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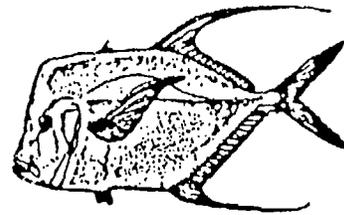
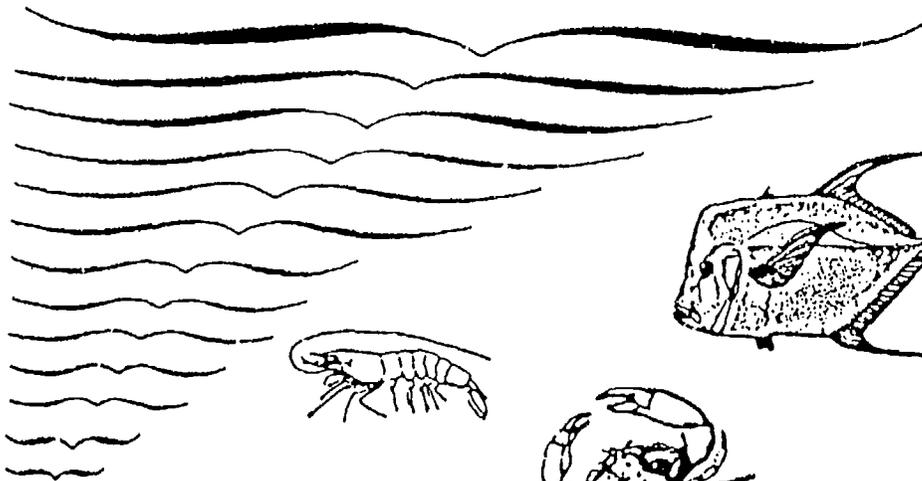
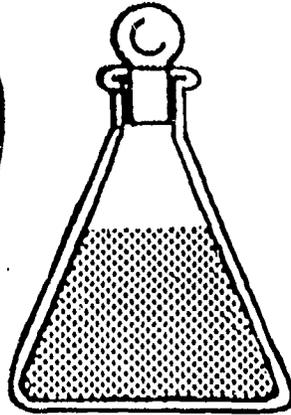
A GLOSSARY FOR  
ECOTOXICOLOGY AND RISK ASSESSMENT

K.S. Mayer

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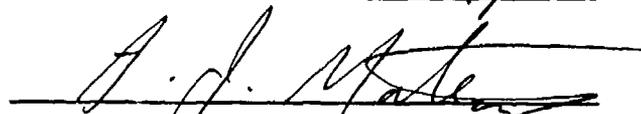


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## PREFACE

As in other scientific disciplines, environmental toxicology has a standard vocabulary to convey information about the effects of contaminants on the environment. These words are highly technical and are not usually defined in readily available sources such as standard dictionaries. Consequently, the vocabulary of environmental contamination can be ambiguous and confusing.

A *Glossary for Ecotoxicology and Risk Assessment* was prepared to help alleviate this problem. It contains over 200 terms relating to environmental contamination. Some terms, such as "tolerance," are used in other disciplines, but they have specific meanings when they are associated with the field of environmental contamination. Words that are adequately defined in other readily available sources<sup>1,2,3</sup> have not been included in the *Glossary*.

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The *Glossary* is intended for use by the Navy in addressing environmental issues should they occur. It is written in semitechnical language for those who lack formal training in environmental toxicology, but who require a working knowledge of the subject. Many of the definitions include examples or explanations containing background information.

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<sup>1</sup>Tucker, R.K., Toxicity of Pesticides to Wildlife, U.S. Fish and Wildlife Service, Resource Publication No. 84, 1970.

<sup>2</sup>Hampel, C.A. and Hawley, G.G., Glossary of Chemical Terms, 2nd edition, Van Nostrand Reinhold, NY, NY, 1982.

<sup>3</sup>Rand, G.M. and Petrocelli, S.R. (Eds.), Fundamentals of Aquatic Toxicology: Methods and Applications, Hemisphere Publishing Corporation, NY, NY, 1985.

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**Absorption.** The passage of a chemical substance into plant tissue or animal membranes, for example, from a soil solution or water into plant cells or from food or water into animal cells. See also **adsorption**.

**Action level.** Informal (not legally binding) regulatory limits (in parts per million) for poisonous or deleterious substances established by EPA or FDA--depending on the commodity in question--to control levels of contaminants in human food, animal feed, and food-producing animals and published in the *Federal Register*. Action levels are particularly useful when available toxicity data are incomplete or the causes or levels of contamination are not clearly established. For this reason, tolerances for industrial chemicals or toxic elements are only infrequently established by FDA. See Table 1.

TABLE 1. Action Levels and Tolerances.

Commodity	Agency responsible	
	Action level	Tolerance
Pesticides	EPA/FDA	EPA
Industrial chemicals (PCBs, etc.)	FDA	FDA
Toxic metals	FDA	FDA

See also **tolerance**.

**Active ingredient.** The part of a chemical formulation of a commercial product that is directly responsible for accomplishing the intended purpose of the product.

