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Glossary of Terms Used in Ecotoxicology

INTERNATIONAL UNION OF PURE AND APPLIED CHEMISTRY

CHEMISTRY AND HUMAN HEALTH DIVISION

GLOSSARY OF TERMS USED IN ECOTOXICOLOGY (IUPAC Recommendations 2008)

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Abstract: The objective of the Glossary of Terms Used in Ecotoxicology is to give clear definitions for those who contribute to studies relevant to ecotoxicology but are not themselves ecotoxicologists. This applies especially to chemists who need to understand the ecotoxicological literature without recourse to a multiplicity of dictionaries. The Glossary includes terms related to chemical speciation in the environment, sampling, monitoring and environmental analysis, as well as to adverse ecological effects of chemicals, ecological biomarkers, and the environmental distribution of chemicals. The dictionary consists of about 993 terms. The authors hope that among the groups who will find this glossary helpful, in addition to chemists, are pharmacologists, toxicologists, ecotoxicologists, risk assessors, regulators, medical practitioners, and regulatory authorities. In particular, it should facilitate the use of chemistry in relation to environmental risk assessment.

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PREFACE

Within the framework of IUPAC Division VII, Chemistry and Human Health, the project to develop a "Glossary for Terms used in Ecotoxicology" was initiated in 2005. Like many IUPAC bodies, the division is concerned to promote world-wide "regulation, standardization, or codification" in relevant areas of chemistry. Over the years, ecotoxicology have grown rapidly in importance. Lack of understanding of the relevant usage of terminology can give rise to confusion. Accordingly, the aim of the project was to compile clear definitions of the current terminology as used in the ecotoxicology literature. In these definitions, chemical terms always follow current IUPAC preferred usage. This is particularly important if there is a less precise, common usage among nonchemists. Thus, readers are referred to the IUPAC *Compendium of Chemical Terminology*, 2nd ed. (the "Gold Book"), compiled by A. D. McNaught and A. Wilkinson, Blackwell Science, Oxford (1997), XML on-line corrected version: <http://goldbook.iupac.org> (2006–) created by M. Nic, J. Jirat, B. Kosata with updates compiled by A. Jenkins, for current definitions of fundamental chemical terms.

The present glossary is compiled primarily for chemists who find themselves working in ecotoxicology or requiring a knowledge of the subject. Faced with an extensive literature and terms that are not always defined in accessible dictionaries, newcomers to the subject can have great difficulty in obtaining the background knowledge essential for their work. Further, many toxicologists, whose previous experience has been limited to clinical and experimental toxicology, under new legislation have to assess possible environmental effects of chemicals and need to understand terms used in the relevant literature. There are also regulators and managers who have to interpret toxicological information and therefore need ready access to internationally accepted definitions of relevant terms in common use.

In order to satisfy the requirements of the many groups concerned with ecotoxicology, the terms included in this glossary have come from a wide range of disciplines. The definitions reflect current knowledge and usage. The compilers of this glossary have deliberately included terms peripheral to ecotoxicology but of importance to the subject because they believe that some redundancy of content is preferable to the difficulties caused by having to consult several dictionaries in order to make a start with the subject.

For some of the entries in this glossary, alternative definitions are given in order to make clear differences in current usage that exist between disciplines, or in historic and developing literature.

We are grateful to all those who have contributed to this glossary with constructive criticism and who have suggested modifications for its improvement. Their valuable comments have been incorporated. There will still be flaws but we hope that the final version will be sufficiently close to achieving the original objectives to justify the very widespread support that we have received.

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ALPHABETICAL ENTRIES

abiological

See *abiotic.*

abiotic

abiological

Not associated with living organisms.

[1]

abiotic transformation

Process in which a substance in the environment is modified by non-biological mechanisms.

[1]

absolute bioavailability

See *bioavailability (in toxico- or pharmacokinetics).*

[2}

absolute fitness

See *fitness*.

absorbate

Substance that enters and is retained inside a solid or semisolid matrix (*absorbent*).

absorbed dose (of a substance)

internal dose

Amount (of a substance) taken up by an organism or into organs or tissues of interest.

See *absorption, systemic.*

[1]

absorbed dose (of ionizing radiation), *D*

Energy imparted by ionizing radiation to a specified volume of matter divided by the mass of that volume.

[1, 3]

absorbent

Solid or semisolid matrix that is able to accommodate and retain an *absorbate*.

See also *sorbate*, *sorbent.*

absorption (in general)

1. Process of one material (absorbate) being retained by another (absorbent).

Note : The process may be the physical solution of a gas, liquid, or solid in a liquid, attachment of molecules of a gas, vapor, liquid, or dissolved substance to a solid surface by physical forces, etc.

See also *adsorption*.

2. Transfer of some or all of the energy of radiation to matter which it traverses.

Note : Absorption of light at bands of characteristic wavelengths is used as an analytical method in spectrophotometry to identify the chemical nature of molecules, atoms or ions and to measure the concentrations of these *species*.

Corrected from [1]

See also *adsorption*, *sorption*.

absorption (in biology)

uptake

Penetration of a substance into an organism and its cells by various processes, some specialized, some involving expenditure of energy (active transport), some involving a *carrier* system, and others involving passive movement down an electrochemical gradient.

Note : In mammals *absorption* is usually through the respiratory tract, gastro-intestinal tract, or skin into the circulatory system and from the circulation into organs, tissues and cells.

After [1]

absorption (systemic)

Uptake to the blood and transport via the blood of a substance to one or more organs or *compartments* in the body distant from the site of *absorption*.

After [1]

abundance

1. Total number of individual organisms in a *population*, seen over a defined period of time in a certain place.

Note: For fish, an estimate of total weight may replace number.

2. Total number of organisms per unit of habitat space seen over a defined period.

3. Amount of an element that exists in nature, usually expressed in relative terms as a percentage of the total amount of all elements in a given medium (e.g., the Earth's crust).
4. Amount of an isotope of an element that exists in nature, usually expressed in relative terms as a percentage of the total amount of all isotopes of the element.

abundant element

Element which is of common occurrence in the earth's crust.

Note : *Abundance* may be defined in terms of occurrence in other regions, e.g., oceans, 'fresh water'.

abundant metal

See *abundant element*.

accessible

Capable of being entered or reached; easy of access; such as one can go to, come into the presence of, reach, or lay hold of; get-at-able.

[4]

accessibility

See *bio-accessibility*.

acclimation

In experimental systems - allowing an organism to adjust to its environment prior to undertaking a study.

See *acclimatization, biological*.

acclimatization, biological

acclimatation

acclimation

1. Processes, including selection and adaptation, by which a *population* of micro-organisms develops the ability to degrade a substance, or develops a tolerance to it.

[1]

2. In experimental systems - allowing an organism to adjust to its environment prior to undertaking a study.

After [1]

3. Modification of biological processes or structures in the maintenance of homeostasis in response to change in some environmental quality such as temperature, salinity, light, radiation, or toxicant concentration.

Note: It is an expression of phenotypic plasticity of individuals in response to a sublethal change in some environmental factor.

accumulation (in biology)

See *bioaccumulation*.

accumulation factor (AF)

See *biota-sediment accumulation factor*.

See also *bioaccumulation factor*.

acid rain

Subset of *acid precipitation*.

acid precipitation

Rain, fog, snow, sleet, or other particulate matter from the atmosphere with a pH below 5.6 deposited from the air.

Note: Rain under clean air conditions has a pH slightly under 6. This natural acidity is caused by dissolved carbon dioxide dissociating to form weak carbonic acid. "Acid rain" is caused by sulfur in fossil fuels, and nitrogen from the air combining with oxygen to form sulfur oxides and nitrogen oxides during combustion.

acid volatile sulfides (AVS)

Soil- and *sediment*-associated solid phase sulfides extractable with cold hydrochloric acid.

Note: AVS may be chemically available by acid extraction without being *bio-available*. Thus, AVS

can reduce metal *toxicity* by binding metals in anoxic soils or sediments thereby rendering them unavailable to most living organisms.

activation

See *bioactivation.*

active transport

Movement of a substance across a cell membrane against an electrochemical gradient, in the direction opposite to normal diffusion and requiring the expenditure of energy.

acute

antonym *chronic*

1. Of short duration, in relation to *exposure* or effect; the effect usually shows a rapid onset.

   Note 1: In regulatory *toxicology*, 'acute' refers to studies where dosing is either single or limited to one day although the total study duration may extend to two weeks to permit appearance of toxicity in susceptible organ systems.

   Note 2: In aquatic ecotoxicology, exposure of the test organisms is typically continuous and of 4 days or less.

2. In clinical medicine, sudden and severe, having a rapid onset.

After [1]

acute-to-chronic toxicity ratio (ACR)

Numerical, unitless value, that is the ratio of an acute toxicity test result (e.g., LC_{50}) to a chronic toxicity test result (e.g., *MATC*) where both are expressed in the same units (e.g., mg L^{-1}). Ideally, the data are for the same species and chemical.

Note : It is in principle the inverse of an *application factor* and is used in a similar manner. The ACR is commonly used for estimating chronic toxicity of a chemical on the basis of its acute toxicity. The ACR should be greater than one because the ratio compares an acute to a chronic value.

After [5]

adaptation

See *genetic adaptation*, *physiological adaptation.*

additive effect

Consequence that follows *exposure* to two or more physico-chemical agents that act jointly but do not interact: the total effect is the simple sum of the effects of separate exposures to the agents under the same conditions.

[1]

additive index

Quantification of the joint action of toxicants in mixture by adding measures of their toxicity calculated in relation to the toxicity of a reference toxicant.

additivity (in toxicology)

Property of the toxicities of substances whereby the toxicity of a mixture of the substances reflects the simple sum of the individual toxicant effects.

adduct

New chemical species AB, each molecular entity of which is formed by direct combination of two separate molecular entities A and B in such a way that there is change in connectivity, but no loss, of atoms within the moieties A and B.

Note 1: Stoichiometries other than 1:1 are also possible, e.g. a bis-adduct (2:1). An 'intramolecular adduct' can be formed when A and B are groups contained within the same molecular entity.

Note 2: This is a general term that, whenever appropriate, should be used in preference to the less explicit term *complex*. It is also used specifically for products of an addition reaction.

[1]

adenylate energy charge (AEC)

Index reflecting the balance of energy transfer between catabolic and anabolic processes, calculated from the equation:

AEC = ([ATP] + ½[ADP]) / ([ATP] + [ADP] + [AMP])

where ATP, ADP, and AMP = concentrations of adenosine tri-, di-, and monophosphate, respectively.

adsorbate

Molecular species of gas, dissolved substance, or liquid that adheres to or is adsorbed in an extremely thin surface layer of a solid substance.

