Chapter 19 Study Guide and Case Studies: Anthropogenic Changes: The Ground

Key Concepts

- Farming, mining, logging, industry and urbanization have an impact on the biodiversity of natural flora and fauna.
- Nearly half of all plant species are recognized as threatened, 30% of fish and invertebrate species, 25% of reptile and mammal. Birds and amphibians are also threatened.
- Dust storms typically originate in desertified regions. Large dust storms can carry dust across oceans, in a matter of days.
- Dust storms can transport toxins, pathogens and chemicals to cause maladies elsewhere.
- Disease agents can be transported by dust storms, air and ship travel into new areas the have not acquired immunity against the disease.
- The spread of new diseases can have an impact on local economies
- Deserts are areas with little rainfall, little vegetation and no permanent streams.
- semi-arid areas are less tolerant to droughts than other climate zones and are particularly vulnerable to desertification
- overgrazing, overpopulation, slash-and-burn farming contribute to desertification
- these factors contributed locally to the 1970 to 1980s famine in the Sahel. Local slash-and-burn farming may have contributed to a long drought through the emission of aerosols, but coal burning in North America also was responsible.
- Soil in the tropical rain forest is much thicker than in the temperate forest but the nutrition-rich humus layer is much thinner. Trees there have adapted to extract the nutrients from the soil much faster than in temperate climates.
- The soil in temperate climates is richer in nutrients than in tropical climates.
- After slash-and-burn, farming in the tropical rain forest is effective for only a few years before farmers have to move on to a new area.
- After deforestation in the tropical rain forest, frequent heavy rain easily erodes the humus layer and badlands can form.
- Rainforest cover less than 2% of Earth's total surface but are home to 50% of Earth's plants and animals.
- Rainforests regulate the world's temperature and weather patterns. They also take up carbon dioxide, produce oxygen and supply fresh water.

- Between the 1960s and 1990s, 20% of the world's tropical rainforest was destroyed, with 57% now gone. After a hiatus, deforestation has recently accelerated. Indonesia currently has the highest deforestation rates.
- Only 50% of the temperate rainforest remains.
- Monocultured land management supports less biodiversity than the original natural land. It is also more vulnerable to pest infestations.
- Farming on land, and the wide-spread use of herbicides, pesticides and fertilizers often has unintended consequences for marine life. E.g., the use of DDT as a pesticide decimated pollinators needed for farming and brought near-extinction to many bird species. Farming run-off and overfertilization of near-coastal areas cause toxic red tides.
- Large-scale farming in the U.S. has led to the drop of groundwater table and unsustainable depletions of critical aquifers.
- Aggressive and ignorant farming practices in the early 20th century caused the Dust Bowl and the massive loss of top soil in the U.S. Midwest
- In the U.S., it takes 30 years to grown one inch of topsoil
- A deforested tropical rainforests takes thousands of years to grow back

Key Terms

- Biodiversity
- Threatened species
- Dust storms
- Pathogens and toxins
- Deserts and desertification
- Slash-and-burn farming
- Soil profiles
- Erosion
- Badlands
- Tropical rainforest
- temperate rainforest
- monoculture
- farming
- pesticides, herbicides
- fertilizer
- red tide
- groundwater table
- aquifer
- dust bowl

Questions for Review

1. How does human activity cause the decline of species?

2. Provide examples for the fraction of threatened species.

3. How can dust storms cause maladies elsewhere?

4. Why would the spread of disease agents into other areas cause problems?

5. How do humans contribute to desertification?

6. Discuss which human actions caused the great famine in the Sahel in the 1970s and 1980s.

7. The famine was ultimately cause by prolonged drought. How did humans contributed to this drought?

8. Compare the soil profiles of a tropical rainforest to that of a temperate rainforest.

9. Why would the tropical rainforest be so lush despite the relative lack of nutrients?

10. What happens to the soil in the tropical rainforest after slash-and-burn farming?

11. What are important benefits of the world's rainforests?

12. How much of the original natural forest remains worldwide?

13. What are the disadvantages of monocultures?

14. What are some of the unintended consequences of farming on land?

15. Discuss two particular problems (one current, one historic) of large-scale farming in the U.S..

Case Studies

Case Study 1: 2002 Dust Storms in Australia

Figure 19.C1: A fierce dust storm pushed by 90 km/h winds approached Griffith, Australia in late 2002. The Sydney Morning Herald reported that the storm rolled in from the southwest after a scorching day of 36ºC (97ºF). The sky turned pitch black when the could engulfed the homes, spreading gritty dust for an hour. The photo was taken 5 min before the dust storm engulfed the homes. (source: snopes.com; hoax-slayer.com; Sydney Morning Herald; Photo by Denis Couch)

