Using Wetlands To Teach Ecology & Environmental Awareness in General Biology

Lyman H. O'Neal

Mangrove forests and freshwater marshes are sensitive wetlands that have historically been abused in southwest Florida. Field trips to these important ecosystems are used to motivate biology students to an environmental awareness and to teach ecological concepts. Advantages of using wetlands educationally and their relevancy to local, national and global environmental issues are discussed.

Wetlands are being lost in this country at an alarming rate of about 300,000 acres annually (Mitchell 1992). With a history of abuse to wetlands in southwest Florida and the importance of these ecosystems, it was a natural choice to use them as an educational tool. Attempts by the government to redefine wetlands (Bohlen 1991; Gnam 1992) so that many seasonal wetlands will not be protected, and continued population growth and development in Florida, make the future of these ecosystems perilous and add to their relevancy for educational purposes. Not only do the wetlands deserve the attention of educators for the purpose of developing a consciousness and a passion in the students for the environment, but they are excellent models for demonstrating certain ecological concepts to a class that has limited time to spend on field trips.

The field trips described here are a part of the laboratory in Biological Science at Edison Community College-Charlotte Campus. Principles of ecology and environmental issues are discussed in the lecture, while the laboratory allows the students to observe and interpret two local ecosystems. Laboratory periods are three hours long and limited to 24 students per section.

The Edison Community College-Charlotte Campus is located in southwest Florida near the Gulf of Mexico on Charlotte Harbor. Two wetlands, the mangrove forest and a freshwater marsh, were chosen as study sites. Both are sensitive wetlands that have suffered disturbance by humans and are now protected by law. In keeping with the spirit of the educational institution interacting with the local community, these field trips contribute to an awareness of the need to protect the quality of the local environment. These ecosystems are transitional habitats between land and water; one is a coastal saltwater (brackish) ecosystem and the other is an inland freshwater ecosystem. The mangrove ties the land and sea, and the freshwater marsh links a wetland to a terrestrial ecosystem. Vegetative zonation is apparent in both of these ecosystems and is easily related to the water level. These wetlands can be contrasted because the mangrove is flooded by saltwater on a daily tidal cycle and the marsh is flooded with freshwater on a seasonal cycle. Some of the advantages of using wetlands are summarized in Table 1. The use of mangroves and marshes may be limited to certain geographical regions, but other wetlands may also be used educationally (e.g. swamps, riverine margins).

While neither field trips nor the use of wetlands are novel ideas, I hope to reiterate the educational value of field trips, to discuss the advantages of using wetlands, and to encourage educators at all levels to provide these firsthand experiences for their students.

Field Trips

It is the premise of these exercises that the students must first be motivated to become interested and then guided in making observations. Some of the objectives of these exercises are for students to:

1. Make firsthand observations of important local ecosystems.
2. Learn some ecological concepts.
3. Consider ecological characteristics.
4. Be stimulated and to become curious about the environment.
5. Appreciate the ecological and sociological value of these ecosystems.
6. Understand human impact upon these ecosystems.
7. Be aware of laws protecting them.
8. See some threatened and endangered species.
9. Relate these wetlands to local, regional, national and global environmental problems.

Lyman H. O'Neal is Professor of Biology at Edison Community College, Charlotte Campus, Punta Gorda, FL 33950.

Table 1. Advantages of using the mangrove and freshwater marsh for teaching ecology and environmental awareness.

1. Ecological gradients and biota zonation
2. Focus on a primary physical factor, water
3. Lands of transition
4. Community interactions
5. Interaction with adjacent ecosystems— mangrove/estuary; marsh/pine-palmetto forest
6. Relationship of an ecosystem to climate
7. Interesting adaptations of the biota to the environment
8. Interesting biodiversity as well as some threatened and endangered species
9. Importance to the local community
10. National relevance: recent discussion of changes in federal policy and redefinition of wetlands
11. Ability to relate to human impact; local, regional, and global
12. Accessibility
13. Opportunity to compare and contrast two different wetlands

Prior to departure on the field trip, the students were instructed on characteristics of the study site and were given questions to guide their investigation. Some of the questions were answered during the pre-trip meeting; some were to be answered during the field trip; and some remained to be answered following the field trip with library research. They were to note physical parameters influencing local and regional distribution of biota. Instruction was given on the equipment to be used on the field trip. Because water is a primary physical factor in both ecosystems, the class used the Hydrolab Surveyor II to measure some parameters (e.g. salinity, pH, temperature, dissolved oxygen, conductivity, and oxidation-reduction potential).