[3]

adsorbent

Condensed phase at the surface of which adsorption may occur.

[3]

adsorption

Increase in the *concentration* of a substance at the interface of a condensed layer and a liquid or a gaseous layer owing to the operation of surface forces.

[1]

See also *absorption, interfacial layer*, *sorption.*

adsorption factor

Ratio of the amount of substance adsorbed at the interface of a condensed layer and a liquid or gaseous phase to the total amount of the substance available for *adsorption*.

[1]

advection (in environmental chemistry)

Process of transport of a substance in air or water solely by bulk motion (in water or air currents).

Note: In open-ocean marine systems advective transport of chemicals into the water column from sediments is small compared with that by diffusion. In estuarine systems, freshwater rivers, and lakes, advective processes can contribute substantially to system transport.

After [1]

AFNOR test

See *Association Francaise de Normalisation test*.

Association Francaise de Normalisation test

Commercially available test kit, certified by AFNOR as valid and equivalent to a standardized method.

age class

Group of organisms of the same age within a *population***.**

age composition

Distribution of organisms among the various age classes present in the *population*. The sum of the number of individuals in all age classes equals the population size.

age distribution

Composition of a *population* in terms of how its abundance is distributed across age classes.

age-specific birth rate

age-specific fecundity

age-specific fertility rate

Mean number of offspring born to a female in a specific age class in a given year, expressed per 1000 females in that age class.

age-specific death rate

age-specific mortality

age-specific number of individuals dying

Mean number of deaths as tabulated for a life table interval or for a specific age class in a given year, expressed per 1000 in that interval or age class.

age-specific fecundity

See *age-specific birth rate.*

age-specific mortality

See *age-specific death rate.*

age-specific fertility rate

See *age-specific birth rate.*

age-specific number of individuals dying

See *age-specific death rate.*

aggregation error

Error in Bayesian analysis of model systems resulting from the use of a single set of parameters to represent a collection of distinct entities, such as individuals, in a *population*.

aging (of contamination)

Decrease in bioavailability of a contaminant with time.

Note: Generally this is due to increased absorption by solid particles.

aging (of enzymes)

Property of the complex formed by reaction of organophosphate (OP) pesticide with acetylcholine esterase whereby the reversible enzyme-OP complex dealkylates itself to form an irreversibly inhibited enzyme.

air pollution tolerance index (APTI) (in plant ecotoxicology)

Index used to assess the tolerance of individual plants to contaminated air. It is calculated as: APTI = [A (T + P) + R]/10 where A = ascorbic acid content mg/g dry mass, T = total chlorophyll mg/g fresh mass, P = pH of leaf extract and R = relative water content (%).

albinism

hypomelanism

hypomelanosis

Congenital disorder characterized by a lack of melanin pigment in the eyes, skin and hair.

Note: The condition is known to affect mammals, fish, birds, reptiles, and amphibians. The lack of melanin is due to a mutation in one of the genes coding for enzymes producing melanin.

alga n., pl. **ae**, adj. **al**

Any of various chiefly aquatic, eukaryotic, photosynthetic organisms, ranging in size from single-celled forms to the giant kelp.

Note: Algae of various species, often unicells, are used for toxicity testing in ecotoxicology. They are an important component of aquatic food webs.

algal bloom

Rapid increase in the abundance of phytoplankton or benthic algae in a given area, often as a result of an increased availability of nutrients or light, or increase in temperature (e.g., the spring bloom).

algicide

Substance intended to kill algae.

algistatic

Inhibiting algal *population* growth.

See *algicide*.

alkalinity

Capacity of natural water to neutralize acid (proton-accepting capacity) as measured by titration of a water sample with a dilute acid to a specific pH endpoint.

Note: Most often, it is a function of carbonate (CO_3^{2-}), bicarbonate (HCO_3^-), and hydroxide (OH^-) concentrations, i.e., the carbonate-bicarbonate buffering of the water. However, dissolved organic compounds, borates, phosphates, and silicates can also contribute to alkalinity.

After [5]

allele

One of several alternate forms of a gene that occurs at the same relative position (locus) on homologous

chromosomes, becomes separated during meiosis, and can be recombined following fusion of gametes.

After [1]

allogenic succession

Sequential appearance of species driven by external influences that alter local conditions; e.g. silt deposits changing a marshland to woodland.

See *succession.*

ambient

Surrounding (applied to environmental media such as air, water, *sediment* or *soil*).

[1]

ambient monitoring

Continuous or repeated measurement of agents in the environment to evaluate ambient exposure and *health* risk by comparison with appropriate reference values based on knowledge of the probable relationship between exposure and resultant adverse health effects.

[1]

ambient standard

See *environmental quality standard.*

amelia

Developmental abnormality in which the individual is born without limbs.

See also *phocomelia.*

anadromous

Showing *anadromy*.

anadromy

Life-history pattern that is characterized by egg incubation and early juvenile development in freshwater,

migration to seawater for adult development, and a return to freshwater for spawning.

Note: Obligatory anadromy is the term applied where migration to seawater is required for survival.

See *catadromy*.

analysis plan (in ecological risk assessment)

Scheme that defines the exact format and design of the assessment, explicitly states the data needed, and describes the methods and design for analyzing these data.

aneuploidy

Deviation from the normal number of chromosomes in an organism.

anoxia

Total absence of oxygen.

See *hypoxia*.

antagonism (in toxicology)

Combined effect of two or more factors that is less than that expected from simple summation of toxicities of the individual compounds.

After [1]

anthropogenic

1. Caused by or influenced by human activities.
2. Describing a conversion factor used to calculate a *dose* or *concentration* affecting a human that has been derived from data obtained with another *species*, e.g. the rat.

[1]

anthropogenic enrichment factor

See *enrichment factor*.

antisymmetry

Quality of a *population* of bilaterally symmetrical individuals in which the difference in measurement of a trait made from the right and left sides of individuals from that population produces a bimodal distribution.

See *fluctuating asymmetry*.

application factor (AF)

See *uncertainty factor*.

arcsine square root transformation

arcsin√P, where P is the value of a measured effect, e.g., the proportion of exposed organisms in a *population*.

Note : This transformation of effects data often fulfills an assumption of homogeneous variances for proportions of exposed individuals responding to a stimulus.

artificial soil test

Test with earth worms in which the toxicity of a substance by skin and gut uptake is determined by adding the earthworms to an artificial soil made of sand, clay mineral and peat, containing the substance of concern.

artisol test

Test with earthworms in which the toxicity of a substance by skin and gut uptake is determined by placing the worms in an artificial substrate consisting of silica, water and glass balls, containing the substance of concern.

Note: In the artisol test, the earthworms ingest the silica paste as they do soil.

aryl hydrocarbon hydroxylase (AHH)

Enzyme activity attributed to cytochrome P-450 mono-oxygenase isoforms and often measured in units of benzo[a]pyrene hydroxylation.

as low as reasonably achievable (ALARA)

Describing the situation in which everything practicable is done to reduce risks to the minimum with the approval of the regulatory authorities.

See *precautionary principle***.**

assemblage

Set of coexisting populations defined by *phylogeny*, location, or life-style. Assemblages are intermediate between *populations* and *communities*.

Note : An operational definition is '*species* located in the same place at the same time'.

assessment endpoint (in ecological risk assessment)

Ecological property that is to be protected and the precise parameter to be measured for this property.

See *measurement endpoint.*

assessment factor

See *uncertainty factor.*

asymptotic threshold concentration (ATCN)

Concentration of a chemical at which some percentage of a *population* of test organisms is in a state of approximate homeostasis for a prolonged period of time (48h or more).

Note 1: This can be demonstrated as the concentration at which the toxicity curve is approximately asymptotic (parallel) to the time axis.

Note 2: The asymptotic LC50 is the concentration at which the LC50 remains constant no matter how long exposure continues, i.e., there is no evidence of significantly increasing effects due to a longer exposure time.

After [5]

atmospheric deposition

Process that tranfers a chemical from the atmosphere to the earth's surface (land, water, or vegetation) by either dry impingement or by transport in rain or snow.

See also *dry deposition*, *wet deposition.*

attenuation

Reduction in amount, e.g., of light - decrease in energy per area due to absorption or scattering.

Note: In reference to pollution, the term is mostly applied to reduction in amount of organic

contamination following microbial mineralization.

attenuation (in genetics)

Regulation of gene expression in bacteria by premature termination of transcription of a biosynthetic operon.

[1]

aufwuchs

Floral and (or) or faunal communities attached to submerged surfaces in aquatic ecosystems.

See *periphyton.*

autogenic succession

Sequential appearance of species driven by processes operating within the community environment (compare allogenic succession), e.g., primary and secondary successions that occur on newly exposed land.

See *succession.*

autotroph

Organism that is independent of outside sources for organic food materials and manufactures its own organic material from inorganic sources.

autotrophic succession

Sequential appearance of species in a location principally involving plants.

See *succession.*

available

See *bioavailable*.

availability

See *bioavailability.*

axenic animal

See *germ-free animal.*

axenic culture

Growth of organisms of a single *species* in the absence of cells or living organisms of any other species.

background concentration

Concentration of a substance in a medium prior to a particular action (usually increasing the concentration), or the concentration that would have occurred in the absence of the action.

baseline

1. Line serving as a basis, as for measurement, calculation, or location.
2. Measurement, calculation, or location used as a basis for comparison.

baseline toxicity

General, nonspecific, reversible mode of toxic action that can be produced in most living organisms by the presence of sufficient amounts of many organic chemicals.

Note 1: Effects result from the general disruption of cellular activity. The mechanism producing disruption is unknown, with the main theories being binding to proteins in cell membranes and "swelling" of the lipid portion of cell membranes resulting from the presence of organic chemicals.

Note 2: Hydrophobicity dominates the expression of baseline toxicity.

See *narcosis.*

batch replacement test

See *static-renewal test.*

behavioral teratology

Study of behavioral abnormalities in otherwise apparently normal individuals after exposure in the embryonic state to a substance or physical agent.

behavioral toxicology

Study of abnormal behavior produced by exposure to a substance or physical agent.

beneficial metal

Non-essential metal which in some form (chemical species) at an appropriate dose can improve health of defined organisms, commonly human beings.

benefit

Advantage to, or improvement in *condition* of, an individual, a *population,* a *species,* an *assemblage,* a *community,* or an *ecosystem*.

Note: For *risk* / benefit comparisons, the probability of benefit is the appropriate comparator.

