What is ecosystem stability?

- The vast majority of natural ecosystems experience regular environmental change, or disturbances.
- Most ecologists describe **ecosystem stability** as the ability of an ecosystem to maintain its structure and function over long periods of time and despite disturbances.
- **Ecosystem structure** includes physical and geological structures of the landscape, the number and diversity of species present, the population sizes of those species, and the ways in which these populations interact.
- **Ecosystem function** refers to processes such as water and nutrient cycling and biomass productivity that the ecosystem provides.

Resistance and Resilience

- There are two main components to ecosystem stability: resistance and resilience.
- An ecosystem displays **resistance** if keeps its structure and continues normal functions even when environmental conditions change**.**
- An ecosystem displays **resilience** if, following a disturbance, it eventually regains its normal structure and function**.**

(contd.)

- Ecosystems that show a high degree of stability may have different combinations of resistance and resilience.
- Research has shown that species diversity is often the key to both ecosystem resistance and resilience.
- An ecosystem rich in biodiversity will likely be more stable than one whose biodiversity is low.

1. Infer *If an ecosystem has low biodiversity, is it more or less stable than an ecosystem of high biodiversity?*

How does environmental change affect ecosystem stability?

- Communities respond to environmental change in ways that reflect the responses of the species and populations in the community.
- Species respond to environmental change in ways that enable them to maintain homeostasis.
- Populations respond in ways that reflect the success or failure of members of the population to survive and reproduce.

(contd.)

- Changing environmental conditions can cause the decline of local biodiversity. If this happens, an ecosystem's resistance and/or resilience may decline. The end result is that the ecosystem loses stability.
- Ecosystems that are less stable may not be able to respond to a normal environmental disturbance, which may damage ecosystem structure, ecosystem function, or both.

How does natural environmental change affect ecosystem stability?

- Fires, heavy storms, and natural climate change can cause major changes in local populations of plants and animals.
- A decline in natural biodiversity can make an ecosystem less stable.

2. Apply Concepts *What is one example of a local natural environmental change? How did it impact ecosystem stability?*

How does environmental change caused by human actions affect ecosystem stability?

- Humans affect ecosystem stability in many ways, including habitat loss, introduction of nonnative species, release of pollution into food webs, and contribution to climate change.
- Ecosystems are frequently destroyed for agricultural activity and
urban development. Clearing patches of habitat can split ecosystems into pieces, a process called **habitat fragmentation.**

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- Remaining pieces of habitat become habitat "islands" surrounded by a different habitat. The smaller a habitat island is, the fewer species can live there, and the smaller their populations can be.
- A **keystone species** is one that has a strong and/or wide-reaching impact on a community's stability. If a keystone species declines in number, the ecosystem becomes much less stable.

3. Predict *Sea otters, a keystone species, eat sea urchins, which in turn eat kelp. In the 1990s, sea otter populations off the coast of Alaska declined because orcas ate large numbers of otters. What effect did this have on the sea otters' ecosystem?*

(contd.)

- Humans sometimes introduce organisms into a new habitat, where
  it can become invasive and threaten biodiversity and ecosystem structure.
- An **invasive species** is a nonnative species that spreads widely in a community. Nonnative species become invasive if their new surroundings lack natural population checks such as predators or competitors.
- Invasive species usually cause local native biodiversity to decline and therefore affect ecosystem stability.

4. Contrast *What is the difference between nonnative species and invasive species?*

(contd.)

- Many pollutants, including pesticides and acid rain, impact plant and animal populations. These changes, in turn, threaten biodiversity.
- Organisms are adapted to their environments and have specific tolerance ranges to conditions such as temperature. If conditions change beyond an organism's tolerance, the organism must move to another location or face extinction.
- Increases in Earth's average temperatures could affect ecosystem structures and functions.
- Scientists are not yet sure how predicted changes in global climate within the next several decades will affect ecosystem stability worldwide.