Artificial Population Regulation (Population Management)

The concepts of population ecology are used to control population size artificially by human intervention in the natural dynamics of the population—a practice known as *population management*. The desired outcome of population management can vary—conservation of the target population without controlled maintenance; controlled maintenance of a desired population; eradication of an undesired or invasive population; or exclusion of a population from a sensitive area—but essentially boils down to two goals: conservation of the population or removal of the population.

The simplest form of population conservation is an establishment of a preserve or refuge of sufficient size to support the population and allowing the natural dynamics of the population to govern it—in other words, no other human intervention. The national parks and wildlife refuges in the United States are examples of this type of conservation. Sometimes, further human intervention is employed in a controlled maintenance program, such as providing nest boxes for desired bird species to increase population size or allowing a hunting season in order to decrease population size. Such controlled maintenance programs should be undertaken only after the population's natural dynamics have been determined.

Eradication of a population means the extirpation or local extinction of the population—usually because the population is an invasive species that is threatening or outcompeting the native species, is destroying the habitat, or is destroying human agricultural crops. A good example is the island sugar cane planthopper (*Eumetopina flavipes*), which was described in the YouTube video in subunit 3.2.1. The native New Guinean insect is invading the sugar cane fields of Queensland, Australia, by "island hopping" across the Torres Strait (i.e., establishing local populations on each of the closely clustered islands in the strait) and thereby reaching Queensland through metapopulation dynamics. As the video suggests, the invasion might be stopped by eradicating the individual island populations in the strait, preventing the continued rescue of the Queensland population by immigration from the island populations. However, it will also be necessary to eradicate the insects currently surviving in Queensland for this management plan to work. Removal of the insect from Queensland is desirable because the insect is the only known vector of Ramu stunt disease, which destroys sugar cane.

In several locations in the world, populations of invasive species are being managed by the construction of barriers to exclude the population. The construction of the north-south running rabbit fence in Western Australia was undertaken with some success to prevent the expansion of introduced rabbits into the fragile desert habitat. New Zealand has constructed an extensive barrier fence around Maungatautari National Park to prevent the invasion of introduced species into the park and thereby protect the native species. The United States is currently dealing with the invasion of Asian carp into the Great Lakes by stretching extensive nets across narrow connections between lakes to prevent the spread of this invasive species into Lake Michigan. Obviously, such control measures work with only certain species; it would be extremely

difficult to try to control European starlings in the United States—or any other flying species anywhere on Earth—with some type of barrier.

If such physical control measures are not possible, biological control methods, such as introducing natural predators, natural parasites, or diseases to which the population is susceptible, might be employed. One of the earliest attempts at controlling the introduced rabbits in Australia involved the intentional introduction of the disease myxomatosis into the rabbit population. While initially successful at reducing the rabbit population, this measure proved unsatisfactory because those rabbits that did not succumb to the disease passed their natural resistance to the disease on to their offspring, and all rabbits were eventually unaffected by the disease. A more permanently successful example is the release of praying mantises and ladybugs into backyard vegetable gardens to control insect pests. The integrated pest management program at Longwood Gardens in Pennsylvania involves the use of domestic cats to control the populations of undesired species within the gardens. Overpopulation by herbivores in Yellowstone National Park is currently being addressed by the reintroduction of wolves—one of the natural predators in this ecosystem—into the park. However, problems exist with such biological control measures, not the least of which is human opposition to the introduction of predators near human habitations.

Chemical controls employed to control populations include pesticides, herbicides, rodenticides, etc. Chemical controls usually involve poisons that interfere with natural physiology and cause death—sometimes in rather gruesome and horrible ways, such as internal bleeding in the case of strychnine. The primary problem with such chemical controls is their nonspecificity; anything coming in contact with the chemical is killed or, if not killed, adversely affected. The pesticide DDT was commonly used in the United States in the 1960s to control populations of undesired insects. The unintentional effect of this chemical was the reduction in population sizes of many song birds that fed on the poisoned insects; the DDT accumulated in the bodies of the song birds and negatively affected their reproduction and survival rates. This crisis was brought to the nation's attention by Rachel Carson, a biologist with the U.S. Fish and Wildlife Service, in her book *Silent Spring*. DDT is now banned from use in the United States. Other pesticides have taken its place.

Integrated regulation of a population uses a combination of the aforementioned methods to manage a population's size. Integrated management techniques are probably the most effective management programs; if some members of a population are unaffected by one method, another method might get them.