What is the Ecological Role of an Estuary?

To most people, an **estuary** (es-chew-airy) is a place where fresh water meets the sea. In its broader meaning, an estuary is that part of the mouth of a stream in which the water level is influenced by the lake or sea into which the stream flows. The Great Lakes have some estuaries. Old Woman Creek on Lake Erie has an estuary that has been set aside by the state and federal governments as a "state nature preserve" and "national estuarine research reserve." Why should the government bother to preserve an estuary such as Old Woman Creek? There are many reasons:

1. The estuaries of the world serve as breeding grounds for many important animals that live in deeper waters.
2. An estuary has a wide variety of habitats available for wildlife to use as nesting and feeding sites. Thus, estuaries harbor a lot of biodiversity.
3. The sediments and waters of an estuary are places where nutrients are recycled and where the basic things needed for life are made available to a wide variety of organisms.
4. Estuaries serve as buffer zones to filter pollutants. Runoff from the land is cleansed before it enters a lake or ocean, and the effects of flooding and water level changes are lessened.
5. Estuaries are "endangered ecosystems." Because of their quiet waters and nearness to lakes or oceans, estuaries are often attractive places for marinas, home sites, and tourist developments. Few estuaries still exist in their natural conditions.

In this investigation, you will examine some of the characteristics of the estuary at Old Woman Creek, near Huron, Ohio. The things you will learn about this estuary will show you the importance of estuaries worldwide.

An estuary contains some areas that are almost always under water, some areas that are almost always dry land, and some areas between these two extremes. Each of these environments has a set of plants that can survive best under the given conditions. Each set of plants has a special role to play in the estuary and contributes to diversity of both plants and animals at Old Woman Creek.

Objectives

When you have completed this investigation, you will be able to:

- Describe the methods used by ecologists to sample populations of plant and animal life in aquatic ecosystems.
- Give a general description of the living communities that are found in different depths of water in an estuary.
- Give examples of how plant communities are important to animal life in an estuary.

Source

Modified from OEAGLS EP-016A, "The Estuary: A Special Place," by Rosanne W. Fortner and Ron Mischler.

Earth Systems Understandings

The activity addresses ESU 2, stewardship, 3, science methods and technology, and 4, interactions.

Materials

- Colored pencils.
- Ruler.

PROCEDURE

Figure 1 is an aerial photograph of the Old Woman Creek estuary, east of Huron, Ohio, on the shoreline of Lake Erie. Figure 2 shows the land use and plant types (called "vegetation") in the same area. Each symbol drawn by the computer stands for the main characteristic of an area equal to about 1/4 of an acre. One-quarter of an acre is equal to about 930 square meters. That's a bit bigger than an average school classroom.

Figure 1. Aerial photograph of Old Woman Creek Estuary.

1. With your pencil, outline the main parts of the Old Woman Creek Estuary on the computer map.

   A. Begin by outlining the beach areas (marked by "K"). One beach that runs along the shore at Oberlin Beach has been outlined as an example. West of Oberlin Beach lies the mouth of Old Woman Creek, and another beach begins just west of that.

NOTE: The mouth of the creek (where it joins the lake) is drawn in one place near the word "Old," but there is really a sand spit there that shifts back and forth over time. Figure 1, taken in 1976, shows another possible position of the spit.

   B. The estuary itself is surrounded almost entirely by deciduous forest (marked by ▲), Look on either side of the creek and find the border of the forest. Draw a line that separates the forest from the estuary. You will also find a patch of forest just below the "B" in "BERLIN." Outline this forest with another line.

   C. What three types of features (see symbols) are now shown to lie <u>within</u> the estuary itself? Remember, the estuary is surrounded by deciduous forest, but the deciduous forest is not a part of the estuary proper.

   D. Use colored pencils to shade in the following features:

      Green: Forest on border of estuary and on the island.
      Blue: The open water of the lake and the main stream channel.
      Brown: The marshy and non-forested wetland areas of the estuary.
      Yellow: The beach.
      Red: Residential areas.