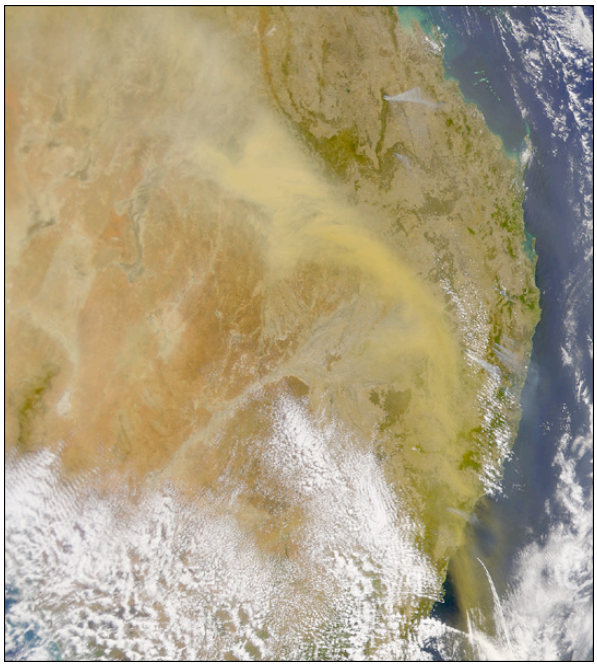

Figure 19.C2: 23 October 2002 NASA satellite image of the Australia dust storm (diagonal streak across the photo). Smoke plumes from a number of wildfires are visible. As small V-shaped features opening toward the east (pushed by northwesterly winds) (source: NASA Earth Observatory)

In October 2002, eastern Australia experienced a massive dust storm that was reported as the worst in 30 years (Figs. 19.C1 and 19.C2). The dust cloud that was 1500 km long, 400 km wide and 2.5 km high, was whipped up by winds blowing across drought-ravaged farms, after the last rain brought less than an inch nearly two months earlier. Tens of millions of tons of valuable topsoil were stripped from bone-dry farmland while the storm moved slowly, at a speed of about 50 km/h (31 mph), across Victoria and New South Whales. The significance of the storm becomes apparent when considering that the cloud had to cross 1-km-high mountain ranges before reaching Newcastle on the Pacific coast. Dust particle were measured in Sydney at a level of 150 $\mu g/m^3$ of air. According to the U.S. air quality index (AQI) for polluting particulate matter PM10 (diameter < 10µm for a 24 h average) a concentration of 150 $\mu g/m^3$ has an air quality index of 100 (moderate). People with respiratory illnesses are at risk. An AQI of 101 fall into the category "unhealthy for sensitive groups". Wildfires in San Diego county may cause similar numbers.

The photo in Figure 19.C1 circulates on the internet as showing the 2004 Sumatra tsunami approaching the coast which is, of course, a hoax.

Figure 19.C3: Disappearance of the Aral Sea, Kazakhstan and Uzbekistan, between 1989 and 2003. (source: NASA Earth Observatory)

Figure 19.C4: Disappearance of the Aral Sea by 5 Oct 2008. (source: NASA Earth Observatory)

Figure 19.C5: Disappearance of the Aral Sea by summer 2009. (source: NASA Earth Observatory)

Figure 19.C6: Two abandoned ships near the former Aral Sea, near Aral, Kazakhstan. (source: Wikipedia)

Case Study 2: Aral Sea, Kazakhstan and Uzbekistan:

Located in Uzbekistan (Fig. 19.C3-19.C6); River water from Amu Darya diverted for farming since 1950s; river now runs low for more than 30 years; between 1960 and 1993 Aral Sea lost > 40% of its area, 75% by 2004; now too salty to support fish; main fishing port Muynak is now stranded 20mi from water; salty dry soil carried by winds as far as Arctic ocean; fouls water supplies, clogs carburetors, induces throat cancer, highest infant mortality rate in FSU.