Interactions Among Organisms

Interactions among organisms are also important in determining population size. For example, white-tailed deer and cottontail rabbits eat the twigs of many species of small trees and shrubs. Repeated browsing by herbivores retards growth and can cause death of trees and shrubs. Thus, damage by herbivores can limit the size of some tree and shrub populations. Many single-celled aquatic organisms produce waste products that build up to toxic levels and result in the death of fish. Parasites and predators weaken or cause the premature death of individuals, thus limiting the size of the population.

Some studies indicate that populations can be controlled by interaction among individuals within the population. A study of laboratory rats shows that crowding causes a breakdown in normal social behavior, which leads to fewer births and increased deaths. The changes observed include abnormal mating behavior, decreased litter size, fewer litters per year, lack of maternal care, and increased aggression in some rats or withdrawal in others. Thus, limiting factors can reduce birthrates as well as increase death rates. Many other kinds of animals have shown similar reductions in breeding success when population densities were high.

CARRYING CAPACITY

The populations of many organisms are at their maximum size when they reach the stable equilibrium phase. This suggests that the environment sets an upper limit to the size of the population. Ecologists have developed a concept for this observation, called the *carrying capacity*. **Carrying capacity** is the maximum sustainable population for an area. The carrying capacity is determined by a set of limiting factors. (See figure 7.7.)

Carrying capacity is not an inflexible number, however. Often such environmental differences as successional changes, climate variations, disease epidemics, forest fires, or floods can change the carrying capacity of an area for specific species. In aquatic ecosystems one of the major factors that determine the carrying capacity is the amount of nutrients in the water. In areas where nutrients are abundant, the numbers of various kinds of organisms are high. Often nutrient levels fluctuate with changes in current or runoff from the land, and plant and animal populations fluctuate as well. In addition, a change that negatively affects the carrying capacity for one species may increase the carrying capacity for another. For example, the cutting down of a mature forest followed by the growth of young trees increases the carrying capacity for deer and rabbits, which use the new growth for food, but decreases the carrying capacity for squirrels, which need mature, fruit-producing trees as a source of food and old, hollow trees for shelter.

Wildlife management practices often encourage modifications to the environment that will increase the carrying capacity for the designated game species. The goal of wildlife managers is to have the highest sustainable population available for harvest by hunters. Typical habitat modifications include creating water holes, cutting forests to provide young growth, planting food plots, and building artificial nesting sites.

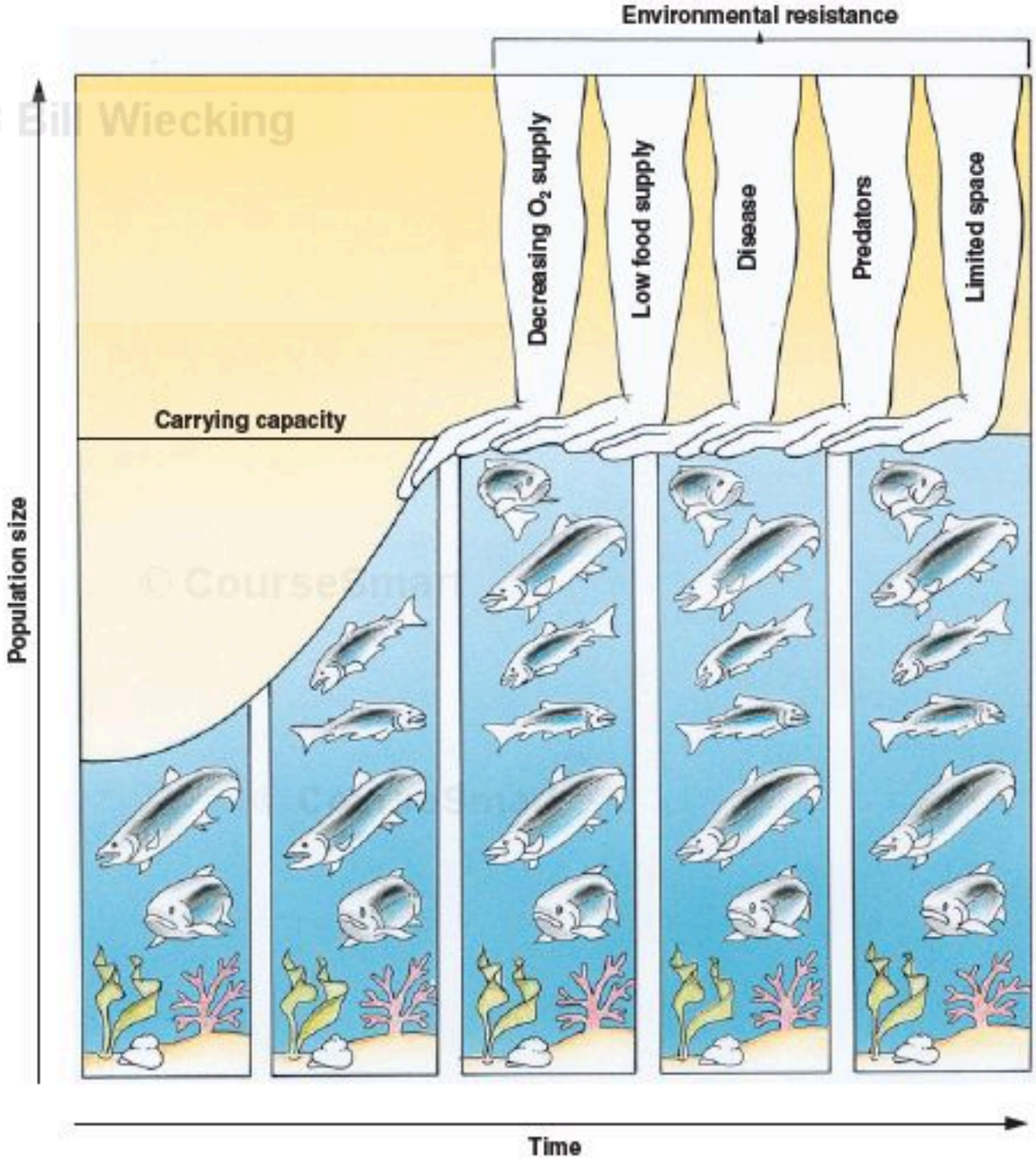

Figure 7.7 **Carrying Capacity** A number of factors in the environment, such as oxygen supply, food supply, diseases, predators, and space, determine the number of organisms that can survive in a given area—the carrying capacity of that area. The environmental factors that limit populations are known collectively as environmental resistance.