Answer

C. Marsh, open water, and deciduous forest.

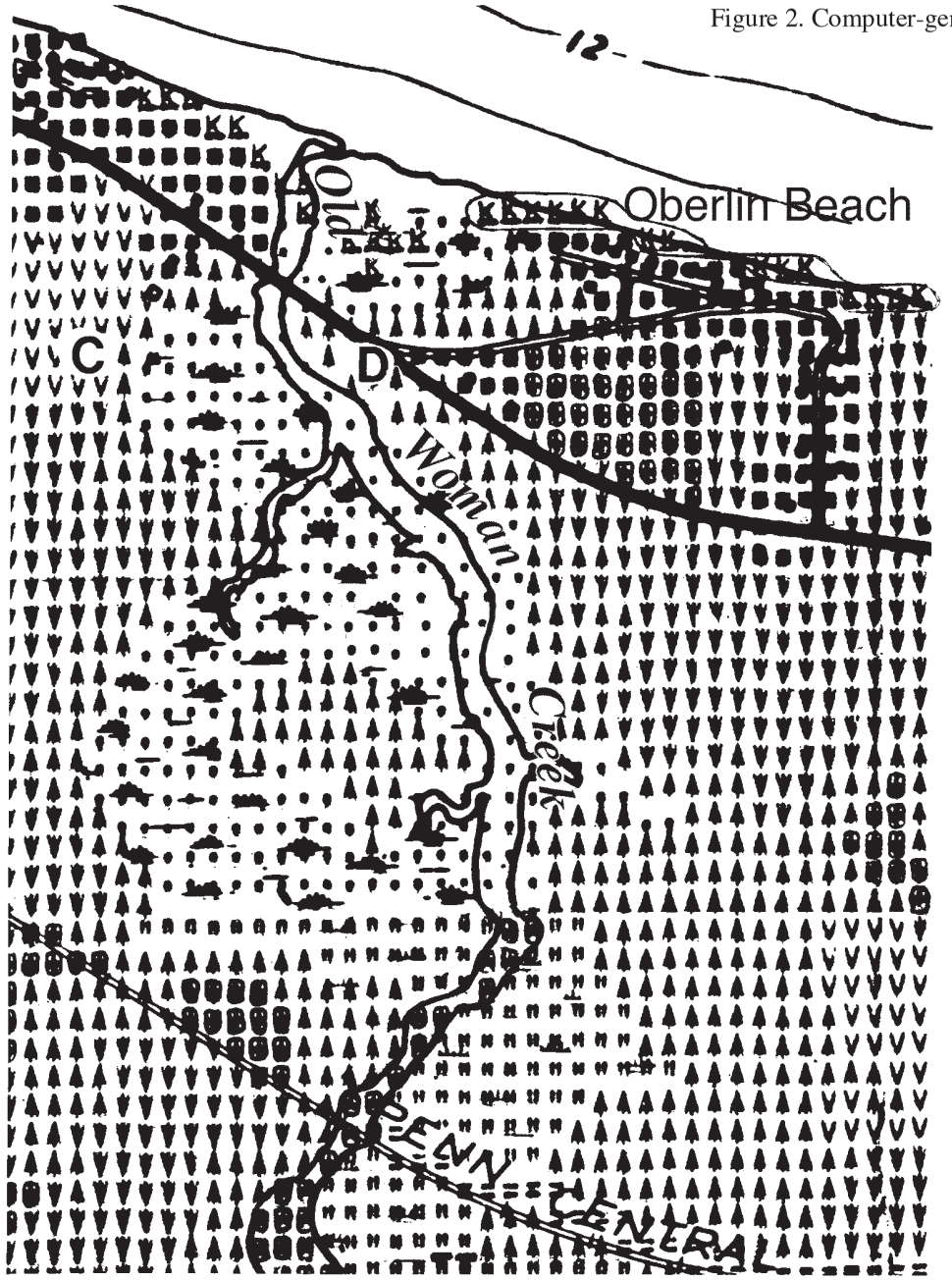
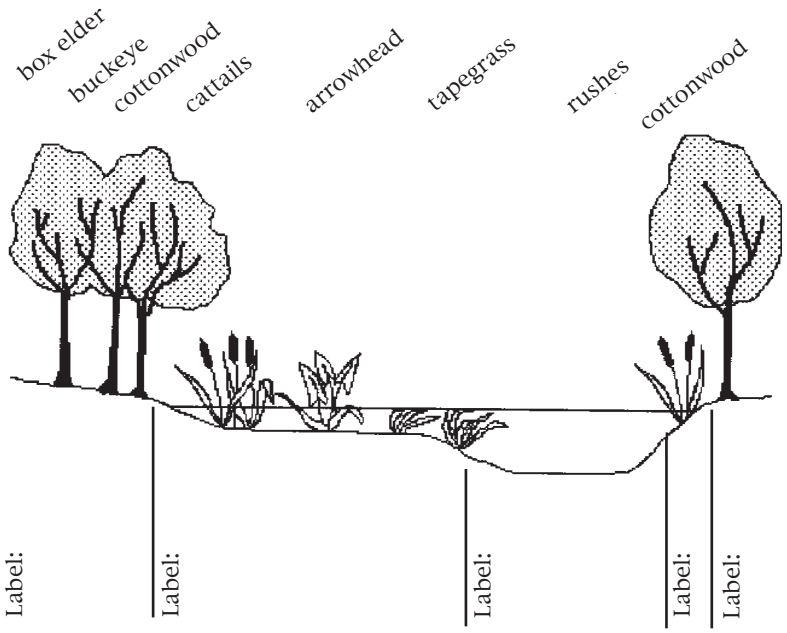