**Acute-chronic ratio.** See **chronicity factor**.

**Acute toxicity.** Toxicity that occurs within a short time (hours to days) of exposure. See **acute toxicity tests**.

**Acute toxicity tests.** Short-term toxicity tests (commonly 96 h for macroinvertebrates, fishes, and amphibians; 48 h for daphnids and midge larvae) that provide information about the immediate effects and relative toxicity of toxicants, and the relative susceptibility of test species. Acute toxicity tests, along with nominal or measured environmental concentrations, provide a basis for decisions concerning further testing in a hazard-evaluation program. Test organisms can be exposed to test solutions containing a toxicant by at least four techniques:

**Static.** Test solutions and organisms are held in chambers for the duration of the test. Food and air are not added, toxicant is not renewed, and metabolites are allowed to accumulate.

**Recirculation.** Test solution is continuously circulated through an apparatus designed to maintain the initial water quality.

**Renewal.** Organisms are periodically exposed to fresh test solution of the same composition, usually every 24 h, either by transferring test organisms to the fresh solution or by replacing the test solution.

**Flow-through.** Test solution flows through the test chamber on a once-through basis, continuously renewing solution throughout the test.

**Acutely toxic.** A chemical having the ability to produce toxic effects shortly after exposure. An acute reaction is generally considered to have rapid onset (hours to days) and pronounced signs.

**Additive toxicity.** The condition that exists when two or more chemicals are combined and the resulting toxicity is equal to the sum of the toxicity values for the individual compounds. For example, the simultaneous effects of copper and ammonia are additive in three species of salmonids.

**Adipose.** Fat or fatty tissue. Due to their lipophilic properties, certain chemicals (e.g., organochlorines) tend to accumulate in fats and adipose tissues (e.g., muscle) of animals.

**Adjuvant.** An ingredient (e.g., potassium nitrate, promex) that improves the pesticidal activity or application characteristics of a pesticide formulation. Adjuvants include wetting agents, spreaders, emulsifiers, dispersing agents, foam enhancers or suppressants, penetrants, and correctives. By using the proper adjuvant, one can combine chemical pesticides in a tank mixture that would otherwise pose compatibility problems.

**Adsorption.** The physicochemical process by which chemicals are held on the surface of a mineral, soil particle, plant, or animal. Adsorption reduces the concentration of a chemical in solution, and thereby reduces chemical transport, degradation, and bioavailability. See also **absorption**.

**Adulterated pesticide.** A substance for pesticidal use that does not conform to the standards documented on its label.

**Analytical grade.** Chemicals that meet or surpass the American Chemical Society highest standards for purity. See also **reagent grade**, **technical grade**.

**Antagonism.** A condition wherein the toxicity of two compounds applied together is less than that expected from the sum of their effects when applied separately. See also **additive toxicity**, **synergism**.

**Application factor.** The ratio of the highest observed no-effect concentration (maximum acceptable toxicant concentration or MATC) from a chronic toxicity test to the acute toxicity value (96-h LC50) that has been determined for a given species. For most chemicals, the ratio is between 0.01 and 0.1; however, values as low as 0.0001 and as high as 0.5 are known. An acute toxicity value (LC50) is multiplied by the application factor to estimate chronic no-effect concentrations. For other species, or on the same species under different environmental conditions. See also **MATC**, **LC50**.

**Asymptotic LC50.** The toxicant concentration at which the LC50 approaches constancy or becomes a constant value for a prolonged exposure time.

**Avoidance response.** The movement of organisms out of a zone of uncomfortable conditions; for example, immature brook trout avoid acidic water and Atlantic salmon avoid water with high concentrations of heavy metals.

**Behavioral response.** An alteration in the behavior of an organism that is attributed to an inability to perceive and respond to normal environmental cues and which ultimately may threaten survival; for example, avoidance and attraction, predator-prey relationships, feeding, swimming, and reproduction. Some behavior responses (e.g., avoidance) may be protective reactions to chemical exposure.

**Bioaccumulation.** The net uptake of a chemical by an organism from food and water.

**Bioassay.** A true bioassay is a biological test to determine the concentration of a chemical in a specific media, however, the term bioassay is commonly used synonymously with toxicity test. See also **toxicity test**.

- Bioavailability.** The extent to which a material is available for biologically mediated transformations (e.g., uptake, degradation, and storage) by or within an organism. For example, a metal or organic chemical that is strongly bound to sediment is not highly bioavailable to aquatic organisms. See also **chemical speciation**.
- Biocide.** A pesticide that kills microorganisms such as bacteria, fungi, molds, and slimes. Sometimes used as a synonym for all pesticides.
- Bioconcentration.** The uptake and concentration of a chemical, usually through gills or ventilation surfaces, by an organism from the surrounding water. The degree of bioconcentration can be predicted for organic chemicals by octanol/water partition coefficients. See also **bioaccumulation**, **bioconcentration factor**, **biomagnification**.
- Bioconcentration factor (BCF).** A ratio of the concentration of a chemical in an aquatic organism to the concentration in the surrounding water, usually under conditions approaching equilibrium.
- Biodegradation.** The breakdown of a compound, generally organic, into simpler components by living organisms. Ultimate biodegradation leads to the production of carbon dioxide and water.
- Bioindicator.** A detectable response of an organism to environmental conditions. The response may be at the community, population, individual, organ, tissue, cellular, or subcellular level; for example, species diversity, growth rates, skeletal anomalies, disease susceptibility, tumor incidence, and enzyme activity.
- Biomagnification.** The uptake of chemicals from low concentrations in the environment to high concentrations in the organism through the food chain. Characteristic of persistent chemicals and their metabolites (e.g., PCBs, toxaphene, and DDT). See also **bioaccumulation**, **bioconcentration**.
- Biorational pesticides.** Biological pest control agents such as bacteria (*Bacillus thuringiensis*), viruses (Helthiothis nuclear polyhedrosis virus), fungi (*Hirsutella thompsonii*), and protozoa (*Nosema locustae*) and chemical analogues of naturally occurring biochemicals such as pheromones and insect growth regulators.
- Bioremediation.** The use of microbial action to reduce contaminant concentrations in soil, groundwater, or waste streams as part of a contaminant clean-up process. The clean-up is an enhanced biodegradation or biological alteration of the contaminant.
- Body burden.** The total amount of a substance present in the body tissues and fluids of an organism. See also **residue**.
- Broad spectrum pesticide.** A general purpose pesticide (e.g., DDT and toxaphene) that is nonselective against a wide variety of pests. See also **selective pesticide**.
- Carcinogen.** Any agent or substance that produces cancer or accelerates its development.
- Carrier solvent.** A material that serves as a diluent or carrier vehicle for an active ingredient in a laboratory toxicity test and that ideally is biologically inert. Commonly used examples are water, acetone, hexane, ethanol, methanol, dimethylformamide, and triethylene glycol. The concentration of solvent in any test solution should not exceed 0.5 ml/liter in static tests and 0.1 ml/liter in flow-through tests.