For the field trip, students were given a data sheet on which to record observations. To get a more complete picture of the ecosystems, the class was divided into groups of two and given field guides. Each student identified dominant plant species and adaptations, observed zonation, and noted ecological gradients, as well as identifying the specific group of biota assigned to them to contribute to the class-wide project.

Mangrove Field Trip

The mangrove forest we used as a study site is on Charlotte Harbor. The nearly pristine water of the harbor is lined with many miles of preserved mangroves and salt marsh.

Because of the demand for coastal land for development, strict laws have been passed that protect the mangrove ecosystem. This has at times been hotly debated and gives this habitat a local relevance. The mangrove is a very interesting and important ecosystem with a limited range of distribution in North America related to climate. As part of the project, students were to map the geographical distribution of red mangroves for their northern and inland limitations.

Tidal inundation is important to the mangrove ecosystem. Students identified three species of mangroves (red, black and white) and noted horizontal zonation (Figure 1a) and adaptations for surviving varying periods of exposure to saltwater and anaerobic sediments. Adaptations of salt exclusion, salt excretion, vivipary, and aerial roots that the mangroves have were especially interesting to the students. We visited at low tide to observe the substrate of the forest and vertical animal zonation with barnacles and oysters on the prop roots of the red mangrove, fiddler crabs on the forest floor, tree crabs on the trunks and branches of the mangroves, and birds in the canopy.

Students were interested in what other groups were doing. For example, we saw a snake coiled in the branches of a red mangrove at the water's edge. One group worked to identify it as a mangrove water snake, while the rest of the class observed. Students identified numerous birds such as pelicans and egrets that roost and nest in the mangroves, white ibis that forage among the roots, and shorebirds that wade in the shallow water of the shoreline. Other students used field guides to identify invertebrates and plants.

The estuary is an adjacent ecosystem that interacts with the mangrove. Students readily saw how flushing action in the mangrove might contribute nutrients to the estuary, how the marine organisms might use this habitat as a nursery, and how the mangrove protects the shoreline and the waters of the estuary. As we stood on the edge of the mangrove and the harbor, we projected to the future with questions of what would happen here if global warming increased the sea level; or how increased temperatures would change the species complex; or how a major oil spill would impact on the mangroves; or what happens to the shoreline, the estuary ecosystem, and inland habitats if the mangroves are destroyed.

Freshwater Marsh Field Trip

The marsh is a good example of a wetland that is not wet all the time but must have a drought period in order to complete its cycle. This habitat demonstrates the climatic effect of the wet-dry season typical of SW Florida. Seasonal fluctuation of water level is an important physical factor in the freshwater marsh. Students identified the plants forming the horizontal vegetative zones in varying depths of the marsh (Figure 1b). The marsh was usually observed when the water level was intermediate. We discussed what happens at the peak of the dry season when "gator holes" have a concentration of aquatic animals that become easy prey. The importance to some plant