Figure 2. Computer-generated Map of Old Woman Creek Estuary.

COMPUTER MAP SYMBOLS

- homes (residential area)
- rangeland (cattle grazing, unused fields, etc.)
- deciduous forest
- stream or canal
- open water
- non-forested wetlands
- marsh or swamp
- beach
- row crops (corn, soybeans, etc.)
- cover crops

Figure 3. Transect and Profile Across Old Woman Creek Estuary.



2. Sampling the populations.

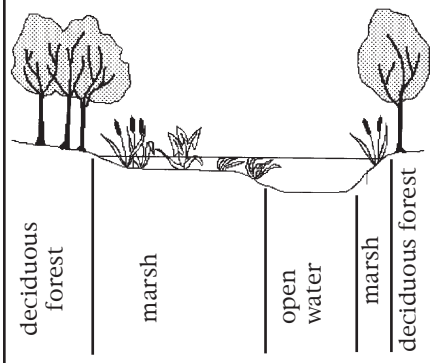
A. With your ruler, draw a line straight across Figure 2 between points C and D. This will be called your transect line. Ecologists (people who study the environment) use a *transect* as a way to sample the populations of living things in a community. For example, by naming and counting the plants along a transect, they get an idea of what the whole plant community is like, without counting and naming every organism in the whole community.

B. Figure 3 represents your transect line and the plants that might be found along it. It is drawn as a profile so you can tell the location and depth of the water. Figure 3 represents a transect approximately 2.3 times as long as line C-D in Figure 2. That means all its parts are that much bigger. Label the parts of Figure 3 to show the type of features (from the computer map) that your transect line crosses. Then turn to the Appendix for descriptions of the plants.

C. Which area of the estuary has plants rooted in fairly dry soil? What do these plants provide for the animals that live nearby?

Teacher's Figure 3. Transect and Profile Across Old Woman Creek Estuary.

Labels under Figure 3 should be as follows:



Answer

C. Forest plants are rooted in dry soil. These plants could provide nest sites, protection (places to hide), and food for the animals.

Figure 4. Animals' Use of the Transect Area of Old Woman Creek Estuary.

