Fish Passage Activity Using GIS-Generated Maps

Background Information

A recent headline in the Centreville News read "Students return fish to Potomac River." These students are among the thousands of Washington area students who have worked with fisheries biologists from the U.S. Fish and Wildlife Service, other government agencies and the *Schools in Schools* program run by the Living Classroom Foundation to bring the American shad back home to the Potomac River.

Fish, such as American shad, need free-flowing rivers that allow them to easily reach areas to lay their eggs. Dams are often an obstacle to the upstream movement of the fish. To overcome this problem, fishways (openings in the dam) are created or dams are removed altogether. Students from Virginia and Maryland helped get a fishway placed into the Little Falls Dam on the Potomac River, which opened up over 16 km (10 mi) of the river for fish passage. In addition, students raised and released American shad above the dam and cleaned and planted native plants along the banks of the river. Thanks in part to their help, shad are returning to the Potomac River.

Geographic Information Systems (GIS) is a cutting edge technology that enables fisheries biologists and other scientists to use data more effectively. GIS allows geo-referenced data (i.e., data that was collected at a specific latitude and longitude) to be viewed in a way that facilitates reasoning and decision-making. The maps generated for use in this activity have been created by combining several GIS data "layers" including river size, flow rate, and dam locations. Today, fisheries biologists use a wide variety of GIS maps to more easily view complex data in order to improve habitat for animals like American shad.

In this activity you will you play the role of a fisheries biologist and analyze data to determine the next dam(s) in the Chesapeake Bay watershed that need fish passage.

Part 1: Fisheries Biologists - How They Are Working to Restore Native Fish to the Chesapeake Bay Ecosystem

Directions:

1. Read Form 2: American Shad Profile and Form 3: Profile of a Fisheries Biologist and answer the following questions.

    (a) According to the "American Shad" profile, what were the three reasons that American shad numbers declined in the Chesapeake Bay?

(b) What are the two ways that federal and state fisheries biologists, such as Albert Spells, work to restore American shad to the Chesapeake Bay?

(c) What are the two ways listed in the articles to help fish get by dams so they can spawn (lay eggs) upriver?

(d) What is the main type of river data used by fisheries biologists to help determine the most important dam to work on?

(e) Why is this data important to consider when attempting to restore American shad?

2. Discuss your answers with a partner and add/delete information as needed to accurately capture the actual processes used by fisheries biologists. You will use this information in **Part 2** of this activity.

Part 2: You Be the Judge: Determine the Next Dam for Fish Passage

Directions:

Obtain from your teacher Maps 1, 2a, 2b, and 2c. Examine the maps (in order) and answer the following questions.

Map 1: American Shad Fish Passage in the Chesapeake Bay Watershed

1. Identify the name of each of the three rivers containing dams blocking movement of American shad upriver.

2. Examine the map legend. Below, draw each legend symbol and provide a brief explanation of its meaning

Map 2a: Drainage Area to the Harvell Dam

3. Briefly describe what this map shows and how this is different from the information available from Map 1.

4. From the information provided by your teachers, explain the following terms and why they are important to the passage of American shad: "Volume of water flowing by a dam each second (in CFS)".

5. Still using Map 2a, calculate the average annual volume of water flowing by the lowest dam in the map's watershed by completing the following steps:
   - On your map, locate the dam at the lowest point in the watershed. Record its name in the table below.
   - Record the Average Annual Flow of water from the drainage area above the dam (underlined on map) in Column A of the table below.
   - Record the Drainage Area (circled on map) in Column B in the table below.
   - Multiply the data in Column A and B and record the product in Column C. This represents the average annual volume of water flowing by the dam every second.
   - Repeat this same process for Maps 2b and 2c.

Table 1: Comparison of Flow Data by Dams

			Column A	Column B	Column C
Map	River Name	Name of Dam	Average Annual Flow of Water from Drainage Area (CFS/ mi^2)	Drainage Area (mi^2)	Average Annual Volume of Water Flowing by the Dam every Second (CFS)
2a	Appomattox				
2b	South Anna				
2c	Wicomico				

6. Calculate the number of river miles that will be opened to American shad in each drainage area if fish passage is placed on each of the dams. To do this, use the string provided to estimate the mileage of the river opened by laying the string along the path of the river from the lowest dam up to the next fish blockage. Use the keys at the bottom of your maps 2a, 2b, and 2c to estimate the mileage. Record the mileage below.

   Harvell Dam drainage area:: _____

Ashland Mill Dam drainage area:_____

Johnson's Pond dam drainage area:_____

7. Analyze your findings

(a) Which dam has the lowest average annual volume of water flowing by it each second (CFS)?

(b) Which dam has the highest average annual volume of water flowing by it each second (CFS)?

(c) Which of the dams listed above would most likely have the best habitat for American shad located above it? Explain your reasoning.

8. Based on data from the maps in the activity and your answers to questions 6 and 7 above, write a short persuasive essay to convince the U.S. Army Corps of Engineers that the dam you have selected is the best one for new fish passage. Include as much background information from the fisheries biologist profile as needed as well as your data and calculations to create a "compelling" essay.

Follow-Up Activity:
The following website http://waterwatch.usgs.gov/ provides data showing current river gauge data measuring river flow through the U.S. Click on your state and move the cursor to each gauge near the rivers analyzed in this activity.

Note the river conditions including flow rate in real time. Compare the current river flow rates shown on the website to the flow rates you calculated in this activity. Why might your calculations be higher or lower than those shown on the website?