Lesson 4: Fish Populations

Activity: Students learn how to determine latitude and longitude. They learn about specific technologies used by fisheries scientists by exploring the movement of salmon using digital maps. They learn about GIS and other monitoring technologies.

Grade level: 4-8
Subjects: Science, social studies
Setting: Classroom
Duration: Three 50 min class periods
Key Terms: Ecosystem, GIS, GPS, hydro-acoustics, mark-recapture, latitude, longitude, population, spatial, biodiversity

Objectives

After participating in this activity, students will be able to:

- Explain why researchers study fish populations
- Describe techniques researchers use to monitor fish populations
- Describe the components of a GIS and other monitoring technologies

Summary

Scientists monitor the size, movement, and health of fish populations to better understand ecosystem interactions, manage sport and commercial fisheries, and help ensure biodiversity. Scientists use many different techniques to monitor Great Lakes fish populations.

Background

As discussed in Lesson 3, fish employ various strategies to reproduce and ensure survival of their own species. A group of individual organisms of the same species living in a particular area is called a **population**. Fisheries scientists study the size and movement of Great Lakes fish populations to understand ecosystem interactions. An **ecosystem** is a community of organisms interacting with one another and the physical environment.

If a fish population shows signs of stress, whether due to over-fishing, pollution, or habitat loss, scientists can pursue strategies to mitigate these factors. Some strategies might involve restoring critical fisheries habitat or implementing harvest restrictions. In this way, scientists help maintain Great Lakes **biodiversity**, or the abundance and variety of native species inhabiting the lakes.

Great Lakes fish populations are also closely monitored to meet fisheries management goals and ensure a sustainable fishery. The Great Lakes fishery is comprised of state and tribal commercial fishing operations and recreational fisheries. Accurate evaluation of fish populations helps fisheries managers establish equitable harvest quotas, set stocking

levels for hatchery-reared fish, establish length and timing of fishing seasons, and help maintain a healthy predator-prey balance.

Studying fish populations often involves estimating the number of fish in a given population and tracking their movement. Fisheries scientists use different methods to do this. Some of these methods include **GIS:** Geographic Information System, **GPS:** Global Positioning System, **Hydro-acoustics**, and **Mark-recapture**. To use these methods correctly, scientists must understand basic geographic concepts. Two of these are **latitude** and **longitude**. See glossary for definitions.

FLOW Case Study

Using GIS to study coho salmon distribution in Lake Michigan

Two species that are closely monitored are coho and Chinook salmon. These Pacific salmon species were introduced to the Great Lakes in the 1960s to boost the sport fishing industry and to help curb the overabundance of alewife. Alewife, an invasive forage fish, entered the Great Lakes in the 1950s following completion of the Welland Canal.
The majority of coho salmon discussed in this FLOW Case Study were stocked at the State of Michigan Platte River fish hatchery in northwest Michigan. Once in the lake, however, their location and movement is of interest to fisheries scientists, managers and the anglers who harvest them.

The series of GIS maps (available in Downloads) display coho salmon distribution in Lake Michigan. The Lake Michigan coho salmon maps contain (1) coho salmon stocking numbers and locations (where the fish actually entered the water) in 1991; and (2) actual fisheries catch data from charter boat captains in Lake Michigan. Catch rates were calculated as the number of fish caught per hour of fishing, considering the number of anglers on each boat. Catch rates are shown for May – September (averaged from 1992-2001 data). *Catch data as reported to DNR.*

By examining the maps, fisheries scientists see that coho salmon are stocked in Michigan waters of Lake Michigan but appear to move to the southwestern corner of the lake. By looking at the catch data, it becomes clear that many of the fish are being harvested by anglers in other states, including Wisconsin, Illinois, and Indiana. In the fall, the data shows that coho salmon return to their native streams to spawn. In this case, many of the fish returned to the Platte River. It is not well understood why they move to southwestern Lake Michigan. Some possible explanations include the availability of high-quality habitat, a genetic predisposition, and predator-prey relationships.

Source: Institute for Fisheries Research, University of Michigan and Michigan Department of Natural Resources (DNR).