See *risk*.

benthic

Living on the bottom of an aquatic system.

[1]

bioaccessible

Able to come in contact with a living organism and perhaps interact with it with the possibility of absorption into the organism.

Note: Contact with a living organism may not result in any interaction of the substance with, and absorption by, the organism. In other words, bioaccessibility is a necessary precursor of bioavailability but not, on its own, sufficient for bioavailability to occur.

See *bioaccessibility*.

[1]

bioaccessibility

environmental bioavailability

Potential for a substance to come in contact with a living organism and perhaps interact with it, with the possibility of absorption into the organism

Note 1: A substance trapped inside an insoluble particle is not bioaccessible, although substances on the surface of the same particle are bioaccessible and may also be bioavailable. Bioaccessibility, like bioavailability, is a function of both chemical speciation and biological properties. Even substances bound to the surface of particles may not be accessible to organisms that require the substances to be in solution.

[1]

Note 2: In ecotoxicology, bioaccessibility is often measured by assessment of the fraction of a substance released from a matrix (usually soil or sediment) into an aqueous medium under defined laboratory conditions. Such measurements must be interpreted with care as laboratory conditions rarely equate to those in nature.

Note 3: In human toxicology, bioaccessibility may be measured as the amount of a specific compound released from a matrix when exposed *in vitro* to conditions mimicking those in the human gut and small intestine. This gives no measure of bioaccessibility on the skin, in the lung, or in the eye.

See *bioavailability*.

bioaccumulation

Progressive increase in the amount of a substance in an organism or part of an organism that occurs because the rate of intake from all contributing sources and by all possible routes exceeds the organism's ability to eliminate the substance from its body.

Note: Bioaccumulation of organic molecules usually correlates with lipophilicity. Bioaccumulation of metal ions tends to correlate with strong binding to biomolecules or incorporation into bone and teeth.

See also *bioaccessibility, bioavailability, bioconcentration*, *biomagnification*.

[1]

bioaccumulation factor (BAF, BF)

accumulation factor

Ratio of tissue chemical residue to chemical concentration in an external environmental phase (e.g., sediment, water, soil, air, or food). BAF is measured at a steady state in situations where organisms are exposed multiple

sources (e.g., water sediment, food), unless noted otherwise.

Note 1: The concentration in the organism is typically expressed per unit body mass or per gram of lipid (bio-accumulation factor, lipid based).

Note 2: The concentration in sediment may be expressed per gram dry weight of sediment or per gram of organic carbon and may be referred to as the biota sediment accumulation factor (BSAF).

Note 3: The compound may have entered the organism by any available route and from any component of the water or sediment.

Note 4: In relation to uptake from food, the concentration in the organism is typically expressed per unit body mass or per gram of lipid and the concentration in food is expressed per gram dry weight of food.

bioaccumulative chemicals of concern (BCC)

See *persistent organic pollutants*.

bioactivation

Metabolic *conversion* of a *xenobiotic* to a more *toxic* derivative or one that has more of an effect on living organisms.

[1]

bioamplification

See *biomagnification*.

bioassay

Procedure for estimating the *concentration* or biological activity of a substance or physical agent by measuring its effect on a living system compared to a standard system.

[1]

bioavailable

Able to be absorbed by living organisms.

See also *bioaccessible*.

bioavailability (general)

biological availability

physiological availability

Potential for uptake of a substance by a living organism, usually expressed as a fraction of the total amount of the substance available in the matrix of exposure

Note 1: Bioavailability, like bioaccessibility, is a function of both chemical speciation and biological properties. Even surface-bound substances may not be bioaccessible, and hence not bioavailable, to organisms which require substances to be in solution before they can interact with them.

Note 2: Bioavailability has been estimated experimentally by determining the fraction of an organic compound extracted from an appropriate matrix into an organic solvent, e.g., extraction of atrazine with 9:1 methanol-water, or extraction of phenanthrene with *n*-butanol, without agitation, has been used to approximate earthworm uptake of these compounds.

bioavailability (in toxico- or pharmacokinetics)

Ratio of the systemic exposure from extravascular (ev) exposure to that following intravenous (iv) exposure as described by the equation:

$F = A_{ev} D_{iv} / B_{iv} D_{ev}$

where F (fraction of dose absorbed) is a measure of the bioavailability, A and B are the areas under the(plasma) concentration-time curve following extravascular and intravenous administration, respectively,and Dev and Div are the administered extravascular and intravenous doses.

[1]

biocenosis

biocoenosis

biotic community

biological community

ecological community

All the interacting organisms living together in a specified habitat.

Note: The area occupied by a biocenosis is defined by a characteristic assembly of species.

biochemical (biological) oxygen demand (BOD)

Amount concentration of oxygen taken up through the respiratory activity of micro-organisms growing on organic compounds present when incubated at a specified temperature (usually 20^{o} C) for a fixed period (usually 5 days).

Note 1: It is regarded as a measure of that organic *pollution* of water that can be degraded biologically but includes the oxidation of inorganic material such as sulfide and iron(II).

Note 2: The empirical test used in the laboratory to determine BOD also measures the oxygen used to oxidize reduced forms of nitrogen unless their oxidation is prevented by an inhibitor such as allyl thiourea.

[1]

biocid / e n., **-al** adj.

1. Substance intended to kill living organisms.

[1]

2. Non-agricultural pesticide used to control the severity and incidence of pests or diseases, e.g., algicide, slimicide, or disinfectant for the control of algal, fungal or bacterial growth.

biocoenosis

See *biocenosis.*

biocommunity

See *community*.

bioconcentration

Process leading to a higher concentration of a substance in an organism than in environmental media to which it is exposed.

Note: Usually applied to *uptake* by aquatic organisms directly from water.

See *bioaccumulation.*

bioconcentration factor (BCF)

Measure of the tendency for a substance in water to accumulate in aquatic organisms defined as the ratio of the

concentration of the substance of concern in the organism to the concentration in water at equilibrium.

Note 1: The equilibrium concentration of a substance in an aquatic organism can be estimated by multiplying its concentration in the surrounding water by its bioconcentration factor in that organism.

Note 2: This parameter is an important determinant for human intake of contaminants from water by ingestion of aquatic food.

After [1]

bioconcentration factor, lipid based

Ratio of the concentration of the substance of concern in the lipid fraction of the test organism to the concentration in the *ambient* water.

biodegradation

Breakdown of a substance catalyzed by enzymes *in vitro* or *in vivo*. In ecotoxicology, it is almost entirely due to microbial or fungal activity.

Note 1: Biodegradation may be classified for purposes of *hazard assessment* into 3 categories:

1. Primary. Alteration of the chemical structure of a substance resulting in loss of a specific property of that substance.

2. Environmentally acceptable. Biodegradation to such an extent as to remove undesirable properties of the compound. This often corresponds to primary biodegradation but depends on the circumstances under which the products are discharged into the environment.

3. Ultimate. Complete breakdown of a compound to either fully oxidized or reduced simple molecules (such as carbon dioxide, methane, nitrate, ammonium, and (or) water).

Note 2: The products of biodegradation can be more harmful than the substance that was degraded.

After [1] and [3]

See also *biomineralization*.

biodiversity

Occurrence of a number of *species* within a given *ecosystem* or *biome*, or the presence of a number of community types in a given area.

Note 1: In special cases, biodiversity may include a degree of genetic variation within a single species.

Note 2: Biodiversity is often a measure of the health of biological systems.

Note 3: Biodiversity can be measured on many biological levels but the term most commonly refers to the number of different species in a defined area (*species richness*) and is quantified by calculating a diversity index which takes into account the relative abundance of individuals of each species.

See also *diversity index*.

Biodiversity Action Plan (BAP)

Internationally recognized program designed to protect and restore biological systems containing threatened *species* and *habitats*.

Note 1: The original impetus for these plans derives from the 1992 Convention on Biological *Diversity* (CBD).

Note 2: The principal elements of a BAP typically include: (a) preparing inventories of biological information for selected *species* or *habitats*; (b) assessing the conservation status of *species* within specified ecosystems; (c) creation of targets for conservation and restoration; and (d) establishing budgets, timelines and institutional partnerships for implementing the BAP.

biogeochemical cycle

Movement of elements or molecules among organisms and non-living compartments of the atmosphere, lithosphere, and hydrosphere.

Note 1: Examples of biogeochemical cycles are the carbon, nitrogen, phosphorus, and sulfur cycles. These are defined as the global flow of C, N, P, and S atoms, respectively, from plants through animals to the atmosphere, soil, water and back to plants.

Note 2: The water cycle refers to the global flow of water from surface and ground water sources to soil, plants, animals and the atmosphere, and back to soil and surface water.

biological indicator

bioindicator

indicator species

Any biological *species* or group of species whose performance, *abundance*, or population status is used to determine the health of an environment or ecosystem by systematic monitoring of chemical, physiological, or behavioral changes.

Note 1: Deviation of bioindicator performance indicates some adverse effect. In a wider sense, the number and abundance of different indicator species (*biodiversity*, *species richness*) is used to calculate *biotic indices*.

Note 2: Bioindicator is commonly misused as a synonym for the term *biomarker*. Such use is to be deprecated.

See *biomarker*.

biological determinant

Property of living organisms that affects human or environmental health.

Note: Biological determinants may be either endogenous or exogenous. Endogenous biological determinants include genetic characteristics and physiological state. Exogenous biological determinants are other living organisms with which the organisms of concern interact, e.g., beneficial or harmful micro-organisms.

biological monitoring (in ecotoxicology)

biomonitoring

Regular systematic use of living organisms (*indicator species, bioindicators, sentinel species*) to evaluate changes in environmental quality, by repetitive measurements taken in a statistical design.

Note: Biomonitoring may involve the study of individuals, *species*, *populations* and *communities* to understand changes due to exposures over extended time periods. It may involve continuous or repeated, invasive or noninvasive measurement of behavioural parameters, physiological parameters, or other *biomarkers,* in captive animals or *indigenous* species at the individual or a lower organizational level, and may contribute to the determination of *biotic indices*.

biological monitoring (in human toxicology)

biological assessment of exposure

biomonitoring

Continuous or repeated measurement of any substance, including potentially toxic substances or their metabolites or biochemical effects in tissues, secreta, excreta, expired air or any combination of these in order to evaluate occupational or environmental exposure and health risk by comparison with appropriate reference values based on knowledge of the probable relationship between ambient exposure and resultant adverse health effects.

[1]

biomagnification

bio-amplification

ecological magnification

trophic enrichment

1. Sequence of processes by which higher *concentration*s of a substance are attained in organisms at higher *trophic levels*.
2. Result of these processes of bioconcentration and bioaccumulation by which tissue concentrations of bioaccumulated chemicals increase as the chemical passes up through two or more trophic levels.

