

# CHANNEL ISLANDS NATIONAL MARINE SANCTUARY

## ***TO FISH OR NOT TO FISH?***

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### **A role-playing activity based on the Marine Reserves process at the Channel Islands National Marine Sanctuary**

**QUESTION:** What complexities are involved in the decision making process to establish marine protected areas and to resolve resource management issues?

**GRADE LEVEL:** 6<sup>th</sup>-12<sup>th</sup>

**UNDERLYING CONCEPT:** People have varied and vested interests regarding the use of marine habitats. It takes accurate scientific information, as well as communication and compromise among the interested parties to arrive at a workable solution to marine resource management problems.

#### **SKILLS**

- analysis
- interpretation
- decision-making
- mapping

#### **CALIFORNIA. SCIENCE STANDARDS**

*Grade 6: Investigation and Experimentation 7f*

*Grade 7: Investigation and Experimentation 7c  
(7b if extend to research project)*

*History/Social Science Standard 11.11e*

**METHOD:** This role-playing activity is designed to teach about marine policy. The game is modeled after a decision-making process that occurred at the Channel Islands National Marine Sanctuary in Santa Barbara, California. In this activity, you will participate as a member of the community (for example: diver, commercial fisherman) to discuss resource management.

**OBJECTIVES** Students will be able to:

- Demonstrate the decision-making process of marine reserves designations
- Analyze maps and data regarding a proposed reserve
- Discuss and communicate ideas based on an assigned point of view
- Analyze opposing points of view
- Interpret and formulate “best” decisions based on overall issues

#### **TIME NEEDED**

- One 55 minute class period

#### **MATERIALS NEEDED**

- Descriptions of various users’ positions (roles) (*provided*)
- Channel Islands maps: locator Map, blank sanctuary map, bathymetry (depth) map (*provided*)
- Maps of lobster fishing grounds, of commercial fishing use (*provided*)
- Maps of relative values of: recreational diving, different areas for squid fishing, recreational fishing, conservation (*provided*)
- User (role player) question sheets (*provided*)
- 7 overhead transparencies of the blank sanctuary maps (make them from the provided map)
- 7 different colored dry-erase markers (for use on overheads)

#### **VOCABULARY:**

*CINMS:* Channel Islands National Marine Sanctuary (off coast of Southern California)

*Constituency:* group of people with similar opinions

*Bathymetry:* the measurement of depths of water in oceans, seas, and lakes.

## INTRODUCTION AND BACKGROUND

This role playing activity is designed to teach you about marine policy. The game is modeled after a decision-making process that occurred at the Channel Islands National Marine Sanctuary in Santa Barbara, California. In this activity, you will participate as a member of the community to discuss resource management.

The Channel Islands National Marine Sanctuary (CINMS) is located off the coast of Southern California near the cities of Santa Barbara and Ventura. The sanctuary includes approximately 1,252 square nautical miles of water around 5 islands: San Miguel, Santa Rosa, Santa Cruz, Anacapa and Santa Barbara. The sanctuary was designated in 1980 to protect the biological, cultural and historic resources of these diverse and productive waters. Sanctuary regulations do not directly protect biological resources, but the sanctuary works with other agencies, including the Department of Fish and Game and the National Marine Fisheries Service to manage biological resources.

The roles you may assume are: sanctuary manager, marine ecologist, squid fisherman, lobster fisherman, recreational fisherman, and recreational diver. Each role represents a *constituency* – a group of people with similar opinions. You have been selected as the representative from your constituency. Your responsibility is to represent your goals during the discussion about resource management. You must propose and discuss ideas that protect your long-term goals for resource management. The sanctuary manager must balance the different opinions offered by different groups during the decision-making process.