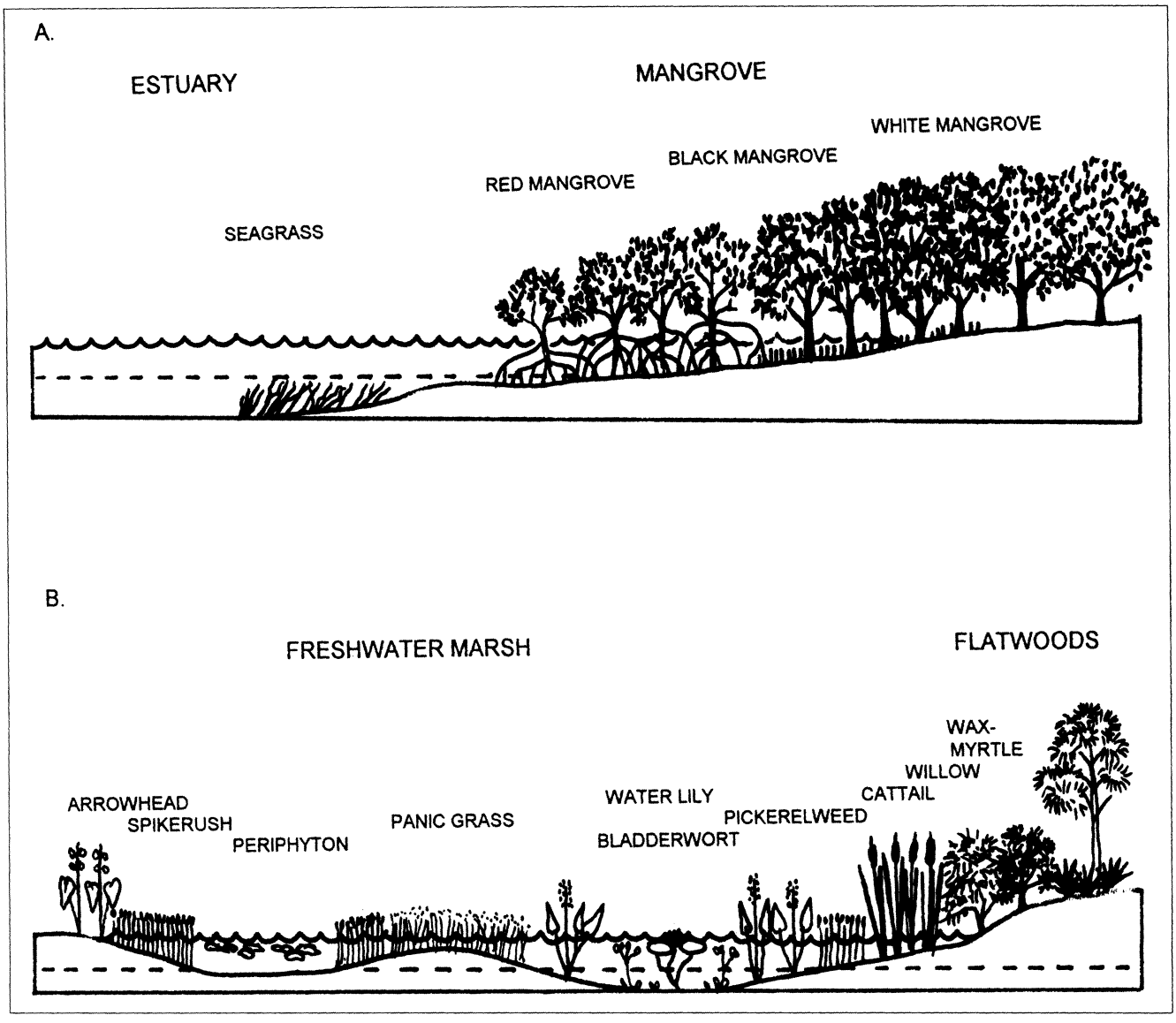

Figure 1. Profile of wetlands showing zonation of vegetation in relation to influence of water. a. mangrove—mean high tide (~~), mean low tide (- - -); b. freshwater marsh—wet season level (~~), dry season level (- - -).

species to have periods when there is no standing water was related to the controversy over the federal redefinition of wetlands. Life cycles of amphibians, reptiles, and insects also reflect this need for a drought period. Because the marshes are habitat for many interesting species of birds, the birds were identified and observed for distribution within these zones and for their adaptations. The pine-palmetto forest is an adjacent terrestrial ecosystem that interacts with the marsh. Tracks of raccoon hinted that they may use the marsh but return to the forest habitat. There was also evidence that otters, alligators and predatory birds moved between other ecosystems.