   Note: Biomagnification occurs in a food chain as a consequence of efficient transfer of a substance from food to consumer accompanied by the lack of, or very slow, excretion or degradation of the substance.

After [1]

biomagnification factor, *B*

Ratio of concentrations of a compound at two consecutive trophic levels at steady state. It can also be expressed in terms of a rate-constant based bioaccumulation model:

$$B = C_n / C_{n-1} = \alpha f / k_e$$

where α is assimilation efficiency, *f* is feeding rate and k_e is the first order elimination constant. *B* can be calculated from field data on assumed trophic relations or from laboratory feeding experiments.

See *trophic enrichment factor*.

biomarker (in ecotoxicology)

Quantifiable behavioural, physiological, histological, biochemical, or genetic property that is used to measure response to an environmental change.

Note 1: It may be a chemical measurement of a *pollutant* or group of pollutants, or metabolite(s) at the organismal or suborganismal level in individual members of a *species* which is regarded as a suitable *bioindicator* or *sentinel* species. Ideally, biomarker results should have the possibility of extrapolation to indicate potential *risk* to *populations*, *communities*, or *ecosystems*.

Note 2: Biomarkers are used as an early warning system to indicate either exposure before serious irreversible damage occurs or increased susceptibility of subpopulations.

Note 3: Biomarkers are used for *biomonitoring* potential effects of environmental factors, either in a time frame or by comparing biomarker intensity between putatively affected and non affected areas.

biomarker (in human toxicology)

Indicator signaling an event or condition in a biological system or *sample* and giving a measure of *exposure*, effect, or susceptibility.

Note: Such an indicator may be a measurable chemical, biochemical, physiological, behavioral, or other alteration within an organism.

[1]

biomarker of effect

effect biomarker

Biomarker that, depending upon the magnitude, can be recognized as associated with an established or possible *health* impairment or disease.

[1]

biomarker of exposure

exposure biomarker

Biomarker that relates *exposure* to a *xenobiotic* to the levels of the substance or its *metabolite*, or of the product of an interaction between the substance and some *target* molecule or cell, that can be measured in a

compartment within an organism.

[1]

biomarker of susceptibility

susceptibility biomarker

Biomarker of an inherent or acquired ability of an organism to respond to *exposure* to a specific substance.

[1]

biomass

1. Total amount of biotic material, usually expressed per unit surface area or volume, in a medium such as water.
2. Material produced by the growth of micro-organisms, plants or animals.

[1]

biome

Set of plants and animals which occupy a certain geographic area.

Note: The term is usually applied to large areas occupied by *climax communities* arising as a result of interactions between biotic and abiotic factors,

biomineralization

1. Deposition of minerals mediated by living organisms.

   Note: Examples include silicates in algae, carbonates in diatoms and invertebrates, and calcium phosphates (e.g., hydroxyapatite in bone) and carbonates in vertebrates.
2. Complete conversion of organic substances to inorganic derivatives by living organisms, especially micro-organisms.

[1]

biominification

bioreduction

See *trophic dilution*.

biomodification

Alteration of the chemical or physical properties of a substance by the action of living organisms.

biomonitor

1. n. Organism that provides quantitative information on the quality of the environment around it.

   Note: The ideal substance biomonitor would indicate the presence of a specific pollutant and provide additional information about the amount present.

2. v. To use organisms to monitor pollutants and to deduce possible effects on biota or routes of toxicant exposure to humans.

biomonitoring

See *biological monitoring*.

[1]

biomonitoring (Type l)

Determination of community changes along a gradient or among sites differing in levels of pollution.

biomonitoring (Type 2)

Determination of bioaccumulation in organisms among sites notionally varying in the level of contamination.

biomonitoring (Type 3)

Determination of effects on organisms using tools such as biochemical markers in sentinel *species* or some measure of diminished fitness or condition of individuals.

biomonitoring (Type 4)

Determination of genetically based resistance in *population*s of contaminated areas.

biopesticide

Biological agent with pesticidal activity, e.g., the bacterium *Bacillus thuringiensis* when used to kill insects.
[1]

bioremediation

Use of biological organisms such as plants or microbes to aid in removing hazardous substances from an area.

biosensor

Device that uses specific biochemical reactions mediated by isolated enzymes, immunosystems, tissues, organelles or whole cells to detect chemical compounds usually by electrical, thermal or optical signals.

[3]

biosphere

ecosphere

Zone of air, land, and water at the surface of the Earth that is occupied by organisms.

biota-sediment accumulation factor (BSAF)

accumulation factor (AF)

biota-sediment factor (BSF)

Ratio of lipid-normalized tissue chemical residue to carbon-normalized sediment substance concentration (units of g lipid / g organic carbon).

Note: Also known as the bioavailability index (BI).

See also *bioaccumulation factor* (definition 2).

[4]

biotic index

One of several ranking systems calculated from the presence or abundance of sensitive species relative to tolerant species.

Note: Biotic indices measure decreased environmental quality from effects on especially sensitive species and should not be compared to *diversity indices*, which measure *community structure*.

biotic ligand

Component of a living organism to which an ion or other substance in aqueous solution can bind, usually with

subsequent beneficial or harmful effect on the physiology of the organism.

biotic ligand model (BLM)

Model that integrates the interactions of metals with ligands in water to calculate the speciation (based on hardness, salinity and presence of other metals) and the concentration of ionic species producing toxicity. The BLM chemically and mathematically models the organism's target site as ligand(s) competing with nonbiotic ligands, based on the concept that toxicity occurs when a metal-(biotic ligand) complex reaches a critical concentration.

Note 1: The BLM is a development of the free ion activity model (FIAM) for calculatingfree metal ions in relation to water borne ligands and the Winderemere Humic Aqueous Model (WHAM) for calculating metal speciation in relation to organic species in water.

Note 2: For fish, the biotic ligand for metal ions is either known or suspected to be the ion channel proteins in the gill surface that regulate the ionic composition of the blood. For other organisms, it is hypothesized that a biotic ligand exists and that mortality can be modeled in a similar way.

Note 3: The model is a generalization of the free ion activity model (FIAM). The difference between the BLM and the FIAM is the consideration of competitive binding at the biotic ligand, which models the protective effects of other metal cations, and the direct influence of pH.

biotic score

Weighted measurement of organisms present - the weighted part is determined by each group's pollution tolerance or intolerance. As pollution increases in a stream, the biotic score value tends to increase.

biotope

Habitat shared by many species, most often an area that is uniform in environmental conditions and in its distribution of animal and plant life.

biotransformation

bioconversion

Chemical conversion of a substance that is mediated by living organisms or enzyme preparations derived

therefrom.

[1]

bioturbation

Group of processes whereby organisms affect the structure of *sediment*.

Note: Bioturbation consists of two processes, particle mixing and *irrigation*, mainly executed by infaunal organisms but also by epifaunal organisms and bottom-feeding fish.

biphasic dose-effect model

1. Model of adverse effect *v*. dose relationship that, owing to hormesis, dips down from the control level before increasing with the dose; individuals exposed to low, but nontoxic concentrations are healthier than individuals not exposed to the chemical.

   Note: Biphasic *dose effect curves* occur for any nutrient. Hormesis is a phenomenon associated with compounds which have no nutrient properties.

2. Model of adverse effect *v*. dose relationship that changes slope owing to a change in the mechanism of toxic action.

   Note: This may, e.g., be due to saturation of a transport or metabolic system.

birth rate

1. (in demography) Number of live births in a defined administrative jurisdiction in a calendar year divided by a midyear population of the jurisdiction, with the customary multiplier of 1 000 to produce a whole number rather than a decimal or a fraction.

[6]

   Note: An alternative statistic is total fertility rate, the average number of children born to each woman over the course of her life. In general, the total fertility rate is a better indicator of fertility rates because, unlike the crude birth rate, it is not affected by the age distribution of the population.

2. (in ecology) Number of births, B, in a population of a defined size, N, during a specified time interval Δt. The rate is calculated from the formula:

   $B = \Delta N / \Delta t$

applied to a limited time period t.

See also *per capita birth rate.*

body burden

Total amount of a substance present in an organism.

boomerang effect

Delayed damage from earlier environmental contamination.

Note: Sometimes stated as "what you throw away can come back to hurt you".

borderline metal ions

Metal ions intermediate in properties between *class a* and *class b metal ions*.

bottom-up ecotoxicological study

Approach to investigating ecotoxicological effects that starts with a determination of the presence and nature of any adverse effects *via* responses at the suborganismal (cellular and biochemical) levelos of organization rather than *via* the communily and (or) ecosystem levels of organization.

See also *top-down ecotoxicological study*.

After [5]

Brillouin index

Quantitative value for community *species* diversity calculated as:

$HB = (\ln N! - \sum \ln n_i!) / N$

where N is the total number of individuals and n_i is the number of individuals in the i^{th} species.

Note 1: Evenness for the Brillouin Index is estimated as:

$E = H_B / H_{Bmax}$

where H_{Bmax} is the maximum possible Brillouin diversity which occurs when all species are equally abundant.

Note 2: When a subsample is taken from a given area, the Brillouin index provides a better estimate of diversity than the *Shannon-Wiener index* for samples of the same size. It also corresponds to situations of sampling without replacement, whereas the Shannon-Wiener index is

appropriate for sampling with replacement.

See also *diversity index*.

broodstock

Adult fish producing either eggs or sperm.

calcinosis

Any pathological condition characterized by the deposition of calcium salts in tissues.

calcium sink

Tissue such as arthropod cuticle, bivalve shell, or vertebrate bone that renders calcium or elements with similar biological behavior (such as lead or cadmium) less bio-available during trophic interactions, thus providing a mechanism for trophic dilution.

carrying capacity, *K*

Maximum *population* size expressed as total number of individuals, biomass, or population density that a given unit of habitat is capable of sustaining.

catadromous

Describing a species exhibiting *catadromy*.

catadromy

Life-history pattern that is characterized by egg incubation and early juvenile development in seawater, migration to freshwater for adult development, and return to seawater for spawning.

Note: Obligatory catadromy is the term applied where migration to freshwater is required for survival.

See *anadromy*.

catagenesis

Long-term geochemical alteration to organic matter, involving high temperatures and pressures deep below the surface of the Earth.

catchment area

See *drainage basin*

cetaceans

Whales, dolphins, and porpoises, in the order Cetacea.