Population growth in Southern California has significantly increased the number of people visiting, using, and impacting our coastal resources. More people are participating in commercial and recreational fishing, wildlife viewing and tourism in the Sanctuary. Technology has increased the efficiency, effectiveness, and yield of sport and commercial fisheries. Increased human, industrial and agricultural waste drains into coastal waters, decreasing water quality. At the same time, there have been large natural changes that have affected resources such as El Nino weather patterns, oceanographic regime shifts from warm to cool water, and dramatic fluctuations in seal and sea lion populations.

Any combination of these factors may contribute to the decline of resources. All members of the community want to understand the impacts of these factors on marine systems. To protect, and enhance living marine resources, you must develop new management strategies. One strategy is to develop marine reserves where all fishing is prohibited. Marine reserves protect plants and animals from the impacts of recreational and commercial fishing. Animals inside marine reserves will have the opportunity to live longer, grow larger, and have more offspring than animals that live in areas where people take resources. Reserves also offer educational opportunities and provide reference areas to study the effects of fishing.

### ACTIVITY PROCEDURE:

*Assign (or choose) roles. Each set of users (e.g., squid fisherman) will form a group. Give each group one overhead transparency of a blank sanctuary map & a dry-erase marker.*

- **Each student** should receive a locator map (overall view of Channel Islands), a blank sanctuary map (Anacapa Island grid map: “Worksheet: Where would you establish marine reserves?”), and the bathymetry map (depths surrounding Anacapa Island).
- Students representing **recreational divers** should also receive the map showing relative value of different areas for recreational diving.
- Students representing **lobster fishermen** should also receive the map showing lobster fishing grounds.
- Students representing **squid fishermen** should also receive the map showing relative value of different areas for squid fishing.
- Students representing **recreational fishing boat captain** AND
- Students representing **recreational fisherman** should each also receive the map showing relative value of different areas for recreational fishing.
- Students representing **scientists/marine ecologists** should also receive the map showing relative value of different areas for conservation.
- Students representing **sanctuary managers** should also receive the maps showing relative value of different areas for conservation and the map showing the different numbers of commercial fishing industries that use each square nautical mile.

*Students should attempt to answer the questions individually and then work with other students who represent the same group. Each group should develop a single map of **marine reserves** around Anacapa Island that represents their interests. Using a dry-erase marker draw this map on the groups’ blank overhead transparency sanctuary map. The groups should choose one person to present their position and their map to the rest of the class. Using an overhead projector he/she can describe the choices on their map.*

*This process can catalyze a discussion about the diversity of interests in a community. If you want to extend the exercise, the students representing sanctuary managers can look at all the maps developed by different groups. The various group overheads may be layered together to look at different perspectives. The managers should attempt to develop a compromise design that uses ideas from different groups, but does not impact any one group too much. The managers can present their compromise map to class and class can discuss how decisions made by managers affect their livelihoods and hobbies.*

**ASSESSMENT:** -answers on assigned question sheets, -individual participation, -quality of group presentation, -additional research (if so assigned)

## Recreational Diver

### Background:

You have been diving in the Channel Islands for about 20 years. You dive primarily at Anacapa Island and at the eastern end of Santa Cruz Island. During your dives, you do sightseeing, photography and research. You observe marine habitats, including kelp forests, and you observe marine species, including a variety of fishes and invertebrates.

### Observations:

You have seen dramatic loss of kelp forest habitat in the Channel Islands over the last 20 years. In the past, the kelp forests around Anacapa extended at least one mile offshore. Today, there is one large kelp forest located in the small “no-take” reserve at the northeast end of the island. The kelp probably persists in the reserve because of the natural balance in the food chain. In the reserve, California sheephead (a fish) and lobsters eat sea urchins that, in turn, eat kelp. The *predators* (sheephead and lobster) keep the sea urchin populations from growing and eating all the kelp. Outside the marine reserve, consumptive divers and fishermen take sheephead and lobsters, and historically, people hunted sea otters at the Channel Islands. Reduced populations of these natural predators allowed urchin populations to grow larger. Large urchin populations ate most of the kelp outside the reserve, causing declines in species associated with kelp forests.