**CAS registry number.** A numeric designation assigned by the American Chemical Society's Chemical Abstracts Service that uniquely identifies a specific chemical compound, regardless of the name or naming system used, for cataloguing chemical and biological properties.

**Chemical name.** The scientific name of a chemical that describes its chemical structure. See also **common name, trade name, trivial name.**

**Chemical speciation.** The molecular or ionic composition of a compound or element that determines its interactions with an organism, especially in toxic reactions. For example, precipitated zinc is sometimes nontoxic, sometimes as toxic as dissolved zinc, and sometimes more toxic than dissolved zinc.

**Chromatogram.** An analysis record produced by chromatographic equipment and consisting of a pattern characteristic of individual chemical compounds or elements, which aid in their identification. Chromatograms are commonly used to identify contaminants or constituents in mixtures, or to verify the purity of chemicals. They are both qualitative and quantitative.

**Chronic toxicity.** The adverse effects occurring as a result of repeated or continuous exposure of organisms to a chemical for a substantial part of the life span.

**Chronic toxicity tests.** Long-term (days, weeks, months) toxicity tests that provide data on a chemical's effect on growth, survival, reproduction, and other direct and indirect responses. Test organisms are exposed to test solutions by at least two techniques:

- (1) **Flow-through.** Fresh test solution flows through the test chamber throughout the test. The exposure can be of two types, continuous or simulated-use/exposure pattern.
  - (a) **Continuous.** The concentration of the test solution remains constant throughout the exposure.
  - (b) **Simulated-use/exposure pattern.** The concentration of the test solution is varied to simulate the disappearance (or reappearance) of the chemical under field situations.
- (2) **Renewal.** Test organisms are periodically exposed to fresh test solution of the same composition, either by transferring the organisms from one test chamber to another or by replacing the test solution.

Chronic toxicity tests are of three types, depending on the duration of the test:

- (1) **Partial life-cycle test.** A test continuing for less than a complete life cycle of the test organism, but usually including early life stages.
- (2) **Complete life-cycle test.** A test continuing for one complete life cycle of the test organism, including reproduction.
- (3) **Multiple generation test.** A test continuing for the duration of more than one life cycle of the test organism.

**Chronically toxic.** Having the ability to produce toxic symptoms during repeated or continuous exposure. Toxicants that accumulate in tissues or inhibit repair mechanisms. For example, organochlorine insecticides and tetrachlorodibenzodioxin are chronically toxic.

**Chronicity.** The ability of a chemical to produce continuous toxicity with increasing exposure time.

**Chronicity factor.** The ratio of a short-term toxicity value to a longer term toxicity value under acute or subacute test conditions, for example, 24-h LC50/96-h LC50. The higher the ratio, the greater the potential for chronicity.

**Clean Water Act.** See Federal Legislation.

**Clearance.** The loss of a material from an organism through respiration, excretion, or metabolism. The rate of clearance depends on the characteristics of the chemical and the biochemical and physiological mechanisms involved. Used synonymously with **depuration**.

**Common name (chemical).** A name, approved by the American National Standards Institute, applied to the active ingredient of a pesticide when no trivial name is commonplace. See also **chemical name, trade name, trivial name**.

**Concentration.** The quantity of substance contained in a unit quantity of solution or sample, usually expressed as g/liter (parts per thousand, ppt), mg/liter or  $\mu\text{g}$ /grams (parts per million, ppm), or  $\mu\text{g}$ /liter or ng/gram (parts per billion, ppb).

**Contaminant.** A material added by human or natural activities that may, in sufficient concentrations, render the environment unacceptable. Its presence is not necessarily harmful.

**Continuous flow testing.** A method of testing that is characterized by the continuous replacement of test solution in exposure chambers for the duration of a test. See also **flow-through toxicity test**.

**Control treatment.** An experimental treatment required in toxicity testing that is subjected to the same variables as other treatments, except that no toxicant is added to the dilution water. If a carrier solvent other than water is used, a solvent control treatment is also required in which the solvent concentration is equal to the highest concentration of solvent used in the other treatments.