Chapman mechanism

Series of reactions by which ozone is formed in the stratosphere.

chemical oxygen demand (COD)

Measure of the amount of oxygen, divided by the volume of the system, required to oxidize the organic (and inorganic) matter in wastewater using a chemically oxidizing agent. In practice, it is usually expressed in milligrams O_2 per litre.

[1]

chemical timebomb

Substance or substances in a component of the environment which are not currently bio-available but which may become bio-avaiable at an unknown time in the future with harmful consequences.

chemisorption

Sorption which results from chemical bond formation (strong interaction) between the sorbent and the sorbate in a monolayer on a surface or internal to an absorbent.

After [3]

See also *sorption*.

chloride cell

Specialized cell with a role in ion regulation, characterized by large numbers of mitochondria, an extensive intracellular tubular network and a high concentration of Na+ / K+ ATPase. This cell is found in salt secreting glands like the rectal gland of elasmobranchs, the nasal gland of seabirds, and the gills of both seawater and

freshwater fish, mainly on the primary lamellae but also on the secondary lamellae.

chlorofluorocarbon (CFC)

Carbon-based chemical containing chlorine and fluorine that has been linked to ozone depletion in the stratosphere.

Note: Commonly used as propellants and coolants.

See *Montreal Protocol*

chronic effect

long-term effect

antonym *acute effect*

Consequence which develops slowly and (or) has a long-lasting course: may be applied to an effect which develops rapidly and is long lasting.

[1]

chlorosis

Loss of green color in plants owing to the lack of production or the destruction of chlorophyll.

cladistics

Systematic classification of groups of organisms on the basis of shared characteristics thought to derive from a common ancestor. Also, the study of the branching of evolutionary lines of descent and the relationship between branches.

[3]

cladogram

evolutionary tree

phylogenetic tree

Dendrogram illustrating the supposed evolutionary relationships between clades; a diagram showing cladistic relationships.

[3]

Note : Cladograms are often based on such information as the number of differences in amino acids or nucleic acid bases in common proteins or genes, respectively. From estimated mutation rates, the evolutionary time can be estimated. Accordingly, cladograms have two components, branching order (showing group relationships) and branch length (showing extent of evolution).

class a metal ion

Metal ion that combines preferentially with ligands containing ligating atoms that are the lightest of their Periodic Group.

See also *borderline metal ion, class (b) metal ion, hard acid.*

[3]

class b metal ion

Metal ion that combines preferentially with ligands containing ligating atoms other than the lightest of their Periodic Group.

See also *borderline metal ion, class (a) metal ion, hard acid*.

[3]

clearance (general) $(c_o/c_i)(\Delta V/\Delta t)$

Product of the *concentration* c_o of a component in an output system and the volume flow rate of the output system divided by the concentration c_i of this component in the input system.

Note: The term 'mean volume rate' is recommended for this quantity.

[1]

clearance (in physiology and toxicology)

1. Volume of blood or *plasma* or mass of an organ effectively cleared of a substance by *elimination* (*metabolism* and *excretion*) divided by time of elimination.

   Note: Total clearance is the sum of the clearances of each eliminating organ or tissue for that component.

2. (in *pulmonary toxicology*) Volume or mass of lung cleared divided by time of *elimination*; used

qualitatively to describe removal of any inhaled substance that deposits on the lining surface of the lung.

3. (in *renal* toxicology) Quantification of the removal of a substance by the kidneys by the processes of filtration and secretion; clearance is calculated by relating the rate of renal excretion to the *plasma concentration*.

[1]

climax community

Community of plants and animals in a steady state due to *ecological succession* resulting in a composition of the community best adapted to average conditions in the area. The term is sometimes applied to soil development.

cold condensation theory

Theory that pollutants with high vapor pressure, e.g., mercury or *persistent organic pollutants* (POPs), in the air will condense onto soil, water, and biota at cool temperatures. Consequently, the ratios for POP concentrations in the air and on condensed phases decrease as one moves from warmer to cooler climates.

cometabolism

Microbial transformation of a compound which is unable to support cell replication in the requisite presence of a transformable co-substrate that supports cell replication.

Note: The mechanisms of co-metabolism considered likely in most cases involve an enzyme or enzymes that change the substrate to a product or products not further transformed by other enzymes (*dead-end metabolites*).

See also *cooxidation, metabolism*, *secondary substrate metabolism*

[7]

community

Assembly of *populations* of different *species* of living organisms, usually interdependent on and interacting with each other, within a specified location in space and time.

See *ecosystem*.

community conditioning hypothesis

Hypothesis that ecological communities retain information about events in their history and will not return to

their original state after perturbation.

Note: This hypothesis was derived from the concept of nonequilibrium community ecology and was developed as a framework for understanding the persistence of dose-related responses in multispecies toxicity tests.

community stability

Tendency of a community to return to its original state after a disturbance (competition, temporarily changing environment, etc.).

community resilience

ecological resilience

1. Ability of a community to return to its former state after perturbation.

Note: A community with high resilience will return to its original state faster than one with low resilience.

community resistance

Ability of a community to avoid displacement from its present state by a disturbance.

community structure

Species present in a community and their relative abundances.

compartment

1. Conceptualised part of the body (organs, tissues, cells, or fluids) considered as an independent system for purposes of modeling and assessment of *distribution* and clearance of a substance.

[1]

2. Part of an *ecosystem* considered as an independent system for purposes of assessment of uptake, distribution and dissipation of a substance.

competition (in ecology)

General struggle for existence in which living organisms in a *niche* compete for the same limited resources.

See *intraspecific competition*, *interspecific competition*.

competitive exclusion

Outcompetition from a *niche* of one *species* by another that uses the available resources of the niche more efficiently, eventually resulting in the exclusion of the outcompeted species.

complimentary niches

Niches where coexisting *species* occupy a similar position along one niche dimension, e.g., altitude, but differ along another, e.g., diet.

See *niche*.

concentration factor (CF)

Quantitative expression of the change in concentration of substance n (*C*n) at different trophic levels relative to the concentration in the ultimate or lowest defined source, e.g., relative to the water concentration (*C*water), CF = *C*n/*C*water. The change in concentration is expressed as a multiple of the source concentration.

concentration-response curve

exposure-response curve

Graph of the relation between *exposure concentration* and the proportion of individuals in a population responding with a defined effect.

[1]

concept of strategy

See *principle of allocation*.

conceptual model (in ecological risk assessment)

Linkage and interrelationship of assessment endpoint(s) and stressors.

Note 1: Establishing this inc1udes evaluation of potential exposure pathways, effects, and ecological receptors.

Note 2: Conceptual models include hypotheses of risk and a diagram of the conceptual model.

conceptual model diagram (in ecological risk assessment)

Figure showing pathways of exposure of organisms and illustrating areas of uncertainty or concern.

conceptual site model (CSM)

Integration of information on contaminants of potential concern (COPCs), ecological resources, evaluated exposure routes, fate and transport mechanisms, evaluated COPC toxicity, identified assessment endpoints, and risk questions and hypotheses into a description of all that is known and/or expected about a contaminated site.

condition (in ecology)

State of health determining potential for reproduction and growth.

Note: Mainly used in fish, mussel and oyster ecology.

condition factor

Parameter used to describe growth in fish. It reflects real growth and nutritional status better than simple measurement of body mass.

The condition factor, K is calculated from the following equation:

$K = \text{mass} \times 100 / (\text{length})^3$

with mass in g and length in cm

condition index

Any quantitative measure of the *condition* in relation to a defined baseline.

Note: In mussels various shell indexes (volume / length, mass / length), glycogen concentration (w / bw) or relative organ mass are used.

congener

1. in chemistry. One of two or more substances related to each other by origin, structure, or function. [1]

2. in ecology. One of two or more species within the same genus.

Note: Congeners in the same ecoregion can compete with one another leading to adaptations

(microevolution) mitigating pressure on populations.

3. in genetics: One of two or more organisms that have almost identical genomes.

Note: Recombinant congeneric mice strains are constructed to study various diseases.

conservation biology

Science applied to the conservation of *genes*, *populations*, *species*, and *ecosystems*.

Note: This science is concerned with the phenomena that affect the maintenance, loss, and restoration of biological *diversity*.

conservation ecology

Science of analysing and protecting the Earth's biological *diversity*.

Note 1: Conservation ecology is based on the biological, physical and social sciences, economics, and the practice of natural-resource management. It concentrates on *population dynamics* issues associated with the small population sizes of rare *species* (e.g*., minimum viable populations*).

contaminant

1. Minor impurity present in a substance.
2. Extraneous material inadvertently added to a *sample* prior to or during chemical or biological analysis.
3. In some contexts, as in relation to gas cleaning equipment, used as a synonym for "*pollutant*", especially on a small scale.
4. Unintended component in food that may pose a *hazard* to the consumer.
5. Any undesirable solid, liquid or gaseous matter occurring, as a result of human activities, in a solid, liquid or gaseous environmental medium even without adverse effects being observed.

See *pollutant.*

After [1]

contamination

1. Presence of a *contaminant*.
2. Process whereby a contaminant reaches the environmental medium or sample affected.

continuous effect

Change that can be measured on a continuum from zero (or even a negative value) to positive values such as growth and reproduction.

See *quantal effect.*

continuous flow test

See *flow-through test.*

control

Treatment in a toxicity test that duplicates all the conditions of the exposure treatments but contains no test material in order to determine the absence of toxicity under basic test conditions (e.g., health of test organisms, quality of dilution water).

convection (as applied to air and water motion)

Predominantly vertical motion of air or of water, induced by the expansion of the air or of water heated by the earth's surface, or by human activity, and its resulting buoyancy.

[1]

cooxidation

Cometabolism whereby growing microorganisms oxidize a compound without using either carbon or energy derived from the oxidation of that compound.

[8]

copepod

Minute marine or fresh-water crustacean, usually having six pairs of limbs on the thorax; some are abundant in plankton and others are parasitic on fish, marine mammals and macro-invertebrates.

corrosion

Process causing a surface-destructive effect on contact; in *toxicology*, this normally means causing visible destruction of the skin, eyes, or the lining of the respiratory tract or the gastro-intestinal tract.

After [1]

corrosive

1. n. Substance having the capability or tendency to cause slow destruction.

2. adj. Gradually destructive; steadily harmful.

cost-benefit analysis (CBA)

Procedure for determining the relationship of the expected benefits of a proposed action to the expected costs in order to decide whether the action provides the best option for the investment of limited resources.

Compare *cost-effectiveness analysis*.

cost-effectiveness analysis

Procedure for determining whether the expected beneficial effects of a defined course of action justify the cost when selecting among competing options for the use of limited resources.

