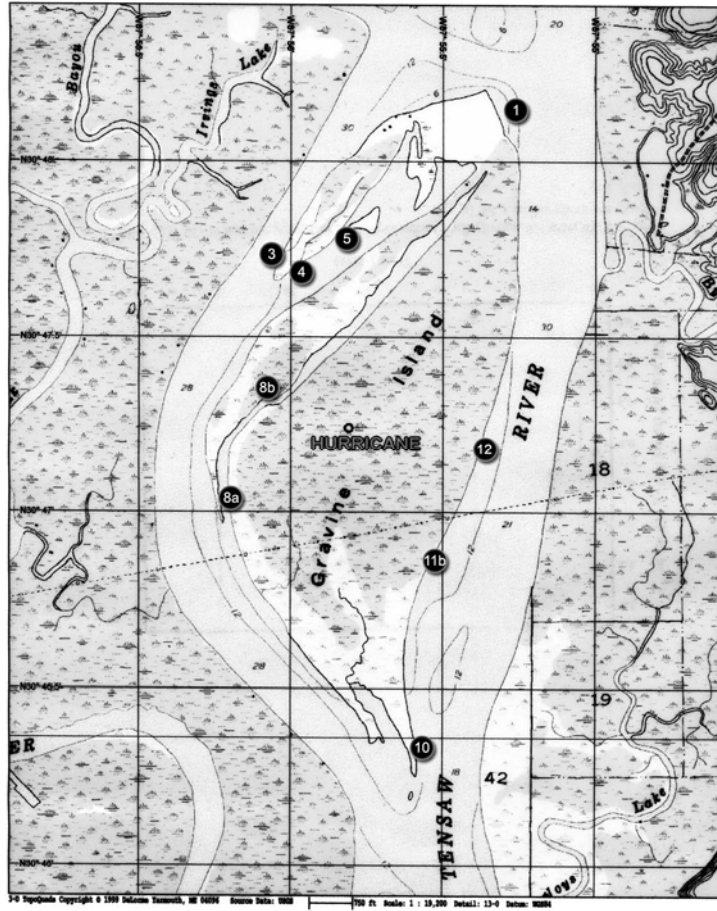


Figure 1. Collections site around Gravine Island, AL

Material and Methods:

Study Site

Gravine Island, a natural island in the Tensaw River, is primarily lowland forest and is dominated by a spoilbank at its northern end. Gravine Creek and a small and large cove lie on the western side of the island. Preliminary vegetation analysis of Gravine Island was carried out as part of a larger project investigating the population ecology of the Alabama redbelly turtle (*Pseudemys albamensis*) (Nelson 1999). Sampling sites for this study centered on the creek and cove areas, and sampling was carried out from April-June 1999. Sampling for the proposed work included areas surveyed as part of the redbelly turtle project (Nelson 1999), and additional sites along the southern and eastern shores of Gravine Island.

Sampling of plant-animal assemblages

Sampling trips were made monthly from August 2000 – August 2002. Twenty meter transects were used to quantify plant species located in each of the ten sites. Two lengths of 10-foot PVC pipe were driven into the ground at the end of each transect to mark the ends of the transect. The transect method consisted of identifying the type of vegetation that was in contact with the 20-meter transect tape every 25-cm. This method allowed us to quantify plant diversity and relative abundance. Sites were located using hand held global positioning units (GPS).

The three dominant plant species were sampled by completely filling the bottom of D-nets. Plant were washed under running water extensively to collect associated macroinvertebrates. Macroinvertebrates samples were preserved in 95% ethanol and stored for further characterization. Macroinvertebrates were identified down to family and number of individuals in a sample were counted. Jaccard's Coefficient tests were run to examine similarity and differences in macroinvertebrate assemblages between sites.

Physical parameters

Light and temperature were measured at the study sites every 15 minutes via Onset Data Loggers (Onset Computer Corp., Pocasset, MA). The light meters were calibrated against a submersible radiometric light meter (Heinz Walz GmbH, Effeltrich, Germany). Dissolved oxygen concentration (YSI 55 oxygen electrode), salinity (Fisher Salinity refractometer with automatic temperature compensation), and pH (IQ Scientific Instruments, Inc., San Diego, CA, IQ151 handheld pH/mV/temperature meter) were determined monthly at each location. Average current velocity were measured at the edge and center of each study site (10 minute period, 0.6 x depth, Flow Wand, Edutech Technologies Corp. Gibson Landing, BC, Canada). Value were below detection limits and so further measurements were discontinued. Dissolved nutrients also were monitored monthly. Samples of the water column were taken (n=2/site), filtered (Whatman GF/C), and nitrate/nitrite and phosphate concentrations were determined with a Skalar SANplus autoanalyzer using standard protocols (Parsens *et al.* 1984). This unit was calibrated using six-point standards of known value. Additionally, samples of known value were placed into the testing regime at 10 to 15 sample intervals to ascertain calibration of the unit during the analytical run.

