# SCIENCE·3D

## MASTERS OF THE DEEP: SPERM WHALES

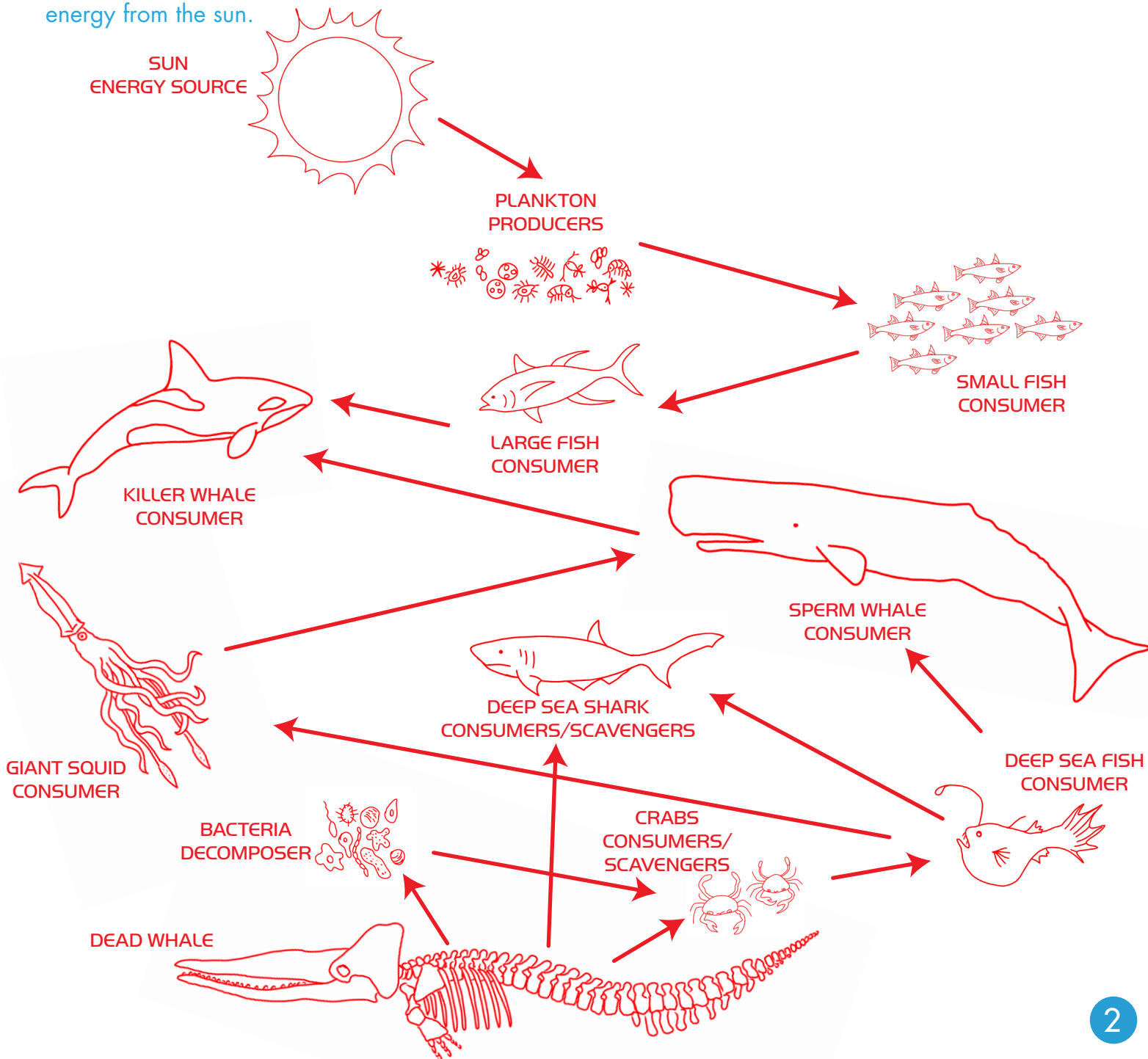In this packet, sample student answers are provided in red and notes to teachers are in blue.

In this **Science Mission**, students will use their knowledge from the **Mission Reader** and **Mission Video** to unravel the roles of organisms in sperm whale ecosystems. Then, they will use data to determine where sperm whale prey is found, and formulate and test hypotheses about sperm whale location and behavior. Finally, they will use their evidence-based knowledge to suggest where marine protected areas should be established.

