TIEE

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ISSUES – FIGURE SET

What's Killing the Coral Reefs and Seagrasses?

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Bleaching in coastal Florida
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Figure Set 4: Loss of Seagrasses in Florida Bay and Nutrient Loading from Watersheds

Purpose: Students learn how to apply information from other sites in Florida and New England to Florida Bay.
Teaching Approach: "Informal Groupwork"
Cognitive Skills: (see Bloom's Taxonomy) — knowledge, comprehension, interpretation, application
Student Assessment: essay

BACKGROUND

Seagrass beds exist in coastal waters worldwide and are important habitats for juvenile fish and many other marine organisms. The seagrass meadows in Florida Bay were known for their species richness and large expanse. Animals that depend on these grassbeds off Florida are pink shrimp, spiny lobsters, bald eagles, manatees, crocodiles, and sea turtles. *Thalassia testudinum*, turtle grass, is a common seagrass here.

In 1987 sport-fishing guides began to notice large patches of brown, floading *Thalssia* in western Florida Bay. The water was also different; normally the water column in the Bay was clear and you could see the bottom in many places, but that year the water was murky and turbid. More seagrass beds deteriorated and fishermen suggested that rotting grass was depleting the water of oxygen and killing more seagrass. In fact, the causal agent of the *Thalssia* die-off remains controversial. Some blame very high salinity (<70 ppt), a result of freshwater diversion from the Everglades and also droughts.

Brian LaPointe, a scientist from the Harbor Branch Oceanographic Institution in Fort Pierce, Florida, is a well known for his research in Florida Bay. LaPointe does not support the salinity theory and points to high nutrient concentrations in Florida Bay water as the cause. He supports his hypothesis with his own research (see Data Set #5) and the fact that nutrient loading to coastal waters is resulting in seagrass die-offs worldwide. In Florida the main nutrient sources are agriculture and sewage.

The main focus in this activity is application. Students often don't appreciate that scientists must use data from other locations or organisms and assess the validity of applying these findings to their own situation. This is certainly true for environmental scientists and planners who must make decisions with limited information. In this case, students are asked to apply data from a bay off western Florida and another off Cape Cod to the Florida Keys.

STUDENT INSTRUCTIONS

Work together in informal groups of 3-5 in the classroom on Figures 4A, 4B, and 4C. As you work to understand these Figures make sure that you follow the Step One - Step Two procedure we have practiced in class.

Figure 4A shows changes in turtle grass over 10 years in Florida Bay by comparing the biomass in 1984 and 1994. After you understand the data, imagine snorkeling over these seagrass beds. What do you think they looked like in 1994 compared to 1984? What change would you actually see? Also, how do you think the scientists got these data - what kind of measurements did they make and how might they have gone about getting this information?

The *s in Figure 4A indicate locations where the difference between the 2 years is significant. What do scientists mean when they say that a difference is "significant"? What do the vertical lines at the top of the histogram indicate?

The next step is to use what you've learned from Figures 4B and 4C to explain why turtle grass biomass declined from 1984 to 1994. Figure 4B is from Sarasota Bay Thallasia (turtle grass) beds off the west coat of Florida, and 4C from eelgrass (another type of seagrass) beds off Cape Cod, MA. Study 4B and 4C to understand the information they provide.

Now apply the findings from Figures 4B and 4C to 4A. If you were asked to propose why seagrasses were declining in Florida Bay based on the findings from Sarasota and Cape Cod, what would you say? Is it valid to use information from one site and apply it to another? How would you assess the validity of doing that in this case? What kind of information would you like to know?

