Bringing Wetlands to Market Part 3 Exercise 1
Worth a lot of clams: putting a price on coastal wetlands

Overview
In this exercise, students will consider the economic value of wetlands goods and services to the environment and to people.

Time Required
One 45-minute class session.

Materials
Writing paper, laptop, or tablet
Student reading
Additional references and information sources are provided below

Background for teaching
Natural systems have many types of value. In Part 1, students learned about the ecosystem services provided by wetlands. In this exercise, they will learn about the complexity and difficulty of calculating the economic value to the community of some of those services. Economists on the Bringing Wetlands to Market project team are working on a method to determine the economic value of carbon sequestration of salt marshes.

Procedure
1. Ask students to choose a local wetland area. This could be the wetland they are adopting for study and stewardship or another wetland in the region. They may choose to focus on a wetland at Waquoit Bay or another National Estuarine Research Reserve if they wish.

2. Have students make two columns on a piece of paper or a word processing program. Give students 5 or 10 minutes to list on the left side of the document at least 3 ways their selected wetland is valuable to them. Next, ask them to add to the list at least 3 ways their wetland is valuable to others.

3. Once they have a list, ask them to put a dollar value on the right hand side next to each item in their list. Have students generate a list on their own, and after 5 minutes ask them to discuss their list with a partner.

4. After you've given the students about 10 minutes to work on the task, discuss the main points using these guiding questions:

    a. What items or services did you have in your list? (ask each student to provide one value that hasn't already been listed).

    b. How did you decide on the dollar value for your items? What factors made this difficult?

    c. Were some items easier to set a value for than others? Were the ones you couldn't easily assign a price to more or less important than the ones for which you could assign a dollar amount?

    d. Why might it be important to be able to put a price tag on the values of wetland ecological services and services to people?

5. After this introductory discussion, have students read the US EPA fact sheet ″Economic benefits of wetlands″ available below or online here and have them answer these questions in writing or as part of a group discussion.

    a. What are some of the economic benefits of wetlands described in this reading?

    b. Are any of these benefits supplied by your local wetlands?

    c. Do the benefits supplied by wetlands represent an important part of the local economy?

6. As a culminating project, you may choose to have students use the resources in this lesson to create outreach and communication materials for educating peers, families, or the community about the importance and economic benefits of wetlands to the community.

Additional Readings and Resources:
If you want your students to examine this issue in more depth, or have students try to quantify the value of a selected wetland, you may wish to use the information from Restore America's Estuaries, a partner in the Bringing Wetlands to Market project. This non-profit conservation organization has many useful resources for estimating and calculating the economic value of coastal wetlands and their services. Resources about the economic value of estuary services can be found here.

"Economic value of ecosystems services of coastal wetlands" has lots of information; it is part of the resource-rich web site at NOAA State of the Coast.

Videos
Economists on the Bringing Wetlands to Market project are working to develop a method to determine the value of salt marshes such as the one at South Cape Beach in Mashpee, Massachusetts, in the carbon market. Students can watch the video "Coastal Blue Carbon" or the Bringing Wetlands to Market "Project Tools" video to learn more about carbon markets and to learn what the project economists hope to accomplish.

Optional activities: Carbon in trees
Since trees are ubiquitous, you may want to have students study schoolyard trees to teach them about carbon uptake and sequestration in plants, and then compare these processes with the higher rates of carbon uptake and sequestration in wetlands.

