

# Whale Rescue! Exploring Coastal Waters in Hawaii

## Lesson Overview

In this activity, learners will explore and analyze the spatial relationships between marine preserves, whale habitat, shipwrecks, parks, coral reefs, and ocean recreation areas on Maui.

## Student Instructions

You are the GIS coordinator for the National Oceanic and Atmospheric Administration's National Marine Sanctuaries. A diver has sent your office a photograph of an injured baby humpbacked whale, entangled in a shipwreck off the coast of one of the Hawaiian islands. You cannot locate the diver—but you need to locate the whale so your office can rescue it and treat it. You don't have time to waste—every minute counts!



Humpback Whale Photo from USGS

Start ArcGIS and access ArcMap. Open an existing map entitled coastal.mxd from the folder that your instructor directs you to. You should see a map that looks like the image on the next page.

### Geography Standards

- How to use maps and other geographic representations, tools, and technologies to acquire, process, and report information from a spatial perspective.
- The physical & human characteristics of places.
- The process-patterns-functions of settlement.
- How physical systems affect human systems.

### Science Standards

- Science in Social Perspectives: Types of Resources.
- Motions and Forces
- Populations and Ecosystems
- Change, Constancy, and Measurement
- Structure of the Earth System
- Environmental Quality
- Science and Technology in Local, National, and Global Challenges

### Mathematics Standards

- Understand measurable attributes of objects and the units, systems, and processes of measurement.
- Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them.
- Problem-solving, reasoning and proof, communication, and representation.

### Environmental Studies Standards

#### Historical Thinking Standards

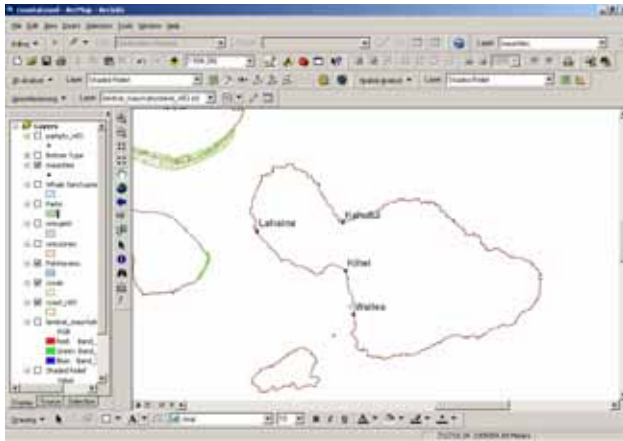
- Historical Analysis and Interpretation: Consider multiple perspectives
- Historical Issues-Analysis and Decision-Making: Formulate a position or course of action on an issue.

#### Technology Standards



- Students demonstrate sound understanding of the nature and operation of technology systems and are proficient in the use of technology.
- Students develop positive attitudes toward technology uses that support lifelong learning, collaboration, personal pursuits, and productivity.
- Students use technology to enhance learning, increase productivity, and promote creativity.
- Students use productivity tools to collaborate in constructing models, prepare publications, and produce other creative works.
- Students use a variety of media and formats to communicate information and ideas effectively to multiple audiences.
- Students use technology to locate, evaluate, and collect information from a variety of sources.
- Students use technology tools to process data and report results.
- Students use technology resources for solving problems and making informed decisions.
- Students employ technology in the development of strategies for solving problems in the real world.


This map shows 4 major cities on Maui, the coastline, fish havens, and major coral reefs.

Examine the fish havens map layer. This dataset contains those fish havens located in marine waters within the vicinity of the main Hawaiian Islands as recorded on the nautical charts.



1) Near what city is the fish haven off the coast of Maui located?

Use the zoom in tool  to draw a box around the areas you wish to examine more closely. You can always go back to the full extent of your map layers using the globe  tool. Note that the "full extent of the map layers" in this project is beyond Hawaii. Therefore, it might be easier to zoom to the extent of each map layer by right-clicking on the layer and selecting "zoom to layer." Alternatively, you can go to View→ Bookmarks and select "Maui", or create your own bookmarks!

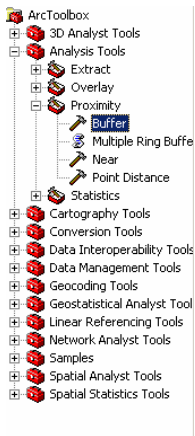
2) Use the measure tool  to answer the following question: What is the length of the fish haven off of Maui in kilometers?