FIGURES

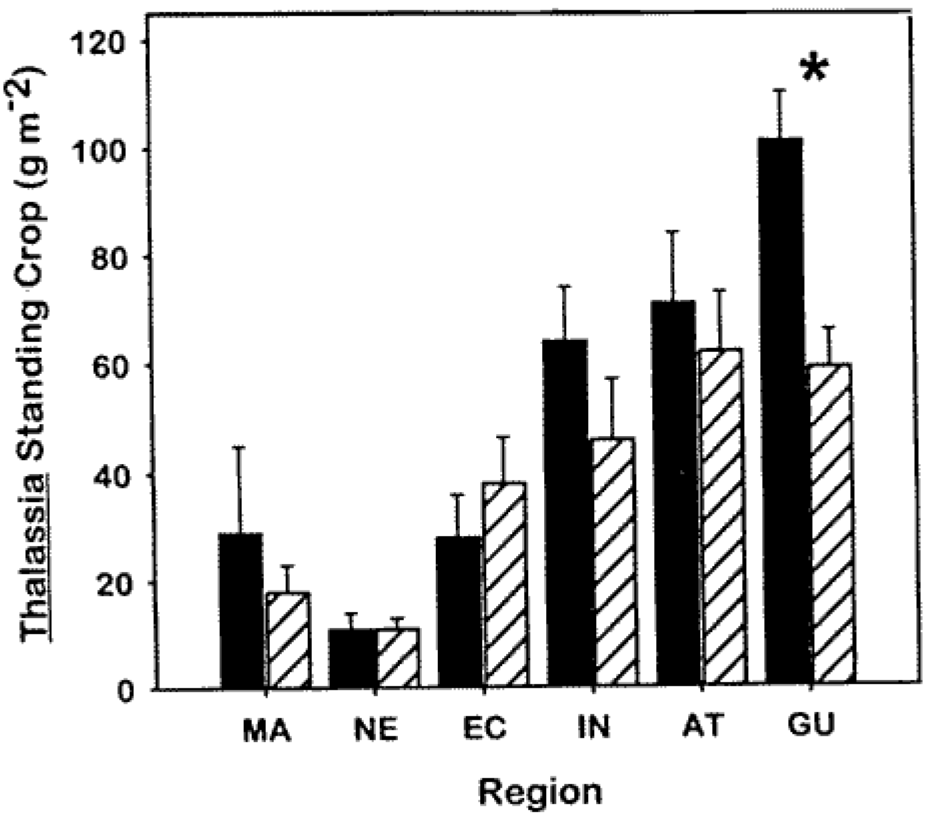

Figure 4A. *Thalassia testudinum* (turtle grass) biomass (grams of dry grass per square meter) in 1984 and 1994 in 6 regions of Florida Bay. (From . Hall, M. O., M. J. Durako, J. W. Fourqurean, J. C. Zieman. 1999. Decadal changes in seagrass distribution and abundance in Florida Bay. Estuaries 22: 445-459).

