

Lab 9—GIS and ocean habitats

Due at the beginning of class Friday, November 19.

* This lab was adapted from a workshop by Deidre Sullivan, Marine Advanced Technology Education (MATE) Center. *

In this lab you will get a taste of an exciting computer technology called Geographical Information Systems (GIS) and its applications in marine science and oceanography. Currently the greatest advances in our understanding of marine and coastal ecosystems are being brought about by advances in technology, such as remote sensing – be it from satellite, from the sea surface using sound, or *in situ* using submersible technology. GIS has become the universal tool to pull together, manage, and visualize large volumes of geospatial data from multiple sources at a variety of scales.

One of the most exciting developments that has resulted from the ability to collect and analyze the geospatial data of the seafloor is the ability to make maps that can predict where a particular species might live. These maps can be very helpful in identifying areas (or habitats) that should be set aside for protection in Marine Protected Areas.

You will first find data on four species in the Monterey Bay. Then, you will look at different characteristics of the Monterey Bay seafloor on a map on the computer. There will be different *layers* that you can turn on and off to look at different types of seafloor data. Think of the *layers* as overheads that can be put on top of each other or looked at separately. **Your goal is to determine the locations of the best habitats for four species and create a map.**

Part I. Find the habitat characteristics for these four species: **market squid eggs, Starry Rockfish, Starry Flounder, and giant kelp.** Use the web sites listed below to find good information.

You must identify the following for **each species**:

- depth range of the species (how shallow to how deep it can live)
- bottom type that it prefers (rocky bottom, sandy bottom, or mixed)
- bottom complexity or roughness that it prefers (does it like crevices and caves or does it like flat bottoms?).
- other important information about the species—is the population decreasing? Is it endangered? Is it important for other species?

Use the following web sites:

- California Department of Fish and Game <http://www.dfg.ca.gov>
- Monterey Bay Aquarium <http://www.montereybayaquarium.org/>
- National Marine Fisheries Service <http://www.nmfs.noaa.gov/>

SPECIES	Depth range	Bottom type	Rugosity	Other important information
Market squid eggs				
Starry Rockfish				
Starry Flounder				
Giant kelp				

Part II. Look at the GIS maps on the computer. Determine where each species is most likely to live.

How to look at the maps:

1. Turn on the computer.
2. Log in using the computer number as the login and “mpc” as the password.
3. Follow the instructions on the board to retrieve the “gis_ocean” folder.
4. Open the folder called “gis_ocean”.
5. Open the file called “Ocean04”.

ArcReader is a GIS program that allows you to look at maps we created for you. We used data from the Monterey Bay to make a set of layers (types of data):

Name of layer	Description
bathy_contours	Low resolution bathymetric data (contour lines that describe the shape of the seafloor)
sss_sat2.tif	Side scan sonar data collected on our class’ Saturday cruise—here for your curiosity. You can see the texture or composition of the seafloor in this small area; this is independent of the bathymetry data.
sb_rugosity	Shale bed rugosity (see below for more information on rugosity)
cr_rugosity	Cannery Row rugosity
cr_seafloor	Cannery Row bottom type (red, blue, and yellow correspond to hard, mixed, or soft sediment)
sb_seafloor	Shale Bed bottom type (red, blue, and yellow correspond to hard, mixed, or soft sediment)
sb_hillshade	Shaded relief map view of the high resolution bathymetry
cr_hillshade	Shaded relief map view of the high resolution bathymetry
topo_map	Topographic map of the Monterey Peninsula- used for reference
noaa_chart	NOAA chart of the seafloor and Monterey Peninsula- used for reference

Each layer (bathymetry, bottom types, and rugosity) is listed on the left of the screen with boxes next to them. You can “turn on” each layer (look at it) by checking the box with the mouse. To “turn off” the layer, uncheck the box with the mouse.