Right-click on the fish haven map layer and open the attribute table. Move the table on your screen such that you can see both the table and the map. Select each record, one at a time, by clicking on the far left side of the row, until the one off of Maui is highlighted in cyan.

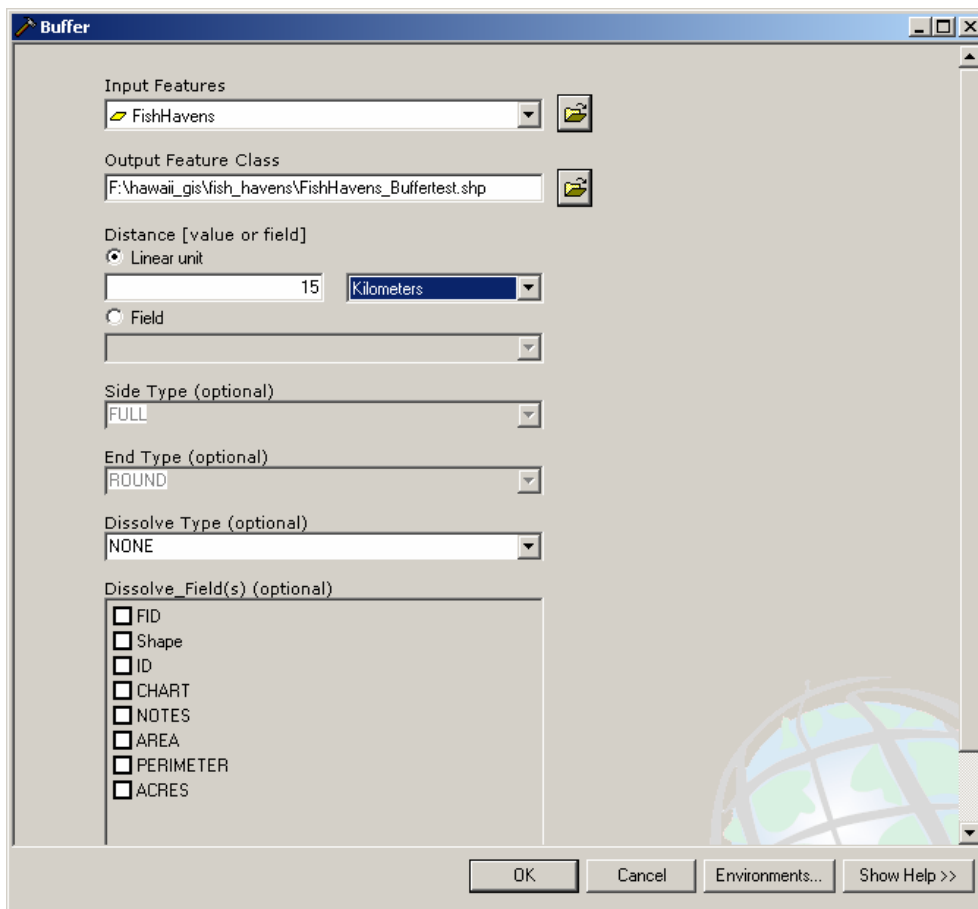
3) What is the official area and perimeter of the fish haven?

4) Should we be concerned about other areas of fish habitat in Maui's coastal waters, or only this one? Why?

You suspect that the whale was within 15 kilometers of a fish haven. Access ArcToolbox via the red toolbox button, and find the Buffer tool under Analysis→ Proximity→ Buffer, as indicated below:



Buffer the fish havens as indicated below to find all areas within 15 km of the fish havens. Save your data as an “output feature class” in the folder indicated by your instructor and give it a logical name.



You should see a buffer around the fish havens, which should help you narrow your search for the whale.

5) What shape is your buffer? Why does it have this shape?

Drag the fish haven buffer layer down until it is below the corals map layer. You will need to have the Display tab selected below the map layer list (the table of contents) to do this.

You suspect that the whale is in one of the whale sanctuaries, where most of the whales off Maui are found. Turn on the whale sanctuaries layer and open its attribute table.

6) Which is the largest whale sanctuary in Hawaii?

Right click on the whale layer and select "label" to label the map layer.

7) What is the name of the whale sanctuary that is off the Maui shore? You see some coral in the photograph, and so you need to investigate the areas where coral exists.

Turn on the Bottom Type map layer and open its table. This map layer indicates the type of ocean bottom in selected locations.

8) How many locations are recorded in this map layer (this is the same number as the number of rows in this table)?