## Activity 1: A Sperm Whale's Ecosystem and Where to Find Them

1. Below is a sperm whale ecosystem. **Draw** arrows in the diagram to show the flow of energy. Be sure your diagram shows the source of energy in the ecosystem.

   a) Label the following organisms in your diagram: **plankton, large fish, deep sea fish, giant squid, sperm whales, killer whales, crabs, dead whale, bacteria, deep sea shark, small fish**.

   b) Label each organism with the role it plays in the ecosystem (**producer, predator, scavenger, decomposer**).

Student diagrams should identify the correct roles and illustrate the correct directions of energy flow. Students may not accurately identify every correct link. Expect the following links to be labeled: 1) sperm whales eating giant squid, 2) killer whales eating sperm whales, 3) phytoplankton getting energy from the sun.



SUN
ENERGY SOURCE

PLANKTON
PRODUCERS

SMALL FISH
CONSUMER

LARGE FISH
CONSUMER

KILLER WHALE
CONSUMER

SPERM WHALE
CONSUMER

DEEP SEA SHARK
CONSUMERS/SCAVENGERS

GIANT SQUID
CONSUMER

DEEP SEA FISH
CONSUMER

BACTERIA
DECOMPOSER

CRABS
CONSUMERS/
SCAVENGERS

DEAD WHALE

If you were a sperm whale, where would you look for food? The science team used sonar to map locations of the squid and fish that sperm whales eat. Use the map and table below to make predictions about where to find sperm whales and how deep they dive.

The map below shows where the teams looked for sperm whales. Table 1 shows the biomass of possible sperm whale prey near the seamount and far from the seamount.



### Table 1. Biomass of prey close to and far away from the seamount

| Habitat | Proportion of total prey biomass |
|---------|----------------------------------|
| Shallow | 0% |
| Deep Seamount | 80% |
| Deep, No Seamount | 20% |

2. Where is most of the sperm whale prey found? What evidence do you have to support this claim? Use the information in the **Mission Reader** to help you answer this question, if needed.

Most of the prey for sperm whales is found near the seamount. There is less prey in deep waters far from the seamount. The data from the sonar shows more prey in deep water than in shallow water. Prey is near the seamount because seamounts bring nutrients from deep water. This helps plankton grow which boosts the whole food web.

3. Where do you think the team should go if they want to find a whale to tag? Use the information you have gathered to support your answer.

The team would most likely find more sperm whales near the seamount and fewer whales in deep waters far from the seamount. They should not find any in shallow water. Sperm whales will go where there is the most food, and there is more food near the seamount. Note: Students may think sperm whales will go somewhere other than the seamount to avoid predators. Alternative answers like this should be accepted as long as students provide a good reason for their prediction.
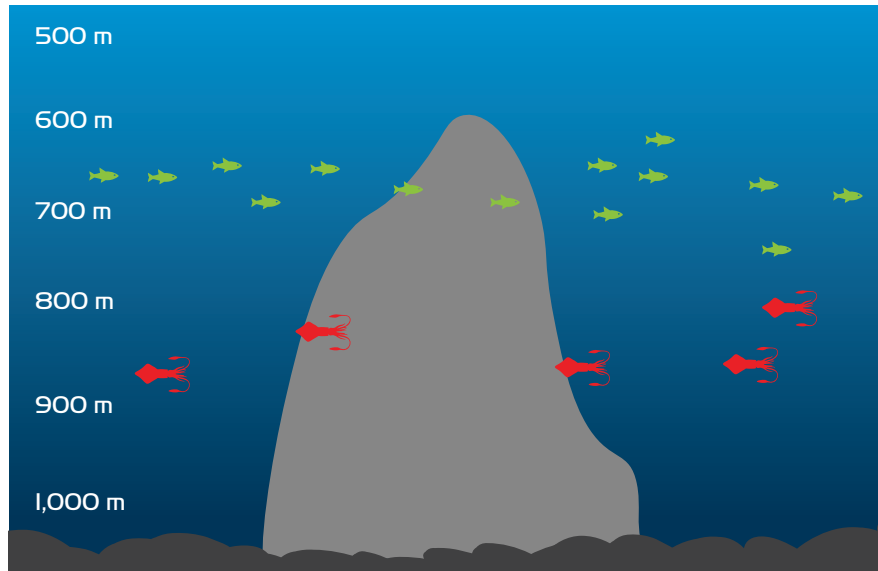
**Figure 1.** Graphic representation of sonar data showing fish and squid near the seamount
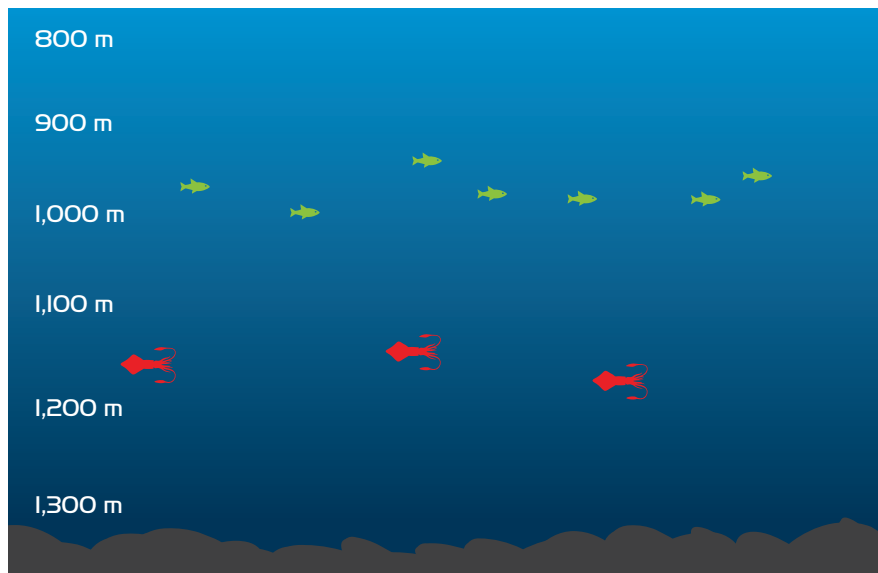


