Frumkin, 2e
Part 4: Environmental Health on the Local Scale

Chapter 17: Pest Control and Pesticides

History of Pests and Pesticides

- Pests have plagued humankind since the beginning of time, as recorded in the ancient writings of the Chinese, Egyptian, and Hebrew peoples.
- Efforts to control pests are also as old as history. Early control measures used chalk, plant extracts, mercury, arsenic, lead, and other compounds.
- Early pesticides were found to be ineffective; however, the development of chlorinated pesticides like DDT changed that.
- In spite of these advances, many new pesticides have been found to be detrimental to public health.

Pests

- A **pest** can be any species of plant, animal, or microorganism that threatens human health and well-being.
- The EPA defines 7 types of pests: cockroaches, lice, mosquitoes, rats and mice, various microorganisms (viruses, bacteria, protozoa), reptiles and birds, and various mammals.

Insects

- Insects belong to the class Insecta or Hexapoda. They have three body regions, sucking or chewing mouth parts, and go through to types of development.
- Examples follow.

Bedbugs

- **Bedbugs** are human ectoparasites (that is, they live on external surfaces) that are universal pests.
- Bedbugs have piercing - sucking mouthparts that are used to penetrate the host's skin in order to feed on blood.
- Normally, they feed at night and hide in areas such as cracks and crevices, the folds of mattresses, the upholstery of chairs and sofas, and bedsprings.

Cockroaches

- Most cockroaches are tropical, and they are very common in the southern areas of the United States.
- In northern areas, those most commonly encountered are the ones that live indoors, in houses, restaurants, and other buildings.
- Cockroaches are not known to transmit any serious diseases. However, they contaminate food, produce an unpleasant odor, can become a serious nuisance, and exposure to cockroach antigen is an important risk factor for developing asthma.

Fleas

- **Fleas** are small ectoparasites, which have piercing sucking mouthparts that are used to feed on blood.
- Fleas are of great importance because they are carriers of diseases such as plague and murine typhus.
- There are several species of fleas, including those that feed on humans and pets.

Lice

- **Lice** that attack humans are flightless, ectoparasitic insects.
- Sucking lice insert their mouthparts into their host in order to feed on blood, whereas chewing lice feed on host skin scales and secretions.
- Body lice are known to spread typhus and relapsing fever.
- Conversely, head lice and pubic lice do not transmit disease but are rapidly transferred between hosts in settings such as schools and day-care centers and can be a serious nuisance.

Mosquitoes

- **Mosquitoes** are a large well-known, and important group of biting flies.
- They are the vector for numerous human diseases, including malaria, dengue fever, yellow fever, and several encephalitis viruses.
- Several species of mosquitoes are responsible for transmitting the most serious diseases.

Sand Flies

- Adult female **sand flies** are bloodsucking pests.

Termites

- **Termites** are responsible for millions of dollars of damage to wood and wooden structures throughout the world.
- Termites live in highly organized colonies and can be divided into three groups: subterranean termites, drywood termites, and dampwood termites.
- They are also responsible for large amounts of methane production.

Ticks

- Ticks are bloodsucking parasites that can feed on a number of hosts, including birds, reptiles, and mammals.
- They represent a danger to animals and humans alike because they can carry disease.
- Particularly harmful to humans, they may carry Lyme disease.

Vertebrate Pests

- Vertebrate pests include rats, mice, and birds.

Rats

- **Rats** are relatively large rodents that are important pests.
- They contaminate grain, destroy food in processing and storage plants, and can bite sleeping children and adults.
- Rats, over time, have caused more human death, misery, and economic hardship than any other vertebrate pest.
- Rats are known carriers of insects (lice, fleas, and mites) that transit plague and murine typhus.
- Rates are highly adaptable and can live in a number of environments.

Mice

- Several species of **mice,** including field mice and house mice, can invade homes and other structures.
- Mice can transmit diseases to humans and can be a vector for rat-bite fever and Weil's disease.
- In addition, their droppings can carry organisms that cause food poisoning and Hantavirus Pulmonary Syndrome.
- House mice can also carry fleas that transmit murine typhus, and they harbor mites that transmit rickettsialpox.