**Criteria.** See water quality criteria.

**Cumulative toxicity.** A condition wherein a toxic effect or response is heightened by repeated or continuous exposures. The material may accumulate until a toxic reaction results, or the material may be eliminated, but a second or repeated exposure produces an effect or response that exceeds the response to the first exposure. For example, acetylcholinesterase inhibition is cumulative when inhibitors are applied more than once although the inhibitor does not accumulate, and may not even be present.

**Delayed mortality.** Death resulting from contaminant exposure, but occurring after exposure has ceased. For example, the mortality of rainbow trout acutely exposed to DEF (S,S,S-tributyl phosphorotrithioate) or methyl parathion continues after the fish are transferred to uncontaminated water.

**Depuration.** See clearance.

**Diluter.** One of several devices used in toxicity testing which mixes water with toxicant and produces multiple preestablished concentrations of toxicant or dilutions of effluent for addition to the exposure chambers. Diluter output may be continuous or cyclic, but the concentration in any of its specific discharges is relatively constant. The most commonly used devices are modeled after the Mount-Brungs diluter developed in 1967.

**Dilution water.** Uncontaminated water used to dilute toxicants in aquatic toxicity studies.

**Dose, dosage.** The total quantity of substance applied per unit treated or applied to or entering an organism; the amount injected or ingested by an animal at one time.

**EC50.** The median effective exposure concentration, expressed as mg/liter (parts per million, ppm),  $\mu\text{g/liter}$  (parts per billion, ppb), et cetera, of a toxicant that is estimated to produce a designated effect other than lethality (usually immobilization) in 50% of the test organisms exposed within a designated time. The EC50 is primarily used for invertebrates in 48-h tests.

**ED50.** The median effective oral dose, expressed as mg/kg of body weight, that is estimated to produce a designated effect, other than lethality, in 50% of the test organisms.

**Effective concentration (EC).** The toxicant concentration that produces a particular effect (e.g., immobilization, pigmentation changes, or loss of equilibrium) in test organisms within a designated time. See also EC50.

**Effective dose (ED).** The dose of chemical, drug, or pathogen that produces a particular effect in test organisms within a designated time. See also ED50.

**Efficacy.** The ability to produce effects or intended results.

**Effluent.** Discharges of air, water, sewage, or industrial wastes flowing out or away from the source of production or use.

**Endpoint.** A variable measured at the end of an interval in a toxicity study to assess the effects of contaminants on an organism or biological system. Examples are survival, growth, reproduction, behavior, histopathology, clinical chemistry, biological diversity, and certain other biochemical and physiological factors.

**Environmental chemistry.** Studies on the identification, transportation, and environmental fate of contaminants in the environment. See also **environmental fate**.

**Environmental fate.** The transport, distribution, partitioning, and transformation of a chemical from the point of entry into the environment to its final disposition.

**EPA.** Acronym for U.S. Environmental Protection Agency.

**Exposure.** The amount of chemical that organisms are exposed to. Models are available to estimate the expected exposure, but actual chemical measurements are preferred. Exposure is one of the two major components in risk assessment.

**Fate of the toxicant.** See **environmental fate**.

**Federal Environmental Pesticide Control Act (FEPCA).** See **federal legislation**.

**Federal Insecticide, Fungicide, Rodenticide Act (FIFRA).** See **federal legislation**.

**Federal legislation.** An overview of legislation is listed in chronological order:

The **Federal Insecticide Act** of 1910 (effective January 1, 1911) was enacted to overcome adulteration and to regulate labelling of insecticides and fungicides.

The **Pure Food Law** of 1906 was amended in 1938 to include pesticides in food. It provided tolerances for residues of arsenic and lead in foods, and required the coloring of white insecticides (e.g., sodium fluoride) to distinguish them from flour or other cooking ingredients of similar appearance.

The **Federal Insecticide, Fungicide and Rodenticide Act (FIFRA)** of 1947 extended coverage of the Federal Insecticide Act of 1910 to include herbicides and rodenticides. All designated pesticides were required to be registered before being marketed in interstate commerce, and to be labeled appropriately (manufacturer's name, address; product name, trademark; net contents; warning statements).

The **Federal Water Pollution Control Act (FWPCA)** of 1948 established joint federal and state program development and financial assistance. The **FWPCA** was amended in 1956 with federal money awarded to local sewage plants to pollution problems.

The **Food Additives Amendment** was passed in 1958 to control pesticide residues in processed foods. It contains the Delaney clause, which states that any chemical that is carcinogenic to laboratory animals may not appear in human food.

**FIFRA** was amended in 1959 to include nematicides, plant growth regulators, defoliants, and desiccants.

**FWPCA** was amended in 1961 to include additional aspects of federal water pollution control.

The **Water Quality Act** was passed in 1972 to delineate federal and state responsibilities for establishing water quality standards for interstate and coastal waters.

**FIFRA** was amended again in 1972 as the **Federal Environmental Pesticide Control Act (FEPCA)**, which made violators (growers, applicators, or dealers) subject to heavy fines or imprisonment. It contains eight provisions: (1) users must follow the label; (2) violators are punished; (3) pesticides are classified as general or restricted use; (4) restricted-use pesticides require a certified applicator; (5) manufacturing plants must be registered and inspected by EPA; (6) states may register pesticides on a limited basis for local needs; (7) all pesticides must be registered by EPA; and (8) to register a product, a manufacturer must provide scientific evidence that when used as directed the product: (a) will effectively control pests listed on the label; (b) not injure humans, crops, livestock, wildlife, or damage the environment; and (c) will not result in illegal residues in food or feed.

