Chapter 10
ECOLOGICAL RESTORATION

Case Study: Demise and Restoration of the Tigris-Euphrates Marshlands
- The extent of these marshes (Fig. 10.1), the ancestral home of the Ma’adan people or Marsh Arabs, has decreased substantially due to dams that have been constructed on the Tigris and Euphrates rivers, diversion of the water for irrigation, and deliberate draining to permit oil exploration. Efforts are underway today to restore these wetlands.

10.1 RESTORE TO WHAT?
- The notion that there is a ‘balance of nature’ that will result in some permanent state is false. Ecosystems are dynamic. The decision to return an ecosystem to some target is a value judgment.
- A prime example of the importance of natural disturbance in maintaining ecosystems is that of fire in the north woods. The Boundary Waters Canoe Area Wilderness is an area that shows a history of fire and it is allowed to burn at the normal frequency and intensity. Tree rings show that it burns about once per century, though natural fires burn in relatively small patches. Fire has beneficial effects (nutrient regeneration, insect control).
- Goals of restoration- what is natural? A common answer is that an ecosystem should be restored to its historical range of variation and to an ability to sustain its structure and functions (see Table 10.1).

10.2 WHAT NEEDS TO BE RESTORED?
- Ecosystems of all types need restoration, including wetlands, rivers and streams, where loss of wetlands and modifications to hydrology are very common; and prairies, where only a few remnants survive today.

10.3 WHEN NATURE RESTORES ITSELF: THE PROCESS OF ECOLOGICAL SUCCESSION
- Recovery of ecosystems following disturbance may occur naturally, and this process is known as ecological succession. Ecological succession is classified as either primary or secondary. Succession always follows a predictable time course or pattern, depending on the type of ecosystem. In addition to the more generic primary and secondary succession, we recognize specific types such as bog succession, dune succession, and old field succession, the latter being an example of secondary succession.
- Early, middle and late stages of succession have general characteristics, such as characteristic assemblages of flora and fauna, and species that possess rapid growth rates and development times, and wide dispersal, in the early stages (termed pioneer species or r-selected species); and species that are slower growing and have adaptations that make
them more competitive in the later stages (termed K-selected species). The function of the ecosystem changes throughout succession too as biomass accumulates and reaches a quasi-steady state and nutrient cycles close.

10.4 SUCCESSION AND CHEMICAL CYCLING

- The storage of essential elements increases throughout succession as biomass accumulates and as nitrogen fixation adds mineral nitrogen. The amount of storage varies with total biomass and with the physical properties of the soil, such as the cation exchange capacity. Organic matter also may continue to accumulate in the soil, particularly in wetlands. In temperate, terrestrial ecosystems there will be greater storage of essential elements in the soil than in the living biota.

10.5 SPECIES CHANGE IN SUCCESSION: DO EARLY SUCCESSIONAL SPECIES PREPARE THE WAY FOR LATER ONES?

- Species that populate different stages of succession interact through facilitation or interference, and they possess different life history traits that endow them with advantages or disadvantages, depending on the stage of succession. Facilitation by early succession species makes conditions favorable for the next wave of species, and there are numerous examples (nitrogen fixation, organic matter accumulation in soil and so on). Interference that impedes the establishment of the next wave of species also sometimes occurs, as when a dense canopy of grasses prevents the establishment of a successful crop of tree seedlings. The life history traits of early and late succession species are wonderful examples of different strategies that either prepare a species for an ephemeral habitat, in

A CLOSER LOOK 10.1: Forest secondary succession.

Within a few years after a field is abandoned, many kinds of seeds sprout and soon establish a community of pioneer forest species. The types or species of the pioneers depends on the region and the biome. They are red cedar in the Poconos of PA, white pine, cherry and birch in New England. After the initial pioneer forest is established, then the slower growing late succession species eventually invade and dominate. In New England, sugar maple is one of the dominants.

A CLOSER LOOK 10.2: Changes in chemical cycling during a disturbance

- Nutrient cycles are greatly altered by disturbances, natural or anthropogenic, to an ecosystem. Loss of the vegetation removes a key link in the overall cycle, and as the mineral nutrients are regenerated in the soil by decomposition in the absence of the plant roots that would normally absorb them, they can leach out of the ecosystem. Thus, the cycles in the early stages of succession can be leaky.

which case dispersal ability and rapid development are favored, or that prepare a species for a long-lasting environment, in which case competitive ability is favored.
10.6 APPLYING ECOLOGICAL KNOWLEDGE TO RESTORE HEAVILY DAMAGED LANDS AND ECOSYSTEMS

- An area in England that have been minded since the Middle Ages is being restored. At first an agricultural approach was tried (non-native grasses planted and fertilized) and failed. An ecological approach was next attempted. Hardy, native grasses were planted.

CRITICAL THINKING

- How can we evaluate constructed ecosystems? This is not simply an academic question. In the case of wetlands, for example, when a developer wins a permit to destroy a natural wetland in exchange for a promise to restore a wetland elsewhere (no net loss), the relative performance and function of the restored wetland becomes a legal issue.

Web Resources

http://www.ser.org This is the web site for the Society for Ecological Restoration. It gives examples and discusses some of the issues related to restoration ecology