Birds

- Birds are associated with several diseases of humans and a number of parasites they carry may irritate or bite humans and play a role in food contamination.
- One of the best-recognized diseases is ornithosis in pigeons. This disease is similar to viral pneumonia and is transmitted to man though infected droppings or respiratory droplets.

Pesticides

- **Pesticides,** materials that are used to kill, repel, or change the behavior of an unwanted organism, are a mainstay of pest control.
- Pesticides are often classified according to the type of pest they control (insectides-insects, herbicides-weeds and plants, etc).
- Pesticides may also be classified according to chemical structure.

Types of Pesticides

- **Organophosphates** are nervous system toxins that function by phosphorylating, and therefore inactivating, molecules of acetylcholinesterase, the enzyme that regulates the neurotransmitter acetylcholine.
- **Carbamates** function through a mechanism similar to that of the organophosphates—binding to and inactivating acetylcholinesterase.
- **Organochlorine** insecticides, which are also nerve poisons, are mostly no longer in use because they are persistent organic pollutants.
- **Pyrethroid** pesticides developed as a synthetic version of the naturally occurring pesticide pyrethri are toxic to the nervous system.
- **Biopesticides** are pesticides of biological origin, derived from such natural materials as animals, plants, bacteria, and certain minerals.

Types of Biopesticides

- **Microbial pesticides** have a microorganism (for example, a bacterium, fungus, virus, or protozoan) as the active ingredient.
- **Plant-incorporated-protectants (PIPs)** are pesticidal substances that plants produce from genetic material that has been added to the plant.
- **Biochemical pesticides** are naturally occurring substances that control pests by nontoxic mechanisms.
- **Botanical pesticides** are those derived from plants or plant parts.

Patterns of Pesticide Use and Human Exposure

- Residential exposure caused by pesticides used in the home is common. Children are especially vulnerable to being exposed and to having negative health effects from exposure.
- Occupational exposure is also common among farmworkers and those who work in manufacturing and distributing pesticides.

Pesticide Toxicity

- Pesticides are toxic and pesticide toxicity may affect humans, making this a public health issue.
- The EPA has estimated that between 10,000 and 20,000 medically treated pesticide poisonings occurred each year in the United States during the 1990s.
- Acute toxicity most associated with the organophosphates and the carbamates.
- Victims who survive exposure to these substances may develop weakness or paralysis of the arms and legs, known as **organophosphate-induced delayed neuropathy (OPIDN),** or they may exhibit an intermediate syndrome characterized by respiratory depression and muscular weakness.
- Chronic toxicity may also effect nervous and reproductive system health, and may contribute to several types of cancers.

Pesticide Regulation

- The EPA is the agency responsible for pesticide regulation, under the authority of two federal statutes: the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and the Federal Food, Drug, and Cosmetic Act.
- The FIFRA gives the EPA authority to regulate pesticide use, sale, labeling, disposal, etc.
- The Federal Food, Drug, and Cosmetic Act authorizes EPA to set maximum residue levels, or tolerances, for pesticides used in or on foods or animal feed.
- The Food Quality Protection Act of 1996 (FQPA) amended FIFRA and FFDCA setting tougher safety standards for new and old pesticides and calling for uniform requirements regarding processed and unprocessed foods.

Pesticide Regulation

- Later laws differentiated between **general use pesticides,** which are lower in toxicity and require few special precautions other than the standard safety measures, and are sold in lower concentrations, and **restricted use pesticides,** which are limited to sale to and use by a licensed pesticide applicator.
- The EPA also has special protections for children and workers.

International Pesticide Use

- Currently, pesticide use is highest in developing countries, particularly in tropical regions.
- In some agricultural countries, the tendency is to still use the “older, ” nonpatented, less expensive, more acutely toxic, and more environmentally persistent agents that can be manufactured in-country or formulated from active ingredients imported from regional sources having chemical synthesizing capabilities.
- Many of these chemicals have been banned or severely restricted in the Western nations.

Integrated Pest Management

- **Integrated pest management,** or **IPM,** is an approach that uses multiple control techniques to maintain, or manage, pest populations below economically damaging levels while maintaining environmental quality.
- IPM uses monitoring, sanitation and solid waste management, structural maintenance, various control measures, and consumer education in order to reduce the harmful effects of pests and pollution alike.