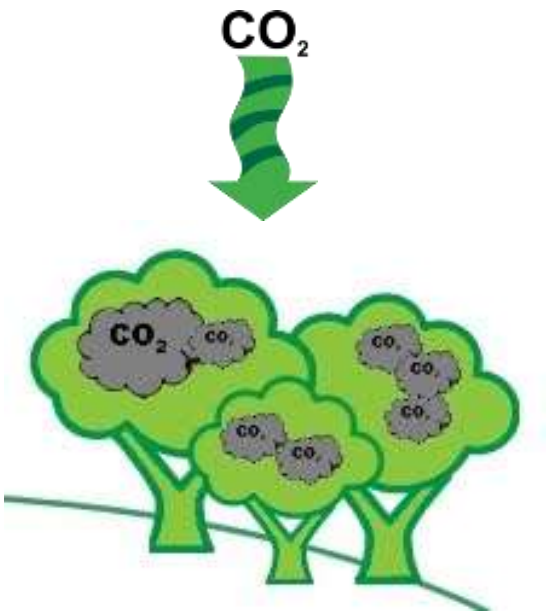
1. Schoolyard survey activity: Students measure the circumference and height of selected trees, and use a formula to calculate the approximate amount of carbon in each tree. This is a fun activity that includes math How much carbon is in a tree?

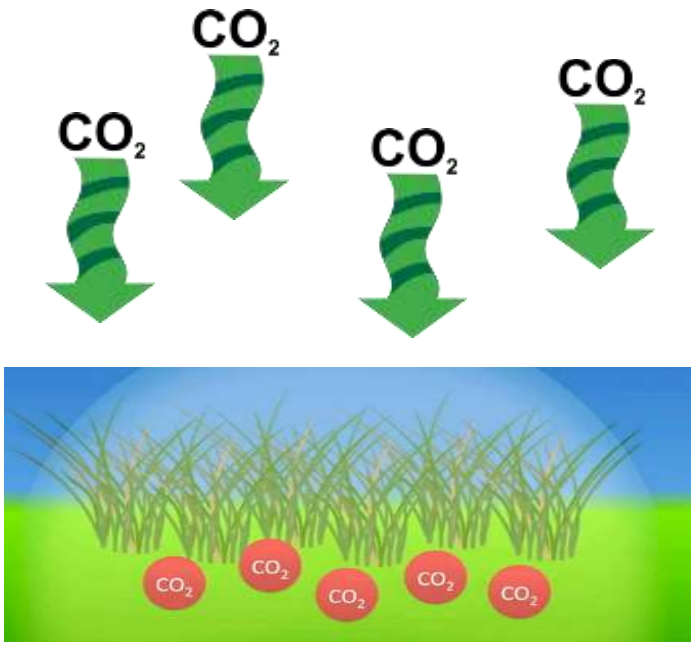
2. i-Tree Design is a creative and engaging interactive online tool that allows anyone to make a simple estimation of the economic benefits individual trees provide. With inputs of location, species, tree size and condition, users generate a table of calculated values for tree benefits related to greenhouse gas mitigation, air quality improvements and storm water interception.

   Students will really enjoy using their own home location or the school's location and finding the potential economic value of planting a tree of a selected species in a selected location.

Additional resources for trees and carbon storage:
This Forest value case study is written for students, and highlights the ecological and community services provided by forests.

This brief reading provides a compelling list of the ecological and cultural benefits of trees, and could be modified by students to describe benefits of wetlands. Benefits of Trees





EPA United States Environmental Protection Agency

Economic Benefits of Wetlands

A wetland is a natural area that is often wet but may not be wet all year round. Wetlands are characterized by their distinctive hydrology, soils and plants. Once regarded as wastelands, wetlands are now recognized as important features of the landscape that provide numerous beneficial services for people and wildlife. The economic value of a wetland is an estimate of the importance, or worth, of one or more of its services to society. Some of these services, or functions, include protecting and improving water quality, supporting the fishing industry, storing floodwaters and providing opportunities for education and recreation. If wetlands are destroyed or damaged, it can be difficult or impossible to replace all of these functions.

Wetlands contribute to the national and local economies by producing resources, enabling recreational activities and providing other benefits, such as pollution control and flood protection. While it can be difficult to calculate the economic value provided by a single wetland, it is possible to evaluate the range of services provided by all wetlands and assign a dollar value. These amounts can be impressive. According to one assessment of natural ecosystems, the dollar value of wetlands worldwide was estimated to be $14.9 trillion. (Source: Costanza et al. 1997) This fact sheet summarizes some of the important ways in which wetlands contribute to the economy.