The **Marine Protection, Research, and Sanctuaries Act (MPRSA)** of 1972, also referred to as The Ocean Dumping Act, empowered the Environmental Protection Agency to regulate the disposal of materials into ocean waters and prevent the dumping of any material that would adversely impact human health or the marine environment.

The **Toxic Substances Control Act (TSCA)** of 1976 allows EPA (1) to obtain information on chemical risks from those who manufacture and process chemicals; (2) to require that companies test selected existing chemicals for toxic effects; and (3) to review all new chemicals before they are marketed. Categories that are exempt from TSCA (and regulated under other Federal laws) include pesticides, tobacco, nuclear materials, firearms and ammunition, food additives, drugs, and cosmetics.

In 1977, the **Federal Water Pollution Control Act (FWPCA) Amendments of 1972** were revised and renamed the **Clean Water Act**. Objectives were "... to restore and maintain the chemical, physical, and biological integrity of the Nation's waters. . . ."

**Federal Water Pollution Control Act (FWPCA).** See federal legislation.

**Flow-through toxicity test.** A test in which solution is replaced continuously or intermittently in test chambers for the duration of the test; includes most chronic and some acute toxicity tests. See also acute toxicity tests, chronic toxicity tests.

**Food Additives Amendment.** See federal legislation.

**Food, Drug and Cosmetic Act.** See federal legislation.

**Formulation.** The prepared or formulated pesticide mixture combined to give "proper results." Few pesticides are sold commercially without being mixed with other ingredients (carriers, diluents, solvents, wetting agents, emulsifiers) because they are usually too concentrated and immiscible with water to be prepared directly for use by the purchaser. The process of preparing a pesticide for practical use, carried out by manufacturers, is also termed formulation.

**General-use pesticide.** A pesticide that can be purchased and used by the general public without undue hazard to the user and environment if the instructions on the label are carefully followed.

**Half-life.** The time required for half the amount of a substance in or introduced into a living system or ecosystem to be eliminated or disintegrated by natural processes. Compounds that are persistent in an organism or in the environment generally have longer residence times and therefore, greater half-lives.

**Hazard evaluation.** A characterization of concentrations of a chemical causing effects on representative organisms and assessment of the potential adverse effects that could result from production, use, or disposal. Hazard evaluation is one the two major components in risk assessment.

**Hazardous waste.** A category of waste that, because of quantity, concentration, or physical, chemical, or infectious characteristics, may contribute to an increase in mortality or serious illness, or may pose a substantial hazard to human health or the environment.

**Heavy metals.** A general name given to the ions of metallic elements having a specific gravity of 5.0 or higher. Examples are copper, chromium, cobalt, gold, iron, lead, manganese, mercury, molybdenum, nickel, silver, tungsten, uranium, and zinc.

**Herbicide.** A pesticide (e.g., atrazine; 2,4-D; 2,4,5-T; and endothall) that is specifically formulated to kill plants or inhibit their growth.

**Histotoxic.** Toxic to cells or tissue(s) but not sufficiently toxic to poison the whole organism.

**Hormesis.** The stimulation of biological processes, such as growth, by subinhibitory concentrations of chemicals (e.g., PCBs, zinc).

**Incipient LC50 (lethal threshold concentration).** The level of toxicant that is lethal to 50% of the individuals exposed for periods sufficiently long such that acute lethal action has diminished or ceased.

**Inert ingredient (pesticides).** The component(s) of a formulation that exerts no pesticidal action but which is not intended to be biologically inactive.

**Insecticide.** A pesticide (e.g., aldrin, carbaryl, and chlordane) that is specifically formulated to kill insects.

**Intoxication.** The process by which a chemical causes poisoning or toxicity to an animal.

**Labile.** Chemically, physiologically, or biologically unstable; a term applied to chemicals that are easily decomposed or transformed.

**LC50.** The median lethal concentration--expressed as mg/liter (ppm),  $\mu$ g/liter (ppb), et cetera--of chemical that is estimated to produce 50% mortality in test organisms exposed for a designated time, for example, 96 h for fish.

**LD50.** The median lethal dose, expressed as mg/kg of body weight, of a compound that is estimated to produce 50% mortality in test animals exposed for a designated time.

**Lethal concentration (LC).** The toxicant concentration that causes death in test organisms within a designated time. See also **LC50**.

**Lethal dose (LD).** The dose of toxicant, drug, or pathogen that causes death in test organisms within a designated time. See also **LD50**.

**Lethal threshold concentration.** See incipient **LC50**.

**Lipid.** A class of organic compounds that contains long-chain aliphatic hydrocarbons and their derivatives (e.g., oils, fats, and waxes). Lipids are soluble in alcohol, chloroform, and other solvents, but only sparingly soluble in water. Persistent chemicals (e.g., DDT, PCBs) are usually accumulated in the lipids of organisms.

**Lipophilic.** Relating to or having a strong affinity for fats or other lipids (e.g., organochlorine insecticides).

**MATC (maximum acceptable toxicant concentration).** The highest toxicant concentration that causes no statistically significant effect on growth, reproduction, or survival of an organism during a full life-cycle test. The MATC for a species in question can be derived by multiplying the acute toxicity value by an application factor that is determined for only one species. The term "estimated MATC" is appropriate for partial life-cycle tests. See also **application factor**, **no-effect level**.