Materials and Preparation

- A world map with lines of latitude and longitude
- See data sheet: *FLOW Case Study* (Print copies for students) *Coho Salmon in Lake Michigan*

Note: See *FLOW Case Study* and other materials at the end of this lesson (supplemental materials).

Procedure

1. Explain that students will learn how to find a specific location using latitude and longitude. Start with the world map and explain the two key terms: latitude and longitude. Latitude measures north and south, and longitude measures east and west. Explain the two points of reference used to determine latitude and longitude: the Equator and the Prime Meridian. The Equator: Located at 0 degrees latitude (north and south of the Equator). Pinpoint the line of the Equator on the world map. The Prime Meridian: Located at 0 degrees longitude (east and west of the Prime Meridian). Look at the world map again and pinpoint the Prime Meridian.
2. Pinpoint the latitude and longitude of the State of Michigan Platte River Hatchery. Provide the street address: 15210 US 31 Highway, Beulah, MI 49617
   - Determine if the hatchery is north or south of the Equator. Determine which two lines of latitude the hatchery is between. Explain how to find the midpoint by splitting the difference between the two lines. Determine if the hatchery is closer to the midpoint or one of the lines, and estimate the degrees latitude. Write the answer in the chart.
   - Determine if the hatchery is east or west of the Prime Meridian. Determine which two lines of longitude the hatchery is in between. Determine the midpoint by splitting the difference between the two lines. Determine if the hatchery is closer to the midpoint or one of the lines, and estimate the degrees longitude. Write the answer in the chart.
3. Use a simple chart, see below, to pinpoint the hatchery and one or two additional locations.

Location Name	Latitude (N/S)	Longitude (E/W)

4. Now, move onto the *FLOW Case Study* examples using GIS to track the movement of coho salmon in Lake Michigan. Explain some of the reasons why scientists study fish populations and track their movement. (Reasons might include gaining knowledge about ecosystem interactions and informing fisheries management.) Discuss some of the methods currently used to monitor fish, such as GIS and mark-recapture.
5. Explain to students that they will review several maps of spatial patterns for a population of fish—coho salmon.
6. Use the FLOW Case Study to briefly review the history of coho salmon, explaining that the majority of coho salmon are stocked at the State of Michigan Platte River Hatchery. Students should know the exact location of this hatchery, as they recorded the latitude and longitude earlier. *(Note: Coho salmon are stocked at 17 locations.)*
7. Hand out the map of coho stocking locations to each group. See the *Coho Salmon in Lake Michigan map* in downloads. Note that the majority of stocked fish enter the lake at the same location near the Platte River. Remind students that scientists learn about

fish populations by mapping their location and movement. Notice how the movement of coho changes. *Note: Because the fish are not tagged, scientists infer movement based on catch data, or Catch Per Unit Effort (CPUE). This is the number of fish caught per hour of fishing.*

8. Compare the six maps: look at the map showing coho salmon during the months of May through September. Ask students: How are the patterns of movement similar or different? Where are the fish moving? Why might the fish be moving to that particular location? What predictions can be made about the habits of the population?
9. Emphasize the amount of information that can be gained, and questions raised, by simply observing the movement patterns of various species of fish, birds and mammals. Relate observations back to fisheries research goals and the value of studying population movement and behavior.

Extension

To learn more about GIS:
Download **Google Earth** to view layers of data about a river near your school. Adjust the views and note the latitude, longitude and elevation of the area you pinpointed. Turn the layers on and off to view different data.

To view GIS fish stocking data:
Add the URL of the database: www.glfc.org/fishstocking

View maps using ArcReader freeware and map files:
www.esri.com/software/arcgis/arcreader/download.html

Source

FLOW Development Team

Acknowledgements

Christine Geddes, Institute for Fisheries Research, University of Michigan School of Natural Resources and Environment and Michigan Department of Natural Resources; and Martha Wolgamood, Hatchery Manager, Wolf Lake State Fish Hatchery, Michigan Department of Natural Resources.