**Figure 2.** Graphic representation of sonar data showing fish and squid far from the seamount

4. Using Figures 1 and 2, predict how deep sperm whales should dive if they want to eat deep sea squid. What if they want to eat fish? Should they dive to different depths in different habitats?

Sperm whales should dive to 800 - 950 meters near the seamount, and 1,100 - 1,200 meters when far from the seamount, when they want to eat deep sea squid. If sperm whales want to eat fish they should dive to 600 - 700 meters near the seamount and 900 - 1,000 meters when far from the seamount.

# Activity 2: Where Are the Sperm Whales?

1. It's time to test your predictions about where the team will find the whales. The team traveled through each area on ten different days and counted the number of sperm whales they found each time. Use the data in Table 2 to calculate the average number of sperm whales in each area.

### Table 2. Number of sperm whales at three areas over ten days

| Day | Deep, seamount | Deep, no seamount | Shallow |
|---|---|---|---|
| 1 | 12 | 0 | 0 |
| 2 | 10 | 0 | 0 |
| 3 | 0 | 3 | 0 |
| 4 | 4 | 2 | 0 |
| 5 | 6 | 2 | 0 |
| 6 | 2 | 0 | 5 |
| 7 | 5 | 4 | 0 |
| 8 | 7 | 2 | 0 |
| 9 | 7 | 0 | 0 |
| 10 | 2 | 2 | 0 |
| **Average** | 5.5 | 1.5 | 0.5 |