**Maximum acceptable toxicant concentration.** See **MATC**.

**Median effective concentration.** See **EC50**.

**Median effective dose.** See **ED50**.

**Median effective time (ET50).** The exposure time required to produce a response or effect in half of the test animals (usually invertebrates) for a specified exposure concentration.

**Median lethal dose.** See **LD50**.

**Median lethal time (LT50).** The exposure time required to produce death in half of the test animals (usually fishes) for a specified exposure concentration.

**Median tolerance limit.** See **TL50**.

**Metabolite.** A compound formed by the breakdown of a pesticide or other chemical by metabolic processes, and that may be less toxic or more toxic than the parent compound. Rotenone is extremely toxic to

fish and chewing insects, but slightly toxic to mammals because insects and fish convert rotenone to highly toxic metabolites, whereas mammals do not.

**Microcosms.** Small-scale experimental units designed to study the fate and effects of applied chemicals in a simulated ecosystem. Variables or processes studied included metabolism, degradation, stability, and movement through aquatic systems. Microcosms may involve only fish, sand, sediment, and water, or they may also include algae, plants, and invertebrates.

**Minimum lethal dose.** The minimum dose of a chemical sufficient to kill all of the animals in a test.

**Minimum threshold concentration (MTC).** The lowest toxicant concentration causing a significant effect on any variable measured during the period of exposure.

**MLD (median lethal dose).** See LD50.

**Mode of action.** The specific manner in which a chemical elicits its effect in an organism. Most toxicants are thought to have a primary effect at one or a few highly specific sites of action, such as inhibition of acetylcholinesterase by organophosphates. Modes of action are known for only a few types of compounds.

**Model.** A system of postulates, data, and inferences that mathematically represents an entity or state of affairs. Models are used to predict the effects and ultimate fate of chemicals in the environment and to screen many pre-market chemicals. Although models may not eliminate the necessity of toxicological testing, they may reduce testing requirements.

**Monitoring.** Repetitive observation, measurement, and evaluation for defined purposes; usually long-term and intended to reflect environmental trends. A laboratory study may be used to monitor growth of an animal exposed to a contaminant, or the presence and concentration of a contaminant may be monitored over a large geographical area. See also **survey**.

**Mutagen.** A substance that causes a sudden variation in some inheritable characteristic of an organism, as distinguished from a variation resulting from generations of gradual change.

**Nematicide.** A pesticide (e.g., aldicarb, carbofuran, dichlorofenthion, and phorate) that is specifically formulated to kill nematodes.

**No-effect level. No observable effect level (NOEL). No-effect concentration (NOEC).** The highest concentration tested that has no statistically significant adverse effect on test organisms. See also **MATC**.

**Nominal concentration.** The estimated or calculated concentration of toxicant before it is actually measured by analytical techniques.

**Nonconservative pollutant.** A pollutant that is quickly degraded and lacks persistence (e.g., most organophosphate pesticides).

**Nonpoint source.** Agricultural and urban runoff, and dredge and fill operations that provide widespread and diffuse sources of contaminants.

**Nonselective herbicide.** A herbicide that is generally toxic to plants, irrespective of species. Some selective herbicides may become nonselective if used at very high rates.

**Nontarget species.** A species affected by a chemical for which an effect was not specified or intended. See also **target species**.

**Nontoxic.** Not harmful, free from toxicity for an indicated organism at concentrations normally employed.

**Octanol/water partition coefficient.** See **partition coefficient**.

**Oncogen.** Any agent or substance that produces tumors.

**Outfall.** Wastewater effluent at its point of discharge or entry into a river or other receiving body of water.

**Partition coefficient.** The ratio of equilibrium concentrations of a chemical between nonpolar and polar solvents, commonly between octanol and water but also between air and water or sediment and water. Partition coefficients are used to predict bioconcentration factors of chemicals in organisms.

**PCB.** Acronym for polychlorinated biphenyl; one of many synthetic organochlorine chemicals.

**Persistent compound.** A relatively stable chemical that is long-lived in soil, aquatic environments, and animal and plant tissues. Persistent compounds (e.g., organochlorines) are not readily broken down by biological or physicochemical processes, and thus tend to bioaccumulate, bioconcentrate, and biomagnify in organisms.

**Perturbation.** Chemical, physical, or biological disturbances or disruptions of an ecosystem; usually induced by humans.

**Pest.** An unwanted organism or population of organisms.

**Pesticide.** Any substance used for controlling, preventing, destroying, repelling, or mitigating any pest or pest action. A generic term that includes insecticides, fungicides, and herbicides, as well as biocides, chemosterilants, defoliants, attractants, and growth regulators.

**Pesticide burden.** See **body burden, residue**.

**Pesticide extender.** A chemical (e.g., PCBs, pinolene, toxaphene) that enhances the efficacy of a pesticide. See also **efficacy**.

**Pesticide (or chemical) interaction.** The action or influence of one pesticide (or chemical) on another and the combined effect(s) of the two. See also **additive toxicity, synergism**.

**Piscicide.** A pesticide (e.g., antimycin A, rotenone, toxaphene) that is specifically formulated to kill fish.

**Point source.** Pipes or flumes that contain discharges from municipal and industrial waste treatment systems. See also **outfall**.

