Section 7

Chemical Toxins

Organophosphorus and Carbamate Pesticides

Chlorinated Hydrocarbon Insecticides

Polychlorinated Biphenyls

Oil

Lead

Selenium

Mercury

Cyanide

Salt

Barbiturates

Miscellaneous Chemical Toxins

Oiling disrupts normal feather structures and function

Photo by Nancy J. Thomas

Introduction to Chemical Toxins

"Dosage alone determines poisoning."
(Translation of Paracelsus)

Many kinds of potentially harmful chemicals are found in environments used by wildlife. Some chemicals, such as pesticides and polychlorinated biphenyls (PCBs), are synthetic compounds that may become environmental contaminants through their use and application. Other materials, such as selenium and salt, are natural components of some environments, but contaminants of others. Natural and synthetic materials may cause direct poisoning and death, but they also may have adverse effects on wildlife that impair certain biological systems, such as the reproductive and immune systems. This section provides information about some of the environmental contaminants and natural chemicals that commonly cause avian mortality; microbial and other biotoxins are addressed in the preceding section.

Direct poisoning and mortality of wildlife caused by exposure to chemical toxins are the focus of this section. However, the indirect effects of chemicals may have significantly greater impacts on wildlife populations than the direct effects. Behavioral changes that affect survival, reproductive success and the survival of young, and that impair the functioning of the immune system are examples of indirect chemical toxicity that are known to occur but that are beyond the scope of this publication. For additional information readers are directed to more comprehensive treatments of environmental toxicology and to publications that focus on specific chemicals and their effects on wildlife.

The diagnosis of chemical poisoning as the cause of wildlife mortality is a challenging task because of the vast array of chemicals that wildlife may be exposed to (Table 1), the variable biological responses following concurrent exposure to multiple chemicals, the absence of tissue residues for some chemical toxins, and the lack of specific pathological changes associated with most chemical toxins in tissues. The diagnostic process can be greatly facilitated by a thorough field observation record, comprehensive background information about the circumstances of a mortality event, and by properly collecting, handling, and preserving samples submitted to the diagnostic laboratory (see Section 1). Sources of assistance for the investigation of wildlife mortality, when toxins are suspected, are listed in Appendix B.

Areas Covered

The chapters that follow address chemical toxins that are recurrent causes of avian mortality. The chapters discuss chemicals that cause frequent and sometimes large-scale mortality events, as well as some chemicals that are less significant, because they are restricted to certain geographic areas or have been recently recognized as emerging problems.

- Pesticides
  - Organophosphorus and carbamate compounds
  - Chlorinated hydrocarbons
- Polychlorinated biphenyls
- Oil
- Lead
- Selenium
- Mercury
- Cyanide
- Salt
- Barbiturates

Quote from:

Philipus Aureolus Paracelsus, a German-Swiss physician and alchemist who lived from 1493 to 1541.

Table 1 *Examples of chemical toxins to which wildlife may be exposed.*

Pesticides

This group includes chemicals that are used to kill or repel organisms that are unwanted in particular situations. Insecticides are generally the best known pesticides but others, their target organisms, and examples of compounds within those groups include the following:

Pesticide type	Target organisms	Compounds
Acaricides	Mites, ticks, spiders	Permethrin, Phosmet, Methiocarb, Bomyl®, Carbofuran, Demeton (Systox®)
Algacides	Algae	Copper sulfate, Potassium bromide, Chlorine
Antibiotics	Bacteria	Phenol, Nitrapyrin
Avicides	Birds	Avitrol®, Fenthion, Compound 1080, Starlicide®
Fungicides	Fungi	Thiram, Ziram, Captan, Hexaconazole
Herbicides	Plants	Diquat®, Alachlor (Lasso®), Atrazine
Molluscicides	Snails and slugs	Bayluscide®, Methiocarb, Zectran®
Nematocides	Nematodes (worms)	Terbufos (Counter®), Isazofos (Triumph®), Aldicarb (Temik®), Carbofuran, Diazinon
Piscicides	Fish	Rotenone, Antimycin
Repellents	Mammals Birds	Thiram Methiocarb
Rodenticides	Rodents	Warfarin, Diphacinone, Brodifacoum (Talon®), Chlorophacinone

Metals

Wildlife may be exposed to metals when they are components of pesticides, such as mercury and cadmium in fungicides, or through other routes, such as aquatic food chains with high mercury levels.

Metal	Source
Arsenic	Used as an insecticide and preservative; present in wastes from metal smelting and glass manufacturing.
Cadmium	Used as a fungicide; waste from electroplating and production of plastics and batteries.
Chromium	Industrial effluents from ore refinement, chemical processing.
Copper	Used as a fungicide, an algicide, and in agriculture.
Lead	Mine tailings, ingestion of particulate lead deposited during sporting activities.
Mercury	Used as a fungicide in paper mills and other industrial and agricultural uses; combustion of fossil fuels.
Selenium	Irrigation drain water from soils with high selenium concentrations; combustion of fossil fuel; sewage sludge.
Zinc	Found throughout the environment; higher levels in areas of industrial discharge.

Petroleum

Wildlife may be exposed to many forms of petroleum, ranging from crude oils to highly refined forms, such as fuel oil.

Others

Many manufactured compounds, such as antifreeze (ethylene glycol) and certain drugs (such as euthanasia agents), present hazards to exposed wildlife.