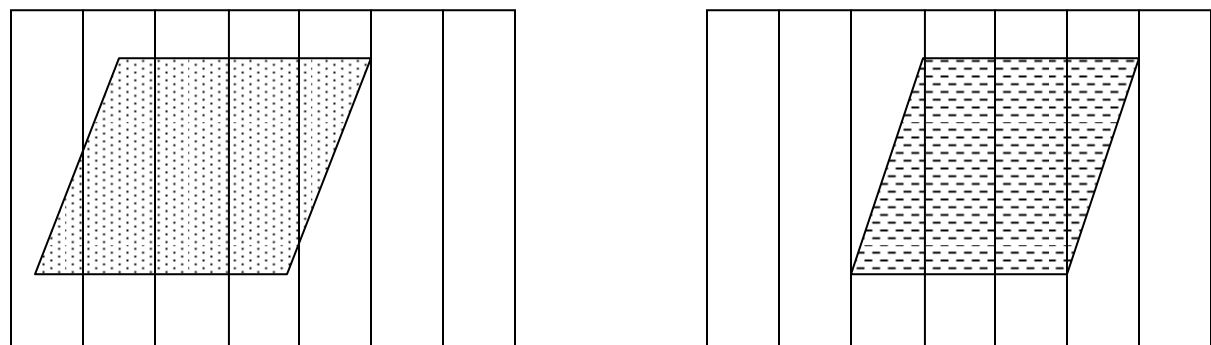
We want you to look at each layer separately and then lay them over each other (check more than one at a time). Based on the data you collected in part one, determine where specifically each species is most likely to be found.

More information on rugosity-- Rugosity is a measure of terrain (in this case seafloor) complexity. Traditionally rugosity was measured by laying a chain across the bottom letting the chain conform to every hump and bump on the seafloor, and then the ratio of the chain length to linear distance was calculated. As the bottom complexity increased, so would the length of chain and as a result the ratio would also increase. Using GIS, the rugosity can be measured by calculating the ratio of surface area to planar area to come up with a measure of terrain complexity. Certain species, like many of the rockfish species, are associated with areas of high rugosity because of the shelter provided by these complex environments.

Part III. Make a map that shows the best habitats for each species.

Each of you will receive a black and white printed map of the area of the Monterey Bay off of Del Monte and Canary Row. Your goal is to determine the best way to show where each of the four species is most likely to be found. You must make a legend in order to show all four species on the same map. Colored pencils are available for you to use.

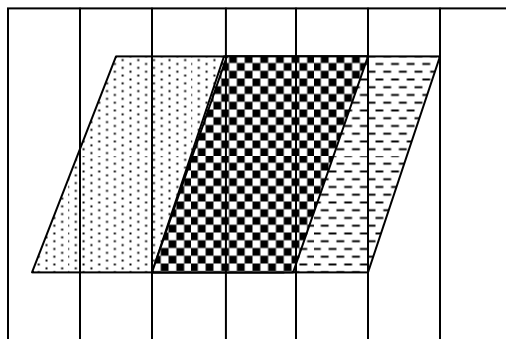
Here is an example of how to make a map that includes more than one thing that overlaps.



Species 1 (people) are found in the dotted area above

Species 2 (mountain lions) are found in the dashed area above

If you put both on the same map:



LEGEND	
	People only
	Mountain lions only
	Both people and mountain lions

Species 1 is found by itself in the dotted area, species 2 is found by itself in the dashed area, and both species are found together in the checked area (uh-oh!).

Part IV. Answer the questions below.