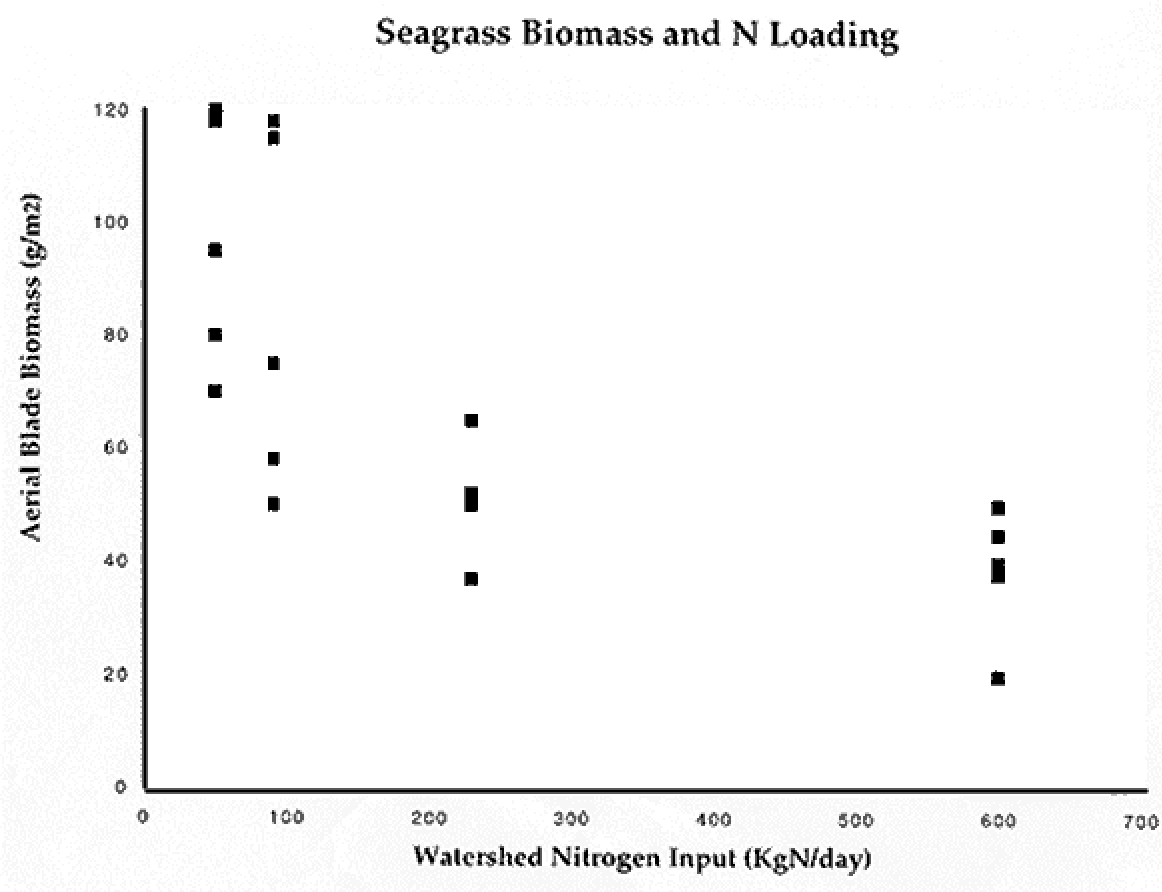

Figure 4B. Relationship between input of nitrogen (kilograms N per day) from 4 watersheds and receiving water seagrass biomass (above ground blade biomass in grams per square meter) in 19 seagrass beds in Sarasota Bay. (From Tomasko, D. A., C. J. Dawes, and M. O. Hall. 1996. The effects of anthropogenic nutrient enrichment on turtle grass (*Thalassia testudinum*) in Sarasota Bay, Florida. Estuaries 19: 448-456).

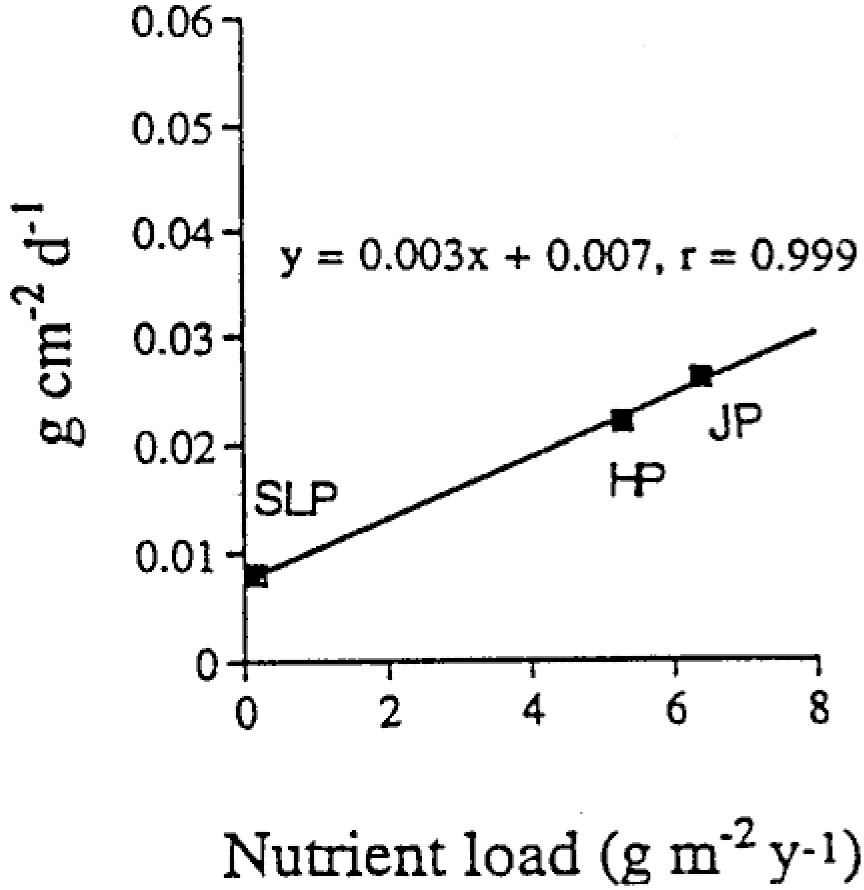

Figure 4C. Relationship between nutrient loading (grams per square meter per year) and biomass of algae growing on blades of eelgrass (*Zostera marina*) in 3 seagrass areas in Waquoit Bay, Cape Cod, MA (From Wright, A., T. Bohrer, J. Hauxwell and I. Valiela, 1995. Growth of epiphytes on *Zostera marina* in estuaries subject to different nutrient loading. Biological Bulletin 189: 261).

NOTES TO FACULTY

*** On the Question - Figure 4A shows changes in turtle grasses over 10 years in the Florida Bay. Imagine yourself snorkeling over these seagrass beds. What do you think they looked like in 1994 compared to 1984? How do you think the scientists got these data - what did they actually do?