You have seen dramatic changes in fish and invertebrate populations. Today, aggregations of fish associated with kelp forests (such as rockfishes, giant seabass, and California sheephead) are smaller than they used to be. In the past, angel sharks and basking sharks were common, but you have not seen any in 10 years. Scientific studies show that several rockfish populations have declined approximately 97% in the last 20 years. Black and white abalone populations have declined to record low numbers and white abalone was recently listed as an endangered species. The primary cause of the white abalone decline was fishing.

### Position:

You support establishing a “no-take” marine reserve network that includes at least 50% of the representative habitats and species of concern in the Channel Islands National Marine Sanctuary. Although recreational diving is limited to the waters between subtidal to 30 meters deep, you are interested in protecting all habitats from the intertidal to deep waters within the Sanctuary. You are concerned that recreational and commercial fishermen are exploiting and depleting a public resource (such as marine fishes and invertebrates) without considering the impacts to other users.

Title

Name:

Date:

What is your role in the community?

What are your goals for resource management?

Where would you establish marine reserves? Use the blank map to draw your answer. Explain why you would establish reserves in these locations.

How large should marine reserves be? Why?

Name three species that interact in the kelp forest that you observe and describe the interactions?

## Lobster Fisherman

### Background:

You started fishing for lobster about 25 years ago and you spend about 150 days fishing in the Channel Islands. You have fished at all five islands in the Channel Islands National Marine Sanctuary. Currently, you concentrate your fishing effort around Anacapa Island.

### Observations:

From your observations, commercial fishing for lobster appears to be sustainable. After fishing for 25 years, you have seen the “ups and the downs” of the fishery, but overall, the lobster population size is similar from year to year.

Lobsters migrate during El Nino conditions and storms, resulting in more productive fishing. A few years ago, warm waters increased the number of large lobsters around the Channel Islands and the fishing was excellent. However, in subsequent years, cooler water reduced the abundance of lobster.

You start fishing on the first Wednesday in October and you are required by law to stop fishing on the first Wednesday after the 15th of March. You can only take lobsters that are larger than 3 \_ inches *carapace* length. Since the early 1970s, lobster fishermen have been required to use “*escape ports*” in traps. Escape ports are small holes that allow small lobsters to get out of the trap while the larger, legal-sized lobsters get stuck in the trap. In 1985, the live fish market for lobster expanded, increasing the demand and the price of lobster. In 1996, the Department of Fish and Game implemented a limited boat entry policy for lobsters, which reduced the total number of lobster fishermen. Today, there are more fishing boats than in the 1970s, but the number of lobster traps in the water has not changed.

### Position:

You support establishing a marine reserve network in the Channel Islands National Marine Sanctuary in order to protect a portion of the lobster population. You anticipate that lobster in the reserves will become larger and produce more offspring. Scientific studies demonstrate the potential for “export” of lobster larvae and “spillover” of lobster adults from reserve areas into nearby fished areas. However, you are concerned that the establishment of a marine reserve network will restrict and concentrate efforts of all fishermen into a smaller area. You would like to establish marine protected areas that allow limited fishing for lobster. You argue that the lobster industry has been sustainable over the last 100 years. You believe that small marine reserves are enough to increase lobster abundance and individual size.

Title

Name:

Date:

What is your role in the community?

What are your goals for resource management?

Where would you establish marine reserves? Use the blank map to draw your answer. Explain why you would establish reserves in these locations.

How large should marine reserves be? Why?

What regulations already exist in the lobster fishery?

What environmental factors affect the size of lobster populations?

# Squid Fisherman

## **Background:**

You are a squid fisherman around the Channel Islands, especially Anacapa Island.

## **Observations:**

Squid populations change with environmental conditions. Today, squid populations are relatively large. However, El Nino conditions and the associated warm water are devastating for squid. Squid populations declined dramatically after the El Nino cycles in 1992-1993 and 1997-1998.