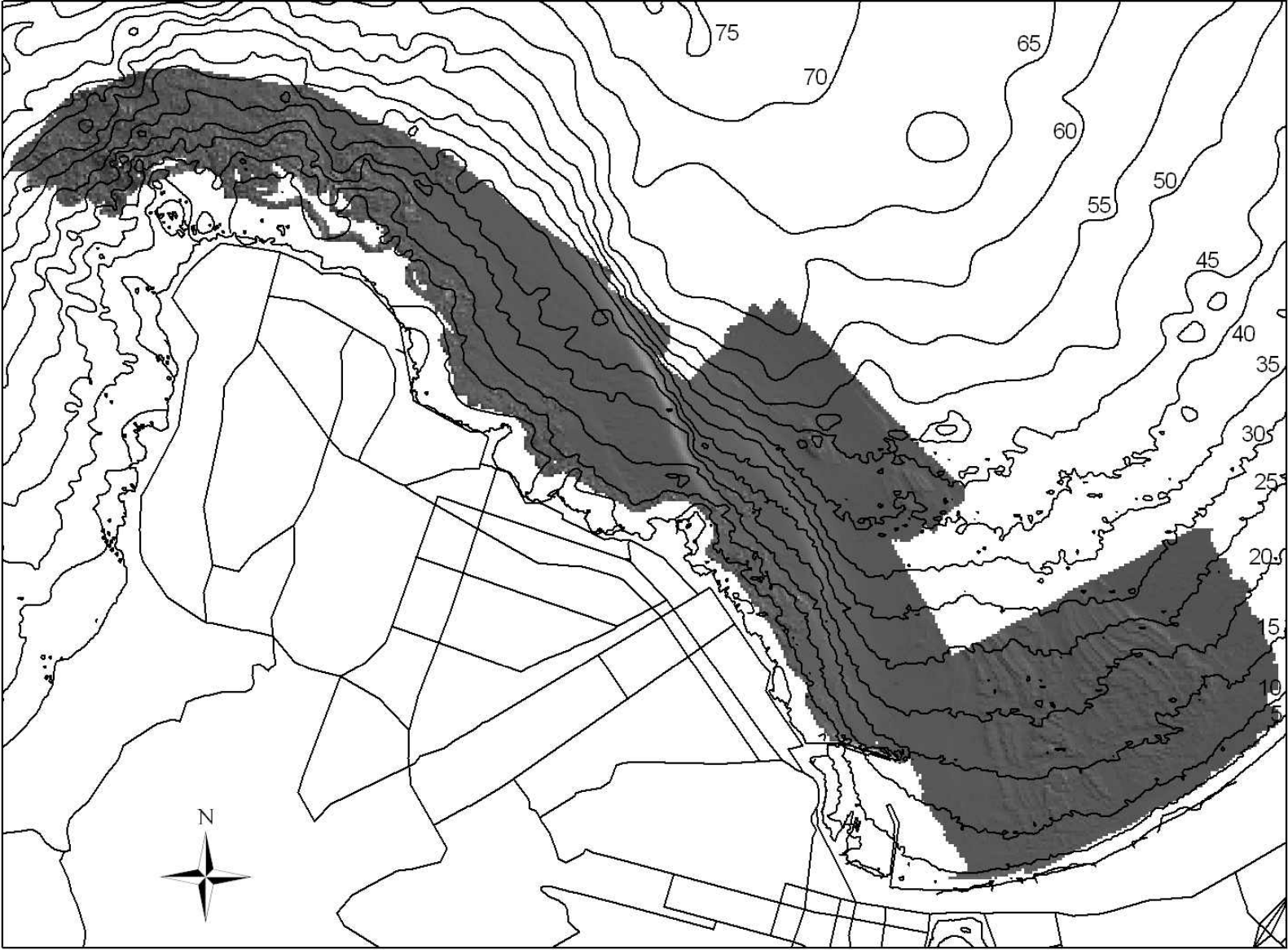
You work for the California Department of Fish and Game. You have limited money and staff to make sure people are fishing where they are supposed to. Which species would you make your first priority to protect?

Why did you choose that species? Use the information you gathered about the species to answer this.

Which area(s) of the Bay would you close to fishing or protect to preserve that species? Use the map you created and explain why you chose those specific areas.

Would you close it all year or just during certain seasons? If so, which seasons? WHY? Use information gathered from the internet as supporting data. (Answer in a couple of sentences.)