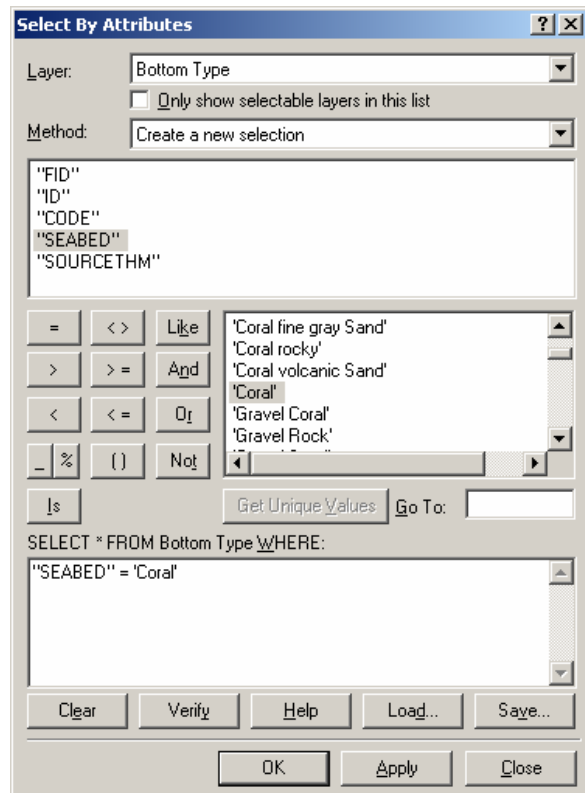
9) Which field (column) name contains the description of the bottom type?

Exit the table. Under Selection → Select by attribute, select the bottom type map layer, and select all of the locations where coral exists, using the field name that you identified above. Build an expression as indicated below, including selecting the "get unique values" button:

10) Go back and open your attribute table again for the Bottom Type. How many points have you selected?

You want to find all areas within 500 meters of the coral. Buffer the selected corals in the Bottom Type layer as you previously buffered the fish havens using 500 meters this time, and only buffering the selected features (corals).

Notice that the points where coral is shown on the Bottom Type map layer is not the same as the Corals map layer. The Corals map layer is



a polygon layer, showing areas of major coral. The coral that you are now investigating is in a point layer, showing where divers have found coral.

11) Which map layer—bottom type or corals layer—do you think is more accurate?

Now you know all of the areas near coral, and you know the area near the fish havens. In the next step, you will narrow your search to areas near coral **and** near the fish havens.

In ArcToolbox, use Analysis → Overlay → Intersect, and intersect fish haven buffers with the bottom type buffers. Use these 2 map layers as your “input features.” Give your output layer a logical name and location in the appropriate folder on your computer.

12) Open the table for your intersected map layer. How many sites have you narrowed your search to?

Zoom out so that you are looking at most of the major Hawaiian Islands.

13) Why do you still have so many sites to choose from?

Turn on the “wrecks” map layer.

14) Near which islands are most of the wrecks in this database near?

Open the “wrecks” attribute table.

15) How many wrecks are in the database?

16) Are you making progress in your search? How do you know?

You are close to your goal! Now you need to narrow your search to only search for (1) coral areas (2) near fish havens (3) near wrecks. You already know (1) and (2). After the next step you will know (1) (2) and (3).

Do this by intersecting the “coral—near fish haven” layer with the “wrecks” layer, using the Intersect tool that you used above. Again, give your output layer a logical name and location in the appropriate folder on your computer.

Open the table of your new map layer.

17) How many wrecks are you now considering?

The photograph looks like a dangerous wreck. Narrow your search by selecting only those wrecks that are dangerous. Use the Select By Attribute and use the field name “Descript.”


Examine your table after your selection.

18) How many wrecks are you now considering?

Note that one of the dangerous wrecks indicates "position doubtful" in the "notes" field. Eliminate this wreck from your consideration since you don't have time to waste on a wreck whose position is doubtful. Select the only 2 remaining rows in the table by highlighting them using the far left column.

Exit your table, right click on your final wrecks layer, and go to "Selection" → Zoom to selected features.

19) Near what island and off of what coast is this wreck?

Use the measure tool  to answer the following:

20) How far off the shore is the wreck?

You need public access to this site. Turn on the parks layer.

21) What is the closest park to the wreck, and how far from the wreck is it?

You now have all of the information you need. Assemble your crew and save that whale!

22) What kind of crew and equipment will you need to accomplish your task?

23) Present the results of your investigations from this lesson to the class in a 5-minute oral report on where you have located the whale and your plan for its rescue, treatment, and release. Use the maps and data you have been studying in your presentation.