Note: Mainly used for comparing the relative value of various clinical strategies.

Compare *cost-benefit analysis*.

cotolerance

See *cross-resistance.*

cough (in fish)

gill purge

Abrupt, periodic reversal of water flow over the gills that dislodges and eliminates excess mucus from the gills' surfaces.

critical body residue (CBR)

Whole-body concentration of a chemical that is associated with a given adverse biological response.

Note: This assumes each organisms is a single compartment, rather than multiple compartments as in reality. It has utility as a first approximation of dose.

After [5]

critical life stage testing

Toxicity testing focused on the *species* life stage thought to be the most sensitive to the toxicant, such as newly

hatched individuals.

criterion (for effect)

See *end point*.

cross resistance

Condition in which enhanced tolerance to one toxicant also enhances tolerance to another.

culture

1. n. Stock of healthy cells, tissue, micro-organisms, or plants raised under well-defined and controlled conditions.
2. v. To maintain a stock of healthy organisms under well-defined and controlled conditions.

cumulative dose

Total dose resulting from repeated exposures or continuous exposure over a defined time to a substance or to radiation.

cumulative exposure

Total exposure resulting from repeated exposures continuous exposure over a defined time to a substance or to radiation.

damage

See *harm*.

Daphnia

Small, mostly planktonic, crustaceans, between 0.2 and 5 mm in length.

Note 1: Daphnia are members of the order Cladocera, and are one of the several small aquatic crustaceans commonly called water fleas because of their saltatory swimming style (although fleas are insects and thus only very distantly related). *Daphnia* spp. live in various aquatic environments ranging from acidic swamps to freshwater lakes, ponds, streams and rivers.

Note 2: Toxicity tests on *Daphnia* are required by most regulatory authorities. The results are often interpreted by extrapolation as applicable to the protection of all crustaceans.

Darwinian fitness

See *fitness*.

dead-end metabolite

Substance formed by a microbe's metabolism of a substrate (most often during *cometabolism*) that cannot be further metabolized by that organism.

Note: Dead end metabolites may be further metabolized by coexisting organisms.

death (in population ecology)

In assessing population ecology, death of an *individual* is loss of the ability to reproduce.

death (biological)

Irreversible cessation of all vital functions of an organism.

death rate

Number of deaths D in a closed *population* of size N during a specified time interval, Δt. The rate is calculated from the formula:

$D = - \Delta N / \Delta t$

applied to a limited time period.

See also *per capita death rate*.

dechlorinated water

Chlorinated water (usually municipal drinking water) that has been treated to remove chlorine and chlorinated compounds from solution.

decomposer

Organism that breaks down dead matter or wastes of other organisms.

defoliant

Substance used for removal of leaves by its *toxic* action on living plants.

[1]

degradation

breakdown

decomposition

Process by which a substance is broken down to simpler structures through biological or *abiotic* mechanisms.

See *biodegradation*, *mineralization*.

demographic stochasticity

Variability in population growth rates arising from random differences among individuals in survival and reproduction within a season.

Note: Such variability is important only in populations that are fairly small.

demography

Study of *population*s, especially their age structure and growth rates.

denitrification

Reduction of nitrates to nitrites, nitrogen oxides or dinitrogen (N_2) catalysed by facultative aerobic soil bacteria under anaerobic conditions.

[1]

density dependence (in population biology)

Variation in characteristics of individuals or of a population produced by changes in the density of the population.

Note: Density dependence may be seen in mortality rate, birth rate, fitness, sensitivity to environmental toxins, transmission of pathogens and parasites etc.

deposit feeder

Animal that feeds on particles of matter in the soil or sediment, usually the top soil or sediment where it is filled with organic matter. Feeding takes place either by ingesting soil or sediment or by trapping particles as

they fall.

Note: Examples of organisms that are deposit feeders are earthworms, terebellids, and fiddler crabs.

deposition

See *atmospheric deposition*, *dry deposition*, *wet deposition.*

depuration

Loss of a substance from an organism owing to elimination and degradation.

Note: The rate of depuration is expressed by its half-life or the time needed to eliminate 50% of the substance in a non-contaminated medium. This term is often referred to as the depuration time (DT50).

derived characteristic

Predicted property of a substance that is dependent upon, or is an approximation of, a fundamental property and the prevailing environmental conditions.

desiccant

Drying agent.

detergent

Cleaning or wetting agent which possesses both polar and non-polar terminals or surfaces allowing interaction with non-polar molecules and making them miscible with a polar solvent.

See also *surfactant.*

deterministic (in toxicology)

Term applied to effects, of which the extent varies with the dose and for which a threshold is believed to exist.

After [1]

See also *stochastic.*

deterministic analysis

Detailed study in which all *population* and environmental parameters are assumed to be constant and accurately specified.

deterministic model

Mathematical model that is fully specified and does not include a stochastic component.

detritus

Organic debris from decomposing plants and animals.

detrivorous

Eating *detritus*.

developmental reference dose (RfD_{dt})

Reference dose determined for developmental consequences of a single, maternal exposure during development.

developmental stability

Potential of an organism to develop into a consistent phenotype in an environment.

diatom

Member of a major group of eukaryotic algae, among the most common types of phytoplankton. Unicellular, some form chains or simple colonies. Diatom cells are encased in a frustule, of widely diverse form, made of silica (hydrated silicon dioxide).

diffuse source

Release into the environment from multiple sources covering a wide area as opposed to *point source*.

diffusion

Spreading or scattering of a gaseous or liquid material. Eddy diffusion in the atmosphere is the process of transport of gases due to turbulent mixing in the presence of a composition gradient. Molecular diffusion is the

net transport of molecules which results from their molecular motions alone in the absence of turbulent mixing; it occurs when the concentration gradient of a particular gas in a mixture differs from its equilibrium value. Eddy diffusion is the most important mixing process in the lower atmosphere, while molecular diffusion becomes significant at the lower pressures of the upper atmosphere.

[3]

diluent

See *dilution water*.

dilution 'paradigm'

Belief that pollution is alleviated by dilution.

Note: Sometimes stated as "The solution to pollution is dilution."

dilution water

diluent

Water used to dilute the test material in an aquatic toxicity test in order to prepare either different concentrations of a test chemical or different percentages of an effluent for the various test treatments.

Note: The water (negative) control in a test is prepared with dilution water only.

After [5]

direct ecological effect

Effect where a stressor acts on immediately an ecological component of interest and not through effects on other components of the ecosystem.

See also *indirect ecological effect*.

directional asymmetry

Deviation within a *population* from a mean of zero for the difference between a trait measured from the right and left sides of bilaterally symmetrical individuals from that population.

Note: For example, measurement of the difference in muscle mass of left and right arms of humans would display directional asymmetry because most humans are right-handed and have larger

right arms.

See also *antisymmetry*, *fluctuating asymmetry*.

direct photolysis

See *photolysis*.

direct toxicity

Toxicity that results from, and is readily attributable to, substances acting at the sites of toxic action in and (or) on the exposed organisms that are exhibiting the adverse biological response in question.

After [5]

discharge

Release of any waste into the environment from a point source.

Note: Usually applied to release of liquid waste into water but may be applied to release to air.

See also *effluent*, *emission*.

[1]

discrimination ratio (or factor)

Ratio measuring the degree of isotopic discrimination, with a ratio of l indicating no discrimination.

Note: In the context of discrimination between elements such as cesium and potassium in a trophic exchange, a discrimination factor or ratio is expressed as [Cs]food / [K]food divided by [Cs]body / [K]body.

See *isotopic discrimination*.

dispersant

Substance used to disperse liquid spills, e.g., oil spills in water.

See also *surfactant*.

dispersion (in environmental chemistry)

Spreading and resultant dilution of a pollutant in a fluid medium (e.g., air or water) due to diffusion or

turbulence.

After [1]

dissolved organic carbon (DOC)

Amount concentration of carbon found dissolved in water samples from aquatic systems, measured as total elemental carbon.

Note 1: The "dissolved" fraction of organic carbon is an operational classification. Operationally, dissolved organic carbon (DOC) is defined as the organic matter that is able to pass through a defined filter (filters generally range in size between 0.7 and 0.22 micrometers). Conversely, particulate organic carbon (POC) in water is that carbon that is too large and is filtered out of a sample.

Note 2: The DOC in marine and freshwater systems is part of the greatest cycled reservoir of organic matter on Earth and consists mostly of humic substances.

Note 3: DOC is important in the transport and bioavailability of *pollutants* in aquatic systems.

Note 4: Metals may form strong complexes with DOC, increasing metal solubility, and concentration in water, while also reducing metal *bioavailability*.

See also *dissolved organic matter (DOM)*.

dissolved oxygen content (DOC)

Amount concentration of oxygen dissolved in water at a particular temperature and pressure.

Note: This can be a limiting factor on the growth of aquatic populations.

dissolved organic matter (DOM)

Analogous to *dissolved organic carbon*, but refers to the entire organic pool dissolved in water.

distribution

1. Apportionment of a solute between two phases. The term partition or extraction may also be used in this sense where appropriate.

[1]

2. Dispersal of a substance and its derivatives throughout the natural environment or throughout an

organism.

[1]

3. Final location(s) of a substance within an organism after dispersal.

[1]

4. (In statistics) Set of numbers and their frequency of occurrence collected from measurements over a statistical population.

distribution constant

See *partition ratio*.

disturbance (in ecology)

Event that introduces, removes or redistributes organisms, changing the colonization potential of a given environment.

diversity

Quality of being made of many different elements, forms, kinds, or individuals.

diversity index

Mathematical descriptor of species variation within a *community*.

Note: All *diversity* indices are based on the relative abundance of a *species*, i.e., the sum of all individuals of that *species* divided by the sum of all individuals in the *community* of interest.

See *Brillouin index*, *Simpson's diversity index*, *Shannon-Wiener diversity index*.

Dobson unit

Unit describing the ozone content of the Earth's atmosphere over a specified area of the Earth's surface, in increments of the amount of pure ozone at standard temperature and pressure (0°C, 1 atm), in a volume having the same area and a thickness of 0.01 mm.

Note 1: Atmospheric ozone content is usually measured by the absorption of UV radiation at the Earth's surface.

Note 2: The Dobson unit is sometimes referred to in terms of numbers of molecules. One square cm of pure ozone with a thickness of 0.01 mm contains 2.69 x 10(16) molecules.

dose (of a substance)

Total amount of a substance administered to, taken up, or absorbed by an organism, organ, or tissue.

[1]

dose (of radiation)

Energy or amount of photons absorbed by an irradiated object during a specified *exposure* time divided by area or volume.