Drinking Water Quality

Wetlands improve water quality in rivers and streams, they are valuable filters for water that may eventually become drinking water.

Wetlands improve water quality in nearby rivers and streams, and thus have considerable value as filters for future drinking water. When water enters a wetland, it slows down and moves around wetland plants. Much of the suspended sediment drops out and settles to the wetland floor. Plant roots and microorganisms on plant stems and in the soil absorb excess nutrients in the water from fertilizers, manure, leaking septic tanks and municipal sewage. While a certain level of nutrients is necessary in water ecosystems, excess nutrients can cause algae growth that's harmful to fish and other aquatic life. A wetland's natural filtration process can remove excess nutrients before water leaves a wetland, making it healthier for drinking, swimming and supporting plants and animals. For example, the Congaree Bottomland Hardwood Swamp in South Carolina removes a quantity of pollutants from the watershed equivalent to that which would be removed by a $5 million treatment plant. (Source: EPA832-R-93-005)

Flood Control

Flood damages in the U.S. average $2 billion each year, causing significant loss of life and property. (Source: National Oceanic and Atmospheric Administration). Wetlands can play a role in reducing the frequency and intensity of floods by acting as natural buffers, soaking up and storing a significant amount of floodwater. A wetland can typically store about three-acre feet of water, or one million gallons. An acre-foot is one acre of land, about three-quarters the size of a football field, covered one foot deep in water. Three acre-feet describes the same area of land covered by three feet of water. Coastal wetlands serve as storm surge protectors when hurricanes or tropical storms come ashore. In the Gulf coast area, barrier islands, shoals, marshes, forested wetlands and other features of the coastal landscape can provide a significant and potentially sustainable buffer from wind wave action and storm surge generated by tropical storms and hurricanes. (Source: Working Group for Post-Hurricane Planning for the Louisiana Coast) After peak flood flows have passed, wetlands slowly release the stored waters, reducing property damage downstream or inland. One reason floods have become more costly is that over half of the wetlands in the United States have been drained or filled. The loss of more than 64 million acres of wetlands in the Upper Mississippi Basin since the 1780's contributed to high floodwaters during the Great Flood of 1993 that caused billions of dollars in damage. (Source: "Flood Damage Reduction in the Upper Mississippi River Basin—An Ecological

One of the most valuable benefits of wetlands is their ability to store flood waters. Maintaining only 15% of the land area of a watershed in wetlands can reduce flooding peaks by as much as 60%. (Source: The Wetlands Initiative, EPA) (See EPA843-F-06-001, "Wetlands and Flooding.")

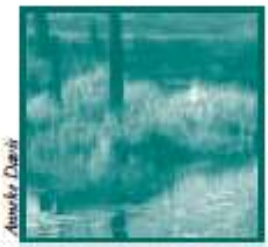
Valuation of Wetlands

Although wetlands provide important services to society, these services are typically not sold nor do they have market value. Wetland benefits can be estimated by several standard market and non-market valuation techniques. The three most common are cost-benefit analysis, cost-effectiveness analysis and benefits valuation for compensation for environmental damages. The techniques can be applied whether the change in the environment is an improvement or degradation. (Source: "Economic Valuation of Environmental Benefits")

Alternative", 2004) The damage sustained by the Gulf Coast during Hurricane Katrina could have been less severe if more wetlands along the coast and Mississippi delta had been in place.

Cleaning the Water

Because natural wetlands are so effective at removing pollutants from water that flows through them, engineers and scientists construct systems that replicate some of the functions of natural wetlands.



Annika Davis

Natural wetlands are effective at cleaning the water passing through them. Wetland plants and soils absorb much of the excess nutrients in the water. Wetlands perform this function so well that similar systems are being constructed to treat wastewater.