Assessment & Standards

See separate document: FLOW_Assessment_GLCE.pdf

FLOW Feedback

Please take 10 minutes to provide us with your feedback.
Go to: http://www.miseagrant.umich.edu/flow/flow-feedback.html

Supplemental Materials: FLOW Unit 3, Fish

Lesson 4 - Fish Populations Documents:

- FLOW Case Study (print copies for students) and Coho Salmon in Lake Michigan
- The *Life of the Lakes, A Guide to the Great Lakes Fishery*, by Shari Dann and Brandon Schroeder, published by Michigan Sea Grant, MICHU-03-400.

FLOW CASE STUDY
USING GIS TO STUDY COHO SALMON DISTRIBUTION IN LAKE MICHIGAN

Two species that are closely monitored are coho and Chinook salmon. These Pacific salmon species were introduced to the Great Lakes in the 1960s to boost the sport fishing industry and to help curb the overabundance of alewife. Alewife, an invasive forage fish, entered the Great Lakes in the 1950s following completion of the Welland Canal.

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Catch data as reported to DNR.

Source: Institute for Fisheries Research (IFR), University of Michigan (UM) and Michigan Department of Natural Resources (DNR).

COHO SALMON IN LAKE MICHIGAN

Unit 3, Lesson 4

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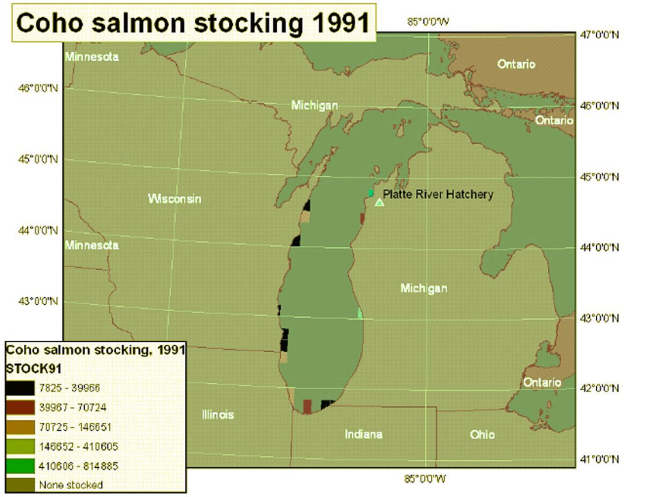

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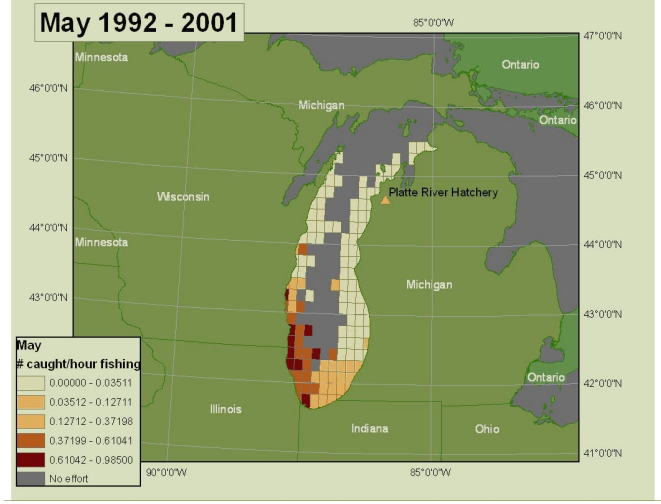

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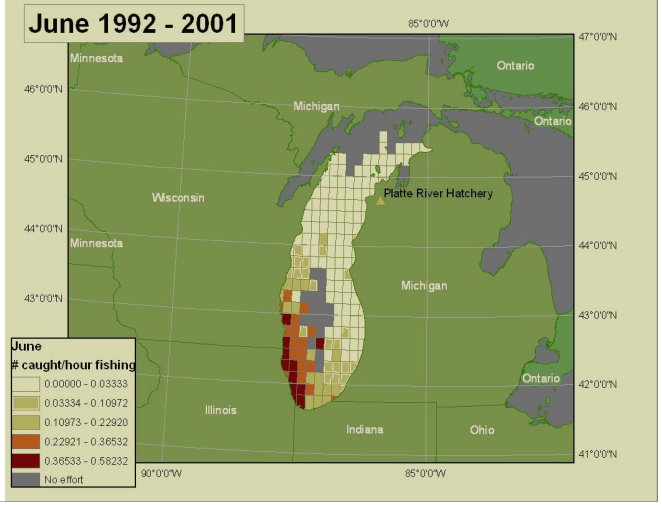