Nearshore Bathymetry of the Monterey Peninsula Area



1,000 500 0 1,000 Meters



Contour Interval: 5 meters

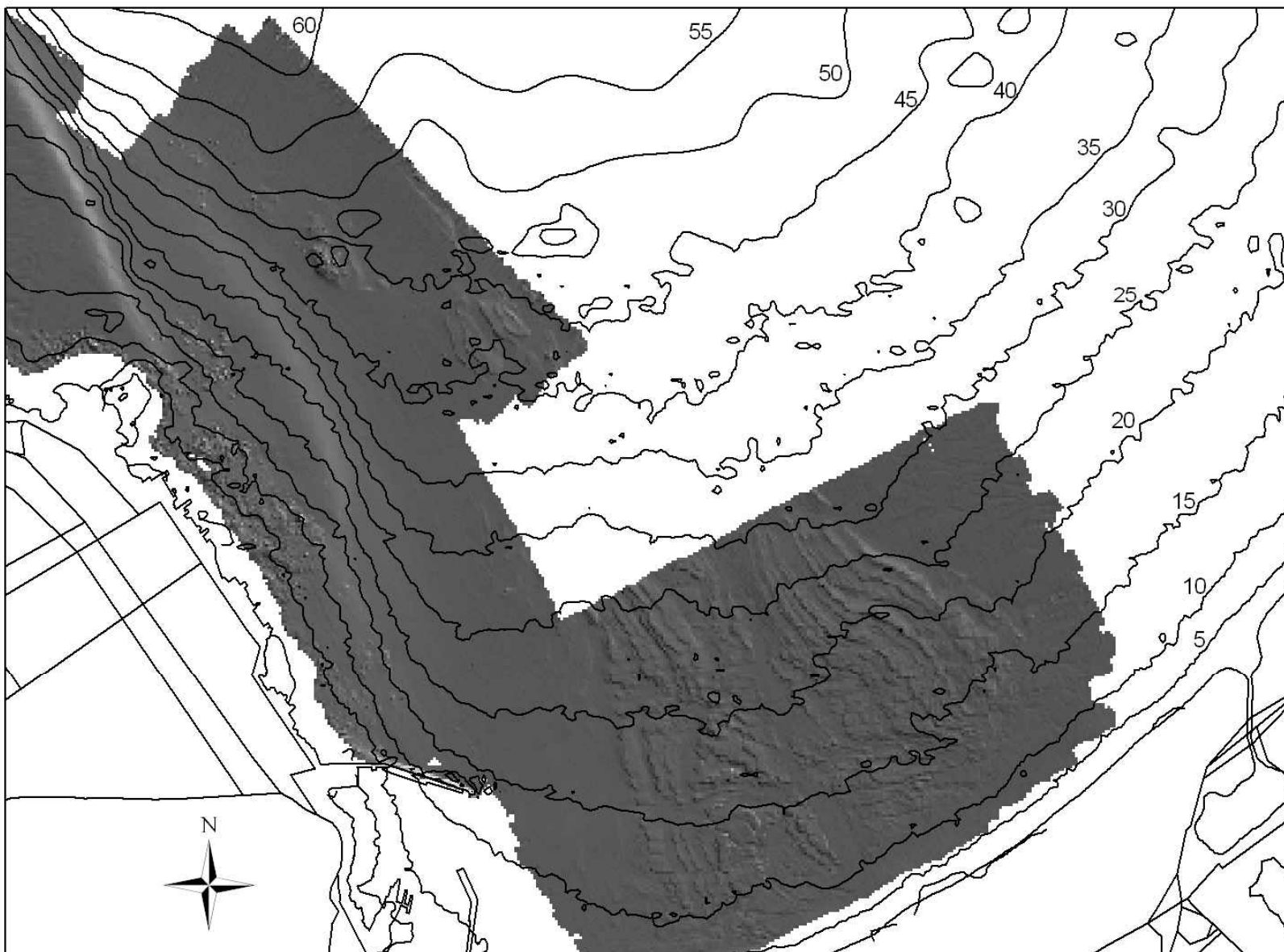
Nearshore Bathymetry of the Pt Pinos to Cannery Row Area



560 280 0 560 Meters

Contour Interval: 5 meters

Nearshore Bathymetry of the Monterey Harbor Area



590 295 0 590 Meters

Contour Interval: 5 meters