Environmental Case Study

DDT and Fragile Eggshells

During the 1960s, peregrine falcons, bald eagles, osprey, brown pelicans, shrikes, and several other predatory bird species suddenly disappeared from former territories in eastern North America. What caused this sudden decline? Studies revealed that eggs laid by these birds had thin, fragile shells that broke before hatching. Eventually, these reproductive failures were traced to residues of DDT and its degradation product, DDE, which had concentrated through food webs until reaching toxic concentrations in top trophic levels such as these bird species.

DDT (dichloro-diphenyl-trichloroethane), an inexpensive and highly effective insecticide, had been used widely to control mosquitoes, biting flies, codling moths, potato beetles, corn earworms, cotton bollworms, and a host of other costly and irritating pest species around the world. First produced commercially in 1943, more than 50 million pounds of DDT were sprayed on fields, forests, and cities in the United States by 1950.

But as we have since discovered, there are disadvantages to widespread release of these toxic compounds in the environment. In the case of falcons, eagles, and other top predators, DDT and DDE inhibit enzymes essential for deposition of calcium carbonate in eggshells, resulting in soft, easily broken eggs. As we will discuss later in this chapter, other compounds chemically related to DDT are now thought to be disrupting endocrine hormone functions and causing reproductive losses in many species other than birds.

These effects, coupled with the discovery of a pervasive presence of various chlorinated hydrocarbons in human tissues worldwide, led to the banning of DDT in most industrialized countries in the early 1970s. Peregrine falcons, which had declined to only about 120 birds in the United States (outside of Alaska) in the mid-1970s, now number about 1400, most of them bred in captivity and then released into the wild. Bald eagle reproduction has increased from an average of 0.46 young per nest in 1974 to 1.21 young per nest in 1994 in eastern Canada. Peregrine falcons and bald eagles had recovered enough to be removed from the endangered species list in the eastern United States in 1994.

What have we learned from this experience? Chemical pesticides offer a quick, convenient, and relatively inexpensive way to eliminate annoying or destructive organisms. At the same time, however, excessive pesticide use can kill beneficial organisms and upset the natural balance between predator and prey species. Modern pesticides undoubtedly have saved millions of human lives by killing disease-causing insects and by increasing food supplies. But we must understand what these powerful chemicals are doing and use them judiciously. In this chapter, we will study the major types of pests and pesticides along with some of the benefits and problems involved in our battle against pests.