The Department of Fish and Game established weekend (2 day) closures for squid in order to prevent excessive fishing. The weekend closure of this fishery is good because it gives all the fishing grounds two days to rest and recover from fishing. Some squid spawn during the weekend closure, allowing populations to increase over time. In addition, the Department of Fish and Game limited the number of tons of squid that can be caught each year. The squid fleet is getting larger every year and that there are many boats that are willing to fish for less money. You think that a reduction in the size of the squid boat fleet is necessary to reduce fishing pressure.

You are concerned that the lights used to attract squid to the surface during fishing may negatively impact seabirds (such as pelicans) that roost on cliffs. Decreasing the power of lights used to attract squid at night (from 100,000 to 30,000 watts per boat) will keep squid closer to the boat and reduce impacts on nesting seabirds. A coastal marine reserve near bird colonies might reduce the negative impacts of squid fishing on seabirds.

## **Position:**

You do not feel that marine reserves are necessary to sustain the squid fishery in the Channel Islands. If a reserve is established, you feel that negative economic impacts on all fishermen must be considered. You recommend establishing a marine reserve in a place that is not used by squid fishermen. You suggest that establishing marine reserves near seabird colonies could be one way to reduce impacts of squid boat lights on seabird populations.



Title

Name:

Date:

What is your role in the community?

What are your goals for resource management?

Where would you establish marine reserves? Use the blank map to draw your answer. Explain why you would establish reserves in these locations.

How large should marine reserves be? Why?

Does the squid fishery have on other species? If so, what species are affected?

## **Recreational Fishing Boat Captain**

### **Background:**

You started working as a deck hand on fishing boats about 25 years ago. After a few years in the business, you became a captain of a recreational fishing boat. You typically fish off the coast of Santa Barbara and around the Channel Islands, from very shallow waters to depths of over 500 feet.

### **Observations:**

Fish come and go over time. For example, white seabass populations vary throughout one year, and from year to year. You have observed large groups of white seabass in spring and early summer, especially when squid are spawning. Populations of Pacific halibut seem to be increasing at the Channel Islands. It is easy to catch halibut in shallow waters, especially during squid spawning. On the other hand, rockfish have declined in recent years. Rockfish populations increased slightly after the 1982-1983 El Nino, but since then, rockfish have been less and less abundant.

Fishing is probably the main cause of the rockfish decline. Environmental and other stresses, such as El Nino cycles, large ocean waves, and strong currents, also impacted rockfish populations. The rockfish fishery has become less productive over time. Areas that have been impacted include Anacapa Island.

Five species of rockfish (canary rockfish, Pacific Ocean perch, bocaccio, cowcod, and lingcod) are considered over-fished by the Pacific Fisheries Management Council. A large area (approximately 4,200 square nautical miles) around the southern Channel Islands (including Santa Barbara Island) was closed to cowcod fishing in waters below 120 feet. The Department of Fish and Game stopped all fishing for rockfish species in Southern California for two months of each year.

### **Position:**

Marine reserves could put recreational fishing boat captains out of business. If marine reserves are established in the Channel Islands, recreational fishermen may go to other places that offer more fishing opportunities. You believe that you will lose business if recreational fishermen stop using your boat.

You think that marine reserves may help some fishes recover from over-fishing. You have heard that, in Florida, all world records for three species of fish are caught within 100 km of a marine reserve. You hope a reserve in the Channel Islands will help rockfish populations grow larger and produce more offspring.

You strongly oppose establishing marine reserves on the south side of Anacapa Island because this is a productive area where you fish.

Title

Name:

Date:

What is your role in the community?

What are your goals for resource management?

Where would you establish marine reserves? Use the blank map to draw your answer. Explain why you would establish reserves in these locations.

How large should marine reserves be? Why?

Which fish species are declining around the Channel Islands and why? There is one main one, but give at least three other reasons fish population may decline.