Results and Discussion:

Data for the aquatic plant and macroinvertebrate bio-inventories and physical parameters 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 (Table 1). 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).

Table 1: List of the aquatic plants that were identified during the survey.

Scientific Name	Common Name	Family	Origin	Located at these sites
<i>Alternanthera philoxeroides</i>	Alligator weed	Amaranthaceae	Introduced	5, 8a, 12
<i>Ceratophyllum demersum</i>	Coontail	Ceratophyllum	Native	4, 5, 8a, 8b, 12
<i>Eichhornia crassipes</i>	Water hyacinth	Pontederiaceae	Introduced	1a, 1b ¹ , 3, 5 ¹ , 8a, 8b, 11b, 12
<i>Hydrilla verticillata</i>	Hydrilla	Hydrocharitaceae	Introduced	4 ¹ , 5 ¹ , 8b, 10
<i>Spirodela polyrhiza</i>	Big duckweed	Lemnaceae	Native	5, 8b
<i>Myriophyllum spicatum</i>	Eurasian milfoil	Haloragaceae	Native	10, 12
<i>Nelumbo lutea</i>	Water lotus	Nelumbonaceae	Native	4 ¹ , 10, 11b ¹
<i>Phragmites communis</i>	Phragmites	Gramineae	Native	11b
Green algae	Filamentous			4, 8b
<i>Potamogeton nodosus</i>	Longleaf pondweed	Potamogetonaceae	Native	1a, 10 ¹ , 11b, 12 ¹
Unknown				5, 8b
<i>Salvinia spp.</i>	Salvinia	Salviniaceae	Introduced	1a, 4, 5, 8a, 10 ¹ , 11b ¹ , 12
<i>Sagittaria lancifolia</i>	Bull-tongue	Alismataceae	Native	4, 8a ¹ , 11b ¹
<i>Sagittaria latifolia</i>	Arrow head	Alismataceae	Native	3, 8a
<i>Scirpus pungens</i>	Common Three-square	Cyperaceae	Native	3 ¹ , 4
<i>Scirpus spp.</i>		Cyperaceae		5 ¹
<i>Typa domingensis</i>	Cattail	Typhaceae	Native	11b
<i>Vallisneria Americana</i>	Tape grass	Hydrocharitaceae	Native	8a
<i>Zizaniopsis miliacea</i>	Cut grass	Gramineae	Native	1b ¹ , 3 ¹ , 8a, 8b, 10, 12
<i>Nuphar luteum</i>	Spatterdock	Nymphaeaceae	Native	1a ¹
<i>Najas spp.</i>	Southern Naiad or Bushy Pondweed	Nafacaceae	Native	4 ¹ , 5, 8a, 8b ¹ , 10
<i>Zosterella dubia</i>	Stargrass	Pontederiaceae		4 ¹ , 8a, 8b, 10

¹ Indicates that these species of plant were dominant at the indicated sites.

Analyses of macroinvertebrate assemblages indicate that gammarid amphipods, small portunid crabs, bivalves in the family Dreissenidae, gastropods in the families Neritinae, Lymnaeidae and Planorbidae, damselfly larvae in the family Coenagrionidae, caddisfly larvae in the family Polycentropodidae, and adult coleopteran beetles are common. An example of an assemblage is seen in Table 2. The results suggest that both invasive and native plant species serve primarily and equally well as habitat for these macroinvertebrates. However, there are differences in the macroinvertebrate distributions among sites. Based on the presence of indicator organisms including members of the orders Ephemeroptera, Plecoptera, and Trichoptera (otherwise known

as EPT) the differences in distribution are thought to be associated with differences in water chemistry.

Table 2 Percent distribution of aquatic insect families, found at sites 1, 3, 4, and 5 of Gravine Island, during July 2000.

