ACES Project Summary

Period Covered by the Report:	6/01/99 – 12/31/01
Date of Report:	4/01/02
Title:	Investigation of the use of pulse amplitude modulated (PAM) fluorometry as an indicator of submerged aquatic vegetation health in Mobile Bay
Investigators:	Dr. Timothy Sherman
Institution:	University of South Alabama
Research Category:	Small Grant for Exploratory Research
Project Period:	6/01/99 – 12/31/01

Objectives of the Research Project:

Beds of submerged aquatic vegetation (SAV) are an important component of estuarine environments, providing habitat for small and juvenile organisms, refuge from predators, and food for estuarine species and migratory waterfowl. The physical structure of SAV serves to remove and trap particulates from the water column and stabilize unconsolidated sediments. Additionally, biological activity and physiological processes of the plants result in improved water quality through the removal and recycling of nutrients, toxins, and other pollutants. Therefore, maintenance of environmental conditions suitable for SAV survival and growth within estuaries is a management goal (Duke and Kruckzynski 1992).

In this exploratory study, I focused on response of SAV photosynthesis to environmental conditions. This physiological parameter is tightly coupled not only to light conditions, but also to nutrient availability [i.e. DIC and nitrogen availability], stress [temperature, UV-B, etc.], and toxins. In this work, measurements of photosynthetic response were conducted both in the laboratory and in the field using intact tissues.

I attempted to determine the utility of PAM fluorometry to ascertain the physiological state and to evaluate environmental conditions that maximize photosynthetic efficiency of a native SAV (*Vallisneria*) and a few common introduced species (Coontail, Eurasian milfoil, and *Hydrilla*) under field conditions

Specifically:

1. PAM measurements was compared with those generated by polarigraphic measurement (using an analytical Clark-type oxygen electrode) under field conditions.
2. Measurements taken in the field were compared to those taken on similar tissues transported back to the laboratory using conditions that have been utilized in previous reports.
3. PAM and oxygen electrode data from different tissues of the same plants (e.g. young vs. old leaves, young vs. old parts of the same leaf, and similar tissues during the course of the growing season were compared.
4. The effects of salinity and dissolved nutrient concentrations were also examined.

Progress Summary/Accomplishments:

Research

Data collected indicate that PAM fluorometry and polarigraphic measurements of photosynthetic oxygen production yield comparable results in the field and in the lab. The relationship between electron transport rate (measured by PAM) and oxygen evolution (corrected for dark respiration) was linear in *Hydrilla* but not in *Vallisneria*, suggesting possible photorespiratory active in the latter species. Measured photosynthetic capacity changed markedly when tissues were transported back to the lab prior to assay, indicating that measurements made in the field may be more relevant for judging competitive differences between species.

A great deal of variability was present in the photosynthetic capabilities of the tissues within an individual plant. Youngest fully mature leaves are probably the best candidates for analysis. A dark adaptation period of 10 minutes was sufficient to open all PS reactions centers with all species examined and was used to determine all maximum quantum yields.

Tissues assayed in the field, measured with both techniques, had photosynthetic capacities that varied during the course of the day, with peak activities occurring early in the day with decreased activity in the early afternoon. This is consistent with recent work (Beer and Bork, 2000). Photosynthetic capacity of a given species was generally constant until late in the growing season when tissues began to senesce or at higher temperatures during the warmest months. *Hydrilla* tolerated higher light intensities and higher temperature than did *Vallisneria*.

Increasing salinity had a negative effect on all plants, but at levels normally experienced by these plants, little adverse effect was noted.

Literature Cited

Duke, T. and W.L. Kruczynski (eds.). 1992. Status and trends of emergent and submerged vegetated habitats, Gulf of Mexico, USA. Report of the U.S. EPA, Gulf of Mexico Program Habitat Degradation Subcommittee. U.S. Environmental Protection Agency, Office of Water EPA 800-R-92-003. 161p.

Beer, S. and M. Björk (2000). "Measuring rates of photosynthesis of two tropical seagrasses by pulse amplitude modulated (PAM) fluorometry." *Aquatic Botany* 66: 69-76.

Publications/Presentations: Manuscript in preparation.

Future Activities:
Based on the results of this pilot study, a variety of larger scale investigations will be possible. For instance, it will be instructive to perform a series of longer-term field studies and experimental light and nutrient manipulations. In these, PAM data could be compared to other methods of assessing environmental quality (e.g. water clarity, plant

morphometrics, biomass production, etc.). The role of milfoil and Hydrilla competition can be addressed through experimental removal plots and assessment of light reduction and nutrient removal characteristics in mixed communities with *Vallisneria*. Additionally, this technique will allow for rapid and continuous assessment of the health of SAV used in transplantation experiments used in wetland reconstruction.

Supplemental Keywords:

Non-indigenous species, submerged aquatic vegetation, SAV, aquatic plants, photosynthesis, PAM fluorometry, estuary, biology, southeast, gulf coast, Alabama, AL

Relevant Websites:

http://aquatl.ifas.ufl.edu/
http://www.invasivespecies.gov/

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