What's the Catch Case Study
Answer Key

Answers to many of the questions are open-ended. The intent of the questions is to encourage students to think about the many facets of the case in a step-wise manner using data to support their responses.

Part 1

1. What changes have the fishermen been noticing on the water?

Joe Fraser has found the normal amounts of fish he's caught has decreased, and he's trying to figure out why.

2. What could be the potential causes of these changes?

Squid has been moving out of the area, and black sea bass are entering the area for one reason or another, but certainly because something in their habitat has changed. Students may bring up the changes in population of predators and prey of each species or the temperature of the water, both of which as plausible. Common prey of squid are euphausiids (krill) and juvenile herring. Common prey of black sea bass include crab, lobster, and squid. Predators of both black seabass and squid include goosefish, and spiny dogfish.

3. What evidence would we need to collect to determine whether these potential causes are in fact the source of the changes? What will this evidence show?

Past and current ocean temperature data or census data for black sea bass and squid, its predators, and its prey. The data could show a relationship between changing ocean temperatures and the location of fish species.

4. What are the potential effects of the shifting fish populations on marine ecosystems and the fishing industry? Create a diagram that models all the potential causes and effects related to this case.

At this point in the case, students will likely include economic effects on the many parts of the fishing industry (fishers, marinas, etc), those who eat the fish, and the marine ecosystem that includes the black sea bass and squid. The model students create should show cause-effect linkages, although at the beginning, it is likely that they may only include one cause (decrease in black sea bass), and multiple effects. Encourage them to identify secondary and tertiary cause-effect relationships. For example, with a decrease in squid there would be loss of income for fishers, which in turn will impact the parts of the industry that supports the fishers. Conversely, an increase in black sea bass might mean a new source of income for fishers.

5. The fishing industry is considered a social-economic-ecological system? - Describe what that means.

Students should describe each entity and may be challenged to identify how the fishing industry is also social. Encourage them to consider the interactions on among fishers, and within the coastal fishing communities in order to identify social aspects of the fishing industry.

Part 2

1. In your own words, describe "climate velocity."

Check student responses to ensure they include shifts in ocean temperature by both latitude (space) and time.

2. Note the data presented in Figure 4. Describe how marine species may respond to shifting temperatures as displayed in the figure.

Students will likely say that species may shift their ranges seeking a location with a more suitable temperature, and in so doing the species may be challenged when adjusting to its new habitat.

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3. Ecosystems are complex. Using a cause and effect frame, identify as many cause-effect relationships that may occur when species shift their locations.
Assist students as they brainstorm as many cause and effect relationships when a fish species shifts its locations. You may want to create a table to display the numerous relationships. For example:

Cause	***Effect***
Fish moving to a new location	*Augment the new food web by eating prey typically eaten by species in the new location*
	Augment the new food web by becoming the prey of species living in the new location
	May dominate the niche of species currently living there.
Fish leaving a previous location	*Removes prey of its predator, and therefore the predator population may decrease.*
	Prey of the species will increase as the carrying capacity will allow.

Part 3
1. How might the interactions of fishing and climate velocity affect the abundance and distribution of marine fish?
Based on the content of Part 3, students should now consider fisheries and fish abundance and distribution together. In responding to this question, students might focus on squid or black sea bass alone, or they might bring up the fact that other species will be affected too. Some species may leave the area for colder water, whereas new species may move in from warming waters elsewhere. This may change how and what a fisher catches.

2. How do fishers and fishing communities adapt to shifts in species ranges and abundances?
Small boat fishers will stay in their locations, whereas large boat fishers may go to where the fish are, catch them, and bring them back to their original port. Small boat fishing communities will likely be adversely affected economically since the landings (haul) will be decreased.

3. Fishing regulations place limits on the quantity and size of fish obtained in sectors of the ocean. Why is it so difficult to establish fishery regulations which ensure fish populations are sustainable?
There are some that support changing the quota system, and some that do not. Large boat fishers prefer to keep the quota system where it is since they have the capability to travel to the fish and bring them back to their port where fishing quotas support their catches. Small boat fishers on the other hand cannot travel to the fish given financial constraints. In addition, those in northern locations where the black sea bass populations have increased, fishers are limited by the quota system on how much they can catch.

4. Revise the model you created in Part 1 to account for the complexity of the issue presented in this case study. Be sure to identify any feedbacks that add to the complexity of developing a sustainable fisheries management plan. Refer to the model presented in Figure 5 to ensure all the components of the system are considered in your plan.
Students can work in small teams (2-4) to create a new model that accounts for all of issues raised in the case. They should discuss their models from part one, combine, and expand on them. Next, they refer to the model in Figure 5 to make sure they've included all aspects of the impacts of climate velocity on the squid and black sea bass fisheries. Groups present their models in a "gallery walk" where the models are displayed, and classmates have a chance to review each one and offer comments. See What's the Catch Case Study Teaching Notes for additional methods on how to wrap up the case.

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