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Why are North Pacific killer whales now eating sea otters?





Marine biologists investigating the North Pacific Ocean along the coasts of Alaska and the Aleutian Islands have observed a serious disturbance to the marine ecosystem. For decades this ecosystem has been relatively stable, with some of the largest populations of marine species in the world. However, in recent years, some species are disappearing and other species are critically affected. The killer whale (also known as the orca) generally did not consume sea otters in the past, but now consumes thousands of otters. As a result, populations of sea otters in the Aleutian Islands have declined from an estimated 60,000 animals in the mid-1980s to under 10,000 by 2000. (The sea otter is an endangered species). In addition, the populations of seals and sea lions and underwater ‘forests’ of kelp are disappearing.

Ecologists believe that the disturbance to the North Pacific marine ecosystem began with a decline in the fish population, and this event had significant impacts on other species.

**Assignment**: You will work with a team of ecologists to investigate the effects of a disturbance to this ecosystem, predict future changes, and consider potential methods to lessen the impacts on the ecosystem.

**Part 1**. **Food Web.**

*Directions:* The table below provides information on species and their food sources in the North Pacfic marine ecosystem. You will work with your team to discuss the ecological information, and **create a food web for this ecosystem**.

|  |  |
| --- | --- |
| **Species** | **Food Source** |
| **Ocean Perch** (large fish) | Eats Zooplankton |
| **Herring** (small fish) | Eats Zooplankton |
| **Seal** (marine mammal) | Eats Perch and Herring |
| **Sea Lion** (marine mammal) | Eats Perch and Herring |
| **Killer Whale** (Orcas) | Eats Seals and Sea Lions |
| **Sea Otter** (small marine mammal) | Eats Sea Urchins |
| **Sea Urchin** (small, spiny animals that live on the seafloor) | Eats Kelp |
| **Kelp** (a large species of algae that attaches to the sea floor, growing upward to form a canopy) | Use energy from the Sunfor photosynthesis |
| **Zooplankton** (tiny, floating animals, including dinoflagellates and larvae) | Eats Phytoplankton and kelp |
| **Phytoplankton** (tiny, floating, single-celled plants, also known as algae) | Use energy from the Sunfor photosynthesis |

Diagram the food web in the space provided below. Be sure to use arrows to show the direction of energy flow.

**North Pacific Marine Ecosystem Food Web**

**Part 2. Ecosystem Disturbance.**

*Directions:* Your team will investigate this ecosystem further by reading about some changes in the northern Pacific Ocean. Discuss the changes, and complete a response to each question.

**A.** In the last decade, populations of ocean perch and herring were greatly reduced. (Later in this investigation, we will explore reasons for the reduction in the populations of ocean perch and herring).

* **When populations of ocean perch and herring are reduced, which other species in this ecosystem are *directly* affected? Identify at least two species that lose their food source.**

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* **Using your food web, what represents the effect of a reduction of perch and herring on the other species?**

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**B.** When the supply of seals and sea lions declined, killer whales found a new food source: sea otters. The killer whales did not necessarily like their new food: otters are less nutritious than seals and sea lions.

* **When the killer whales consume sea otters, what additional species are impacted? Explain the impacts.**

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* **If otters provide less nutrition to the killer whales, how will the whales have to change their eating habits? Use evidence from food web.**

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**C.** The killer whales have eaten more than 40,000 otters since the early 1990’s, leaving fewer otters to consume sea urchins from the ocean floor. As a result, the population of sea urchins has risen dramatically, and the sea urchins began eating kelp at an alarming rate. At one time, the kelp grew so thick along the shorelines of the region that they formed large underwater ‘forests’. Now, many of those kelp forests are completely gone.

* **How will the loss of kelp likely change the ecosystem?**

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* **How might the loss of kelp change the carrying capacity of the North Pacific marine ecosystem?**

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**Part 3**. **Predictions for the Future.**

1. **What will happen next? Use the following information to predict two additional changes to the ecosystem.**
2. Starfish thrive on seafloor that is **not** covered by kelp.
3. Rockfish and greenling fish find protection by hiding within underwater kelp forests.

*Your two predictions:*

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1. **As this marine ecosystem continues to change and adjust to the disturbances, …**
* **In what ways will the new ecosystem be similar to the original ecosystem (before the disturbance)?**
* **In what ways will the new ecosystem be different from the original ecosystem?**

Consider the number of different species, population sizes of different species, carrying capacity, and other biotic or abiotic factors.

Use the graphic organizer on the next page to complete your response.

|  |  |
| --- | --- |
| In what ways will the new ecosystem be similar to the original ecosystem? | In what ways will the new ecosystem be different from the original ecosystem? |
|  |  |





