1 **Introduction to Environmental Geology, 5e**

2 **Ecology: summary in haiku form**

*Here's ecology***.*
It's the study of the Earth -
complete entity.

3 **Case History: Endangered Trout in CA**

4

5 **Ecology and Geology Linkage**

6 **Fundamental Ecology Terms**

7 **Species**

8 **Ecosystem**

9

10 **Types of Ecosystem**

11 **Natural Service Functions of Ecosystems**

12 **Biodiversity**

13 **Geology and Biodiversity**

14 **Keystone Species (1)**

- Keystone species: Species exert a strong community effects disproportionate to their abundance
- Case study: Wolf, elk and mountain stream system in the Yellowstone National Park
  - 1960s–mid-1990s: Elk overbrowsed the riparian vegetation, affected the stream ecosystem
  - late 1990s: Reintroduced wolves that hunted elks and promoted the growth of riparian vegetation, water quality, and stream ecosystem
-

15 **Keystone Species (2)**

Figure 4.5

16

17 **Keystone Species (3)**

- Sea otters, urchins, and kelp
- Kelp forests: Three parts – root-like holdfast, stem (stipe), and blades (leaves)
- Holdfast attached to boulders or the rocky bottom, part of the active geological environment
- Urchins fed on the holdfast of kelp
- Sea otters restored and fed on urchins, kelp forests restored

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20 **Factors To Increase Biodiversity**

21 **Factors To Reduce Biodiversity**

- Extreme geological environment
  - Extreme disturbances damage habitats
  - Limit the number of habitats and ecological niches at a local scale
  - Pollution and other stresses restricting the flow of energy and nutrients
- Fragmentation of ecosystems by land use transformation
- Intrusion of invasive exotic species
- Habitat simplification (engineering structure) or migration barriers

22 **Human Domination**

Human activities exerting dominant community effects

- Dominate almost all ecosystems on Earth
- Massive land use transformation – urban, agriculture, recreation and industry development
- Global climate changes

- Changes in biogeochemical cycles – O, CO_2, energy, and nutrients
- Most rapid extinction of many species during the last 2000 years

23 **Case Study: Seawalls and Biodiversity**

- Seawall: structures made of concrete, large boulders, or wood parallel to the shore with the objective of stopping coastal erosion
  - Beach space narrowed, and gradient increases of offshore slop
  - Waves are reflected, further narrows the beach
  - Fewer animals in the sand, fewer insects, fewer birds to feed and rest on the beach, reducing biodiversity

24 **Case Study: Seawalls and Biodiversity**

Figure 4.B

25

26 **The Golden Rule of the Environment: All About Timing**

- Geological processes on Earth time scale
- Human activities and expectations on human time scale
- Need to operate with an appropriate environmental ethic
- Need to make a “pact” with the Earth to achieve a more compatible relationship
- Disrespect and disregard resulting environmental degradation

27 **Reduce the Human Footprint**

- Total footprint: The product of the footprint per person times the total number of persons
- Human population reduction
- More efficient use of resources
- Better management of our waste
- Better understanding of ecosystems
- The importance of human-dominated ecosystems and other types of ecosystems

28 **Ecological Restoration**

- Process of altering a site or area with the objective of reestablishing indigenous, historical ecosystems
- River restoration: Channel restoration, dam removal to reunite fragmented river ecosystems
- Beach and coastal sand dune restoration
- Reshaping the land, drainage, and vegetation patterns

29 **Ecological Restoration Kissimmee River**

- The process of altering a site or area to reestablish indigenous historical ecosystems
  - Prior to 1940, wide floodplain with diverse wetland plants, wading birds, waterfowl, fish, and other wildlife
  - 1942–1971: Two-thirds of the floodplain drained, degraded ecosystem functions and reduction of birds and fish population
  - 1992: Restoration project authorized by the Congress
  - 12 km straight channel restored to a meander
  -

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33 **Ecological Restoration Everglades**

- Since 1900, urban development, much of the Everglades drained
- One of the most valuable wetland ecosystem
  - 11,000 species of plants
  - 100s species of birds, fish, marine mammals
  - 70 threatened or endangered species
- Multi-level partnership restoration project

- Reduce pollution, remove invasive exotic species, and apply the precautionary principle
- Control human population, development, and access

34 **Everglades Ecosystem**

Figure 4.E1

35

36 **Important Restoration Aspects**

- Hydrologic process: surface water and ground water
- Soil and Rock: Geological conditions (rock and soil type, slope, landscape)
- Vegetation: The cover materials on land and wetland
- Socio-economic shareholders: Interests and start points
- Science: Restoration goals and endpoints

37 **Restoration Process and Procedure**

Table 4.1

38 **Biological Engineering in Ecologic Restoration**

- Using vegetation in engineering projects to achieve specific ecological goals
- Designing and constructing certain ecosystems
- Modifying functions of ecosystems
  - Solarizing the ice plant of the sand dunes in Santa Barbara
  - Planting native dune vegetation species

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40 **Critical Thinking and Applied Questions**

- An ecosystem consists of both living community and its nonliving environment. Is one of two components is more important?
- Based upon the linkage between ecology and geology, what is the importance of interdisciplinary collaborations in ecological restoration?
- What are the critical ecological challenges in your area?
- Are there any positive impact of land transformation on your local ecosystems?

41 **End of Chapter 4**