2. Make a bar graph of the number of whales observed in each area. Label the axes and give the graph a title.



Average number of whales

Deep, seamount          Deep, no seamount          Shallow
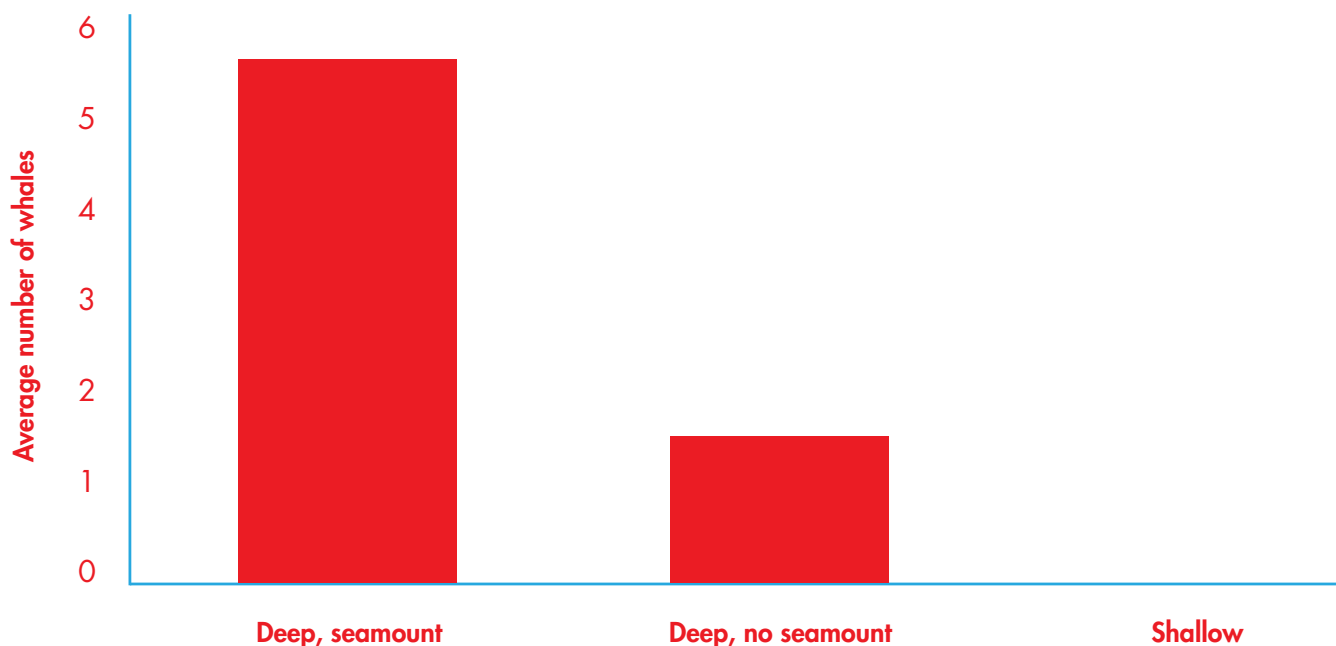
**Average number of sperm whales observed in different habitats**

3. Was your hypothesis about where whales would be found supported? Explain the evidence for your claim.

Most students will say yes, they found more whales where there was more food. They might say they were surprised by seeing some whales in shallow water, where there is no food. This is an opportunity to discuss why sperm whales might be found here. For example, they may be found in shallow water because they are looking to avoid predators or to sleep, or as result of an accident when they were playing or socializing. If students didn't predict more whales where there was more food, their answer should reflect rejecting their hypothesis.

4. Look at Table 2. Do you think it was a good idea that the team surveyed the areas on many different days? Why or why not? Use information from the table to support your answer.

It was a good idea because numbers are different on different days. If the team had only gone out on day 6, for example, they would not have found data that represents the whales' pattern of behavior.

# Activity 3:  How Deep to Dive? What Would You do?

Use Figure 3 to help test your ideas about how deep whales should dive to find food.
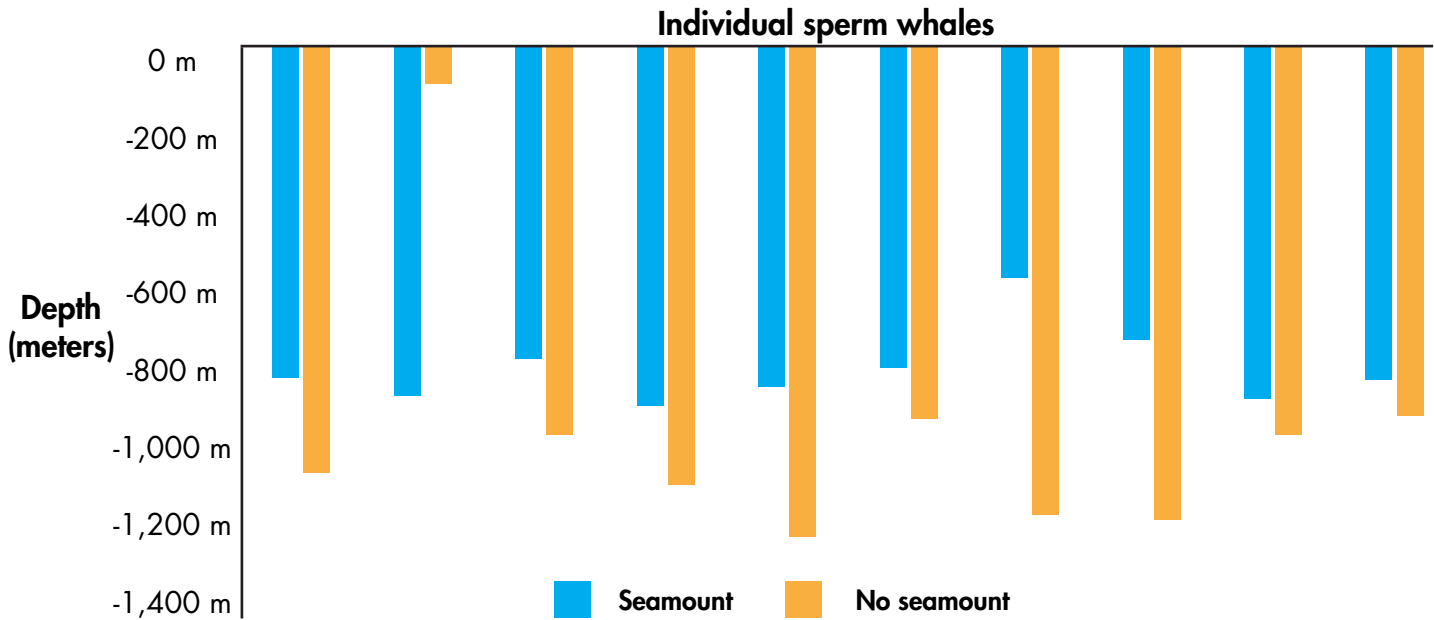
**Individual sperm whales**