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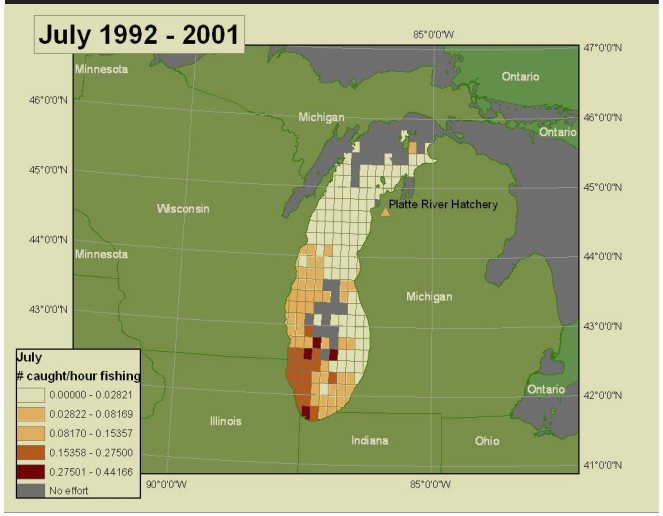

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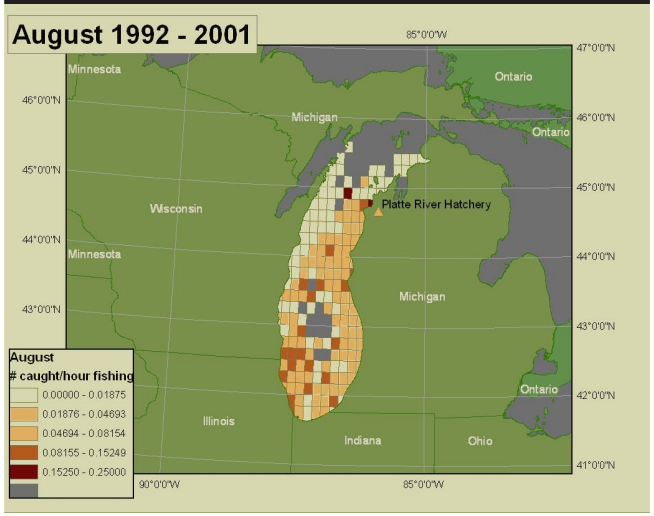

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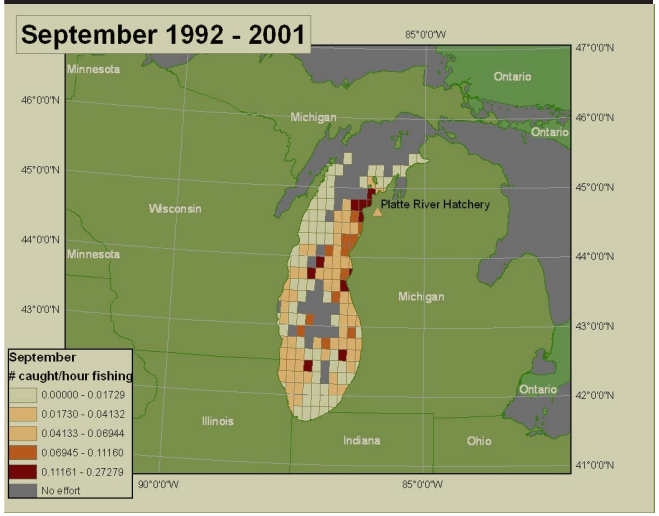

GIS images provided by Institute for Fisheries Research