**Pollutant.** A wide range of toxic organic and inorganic chemicals, suspended sediments, et cetera, introduced into the environment and whose presence alters the state of the environment, which usually implies harm to organisms. Certain pollutants (e.g., nontoxic organics), in proper proportion to the recipient water volume, may act as fertilizers and increase productivity.

**ppb.** The number of parts of chemical per billion parts of substance; parts in  $10^9$  parts. Also expressed as  $\mu\text{g/liter}$  or  $\text{ng/ml}$ ;  $\mu\text{g/kg}$  or  $\text{ng/g}$ .

**ppm.** The number of parts of chemical per million parts of substance; parts in  $10^6$  parts. Also expressed as mg/liter or  $\mu\text{g}/\text{ml}$ ; mg/kg or  $\mu\text{g}/\text{g}$ .

**Pure Food Law.** See federal legislation.

**Reagent grade.** Meeting or surpassing the latest American Chemical Society standards for purity. The purity is higher than technical grade but lower than analytical grade. See also **technical grade**, **analytical grade**.

**Rebuttable Presumption Against Registration (RPAR).** A regulatory investigation process used by EPA when a pesticide shows potentially dangerous characteristics. At the conclusion of the investigation, EPA (1) returns the chemical to full registration; (2) restricts some or all uses of the chemical; (3) announces an intent to cancel or suspend some or all uses; or (4) a combination of 1 through 3.

**Reconstituted water.** Prepared dilution water used in toxicity tests to maximize the number of reliable comparisons that can be made about relative toxicity and relative sensitivity. Reconstituted water, prepared by adding known amounts of specified reagent-grade chemicals to water (usually distilled or deionized), meets certain specifications to help ensure that test organisms are not stressed during holding, acclimation, and testing and that test results are not unnecessarily affected by water quality. For example, freshwater organisms are normally tested in reconstituted water of pH 7.4, alkalinity 35 mg/liter, and hardness 40 mg/liter as  $\text{CaCO}_3$ . Sometimes also called "reconst water."

**Registration.** The process specified by FIFRA (FEPCA) and executed by EPA by which a pesticide is legally approved for use. See also **FEPCA**, **FIFRA**.

**Reregistration.** Renewal of registration to meet current requirements for pesticide registration, in light of new knowledge concerning human health and environmental safety; applies to all pesticides registered before August 1975.

**Residue.** The amount of a chemical or its metabolites and degradation products remaining in a substance or organism after application or exposure; usually the active ingredient. The amount of residue is governed by the rate of application or exposure and the rate of degradation.

**Risk assessment.** An assessment of the probability that adverse ecological effects will or will not result from environmental release of a given contaminant. The Toxic Substances Control Act of 1976 clearly indicates that an "unreasonable risk" of injury to health or the environment caused by manufacture, distribution, use, or disposal is needed to establish a chemical as hazardous. Risk assessment involves a sequential and integrated approach and may include information on a number of factors: (1) chemical production, use, and disposal patterns; (2) expected or measured environmental concentrations; (3) acute and chronic toxicity; (4) residue dynamics and bioconcentration; (5) environmental fate; and (6) chemical and biological monitoring in the field. A risk assessment is not necessarily a one-time estimate; additional evaluations must be made as the data base expands. The evaluation, in essence, is a scientific judgment of the potential for environmental effects (toxicity tests) with measured (or estimated) environmental concentrations. The degree of confidence in the evaluation is greatest with reliable estimates of environmental concentrations and data on effects that include studies on representative species under conditions simulating those in natural aquatic environments. Risk increases as concentrations known to cause effects approach estimated or measured environmental concentrations. Likewise, risk decreases as estimated or environmental concentrations approach those known to cause effects.

**Safe concentration.** The concentration of a material that has no adverse sublethal or chronic effect on the organism in question.

- Safener.** A chemical (e.g., Compex, Concep, Concep II) that prevents objectionable changes when two or more substances must be mixed that would otherwise not be compatible.
- Safety factor.** A numerical value applied to toxicity test data (acute or chronic) in order to approximate the concentration of a substance that will not harm or impair the organism in question or that will ensure that adverse effects will not result from exposure to a chemical in a specific environment.
- Sample cleanup.** A generic term for the removal of fats and other interfering compounds from samples being prepared for chemical analyses to facilitate contaminant residue analysis.
- Selective pesticide.** A pesticide (e.g., Atrazine, Bladex, Prowl) that is more toxic to some species than to others, due to differential toxic action or the manner in which it is used (formulation, dosage, timing, placement, etc.).
- Selective toxicity.** Differential toxicity by virtue of target selectivity. For example, malathion's selectivity is largely due to its chemical structure because organophosphates are cholinesterase inhibitors.
- Shelf-life.** The length of time a chemical can be stored without losing efficacy as a result of biological or physicochemical changes. See also **efficacy**.
- Sorption.** A generic term for the processes of absorption or adsorption, or a combination of the two. See also **absorption, adsorption**.
- Standard water.** Dilution water with fixed chemical characteristics for use in toxicity tests.
- Static toxicity tests.** See **acute toxicity tests**.
- Subacute.** A concentration or response involving a stimulus that is not severe enough to bring about a rapid or intense response. In toxicity tests, subacute responses usually occur after exposures longer than 96 h.
- Sublethal.** A concentration or response involving a stimulus below the level that causes death.
- Survey.** A short-term or limited system of observations for specified purposes that may involve only one period of sampling at each sampling site. Surveys are generally required to identify and establish the magnitude of particular study variables and appropriate methodology before a monitoring program or comprehensive investigation is designed. See also **monitoring**.
- Synergism.** A condition wherein the toxicity of two compounds applied together exceeds the sum of their effects when applied separately.
- Synergist.** A material (e.g., piperonyl butoxide, piprotol, sesamin) used with pesticides to enhance or synergize pesticidal activity. See also **synergism**.
- Synfuel.** A generic term for synthetic fuels that are being considered as alternate energy sources, such as products from coal, oil shale, tar sands, and nuclear resources.
- Target species.** A species at which control is directed in a pest management program. All other organisms are considered nontarget species. See also **nontarget species**.