## **Recreational Fisherman**

### **Background:**

You began recreational fishing about 20 years ago and you fish about 75 days each year. You enjoy fishing in the Channel Islands and along the coast from Santa Barbara to Ventura. You fish for many different species, including kelp bass, white seabass, yellowtail, rockfish, barracuda, squid, sardines, anchovies, halibut, sand bass, lingcod, mackerel, and bonito.

### **Observations:**

You believe that some fish species, including rockfish, lingcod, and California sheephead, are seriously depleted. These fish are less abundant and smaller than they were 10 years ago. You are concerned about the recent declines in fish abundance, so you *catch and release* all kelp bass, sheephead and rockfish that you catch. On the other hand, yellowtail, white seabass, and albacore seem more abundant now than in previous years, so you catch these species for food.

### **Position:**

You think that small marine reserves could help some fish populations grow larger. However, you are against closing large areas where you enjoy fishing. You are concerned that commercial fishing is causing the decline of rockfish and you do not want recreational fishermen to be punished for impacts of commercial fishing. You are strongly opposed to establishing marine reserves on the south side of Anacapa Island because these areas are traditional recreational fishing grounds and because this is an area where you fish.

Title

Name:

Date:

What is your role in the community?

What are your goals for resource management?

Where would you establish marine reserves? Use the blank map to draw your answer. Explain why you would establish reserves in these locations.

How large should marine reserves be? Why?

List three fish species that live in the Channel Islands National Marine Sanctuary.

Which of these fish species are becoming more abundant? Which species are declining?

## **Marine Ecologist**

### **Background:**

You are a marine ecologist at University of California at Santa Barbara. You have studied rockfish populations in the Channel Islands for over 25 years. You have worked with marine scientists to establish marine reserves in New Zealand and South Africa.

### **Observations:**

Over the last 25 years, you have observed many declines in marine resources. There are many causes of these declines, including fishing, El Niño cycles, disease, and increased pollution. The populations of some species, such as squid and red sea urchin, vary from year to year. Other species, such as rockfish, sharks, abalone, sheephead, black sea bass, and sea cucumber, have declined. In addition, many species that are fished interact with other species as predators or prey. Changes in the population sizes of fished species will affect many other species through interactions. After considering the data, you concluded that current management strategies do not provide enough protection for some species, particularly rockfish. Rockfish are vulnerable to fishing because they grow slowly and they have relatively few offspring.

You gathered data to show that marine reserves will help vulnerable species recover from the impacts of fishing. You studied 80 marine reserves from different places in the world. On average, targeted populations are larger in marine reserves. Average body size of targeted species is larger in marine reserves than in fished areas. Larger fish produce more eggs than small fish. In some places where marine reserves were established, fishing has gotten better. You heard that, in Florida, all world records for 3 species of fish were caught within 100 kilometers of a marine reserve.

### **Position:**

The size of a marine reserve network depends on the goals established by the community. If conservation is the primary goal for reserves, then the reserve should be approximately 50% of the total area under consideration. Larger reserves will protect more species. If the goal for marine reserves is to sustain fisheries, then reserves should be approximately 30% of the fishing grounds. Without reserves, fish populations will continue to decline, putting fishermen out of a job.

Title

Name:

Date:

What is your role in the community?

What are your goals for resource management?

Where would you establish marine reserves? Use the blank map to draw your answer. Explain why you would establish reserves in these locations.

How large should marine reserves be? Why?

What fish species have declined? Give two reasons for the decline, in addition to fishing.

How do marine reserves help marine animals?

## **Sanctuary Manager**

### **Background:**

You are appointed by the United States government to enforce the National Marine Sanctuary Act of 1972 at the Channel Islands National Marine Sanctuary. The mission of the National Marine Sanctuary Act is to manage areas of special significance and to protect their ecology and culture for current and future generations. In 1980, due to its exceptional natural resources and beauty, the waters around the Channel Islands were designated as the Channel Islands National Marine Sanctuary. The sanctuary includes waters within 6 nautical miles of five of the Channel Islands: San Miguel, Santa Rosa, Santa Cruz, Anacapa and Santa Barbara Islands.