These constructed treatment wetlands use natural processes involving wetland vegetation, soils and their associated microbial life to improve water quality. They are often less expensive to build than traditional wastewater and stormwater treatment options, have low operating and maintenance expenses and can handle fluctuating water levels. For example, in 1990 city managers in Phoenix, Arizona, needed to improve the performance of a wastewater treatment plant to meet new state water quality standards. After learning that upgrading the plant might cost as much as $635 million, the managers started to look for a more cost-effective way to provide final treatment to the plant's wastewater discharge into the Salt River. A preliminary study suggested that a constructed wetland system would sufficiently clean the discharge water while supporting high-quality wetland habitat for birds, including endangered species, and protecting downstream residents from flooding. All these benefits would be achieved at a lower cost than retrofitting the existing treatment plant. As a result, the 12-acre Tres Rios Demonstration Project began in 1993 with assistance from the Corps of Engineers, the Bureau of Reclamation and EPA's Environmental Technology Initiative and now receives about two million gallons of wastewater per day. This project is still flourishing, serving as a home for thousands of birds and other wildlife. (Source: City of Phoenix) There are hundreds of wastewater treatment wetlands operating in the United States today. (Source: EPA832-R-93-005)

Fisheries

The Nation's wetlands are vital to fish health and thus to the Nation's multi-billion dollar fishing industry. Wetlands provide an essential link in the life cycle of 75 percent of the fish and shellfish commercially harvested in the U.S., and up to 90 percent of the recreational fish catch. Wetlands provide a consistent food supply, shelter and nursery grounds for both marine and freshwater species. Landings of crab, shrimp and salmon were valued at $1,167 billion in 2004. These species are dependent on wetlands for at least part of their life cycles. In 2004 the dockside value of fin fish and shellfish landed in the United States was $3.7 billion and was the basis for the $7.2 billion fishery processing business. U.S. consumers spent an estimated $54.4 billion for fishery products in 2000. (Source: U. S. Fish and Wildlife Service (USFWS), National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS))

Wetlands are essential to our multi-billion dollar National commercial fishing industry. Wetlands have an important place in the life cycle of 75 percent of the fish and shellfish commercially landed in U.S. waters.

Recreation

Wetlands are often inviting places for popular recreational activities including hiking, fishing, bird watching, photography and hunting. More than 82 million Americans took part in these activities in 2001, spending more than $108 billion on these pursuits. (Source: USFWS, Ducks Unlimited). For example, over 34 million people went fishing in 2001, spending an average of $1,046 and 16 days each on the water. Anglers spent $14.7 billion in 2001 for fishing trips, $17 billion on equipment and $4 billion for licenses, stamps, tags, land leasing and ownership, membership dues, contributions and magazines. The overall economic impact of recreational fishing is estimated at $116 billion (American Sportfishing Association), and wetlands play a crucial role in the life cycle of up to 90 percent of the fish caught recreationally. In 2001, approximately 3 million people hunted migratory birds, and 6.5 million small mammals that are often

Wetlands are pleasant places for recreational activities like fishing. They may provide a place of natural beauty and solitude that can be enjoyed by persons of all ages who may seldom be exposed to nature.

found in wetlands. They spent more than $2.2 billion, including $111million paid by migratory bird and large game hunters to lease hunting areas and blinds, often located on private property with wetlands. (Source: U. S. Fish and Wildlife Service) Each year nearly $200 million in hunters' federal excise taxes are distributed to state agencies to support wildlife management programs, the purchase of lands open to hunters and hunter education and safety classes. Proceeds from the federal Duck Stamp, a required purchase of migratory water fowl hunters, have purchased more than five million acres of habitat for the refuge system. (Source: Ducks Unlimited) Just watching the wildlife, many of which depend on wetlands, has become a popular pastime. More than 66 million people 16 years old and older--31% of all Americans-- fed, photographed and observed wildlife in 2001 and spent $40 billion on their activities. (Source: U. S. Fish and Wildlife Service)

Wildlife Habitat

Patrick Dorge

Many species of wildlife rely on wetlands for their very existence. Wetlands provide mammals, plants, amphibians, reptiles, birds and fish with food, habitat, breeding grounds and shelter. While the diversity of wetland wildlife contributes to many businesses, they are also inherently wonderful to observe.