Animals observed in a typical Great Lakes estuary during one week

ANIMAL	HOW MANY	AREA	ACTIVITY				
			Hunting	Eating	Reproducing	Hiding	Other
Raccoon	1	forest edge		X			washing food
White-tail deer	2	forest		X		X	drinking
Fox	1	forest	X	X			
Songbirds	21	forest edge		X	X		nesting
Black snake	1	forest	X			X	
American egret	8	forest			X		nesting
American egret	15	marsh	X	X			
Green heron	2	marsh	X	X			
Kingfisher	4	marsh	X	X	X		
Water snake	1	marsh	X	X			swimming
Seagull	4	marsh		X	X		
Carp	8	marsh		X	X		
Yellow perch	60	marsh		X	X		
Yellow perch	12	open water		X			swimming
Freshwater drum	9	marsh		X			
Gizzard shad	150	marsh			X		swimming
Gizzard shad	30	open water		X			
Clam	17	marsh mud		X	X		
Emerald shiner	42	open water		X			
Walleye	84	marsh		X	X		

D. What area(s) have plants with roots <u>submerged</u> (underwater) but leaves <u>emergent</u> (sticking out of the water)? Which areas have plants submerged?

Answers

D. Marsh areas have emergent plants. Some submerged plants are in the open water areas and the marsh.

Each of the areas crossed by the transect line is able to support a group of animals. Suppose the area is watched for one week. Figure 4 is a list of the larger animals that might be seen and their activities.

Remember, these plant communities and their animal visitors are only being <u>sampled</u>. There are many more organisms in the estuary than we have mentioned here.

E. In which part of the estuary would you find the largest number of animals?

E. The marsh has the greatest number of animals.

F. What are the two main activities carried on by animals in this area?

F. Most of the animals are eating or reproducing there.

Answers

G. The plants provide food, nest sites, and protection.

H. Most of the fish listed are plant eaters when they are young. Carp eat plants as adults, too. Songbirds may eat the seeds of the plants.

I. The bottom of the estuary is muddy. This provides the plants with something to hold their roots in place.

J. An estuary is that part of the mouth of a stream in which the water level is influenced by a lake or ocean into which the stream flows.

K. The water level must have been (actually was) higher when the picture was taken than when the computer map was made.

G. Your answers to questions D and E should all be the same. Why would an area with many aquatic (water) plants be visited by such a large number of different animals? (Hint: See the list of animal activities in Figure 4.)

H. Perhaps you have listed "eating" in some of your answers above. Which of the animals in Figure 4 might be using the marsh plants as food?

I. What is the bottom of the estuary marsh probably like: muddy or rocky? Why do you think so?

The plants in an estuary tend to slow down the stream's flow. When water slows down, it cannot carry as much sediment. Much of the stream's load of sediment is, therefore, deposited in the shallow areas where plants are rooted in the water. Pollutants suspended in the water may also be trapped in the estuary this way.

J. Much of the Old Woman Creek area marked "marsh" on the computer map does not appear that way in Figure 1. An estuary isn't always marshy and a marsh isn't always an estuary. Look back at the introduction and find the "larger meaning" of the term estuary. Write that meaning on your worksheet.

K. Based on this definition, why doesn't the Figure 1 photograph show much marshy area?

Review Questions

1. Define estuary. Where are estuaries found? What are some of the functions served by estuaries that affect an ecosystem?

2. Give a general description of the types of plants found in different depths of water in an estuary.

3. List some ways in which plants are useful to animals in the estuary. Are there ways that animals are useful to the plants?

4. Describe a method by which scientists can sample a macroscopic community. (Hint: See the procedure to the activity.) What do you think are the challenges in trying to find a representative sample of all of the organisms in an estuary?

Extensions

1. How might the roles of plants vary in different depths of water in an estuary?

2. Refer to the computer map noting the different types of land uses in the region. What impact could land use have on the estuary? Do research to find examples you can use to support your answer.

