NO PREP

# Abiotic and Biotic Factors Shaping Marine Ecosystems

MORE LESSONS LESS PLANNING

MLLP

FREE TODAY · FREE TOMORROW · FREE FOREVER

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

Name: Period: Date:

## Abiotic and Biotic Factors Shaping Marine Ecosystems

**Name:** **Period:** **Date:**

# Abiotic and Biotic Factors Shaping Marine Ecosystems

### Environmental Forces That Shape the Ocean

Marine ecosystems are influenced by two broad categories of factors: abiotic (non-living) and biotic (living). These elements work together to determine where organisms live, how they behave, and how communities change over time. Abiotic factors are things like temperature, salinity, light availability, pH, nutrient levels, and ocean currents. Each plays a role in shaping life in the sea. For example, water temperature affects metabolic rates in fish, and light penetration sets the boundaries for photosynthetic organisms like phytoplankton. Currents distribute nutrients, while salinity determines which organisms can thrive in estuaries versus the open ocean. Biotic factors include all living interactions. This includes competition, predation, mutualism, and the presence of keystone species. A coral reef, for example, may be stable because of the relationships among corals, algae, grazing fish, and apex predators. If one of those links is altered, the biotic balance shifts. Thus, marine life exists within an ever-changing mosaic where the abiotic "stage" sets the physical conditions, and the biotic "actors" interact within those limits.

### Abiotic Factors in Depth

The abiotic environment of the ocean is not uniform. Temperature decreases with depth, light fades as water thickens, and dissolved oxygen varies with circulation patterns. Nutrient availability often controls productivity, especially nitrogen and phosphorus. These nutrients are most abundant near coastlines and areas of upwelling, where deep, nutrient-rich water rises to the surface. Regions with strong upwelling, such as the coast of Peru, often support massive fisheries because plankton growth is sustained by this nutrient delivery. Salinity—the concentration of salts—affects buoyancy, osmoregulation, and species distribution. Most marine

organisms are adapted to fairly stable salinities, but in estuaries, salinity can fluctuate with tides and rainfall, demanding special adaptations. Light penetration limits photosynthesis to the upper photic zone. Beyond this zone, life depends on detritus sinking from above or on chemosynthesis around hydrothermal vents. These abiotic constraints mean life is clustered where conditions allow survival.

**Biotic Factors in Depth**

Biotic interactions shape the character of every marine community. Predators regulate prey populations, preventing overgrowth of certain species. Competition forces organisms to exploit resources in unique ways, helping establish ecological niches. Symbiosis produces fascinating survival strategies: cleaner fish remove parasites from larger hosts, corals and algae share resources, and parasites exploit their hosts. The presence of a keystone species can restructure whole ecosystems. For example, grazing herbivorous fish on coral reefs prevent algae from smothering corals. Similarly, sharks often regulate populations of mid-level predators, which in turn affects the abundance of species lower in the food web. Biotic forces are dynamic, sometimes reinforcing stability, sometimes producing sudden shifts when species are added, removed, or altered by human impacts.

**How Abiotic and Biotic Factors Interact**

Abiotic and biotic factors do not act in isolation. Temperature changes caused by climate events such as El Niño can alter nutrient upwelling, reducing phytoplankton growth and starving higher trophic levels. Pollution can lower oxygen levels, creating "dead zones" where fish cannot survive, shifting predator-prey dynamics. Biotic interactions, in turn, can influence abiotic conditions. Dense seagrass meadows, for example, trap sediment, alter light penetration, and stabilize shorelines. Coral reefs modify wave energy, changing currents and reducing erosion.

**Key Information: Table: Examples of Abiotic and Biotic Factors**

| Factor Type | Examples | Effect on Marine Life |
|---|---|---|
| Abiotic | Temperature | Determines metabolic rates and species ranges |
| Abiotic | Salinity | Limits species to certain habitats (estuaries vs. open sea) |

| Factor Type | Examples | Effect on Marine Life |
|---|---|---|
| Abiotic | Light availability | Sets depth limits for photosynthesis |
| Biotic | Predation | Controls prey populations |
| Biotic | Symbiosis | Enhances survival for one or both partners |

**Case Study: Coral Reefs and Environmental Stress (Excerpt)**

**Coral reefs are among the most biodiverse ecosystems on the planet, but they are also sensitive to abiotic stress. When seawater temperatures rise even a few degrees above normal, corals expel the symbiotic algae (zooxanthellae) that live in their tissues. Without these algae, the coral loses its main food source and turns white, a phenomenon called coral bleaching. If the heat stress is brief, corals may recover; if it is prolonged, the coral may die. Entire reefs can be transformed within months. At the same time, biotic factors interact with this stress. Grazing fish normally prevent algae from overtaking dead coral skeletons. But when fish populations are reduced by overfishing, algae rapidly colonize bleached reefs, making it harder for corals to reestablish. Scientists now recognize that both abiotic stress (warming, acidification, pollution) and biotic stress (overfishing, loss of key grazers) work together to determine reef survival. Conservation projects that combine reducing local fishing pressure with global efforts to lower greenhouse gas emissions give reefs the best chance at long-term resilience.**

1. How does increased seawater temperature disrupt the coral-algae symbiosis?

2. Why is the presence of grazing fish important after coral bleaching events?

_____

_____

**Multiple Choice**

1. Which abiotic factor limits photosynthesis in the ocean?

    a) Light availability

    b) Oxygen levels in seawater

    c) Salinity

    d) Pressure

2. Which of the following is a biotic factor?

    a) Salinity

    b) Nutrient level

    c) Predation

    d) Current strength

3. What do scientists call ecosystems where abiotic and biotic factors interact?

    a) Food chains

    b) Niches

    c) Habitats

    d) Ecosystems

**Matching**

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

| Term | Definition |
|---|---|
| 1. ___ Temperature | A) One species hunting another |
| 2. ___ Symbiosis | B) Determines metabolic rates and ranges |
| 3. ___ Salinity | C) Long-term partnership between species |
| 4. ___ Predation | D) Organisms competing for the same resource |
| 5. ___ Competition | E) Salt concentration affecting habitat use |

**Fill-in-the-Blank**

1. The upper zone of the ocean where sunlight penetrates is called the _____ zone.

2. When corals lose their algae due to heat stress, the process is called _____.

3. Nutrient-rich water rising to the surface is known as _____.

**Short Answer**

Answer each question in 2-4 complete sentences.

1. Explain how abiotic and biotic factors work together to shape marine ecosystems.

_____

_____

_____

2. Provide an example of how human activity changes abiotic conditions in the ocean.

_____

_____

_____

3. How can protecting a keystone species help maintain the balance of an ecosystem?