[1]

dose-effect

Relation between *dose* and the magnitude of a measured biological change.

[1]

dose-effect curve

Graph of the relation between *dose* and the magnitude of the biological change produced measured in appropriate units.

[1]

dose-effect relationship

Association between *dose* and the resulting magnitude of a continuously graded change, either in an individual or in a population.

[1]

dose-response curve

Graph of the relation between *dose* and the proportion of individuals in a population responding with a defined biological effect.

[1]

dose-response relationship

Association between *dose* and the *incidence* of a defined biological effect in an *exposed* population usually expressed as percentage.

[1]

doubling time

Estimated time required for a *population* of living organisms to double its size; it is estimated from the intrinsic rate of increase (r) as $(\ln 2)r^{-1}$.

drainage basin

catchment

catchment area

catchment basin

drainage area

river basin

water basin

watershed

Area of land where water from rain or snow melt drains downhill into a body of water, such as a river, lake, dam, *estuary*, *wetland*, sea or ocean.

Note 1: A drainage basin includes both the streams and rivers that convey the water as well as the land surfaces from which water drains into those channels, separated from adjacent basins by a drainage divide.

Note 2: A drainage basin acts like a funnel - collecting all the water within the area covered by the basin and channeling it into a waterway. Each drainage basin is separated topographically from adjacent basins by a ridge, hill or mountain, which is known as a water divide.

dry deposition

Transfer of chemicals from the atmosphere to the earth's surface not involving *precipitation* (rain, snow, hail etc.).

See also *atmospheric deposition.*

dynamically fragile community

Community that is stable for only a very limited range of environmental characteristics, e.g., a stable and predictable environment with respect to predator-prey ratios or disturbances caused by humans.

dynamically robust community

Community that is stable within a wide range of conditions, e.g., in very variable and unpredictable environments.

dynamic energy budget (DEB) **theory**

Theory that simple quantitative rules may be applied to define the organization of metabolism of individual organisms.

Note 1: 'Dynamic' refers to dynamic changes in energy budgets in relation to individual life cycle. The theory includes stoichiometric constraints and mass balance equations, allometric relationships, organisational uncoupling of metabolic modules, strong and weak homeostasis, and partionability of reserve kinetics.

Note 2: In relation to ecotoxicology, effects of toxicants on energy allocation have been modelled by Kooijman and Bedaux, 1996. [9]

dynamic stability hypothesis

Hypothesis that long food chains are less stable than short food chains.

early life stage (ELS) **test**

Toxicity test using early life stages such as embryos or larvae based on the observation or assumption that the early life stage is the most sensitive part of the *species* life cycle.

ecogenetics

Study of the influence of hereditary factors on the response of individuals or populations to environmental factors.

Note: Examples of ecogenetic phenomena are the effects of CYP polymorphisms on cancer risk, and the mechanisms of development of pesticide resistance in insects and metal tolerance in

plants.

After [1]

ecology

Branch of biology that studies the interactions between living organisms and all factors (including other organisms) in their environment. Such interactions encompass environmental factors that determine the distributions of living organisms.

[1]

ecological character

Sum of biological, physical, and chemical components of an ecosystem and their interactions that maintain the ecosystem and its products, functions and attributes.

ecological energetics

Study of the flow of energy within an ecological system from the time the energy enters the living system until it is irretrievably lost from the system as heat.

Note: It is also referred to as production ecology, because ecologists use the word 'production' to describe the process of energy input and storage in ecosystems.

ecological epidemiology

Application of epidemiological methods to determine the cause, incidence, prevalence, and distribution of adverse effects in nonhuman *species* inhabiting contaminated sites; it is frequently associated with retrospective ecological risk assessment.

See also *retroactive risk assessment.*

ecological imbalance

Change in any biological, physical, or chemical components of an ecosystem, or in their interactions, which result in change in ecological character and its functions and attributes.

See also *species imbalance.*

ecological magnification

See *biomagnification.*

ecological mortality

ecological death

Toxicant-related diminution of fitness of an individual functioning within an ecosystem that is of a magnitude sufficient to be equivalent to somatic death.

Note: This concept implies that an individual organism may be so incapacitated by an environmental change that, though still alive, its contribution to the *ecosystem* becomes negligible.

ecological parameter

Measurable variable whose value is a determinant of the characteristics of an *ecosystem*.

ecophysiology

Study of physiology and tolerance limits of *species* that enhances understanding of their distribution in relation to abiotic conditions.

ecoregion

bioregion

1. Any of a number of regions into which a continent, country, etc., can be divided according to their distinct environmental conditions and habitat types.

[4]

2. Large area of land or water with a characteristic, geographically distinct assemblage of natural communities and species comprising a recurring pattern of ecosystems associated with characteristic combinations of soil and landform.

   Note: The biodiversity of ecosystems in an ecoregion is often distinct from that of other ecoregions.

ecosphere

Region of the Earth that is capable of supporting life.

Synonym *biosphere*.

ecosystem

Grouping of organisms (micro-organisms, plants, animals) interacting together, with and through their physical and chemical environments, to form a functional entity within a defined environment.

[1]

ectotherm

See *poikilotherm*.

ecotone

Area of gradual transition between two or more ecosystems.

See also *edge effect*.

ecotoxicology

Study of the *toxic* effects of chemical and physical agents on all living organisms, especially on *population*s and communities within defined *ecosystems*; it includes transfer pathways of these agents and their interactions with the environment.

[1]

ecotoxicologically (environmentally) relevant concentration, ERC

Concentration of a pesticide (active ingredient, formulations, and relevant metabolites) that is likely to affect a determinable ecological characteristic of an exposed system.

After [10]

edaphic

Pertaining to the soil.

eddy diffusion

See *eddy dispersion*.

eddy dispersion

eddy diffusion

1. Process by which substances are mixed in the atmosphere or in any fluid system due to *eddy motion*. [3]

2. Irregularity in the diffusion of solute molecules which occurs in a porous chromatographic support.

Note: The phenomenon is due to the fact that (a) the path lengths of some solute molecules are either shorter or longer than those of most of the molecules, and (b) the rate of solvent flow varies in different regions of the porous support.

eddy motion

Movement in a current of water or air, that is contrary to the direction of the main current, especially in a circular motion, leading to irregularity in the motion of molecules.

edge effect

Influence of the closeness of contrasting environments on an ecosystem, seen at boundaries between natural habitats, especially forests, and disturbed or developed land.

Note: Edge effects lead to changes in species richness and population size at the boundary between two communities, most pronounced in small habitat fragments where they may extend throughout the patch..

Note: *Ecotones* often have *species* assemblages with high *species richness (S)* and high abundance of individuals relative to those of the adjacent communities.

effective concentration (EC)

Concentration of a substance that causes a defined magnitude of *response* in a given system after a specified exposure time, e.g., concentration which affects x% of a test *population* after a given time (EC_x).

Note: EC_{50} is the median concentration that causes 50 % of maximal response.

After [1]

effective dose (ED)

Dose of a substance that causes a defined magnitude of *response* in a given system after a specified exposure

time; e.g., dose which affects x% of a test *population* after a given time (ED_x).

Note: ED_{50} is the median dose that causes 50 % of maximal response.

effective half life (k_{eff})

Estimated half life in a compartment model that has numerous elimination mechanisms, each with an associated k. It is equal to (ln 2) / $\sum k_i$.

effects assessment

Component of *risk assessment* concerned with quantifying the manner in which the frequency and intensity of effects increase with increasing exposure to a contaminant or other source of stress (also known as dose-response assessment or toxicity assessment).

effect time (ET)

Time taken for a substance to produce a precisely defined effect.

Note: ET_{50} is the median time it takes for a toxicant to produce a precisely defined effect in 50% of a *population*.

effluent

Complex waste material (e.g. liquid industrial discharge, solid or gas) which may be released into the environment.

elasticity (community)

Ability of a community to return to its prestressed condition.

elutriate

Aqueous solution obtained after adding water to a solid substance (e.g. *sediment*, tailings, drilling mud, or dredging spoil), shaking the mixture, then centrifuging or filtering it or decanting the supernatant.

Note: An operational definition is water collected from vigorous shaking (15 to 30 min) of one part sediment with four parts water. This mixture is allowed to settle and the liquid phase is centrifuged and may be filtered.

[10, 11]

elutriate test

Test in which a nonbenthic *species*, such as *Daphnia magna*, is exposed to an elutriate produced by mixing test *sediment* with water and then centrifuging the mixture.

Note: The elutriate test was developed for evaluating the potential effects of disposing of dredged material in open water. Analyses of elutriate samples measure the water-soluble constituents potentially released from sediment to the water column during dredge disposal operations

[11]

elutriation

Process of separating the lighter particles of a powder from the heavier ones by means of an upward directed stream of fluid (gas or liquid).

[3]

emergent properties

New properties emerging with upward steps in hierarchical systems, such as ecological communities or ecosystems, that cannot be predicted solely from our limited understanding of the system's parts or components.

Note: Such properties arise during the self-organization of complex systems and are the product of the evolution of these systems.

emission

discharge

effluent

release

Release of a substance from a source, including discharges to the wider environment.

[1]

emission standard

Quantitative limit on the *emission* or discharge of a substance from a source, usually expressed in terms of a time-weighted average concentration or a ceiling value.

[1]

emulsifier

Chemical substance that aids the fine mixing (in the form of small droplets) with water of an otherwise hydrophobic substance.

See also *dispersant*.

[1]

endemic

Pertaining to a *species* found in a discrete geographical unit, such as an island, habitat type, or other defined area or zone.

endemism

Ecological state of being unique to a place.

Note: There are two subcategories of endemism - paleoendemism and neoendemism. Paleoendemism refers to a species that was formerly widespread but is now restricted to a smaller area. Neoendemism refers to a species that has recently arisen e.g. by hybridization (see *hybrid*) and is now classified as a separate species. This is a common process in plants especially those which exhibit *polyploidy*.

endocrine disrupter

endocrine modifier

Exogenous chemical that alters function(s) of the endocrine system and consequently causes adverse health effects in an intact organism, its progeny or (sub) *population*s.

[1]

endogenous

Antonym *exogenous*

Produced within or caused by factors within an organism.

[1]

endotherm

'Warm blooded organism' that regulates its body temparature to be (almost) constant.

end point (of toxicity)

Objective of measurement of a toxicity test.

Note: End points vary with the level of biological organization being examined and may include changes in biochemical markers or enzyme activities, mortality or survival, growth, reproduction, primary production, and changes in structure, abundance, and function in a community. End points are used as criteria for toxicity.

end point assessment

Quantitative or quantifiable expression of the environmental value considered to be at risk in a risk analysis.