Visualizing a data set helps student understand the findings concretely - it can make a abstract finding more real, especially for more visual learners. Asking the students to think about the methods also achieves this and it also helps students realize that many people, even they, could do this part of the project. In this case, 15 cm diameter cores were collected by divers off a boat; the sediment cores were taken back to the lab and grass stem density and dry weight measured.

Figure 4B (Tomasko et al. 1996) shows a nice relationship between watershed N loading and *Thalassia* biomass in Sarasota Bay on the west coast of Florida. Five nutrient sources were included in the watershed loading calculation: stormwater, groundwater, point sources (sewage and industrial outfalls), septic tanks, and rain. Various beds were studied and their watershed inputs calculated individually.

Figure 4C is from temperate eelgrass (*Zostera marina*) beds in Waquoit Bay on Cape Cod, MA. These data show a linear relationship between biomass of algal epiphytes (algae growing on the seagrass leaves) and nutrient loading. Data like these give support to the idea that nutrient loading to seagrass beds results in high biomass of epiphytic macroalgae, which in turn shade the seagrass. High phytoplankton biomass in the water column also results in shading. In both cases, the seagrasses die as a result of light limitation. For each data set give students the methods in writing either in a handout or an overhead.

*** On the Question - The *s on the figure indicate locations where the difference between the 2 years is significant. What do scientists mean when they say a difference is “significant”? What do the vertical little lines at the top of the histograms indicate?

Four randon cores were taken at each site. The figure legend does not say whether the “error bars” are standard deviation or standard error; what you want your students to think about in a general way is the importance of replication and the meaning of statistical significance.

*** On the Question - Make sure you understand the data in Figures 4B and 4C. Figure 4B is from Sarasota Bay *Thalssia* beds off the west coast of Florida and 4C from eelgrass (another type of seagrass) beds off Cape Cod. If you were asked to propose why seagrasses were declining in Florida Bay based on the findings from Sarasota and Cape Cod, what would you say? Is it valid to use information from one site and apply it to another? How would you assess the validity of doing that in this case - what types of information would you like to know?

This question helps students better understand the process of science - that scientists must use information from all sorts of sources and judge the usefulness of these findings for their particular situation. Good responses include: how did the scientists working in Sarasota Bay measure watershed input? How did they know what it was? Where is the N coming from there and are these the same types of sources in Florida Bay? Are the seagrass data good (e.g. valid methods)? There is a lot of variation in blade biomass for the same input; this might be a problem. How did the scientists working off Cape Cod measure nutrient load? How did they measure epiphyte biomass? Are these methods good? Can we use data about eelgrass and apply it to turtle grass? Can we use data from Cape Cod and use it for Florida? What you are looking for in their responses, either written or oral, are not answers to these questions but various ways that they might be able to address them.

This exercise will take a good amount of class time. You could also assign it as a group homework assignment if your students have enough experience with data interpretation to do this on their own.

Student Assessment: Essay

Loss of submerged aquatic vegetation (SAV) is a severe problem in estuaries receiving high nutrient loads from agriculture and other sources. Explain the link between nutrient loading and loss of SAV.

Evaluating an Issue: How do you know whether it is working?

On-going (also called formative) evaluation of the approaches your are using is critical to the success of student-active teaching. Why try out new ideas if you don't know whether or not they are working? This is a brief overview of formative evaluation. For more information, go to the Formative Evaluation essay in the Teaching Section.

Course Goals:

Formative evaluation only works if you have clearly described your course goals - because the purpose of the evaluation is to assess whether a particular technique is helping students reach these goals. For instance, most of us have "learn important ecological concepts and information" as a course goal. If I reviewed the nitrogen cycle in a class, for evaluation I might ask students to sketch out a nitrogen cycle for a particular habitat or system. Each student could work alone in class. Alternatively, I might ask students to work in groups of 3 and give each group a different situation (e.g. a pond receiving nitrate from septic systems, an organic agricultural field, an agricultural field receiving synthetic fertilizer). The students could draw their flows on a large sheet of paper (or an overhead transparency) and present this to the rest of the class.

The Minute Paper:

Minute papers are very useful evaluative tools. If done well they give you good feedback quickly. Minute papers are done at the end of a class. The students are asked to respond anonymously to a short question that you ask. They take a minute or so to write their response in a 3x5 card or a piece of paper. You collect these and learn from common themes. In the next class it is important that you refer to one or two of these points so that students recognize that their input matters to you. The UW - FLAG site (www.wcer.wisc.edu/nise/cl1/flag/) gives a good deal of information about using minute papers including their limitations, how to phrase your question, step-by-step instructions, modifications, and the theory and research behind their use.