**Figure 3. Average dive depths of ten whales that spent time near the seamount and in deep water far away from the seamount**

1. Did the whales dive the way you predicted? Did they all do the same thing? Why do you think they behaved this way?

Yes, most whales dove to the areas where the sonar showed the most prey, but not all animals did the same thing. One whale (second from left) may not have been looking for food when it left the seamount. Other whales had to dive deeper to find food when they were not at the seamount.

7

2. If a government wants to choose the best location to make a reserve that would protect sperm whales, where should the reserve be located? Provide evidence for the government to use to help make their decision.

It should be in deep water and include the areas with seamounts because that is where whales and their prey are found.

3. The government of Montserrat, near Guadeloupe, is trying to decide where to create their own protected area. They don't have data on whales or their food. On the map below, **circle** where it should create protected areas. Explain your reasoning.
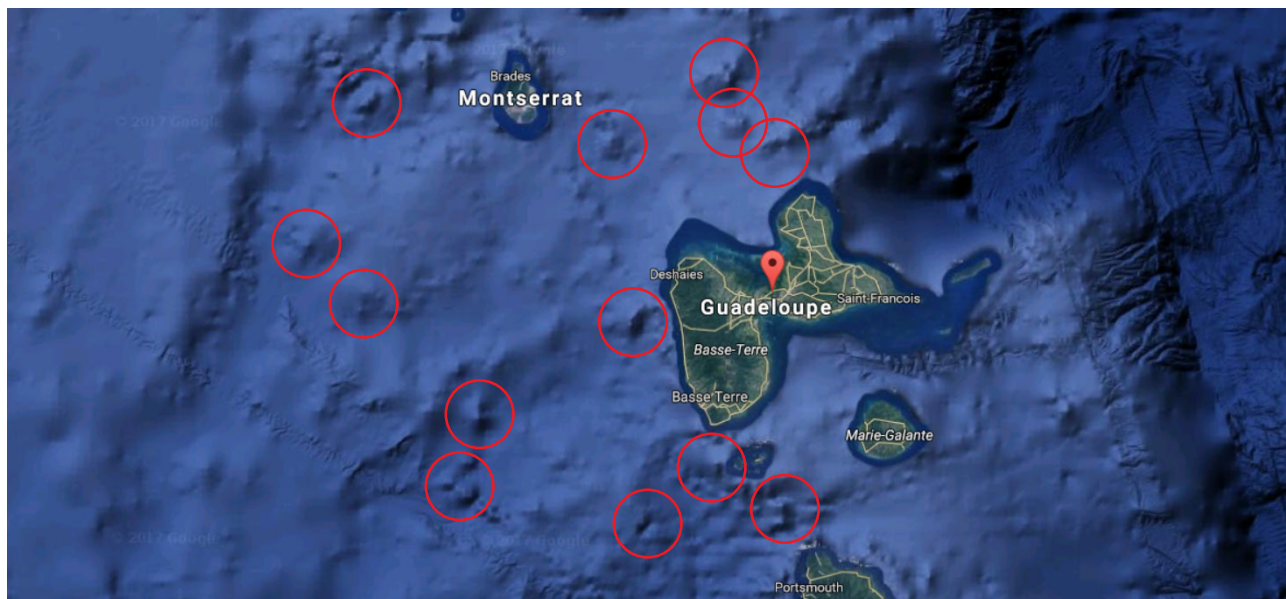


Answers should show protected areas near the seamounts. Explanations should include this is where there is likely the most food for whales and therefore probably where whales will be found.