Chapter 11

Testing Your Comprehension

1. Biodiversity has no single definition. At the species level, it refers to both the number of different species present in an area and to the evenness or relative abundance of those species. At the genetic level, it refers to the genetic variety within a single species. At the ecosystem level, it refers to the number and variety of ecosystems in an area. The concept may be applied at the levels of the community, the habitat, or the landscape as well.

2. Habitat alteration, invasive species, pollution, overexploitation, and climate change are all causes of biodiversity loss. Examples, in the order of the factors just mentioned, are hydroelectric dams altering stream habitat, zebra mussels in the Great Lakes, air pollution killing forest trees, Siberian tigers being hunted to near extinction, and climate change affecting the cloud forest fauna in Monteverde.

3. The zebra mussel, a small, striped mollusk, has spread rapidly through eastern North American waterways, fouling ship motors, pumps, docks, etc. Feral pigs in Hawaii alter the habitat for mosquitoes, aiding the spread of the invasive mosquito species Culex quinquefasciatus, which spreads avian malaria and avian pox diseases amongst the native bird populations. Humans are an invasive species in many parts of the world. We’ve brought with us many agricultural species, as well as many weeds, some of which have naturalized in their new habitats, thus altering the local ecological balance.

4. Processes provided by ecosystems, such as air and water purification, are called ecosystem services. Besides those just mentioned, ecosystems also provide food, fuel, and fiber; detoxify and decompose waste; and stabilize and moderate Earth’s climate.

5. Biodiversity increases food security by providing the genetic diversity to adapt to a wide range of growth conditions, and by providing potential new species for cultivation. Salt-tolerant plants that produce animal feed, vegetable oil, and wood may increase the food supply and prosperity of the world’s poor living in areas with saline soils. Many pharmaceuticals are derived from wild species, and many more are awaiting discovery. Australia has an active research program to survey its unique biota for useful pharmaceuticals, and has found the compounds hycoscine, salsodine, and prostaglandin E2, among others.

6. Biodiversity provides valuable ecosystem services free of charge. It helps maintain ecosystem function, provides natural classrooms, enhances food security, provides economic benefits through tourism and recreation, and provides traditional medicine and high-tech pharmaceuticals.

7. An “umbrella” species requires large areas of habitat. If sufficient habitat is protected to preserve that umbrella species, many other species with smaller habitat requirements will also benefit. A “keystone” species is one that plays a crucial role in the trophic web of an ecosystem. Since keystone species are often top predators that require a large area of habitat, they can be both keystone and umbrella species.

8. The equilibrium theory of island biogeography predicts the number of species on an island based on the island’s size and its distance from the nearest mainland. In the case of the Siberian tiger, its habitat in the Sikhote-Alin Mountains can be viewed as a series of islands isolated from one another by topography, lowland “oceans” of logged forests and populated
areas, and literal oceans to the east. Any habitat that becomes fragmented into isolated patches can be viewed as an archipelago of islands.

9. The U.S. Endangered Species Act (ESA) has resulted in the rebounding populations of the peregrine falcon, brown pelican, and bald eagle, all of which have been removed from the endangered species list. Fully 40% of species with declining populations have been stabilized. The ESA has been criticized for valuing endangered species above the livelihood of humans, and because of fears that it will unreasonably restrict the use of private land.

10. A biodiversity hotspot is an area that supports at least 1,500 endemic plant species, has suffered extensive habitat alteration, and has lost 70% or more of its original habitat. Community-based conservation engages local people in efforts to protect the land and wildlife in their own regions.

**Interpreting Graphs and Data**

1. Positive effects were shown in 66 studies; negative effects in eight studies; and no effects in 25 studies.
2. The strongest evidence is for plant biodiversity, with 13 studies showing a positive effect, two showing no effect, and none showing a negative effect. Similarly, the evidence for birds (seven positive, two with no effect, and none showing a negative effect) is also strong. The spiders and other arthropods would be the next two groups that have been studied frequently and show a preponderance of positive effects. Somewhat surprisingly, mammals have not been the focus of research on the impact of agricultural practices on biodiversity.
3. Plants provide food, fuel, and fiber; provide shelter and building materials; purify air and water; moderate floods, droughts, wind, and temperature extremes; generate and renew soil fertility and nutrient cycles; control pests and diseases; and maintain genetic resources. Birds also control pests and diseases, recycle nutrients, and maintain genetic resources. Spiders control pests and diseases. Other arthropods pollinate crops and other plants, generate and renew soil fertility and nutrient cycles, and control pests and diseases.

**Calculating Ecological Footprints**

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<th>Hectares of forest used for housing</th>
<th>Total forest hectares used</th>
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<tr>
<td>You</td>
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<td>0.59</td>
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<tr>
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1. The majority of the remainder of forest product use is wood pulp for the production of paper and packaging materials.
2. If a forest is harvested at greater than its sustainable rate, the result will be a decrease in the standing stock of forest materials. This will eventually result in deforestation.
3. Tropical and temperate forests especially provide complex habitats with many niches, and support high species diversity. Simplification of that forest into a plantation monoculture of
equal-aged trees reduces the diversity of niches available, and thereby reduces the species
diversity of the forest community. If the population of a species which no longer has a home
in a given forest can move elsewhere, then they have merely been extirpated, but if this
phenomenon is widespread, the population will have nowhere to go and will become extinct.