**Technical grade.** Chemicals of selected commercial grades that are clean and of reasonably high chemical purity. More economical to use when reagent grade or analytical grade is not specified. See also **analytical grade, reagent grade.**

**Teratogen.** An agent or substance that produces defects in developing embryos.

**Time-independent LC50 (TILC50).** A mathematically derived toxicant concentration at which 50% of the test animals would be expected to survive indefinitely.

**TL50.** The concentration of toxicant that kills 50% of the test organisms within a designated period of time. The term "LC50" is preferred. See also **LC50.**

**TLM. TLm. Median tolerance limit.** See **TL50.**

**Tolerance.** (1) A special form of adaptation in which continued exposure to a chemical results in increased resistance to the noxious consequences of the exposure; the ability of an organism to show less response to a specific dose or concentration of a chemical than it showed on a prior occasion to that same dose or concentration. For example, induction of the mixed function oxidase system by certain organic compounds may stimulate their own detoxification and that of other organic compounds. (2) Legal regulatory limits (in ppm) of poisonous or deleterious substances established by EPA or FDA--depending on the contaminant and/or food commodity in question--to control levels of contaminants in human food, animal feed, and food-producing animals, and published in the *Federal Register* and the *Code of Federal Regulations*. To remove adulterated products from the market, an agency must show in court only that the tolerance was exceeded. States may set their own regulatory limits for contaminants, but they must be equal to or lower than tolerances established by the federal government. See also **action level.**

**Toxic.** Relating to harmful effects by a poison or toxin.

**The Toxic Substance Control Act (TSCA).** See **Federal legislation.**

**Toxicant.** A material that produces a toxic effect on organisms exposed to it. Sometimes erroneously extended to include inert substances that adversely affect health by physical means.

**Toxicity.** A relative term commonly used to compare the toxic effects of one chemical with those of another. If toxicity is high (LC or EC50 value low) small amounts of a chemical are capable of causing death, ill health, or other adverse effects. Toxicity is a result of exposure concentration and time, modified by such variables as life stage, temperature, pH, salinity, chemical form, and bioavailability.

**Toxicity curve.** A graph showing the response of a population of test organisms to a given chemical, usually plotted either as a function of exposure time or exposure concentration. Typically, cumulative mortality is plotted on the vertical axis (ordinate, Y) against time or concentration on the horizontal axis (abscissa, X).

**Toxicology.** A multidisciplinary science that encompasses the effects of chemicals on organisms, with emphasis on the mechanisms and the conditions under which they occur. M.J.B. Orfila (Spain) wrote the first book on the harmful effects of chemicals in 1815, and is credited as being the father of modern toxicology. Toxicology has developed into three major divisions:

**Environmental toxicology.** The science of incidental, occupational, or recreational exposure of organisms, including humans, to chemicals that are contaminants of the environment, food, or water.

**Economic toxicology.** The science of harmful effects of chemicals that are intentionally administered to organisms for the purpose of achieving a specific effect. It involves information concerning the mechanisms of actions of such chemicals on both the economic and uneconomic species, the nature of the harmful effects, and the conditions under which they occur, and the chemical and biological factors that regulate the selectivity of action of these chemicals.

**Forensic toxicology.** The science of medical and legal aspects of the harmful effects of chemicals on humans.

**Toxicosis.** Any disease caused by poisoning; a detrimental change in physiology due to the presence of a poisonous substance.

**Toxin.** A particular class of poisons produced by animals or plants to which the body may respond by producing antitoxins.

**Trade name. Trademark name. Proprietary name. Brand name.** A name given to a product by its manufacturer or formulator to identify it as being owned by, produced, or sold exclusively by that company. See also **chemical name, common name, trivial name.**

**Trivial name.** A vernacular name (e.g., nicotine) in common use for a chemical. See also **chemical name, common name, trade name.**

**TSCA.** See **Toxic Substances Control Act.**

**Water quality.** Physical, chemical, biological, and aesthetic characteristics of water, which vary widely with location and influencing factors, for example, human use.

**Water quality criteria.** Physicochemical and biological characteristics of water, as recommended by EPA, that should protect defined uses based on scientific data. As criteria are currently associated with the aquatic environment, they have come to mean a designated concentration of a constituent that, when not exceeded, is not harmful to an organism, a community of organisms, or a prescribed water use.

**Water quality standard.** Legally required conditions recommended by EPA for a particular site or water resource. A standard may use a scientifically derived criterion as a basis for regulation or enforcement, but it may differ from the criterion because of prevailing local conditions or because of the importance of a particular waterway, economic considerations, or the degree of safety to a particular ecosystem that may be desired.

**Xenobiotic compound.** A generic term for a compound foreign to the organism or medium in question (e.g., contaminants). The presence of the material, however, does not connote harmful effects.

**Other Related NAMRL Publications**

**None are applicable.**