### **Position:**

You are a SCUBA diver, boat captain, and pilot. Your skills help you investigate the different habitats in the sanctuary. You lead a team of experts that help you make decisions about management. Your team includes marine scientists and teachers. You also talk with commercial and recreational fishermen and divers that use resources in the sanctuary. You must lead a fair discussion about marine resource management by listening to different perspectives of people in the community.

### **Observations:**

The Sanctuary Act requires that we protect the natural environment while allowing people to use the Islands for recreation and commercial reasons. Your job is to maintain a balance of interests. You work with the California State Department of Fish and Game to manage fishing in the sanctuary. The Department recently released stopped fishing for rockfish during two months of the year and completely stopped fishing for abalone (an invertebrate mollusk). Information gathered during years of experience suggests that you should designate between 30% and 50% of the sanctuary waters as marine reserves. You must balance the different ideas in your community in a way that will be fair to everyone while following the Sanctuary Act.



Title:  
Name:  
Date:

What is your role in the community?

What are your goals for resource management?

Where would you establish marine reserves? Use the blank map to draw your answer.  
Explain why you would establish reserves in these locations.

How large should marine reserves be? Why?

List five recreational or commercial activities that occur in the ocean.

## ANSWER KEY

Title: Recreational Diver

Name:

Date:

What is your role in the community?

*Recreational Diver.*

What are your goals for resource management?

*Protect marine species and habitats, including all habitats from the intertidal to deep waters within the Sanctuary. Recreational and commercial fishermen should be restricted from certain areas because they are depleting public resources.*

Where would you establish marine reserves? Use the blank map to draw your answer. Explain why you would establish reserves in these locations.

*Answers may vary. Reserves must be at least 50% of the study area.*

How large should marine reserves be? Why?

*50% of the study area to protect representative habitats and species of concern. Recreational and commercial fishing is causing declines of certain species. Reserves will help restore these species.*

Name three species that interact in the kelp forest that you observe and describe the interactions?

*Urchins eat kelp. Lobsters and California Sheephead eat urchins. Sea otters (that have been hunted to extinction in southern California) eat urchins. Because people fish lobsters and California Sheephead, and people already hunted the sea otters to extinction in southern California, the urchin populations are very large. Large urchin populations eat kelp and the kelp-associated species decline.*

## ANSWER KEY

Title: Lobster Fisherman

Name:

Date:

What is your role in the community?

*Lobster fisherman*

What are your goals for resource management?

*Establish small reserves to grow big lobster. If large reserves are established, sustainable lobster fishing should be allowed in the reserves.*

Where would you establish marine reserves? Use the blank map to draw your answer. Explain why you would establish reserves in these locations.

*Answers may vary.*

How large should marine reserves be? Why?

*Small because the lobster industry is sustainable over the last 100 years. It is not necessary to add to the existing regulations with marine reserves.*

What regulations already exist in the lobster fishery?

*Seasonal closures from March to October. Size limit to no less than 3 \_ inches carapace length. All traps must have “escape ports”. The number of lobster fishing boats is limited.*

What environmental factors affect the size of lobster populations?

*El Nino conditions (warm water) and storms affect lobster populations.*

## ANSWER KEY

Title: Squid Fisherman

Name:

Date:

What is your role in the community?

*Squid Fisherman*

What are your goals for resource management?

*Keep fishing squid at sustainable levels. Marine reserves are not necessary to sustain the squid fishery. Use marine reserves to reduce the impact of squid fishing boats on seabird populations on offshore islands.*

Where would you establish marine reserves? Use the blank map to draw your answer. Explain why you would establish reserves in these locations.

*Answers may vary.*

How large should marine reserves be? Why?

*Small. Squid fishing is sustainable under the current management strategies. Small reserves located near seabird colonies could help reduce the impacts of squid light boats on seabirds.*

Does the squid fishery have on other species? If so, what species are affected?

