NO PREP

Invertebrates in Food Webs

Ecosystem Engineers of the Sea

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

Name: Period: Date:

Invertebrates in Food Webs: Ecosystem Engineers of the Sea

Marine invertebrates are not only diverse in form and function, but they also hold positions of immense importance in marine food webs. These animals, ranging from tiny planktonic crustaceans to massive reef-building corals, are the foundation for energy transfer in the ocean. Without their roles as prey, predators, filter feeders, and ecosystem engineers, marine systems would collapse. Understanding how invertebrates interact with one another and with other species allows us to appreciate how finely balanced ocean ecosystems really are.

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Primary Consumers and Filter Feeders

Many marine invertebrates function as primary consumers, feeding on microscopic algae, phytoplankton, or detritus. Small crustaceans such as copepods and krill are critical players at this level. By grazing on phytoplankton, they transfer energy from the sun (captured through photosynthesis by algae) up the food chain to fish, whales, and seabirds. Similarly, filter feeders such as sponges, bivalves, and tunicates clean the water as they feed, removing excess particles and maintaining water clarity. Their activity reduces harmful algal blooms and provides stability to coastal ecosystems. By occupying these roles, filter feeders not only support higher levels of the food web but also regulate their environments in ways that benefit countless other organisms.

Predators and Keystone Roles

Other marine invertebrates serve as predators, helping control populations and preventing any single species from dominating. Sea stars, for instance, are known as keystone predators because of their ability to regulate mussel populations. Without sea stars, mussels would outcompete other species and reduce biodiversity. Similarly, jellyfish feed on plankton and small fish, impacting fish populations and competing directly with humans in some areas for food resources. The predatory

nature of these animals is essential to maintaining ecological balance. Predators prevent unchecked growth of prey species, fostering healthier and more resilient communities.

Ecosystem Engineers

Some invertebrates go beyond feeding roles and physically change their environment, earning the title of ecosystem engineers. Corals build massive reef systems that provide shelter, food, and breeding grounds for thousands of species. Worms and bivalves burrow into sediment, mixing nutrients and allowing oxygen to penetrate layers of the seafloor. Even sea urchins shape their environment by grazing on algae, which helps prevent overgrowth that could otherwise smother coral reefs. These engineering roles demonstrate how invertebrates create habitats that benefit other species and sustain entire ecosystems.

Detritivores and Nutrient Recyclers

In addition to predators and filter feeders, many invertebrates act as detritivores, consuming dead organic material and recycling nutrients. Worms, sea cucumbers, and crustaceans like amphipods break down waste and return nutrients to the system, making them available again for primary producers like algae. This process ensures that ecosystems remain productive over time. Without detritivores, waste would accumulate, and essential nutrients would be locked away instead of re-entering the food web. These roles may not seem glamorous, but they are essential for maintaining ecological balance.

Human Connections and Threats

Humans depend heavily on marine invertebrates, whether directly for food (shrimp, crabs, clams, squid) or indirectly through the ecosystems they support. However, human activity also threatens their survival. Overfishing disrupts food webs, while pollution and climate change weaken coral reefs and damage habitats. If keystone species or ecosystem engineers decline, the consequences ripple outward, affecting biodiversity, fisheries, and even coastal protection. Protecting invertebrates is not just about saving interesting creatures—it is about preserving the stability of marine food webs that sustain life on Earth.

Case Study Excerpt: The Collapse and Recovery of Sea Otters and Sea Urchins

In the North Pacific, sea otters were once hunted nearly to extinction for their fur. This decline had a profound effect on food webs, particularly involving sea urchins and kelp forests. Without sea otters to prey on them, sea urchin populations exploded. These urchins grazed so heavily on kelp that entire forests disappeared, leaving behind barren seascapes known as "urchin barrens." Kelp forests, however, are critical ecosystems that provide shelter for fish, feeding grounds for sea lions, and carbon storage for the planet. Scientists documented how the removal of one predator triggered cascading effects through the ecosystem. When conservation measures allowed sea otter populations to rebound, urchin numbers declined, and kelp forests began to recover. This case demonstrates the interconnectedness of marine invertebrates and the predators that regulate them. Food webs are not simply linear chains but complex networks where the loss or addition of one species can cause dramatic shifts throughout the system.

1. How did the decline of sea otters affect sea urchin and kelp populations?

_____

_____

2. Why are kelp forests considered critical ecosystems in marine food webs?

_____

_____

Multiple Choice

1. Why are sea stars considered keystone predators?

    a) They filter plankton from seawater

    b) They consume detritus and recycle nutrients

    c) They regulate populations of mussels

    d) They build reef habitats for fish

2. Which marine invertebrates function as important filter feeders?

    a) Crabs and shrimp

    b) Sponges and bivalves

    c) Corals and sea urchins

    d) Jellyfish and flatworms

3. What is the primary role of detritivores like sea cucumbers?

    a) Building reef structures

    b) Preying on and controlling mussel populations

    c) Supporting larval dispersal

    d) Recycling nutrients by breaking down waste

Matching

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

Term	Definition
1. ___ Copepods	A) Ecosystems built by invertebrates that shelter thousands of species
2. ___ Coral reefs	B) Organisms that recycle nutrients by feeding on waste
3. ___ Sea urchin barrens	C) Small crustaceans that graze on phytoplankton
4. ___ Detritivores	D) Species that regulate populations and maintain biodiversity
5. ___ Keystone predator	E) Areas created by overgrazing when predator control is lost

Fill-in-the-Blank

1. When sea otters declined, _____ populations grew unchecked and destroyed kelp forests.

2. _____ are invertebrates that feed on phytoplankton and transfer energy to higher consumers.

3. Corals are considered _____ engineers because they physically build habitats.

Short Answer

Answer each question in 2-4 complete sentences.

1. Explain how filter feeders contribute to water clarity and ecosystem stability.

_____

_____

_____

2. Describe how the removal of a predator can cause cascading effects in a marine food web.

3. Why are detritivores essential for the long-term productivity of marine ecosystems?