Site	Family	Total # Found	% Of Each Sample
1	Lymnaeidae*	578	60.0
	Chironomidae*	165	17.1
	Dreissenidae	85	8.8
	Gammaridae	40	4.2
	Unknown eggs ¹	33	3.4
	Hyaellidae	19	2.0
	Coenagrionidae	15	1.6
	Neritinae	9	.9
	Physidae	8	.8
	Naucoridae	4	.4
	Culicidae	2	.2
	Potamanthidae	1	.1
	Staphylinidae	1	.1
	Belostomatidae	1	.1
	Libellulidae	1	.1
	Leptoceridae	1	.1
3	Gammaridae*	61	44.2
	Unknown eggs ¹	19	13.8
	Dreissenidae*	18	13.0
	Chironomidae*	14	10.1
	Xanthidae	8	5.8
	Neritinae	6	4.3
	Lymnaeidae	6	4.3
	Caenidae	3	2.2
	Polycentropodidae	2	1.4
	Culicidae	1	.7
4	Chironomidae*	18	33.3
	Neritinae*	8	14.8
	Physidae*	7	13.0
	Coenagrionidae*	7	13.0
	Mesoveliidae	3	5.6
	Polycentropodidae	3	5.6
	Hyaellidae	2	3.7
	Culicidae	2	3.7
	Pyralidae	2	3.7
	Gerridae	1	1.9
	Lymnaeidae	1	1.9

Site	Family	Total # Found	% Of Each Sample
5	Hyaellidae*	668	71.3
	Physidae	69	7.4
	Planorbidae	54	5.8
	Lymnaeidae	31	3.3
	Dreissenidae	27	2.9
	Libellulidae	24	2.6
	Unknown Eggs ¹	18	1.9
	Dytiscidae	9	1.0
	Curculionidae	6	.6
	Chironomidae	5	.5
	Crangonyctidae	4	.4
	Coenagrionidae	4	.4
	Hydrophilidae	2	.2
	Pyralidae	2	.2
	Glossiphoniidae	2	.2
	Asellidae	2	.2
	Caenidae	2	.2
	Mesoveliidae	2	.2
	Erpobdellidae	1	.1
	Corixidae	1	.1
Neritinae	1	.1	
Paleamonidae	1	.1	
Baetida	1	.1	
Homoptera ²	1	.1	

Literature Cited

- Lodge, D.M., R.A. Stein, K. M. Brown, A.P. Covich, C. Bronmark, J.E. Garvey, and S.P. Klosiewski. 1998. Predicting impact of freshwater exotic species on native biodiversity: challenges in spatial scaling. *Australian Journal of Ecology*. 23: 53-67.
- 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.
- Walker, B. and Steffen, W. 1997. An overview of the implication of global change for natural and managed terrestrial ecosystems. *Conservation Ecology [online]*, 1, URL: <http://www.consecol.org/vol1/iss2/art2>

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.

Zolczynski, J. and R. Shearer. 1997. Mobile Delta submersed aquatic vegetation survey 1994. *Report to Department of Conservation and Natural Resources*, January 1997

Changes in Scope or Objectives:

A supplemental grant entitled, “Role of Invasive Species in Shaping Diversity of Aquatic Vegetation in the Mobile-Tensaw River Delta” to A. Boettcher and T. Sherman was funded during 2001 cycle. This grant provided funding for a second year of plant sampling, which was completed during the summer of 2002. Analyses are currently being carried out on data from both years of sampling.

Comparison of Completed to Projected Research Progress

All field sampling has been completed and all plant and physical data entered into a database. Analyses will be completed during spring 2003. A MS student, Anna Penton, funded through the supplemental grant (see above) is completing the macroinvertebrate bio-inventory and analyses of this data as a component of her MS thesis research.

Report of Expenditures to Date

Item	Budget	Expenditure*	Remaining
Personnel	15,511 ¹	15,458	53
Fringe Benefits	2,278	1,640	638
Materials/Supplies	4,000	5,464	-1,464
Consultant/contracts	5,900 ¹	4,101	1,799 ²
Total Direct	27,689	26,663	1,026
FA Cost	6,424	6,186	238
Total Cost	34,113	32,849	1,264

*Expenditures as of 11/06/02 reporting period. ¹Original personnel budget 19,511 and consultant/contract budget 1,900 in a revised budget \$4,000 transferred from personnel to subcontract. ²Funds will be used to pay for analyses during Spring 2003.

Note: A no cost extension through June 2003 was granted.

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.