We speculated on how a change in the rainfall patterns due to global climatic changes might affect distribution and abundance of species in the marsh. Marshes have long undergone abuse by draining or filling. Students predicted how population growth and development in the region might impact on the marshes, and how the disappearance of these ecosystems would affect other ecosystems and the water supply to the region immediately and in the long-term.

After each field trip, groups returned to the laboratory, exchanged their observations, and each student incorporated these data into a comprehensive report. Data included identification and notes on biota, and the water analysis. Students were also asked what aspects of the ecosystem may not have been sampled or considered. The educational merits of these field trips, therefore, extend to the integration and interpretation of data, and presentation in a written format.

We discussed how human activities (such as draining, cutting, introduction of exotics, and habitat destruction) may affect each of these ecosystems. While local importance was emphasized, global issues were

related to these ecosystems (e.g. reduced biodiversity, modification of climate, pollution, population growth, carrying capacity, loss of habitat).

Discussion & Conclusions

We are in an environmental crisis and education must play a role in developing environmental literacy and awareness in our society (Bybee 1991) and perhaps instill a passion for the environment. Some of the responsibility must fall on the liberal arts science course. These courses may be the last chance to inspire and educate some students about the environment.

Teaching about ecology from textbooks with pictures and diagrams, videotapes, videodiscs, and computer simulations may have certain advantages, but an actual firsthand experience of sensing the environment close-up has no substitute. We must get out of the classroom to study ecology. As Orr (1990) said, "The conventional campus has become a place where indoor learning occurs as a preparation for indoor careers." Yet the quality of life is influenced by the outdoor environment. Reading Marjorie H. Carr's forward in *Ecosystems of Florida* (Myers & Ewel 1990), one feels the value of the field experience that was so much a part of education years ago. At a time when we are deficient in field-oriented experiences (Carter et al. 1990), it is proposed that ecology field trips be included in the education of our undergraduates.

The mangrove and freshwater marsh not only have educational merit from an ecological perspective but also have sociological and ethical ramifications. The choice to use these ecosystems presents an opportunity to relate not only to local environmental issues but regional, national and global issues as well.

Wetlands are suitable because a single physical factor plays such a dominant role; and it is simpler for the students to visualize the interaction of the physical and biological environments. Environmental gradients and vegetative zonation are easy to see. The presence of a diversity of animals, some endangered and threatened species, captured the interest of the students.

Many students have not taken time to enjoy the beauty of nature much less try to understand the natural world. Many had never been on a field trip, used a field guide, nor visited these important local habitats. Motivation is an important part of teaching, and one of the missions of these exercises was to stimulate an interest in the environment using wetlands of local importance. To see, smell, hear and touch the environment and to perceive the spatial limits and predict temporal changes of the ecosystem have an indelible mark on the minds of the students.

Students indicated they enjoyed this activity and it was supported by their enthusiasm and discussions.

They came away interested and more observant of their surroundings. Questions and discussions that followed these field trips throughout the semester indicated that this may have had a long-term influence on their attitudes as well. A survey of the students at the end of the semester showed that an overwhelming majority said that the field trips were the best laboratory experiences of the year. If these trips accomplish no more than to arouse an awareness of the environment, an appreciation of nature, and a sensitivity for the wetlands in particular, it was worthwhile. It is hoped they will also gain some understanding of structure and function of the wetlands.

Very few of these students will become scientists, and even fewer will become ecologists, but they will become citizens faced with environmental choices. If we expect a society to have an interest in the global environmental crisis, we must first motivate them with an experience in their own environment. Through education we hope to save the wetlands but also develop attitudes and knowledge that will be conducive to saving the global environment as well. Special efforts to include relevant field experience at all levels of education should be made. The rewards are worth the trouble it takes to plan and conduct field trips. The question does not seem to be the value of these trips, but rather, why are we not doing more of them?

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