Diverse species of mammals, plants, insects, amphibians, reptiles, birds and fish rely on wetlands for food, habitat or shelter. Wetlands are some of the most biologically productive natural ecosystems in the world, comparable to tropical rain forests or coral reefs in the number and variety of species they support. Although wetlands make up only about 5 percent of the land area of the lower 48 states, more than one-third of threatened and endangered species live only in wetlands. An additional 20% of the country's threatened and endangered species use or inhabit wetlands at some time in their life. Some species must have a wetland in order to reproduce. Migrating waterfowl rely on wetlands for resting, eating and breeding areas, leading to increased populations. As noted, the appeal of wetlands and the diversity of plant and animal life they attract contribute to or support many businesses. (Source: U.S. Fish and Wildlife Service)

Other Commercial Benefits

Many industries, in addition to the fishing industry, derive benefits or produce products dependent on wetlands. Part of this economic value lies in the variety of commercial products they provide, such as food and energy sources. Rice can be grown in a wetland during part of the year, and the same area can serve as a wildlife habitat for the rest of the year. Some wetland plant species, such as wild rice and various reeds, can be harvested for or used to produce specialty foods, medicines, cosmetics and decorative items. In many coastal and river delta wetlands, haying of wetland vegetation is important to livestock producers. In Europe, reed-growing for building materials is undergoing a revival in some countries as people realize the full potential of reeds as a roofing material. Aesthetically pleasing, thatched roofs are superior insulators to conventional tile roofs, and they have a life span of 25-40 years. (Source: Ramsar) Fur-bearing animals, such as mink, muskrat and beaver, use wetlands during some part of their life cycle. Income can be derived from trapping these furbearers, either by direct sale of their pelts or by leasing wetlands for the fur harvest. The nation's harvest of muskrat pelts alone was worth $124 million in 2004. (Source: U.S. Fish and Wildlife Service) Wetlands also provide employment opportunities, including such positions as surveyor or park ranger. The production of raw materials from wetlands provides jobs to those employed in the commercial fishing, specialty food and cosmetic industries. These are billion dollar industries that depend in part on wetlands to flourish.

In addition to the many ways wetlands provide economic benefits, they offer numerous less tangible benefits as well. These include providing aesthetic value to residential communities, reducing streambank erosion and providing educational opportunities as an ideal "outdoor classroom." By nearly any measure used, it pays to save wetlands.

Did You Know?

- Although wetlands cover only about 5 percent of the land surface in the lower 48 states, they are home to 31 percent of plant species. (U.S. Fish and Wildlife Service)
- In 2002 Louisiana commercial fish landings exceeded 1 billion pounds with a dockside value of $343 million – approximately 30% of the total catch by weight in the lower 49 states. (Source: America's Wetland)
- Rivaling the likes of tropical rainforests and coral reefs, wetlands are among the most fertile, productive ecosystems in the world. (Source: Ramsar)
- Two thirds of all fish consumed worldwide are dependent on coastal wetlands at some stage in their life cycle. (Source: Ramsar)
- Annual fish and seafood production in swamps and marshes worldwide has been estimated at an average of nine tons per square kilometer, 259 hectares or 640 acres. (Source: Ramsar)
- As many as one-half of all North American bird species nest or feed in wetlands.
- Five to seven million migratory waterfowl, including the endangered whooping crane, use wetlands, i.e. prairie potholes, as resting and feeding areas and as an abundant food source. (Source: U.S. Fish and Wildlife Service)

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For additional information, visit the U.S. EPA's website (www.epa.gov/owow/wetlands), or call the toll-free Wetlands Helpline at 1-800-832-7828.