3. What are some important estuaries in the Great Lakes region? Are there any near your school? Do an Internet search for information about estuary environments in the Great Lakes region. Begin with the examples here and add more sites:
   Old Woman Creek has its own Home Page – http://inlet.geol.sc.edu/OWC/home.html
   Milwaukee Estuary Area of Concern, http://epaserver.ciesin.org/glreis/nonpo/nprog/aoc_rap/michigan/milwaukee-home.html

References

Archie, Michele, writer and Ellen Lambeth, copy editor. *The Wetlands Issue: What should we do with our bogs, swamps and marshes?* 1992. North American Association for Environmental Education (NAAEE) Environmental Issues Forum, with support from the Kettering Foundation. Troy, OH: NAAEE.

NOAA is responsible for the nation's management of estuaries. Find more information about NOAA's work with National Estuarine Research Reserves. Old Woman Creek is one of the areas included under this program. Web sites include: National Ocean Service, National Oceanic and Atmospheric Administration, Sanctuaries and Reserves Division, http://www.nos.noaa.gov/ocrm/srd/; and National Estuarine Research Reserve, Old Woman Creek – http://wave.nos.noaa.gov/ocrm/nerr/reserves/nerroldwoman.html. Web sites sometimes change. Do a word search to find related sites.

The Environmental Protection Agency is also a source for information about wetlands. The agency operates a Wetlands Helpline (1-800-832-7828) and provides educational materials and referrals to other educational resources. Contact the E.P.A. for a "Wetlands Information Hotline Publication List," or a "Wetlands Reading List, Pre-kindergarten through Grade 12." Other materials should be available depending on the grade level. E-mail: wetlands-hotline@epamail.epa.gov. Information is available over the internet http://www.epa.gov/OWOW/wetlands/education. Additional EPA's web sites of interest include: Coastlines homepage http://www.epa.gov/nep/coastlines, a publication which featured an article about Old Woman Creek Estuary; Office of Water, National Estuary Program: Bringing Our Estuaries New Life, http://nepis.epa.gov. [Use simple search and type 842F93002.]

Wonders of Wetlands Reference and Activity Guide (*WOW!*). A 325-page curriculum for wetlands with 45 activities. Order from: The Watercourse/Project WET Fund, 201 Culbertson Hall, Montana State University, Bozeman, Montana 59717-0057.

Local and state governments may provide wetland guides for your area. Contact your state's natural resource agencies for more information.

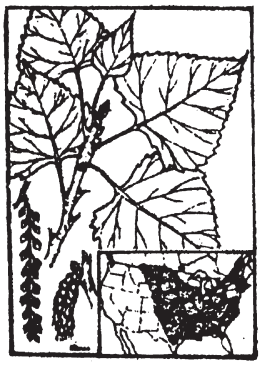
APPENDIX

Macroscopic Plants of the Estuary (Old Woman Creek)

Trees (Rooted on land. Excess water around root system may destroy some trees.)

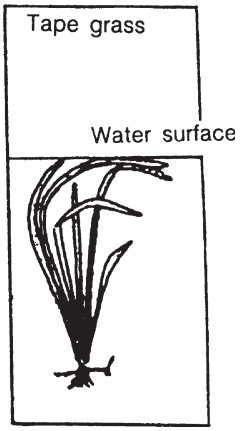
Box elder

Cottonwood



Buckeye

Submerged plants
(Roots and leaves underwater.)

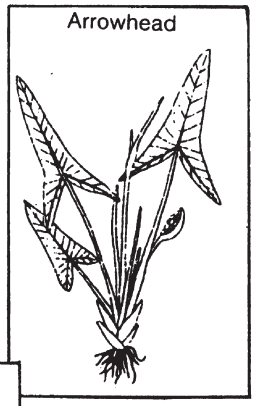


Emergent plants (Roots in water, but leaves and seeds emerge into the air.)

Rushes

Cattails

Arrowhead



Reeds

Pickerelweed