NO PREP

Keystone Species and Their Role in Ecosystem Balance

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Includes: Student reading, case study, differentiated questions, teacher key

Name: Period: Date:

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What Are Keystone Species?

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What Are Keystone Species?

In marine ecosystems, certain species play roles so critical that the entire community depends on them. These are known as keystone species. The term refers to the central wedge of an arch: if the keystone is removed, the structure collapses. Similarly, if a keystone species disappears, the balance of the ecosystem can unravel. Not all keystone species are abundant. Some may exist in relatively small numbers but exert a disproportionate influence on food webs, habitats, and biodiversity. Their effects are often linked to controlling prey populations, maintaining habitats, or regulating competition. Identifying and protecting keystone species is one of the most important goals in conservation biology.

Examples of Keystone Species in the Ocean

A well-known keystone predator is the sea otter. In kelp forest ecosystems, sea otters feed on sea urchins. Without otters, urchin populations explode, devouring kelp and leaving behind barren underwater landscapes. When otters return, kelp forests recover, showing how one species can shape entire habitats. Another example is sharks. As apex predators, they regulate mid-level predators, preventing them from overconsuming herbivorous fish. This maintains balance and indirectly protects coral reefs. Even smaller creatures, like mangrove crabs, play keystone roles by turning over sediment and recycling nutrients in coastal wetlands. These examples remind us that ecosystem stability often hinges on a few critical players.

Why Keystone Species Matter

The presence of keystone species often enhances biodiversity, stability, and productivity. By controlling populations, they prevent resource monopolies. By shaping habitats, they create opportunities for other species. When keystone

species decline, ecosystems may shift into less productive or less diverse states. For marine conservation, focusing on these species is often more effective than spreading resources too thinly across all species.

Key Information: Table: Examples of Marine Keystone Species

Keystone Species	Ecosystem Role	Effect on Ecosystem
Sea otter	Predator of sea urchins	Maintains kelp forests
Shark	Apex predator	Controls mid-level predator numbers
Coral	Reef builder	Provides habitat for many species
Mangrove crab	Sediment recycler	Maintains coastal wetlands
Krill	Primary food source for many species	Supports whales, seals, penguins

Case Study: The Sea Otter and Kelp Forests (Excerpt)

In the North Pacific, sea otters were once hunted nearly to extinction for their fur. As otters disappeared, sea urchins multiplied unchecked. The urchins grazed kelp so heavily that entire forests vanished, taking with them countless fish, invertebrates, and marine mammals that depended on the kelp habitat. When conservation laws allowed sea otters to rebound, kelp forests slowly returned. Fish populations increased, and biodiversity flourished again. Scientists recognized the otters as a keystone species because their presence—or absence—determined the survival of the entire ecosystem. This case highlights how protecting one species can restore ecological balance. It also shows how human actions, like overhunting, can accidentally destabilize ecosystems. Conservation of keystone species is therefore not just about saving individual animals but about protecting the structure of entire marine environments.

1. Why are sea otters considered a keystone species in kelp forests?

_____

_____

2. How did hunting sea otters affect the ecosystem balance?

_____

_____

Multiple Choice

1. What is a keystone species?
    a) A species found only in shallow coral reef areas
    b) A species that controls ecosystem structure
    c) A species with the shortest life span
    d) A species with the largest population

2. How do sharks function as keystone species?
    a) By eating plankton
    b) By regulating mid-level predators
    c) By building reef habitat for coral
    d) By photosynthesizing

3. Which event showed the importance of sea otters in kelp forests?
    a) Otter hunting and ecosystem collapse
    b) A sudden decline in shark populations
    c) Whale migration changes
    d) Coral bleaching

Matching

Write the letter of the correct definition on the line next to each term.

Term	Definition
1. ___ Sea otter	A) Recycles sediment in wetlands
2. ___ Shark	B) Supports whales and penguins
3. ___ Coral	C) Controls mid-level predators
4. ___ Krill	D) Maintains kelp by eating urchins
5. ___ Mangrove crab	E) Reef builder providing habitat

Fill-in-the-Blank

1. Keystone species often have a _____ impact on ecosystems despite low numbers.

2. Without sea otters, _____ populations overgraze kelp forests.

3. Krill are a keystone species because they are a primary _____ source for whales, seals, and penguins.

Short Answer

Answer each question in 2-4 complete sentences.

1. Explain why the loss of a keystone species can destabilize an ecosystem.

2. How does protecting keystone species help conserve biodiversity?

3. Give one example of a smaller marine organism that functions as a keystone species.