*Squid fishing boats, which go out at night, cast light into the water to attract squid. The light may wake up seabirds on offshore islands and cause them to abandon their nests for a long period of time. Therefore, squid fishing affects seabird populations.*

## ANSWER KEY

Title: Recreational Fishing Boat Captain

Name:

Date:

What is your role in the community?

*Recreational Fishing Boat Captain*

What are your goals for resource management?

*Establish small reserves to help offset the effects of overfishing. No reserves should be placed on the south side of Anacapa Island.*

Where would you establish marine reserves? Use the blank map to draw your answer. Explain why you would establish reserves in these locations.

*Answers may vary. No reserves should be placed on the south side of Anacapa Island.*

How large should marine reserves be? Why?

*Small, to offset the negative effects of overfishing.*

Which fish species are declining around the Channel Islands and why? There is one main one, but give at least three other reasons fish population may decline.

*Rockfish species are declining, including canary rockfish, Pacific Ocean Perch, bocaccio, cowcod, and lingcod. They are declining because of overfishing, El Nino cycles (warm water), large ocean waves, and strong currents*

## ANSWER KEY

Title: Recreational Fisherman

Name:

Date:

What is your role in the community?

*Recreational Fisherman*

What are your goals for resource management?

*Small marine reserves could help some fish populations grow larger. No reserves should be established on the south side of Anacapa Island because these areas are traditional recreational fishing grounds.*

Where would you establish marine reserves? Use the blank map to draw your answer. Explain why you would establish reserves in these locations.

*Answers may vary. No reserves should be established on the south side of Anacapa Island because these areas are traditional recreational fishing grounds.*

How large should marine reserves be? Why?

*Small, to offset the negative effects of overfishing.*

List three fish species that live in the Channel Islands National Marine Sanctuary.

*Rockfish, lingcod, California sheephead, yellowtail, white seabass, albacore, kelp bass, barracuda, squid, sardines, anchovies, halibut, sand bass, etc.*

Which of these fish species are becoming more abundant? Which species are declining?

*Some fish species, including rockfish, lingcod, and California sheephead, are seriously depleted. These fish are less abundant and smaller than they were 10 years ago. On the other hand, yellowtail, white seabass, and albacore seem more abundant now than in previous years.*

## ANSWER KEY

Title: Marine Ecologist

Name:

Date:

What is your role in the community?

*Marine Ecologist*

What are your goals for resource management?

*Protect marine habitats and species. If the goal is for conservation, then approximately 50% of the total study area should be protected. If the goal is to sustain fisheries, then approximately 30% of the fishing grounds should be protected.*

Where would you establish marine reserves? Use the blank map to draw your answer. Explain why you would establish reserves in these locations.

*Answers may vary.*

How large should marine reserves be? Why?

*If the goal is for conservation, then approximately 50% of the total study area should be protected. If the goal is to sustain fisheries, then approximately 30% of the fishing grounds should be protected.*

What fish species have declined? Give two reasons for the decline, in addition to fishing.

*Rockfish, sharks, abalone, sheephead, black sea bass, and sea cucumber. Reasons for the decline include fishing, El Nino cycles, disease, and increased pollution.*

How do marine reserves help marine animals?

*Animals in marine reserves can grow larger and produce more offspring.*





## ANSWER KEY

Title: *Sanctuary Manager*

Name:

Date:

What is your role in the community?

*Sanctuary Manager*

What are your goals for resource management?

*Protect the natural environment while allowing people to use the ocean for recreation and commercial reasons.*

Where would you establish marine reserves? Use the blank map to draw your answer. Explain why you would establish reserves in these locations.

*Answers may vary.*

How large should marine reserves be? Why?

*Between 30-50% to protect marine habitats and species.*

List five recreational or commercial activities that occur in the ocean.

*SCUBA diving, Sailing, Commercial Fishing, Recreational Fishing, Free Diving, Photography, Science, Etc.*