Note: Examples include a 25% or greater reduction in gamefish biomass or local extinction of an avian *species*.

enrichment factor (EFcrust)

anthropogenic enrichment factor

Measure of anthropogenic enrichment in defined environmental samples of an element above natural levels. EFcrust is an element's concentration ($C_{element}$) measured in samples divided by that expected in the Earth's crust:

EFcrust = $[C_{element} / C_{aluminum}]_{sample} / [C_{element} / C_{aluminum}]$crust.

In this equation, both air and crustal concentrations are normalized with respect to aluminum concentrations.

Note: Alternatively normalization with respect to iron may be used. Recent studies have shown that iron may be a better predictor than Al for background trace metal levels.

[12]

environmental assessment (EA)

Short, preliminary assessment of potential environmental harm used to determine if a full environmental impact

statement (EIS) is required.

environmental availability

Portion of the total amount of a substance present in the environment that is involved in a particular process and is subject to physicochemical and biological modifying influences.

See also *environmental bioavailability*.

environmental bioavailability

Ratio of uptake *clearance* to the rate at which an organism encounters a given contaminant in an environmental medium (e.g., soil, sediment, water, food) being processed by the organism.

Note: This is a measure of an organism's extraction efficiency, via respiratory, dietary, and surface absorption processes, from the environmentally available (*bioaccessible*) portion of a material.

See also *bioaccessibility*.

environmental epidemiology

Subdiscipline of human epidemiology concerned with diseases caused by chemical or physical agents in the environment.

environmental fate

Destiny of a chemical or biological *pollutant* after release into the natural environment.

[1]

environmental impact assessment (EIA)

Appraisal of the possible environmental consequences of a past, ongoing, or planned action, resulting in the production of an environmental impact statement or 'finding of no significant impact' (FONSI).

[1]

environmental impact statement (EIS)

Report resulting from an *environmental impact assessment*.

[1]

environmental monitoring

Continuous or repeated measurement of agents in the environment to evaluate environmental exposure and possible damage by comparison with appropriate reference values based on knowledge of the probable relationship between ambient exposure and resultant adverse effects.

Note: Measurements of substance, and (or*) biological indicators,* and (or) *biomarkers* may be repeated daily, weekly, monthly, or quarterly. Such measurements are recorded systematically and assessed in relation to location and time for any change in order to determine its possible significance.

After [1]

environmental quality objective (EQO)

Overall state to be aimed for in a particular aspect of the natural environment, for example, "water in an estuary such that shellfish *population*s survive in good health".

Note: Unlike an environmental quality standard, the EQO is usually expressed in qualitative and not quantitative terms.

[1]

environmental quality standard (EQS)

ambient standard

Amount concentration or mass concentration of a substance that should not be exceeded in an environmental system, often expressed as a time-weighted average measurement over a defined period.

See *limit value*.

[1]

environmental risk analysis

Determination of the probability of adverse effects on humans and other biota resulting from an environmental hazard (a chemical, physical, or biological agent occurring in or mediated by the environment).

environmental risk assessment

Estimate of the probability that harm will result from a defined exposure to a substance in an environmental medium. The estimate is valid only for a given *species* and set of conditions.

[1]

environmental security

United Nations concept, defined as the relative stability of Earth's natural ecosystems against human activity, most notably:

* global climate change caused by human release of greenhouse gas;
* deforestation caused by so-called "clearing" of lands;
* soil depletion and desertification caused by intensive monoculture techniques.

environmental transformation

Chemical transformation of a substance resulting from interactions in the environment.

environmentally relevant concentration

See *ecotoxicologically relevant concentration*.

environmental transport

Movement of *contaminants* from their point of release through the various *compartments* to locations where exposure is assumed to occur.

enzootic

Present in a community or among a group of animals; term applied to a disease prevailing continually in a region.

epibenthic

Living on the bed of an aquatic system, normally on *sediment*.

epifauna

Animals that live on the surface of soil or of the bed of an aquatic system, normally on *sediment*.

See also *infauna*.

epigene/sis n., **-tic** adj. (in biology)

1. Phenotypic change in an organism brought about by alteration in the expression of genetic information without any change in the DNA genomic sequence.

Note: Common examples include changes in nucleotide base methylation and changes in histone acetylation. Changes of this type may become heritable.

After [1]

2. Of, relating to, or produced by the chain of developmental processes in epigenesis that lead from genotype to phenotype after the initial action of the genes.

[13]

epigenetic (in geology)

Describing a deposit of later origin than the rocks among which it occurs.

[4]

episodic

Discontinuous.

epizootic

Outbreak of disease in a *population* or in a large number of individuals of a species.

equilibrium (diffusion)

Thermodynamic state in which both a steady state of flux and an equivalence in chemical activity have been reached in compartments or phases separated by a membrane or boundary across which the chemical fluxes occur.

After [5]

equilibrium partitioning (EqP)

Tendency for a substance to achieve the same fugacity (chemical activity) in different compartments of a complex system.

equilibrium partitioning (EqP) **approach**

Approach to estimating the fate of chemicals in the aquatic environment that is based on *equilibrium partitioning*.

Note: The EqP approach is often exploited (primarily for organics), for interpretation and extrapolation purposes, by normalizing chemical concentrations based on the lipid content of the aquatic organisms and the organic carbon content of the sediments. These normalized BSAF values are considered to be independent of particular sediments and species.

After [5]

essential element

See *essential nutrient*.

essential metal

See *essential nutrient*.

essential nutrient

Substance which is absolutely required for the normal growth and development of a defined organism throughout a complete life cycle.

Note 1: According to criteria of essentiality suggested by Arnon and Stout, a nutrient can be called essential if: (i) Its deficiency makes it impossible for an organism to complete its life cycle; (ii) Its deficiency is specific to the element in question and can be corrected only by supplying this element; and (iii) The nutrient is directly involved in the organism's nutrition.

Note 2: It has been suggested that an element should be considered essential if its addition enhances growth or if it can substitute for one of the elements that satisfy the criteria of Arnon and Stout. It has also been suggested that three other elements which do not satisfy the criteria for many plant species but contribute indirectly to their survival should be classified as essential. These elements are nickel (urea transformations), cobalt (N_2 fixation), and silicon.

Note 3: Related terms are essential element and essential metal which may be given the same definition, simply by substituting 'element' or metal' for nutrient.

Note 4: The term is often used misleadingly since it is meaningless unless accompanied by a statement of which organisms show a requirement for the nutrient.

[14]

estimated environmental concentration (EEC)

See *predicted environmental concentration*.

estuary

1. general. Tidal opening, an inlet or creek through which the tide enters; an arm of the sea indenting the land. rare in modern use.

2. specific. Tidal mouth of a great river, where the tide meets the current of fresh water.

[4]

Note 1: An estuary is a semi-enclosed coastal body of water with a free connection to the open sea made up of brackish water, typically the tidal mouth of a rivers, often associated with sedimentation of material from terrestrial runoff.

Note 2: An estuary is often associated with a high rate of biological productivity.

etiologic(al) agent

Factor contributing to the cause of a disease.

Euler-Lotka equation

Equation used to estimate the intrinsic rate of increase from life table data.

eutrophic

1. Describing an environment having a high concentration of nutrients.

Note: The term is usually used to describe nutrient-rich bodies of water or soil having a high or excessive rate of biological production.

See also *oligotrophic*.

2. In medicine, tending to promote nutrition.

After [1]

eutrophication

Process producing a high concentration of nutrient salts and a high or excessive rate of biological production in water.

Note: Usually involves depletion of the oxygen content caused by decay of organic matter resulting from high primary production as a result of enhanced input of nutrients.

[1]

eutrophy

1. State of being *eutrophic*.

See also *oligotrophy*.

2. in medicine, good nutrition.

evolution (in biology)

1. Transformation of animals, plants, and other living organisms into different forms by the accumulation of changes over successive generations.

2. Transmutation of species.

3. Origination or transformation of an organism, organ, physiological process, biological molecule, etc., by a series of changes.

*Note***:** The theory of evolution (in general) is the proposition that all living organisms have undergone a process of alteration and diversification from simple primordial forms during the earth's history; (in particular) it is a scientific theory proposing a mechanism for this process, now *esp.* that based on Darwin's theory of the natural selection of genetically inherited and adaptive variation (see *neo-Darwinism*).

After [4]

evolutionary tree

See *cladogram.*

evolutionary adaptation

See *genetic adaptation*.

exchange diffusion

Diffusion across a membrane by means of a carrier molecule that requires no energy and involves the exchange of two ions across the membrane.

exotherm

See *poikilotherm*.

expected environmental concentration (EEC)

See *predicted environmental concentration*.

expected life span

Average length of time an organism can be expected to survive, or a substance can be expected to persist.

experimental ecosystem

Manmade construction intended to simulate a natural environment.

See *mesocosm*, *microcosm*, *limnocorral*, *littoral enclosure*.

exploitation competition

Interspecies competition in which *species* compete for some limiting resource such as food.

exponential decay

Variation of a quantity according to the law

$A = A_0 e^{-\lambda t}$

where A and A_0 are the values of the quantity being considered at time t and zero respectively, and λ is an appropriate constant.

[3]

exponential growth

Growth of cells, organisms or *population*s in which the number or mass increases exponentially and growth at any time is proportional to the number or mass present.

Note: The mathematical relationship is of the same form as that for *exponential decay*.

See *growth*.

exposure

1. Concentration, amount or intensity of a particular physical or chemical agent or environmental agent that reaches the target *population*, organism, organ, tissue or cell, usually expressed in numerical terms of concentration, duration, and frequency (for chemical agents and micro-organisms) or intensity (for physical agents).
2. Process by which a substance becomes available for *absorption* by the target population, organism, organ, tissue or cell, by any route.
3. For X- or gamma radiation in air, the sum of the electrical charges of all the ions of one sign produced when all electrons liberated by photons in a suitably small element of volume of air completely stopped, divided by the mass of the air in the volume element.

[1]

exposure assessment

Process of measuring or estimating concentration (or intensity), duration and frequency of *exposure*s to an agent present in the environment or, if estimating hypothetical exposures, that might arise from the release of a substance, or radionuclide, into the environment.

[1]

exposure characterization (in ecological risk assessment)

Description of the presence and characteristics of contact between the *contaminant* and the ecological entity of concern, and a summary of this information in an exposure profile.

exposure pathway

Route by which an individual is exposed to a *contaminant*, including the source and point of contact.

exposure profile (in ecology)

Outline of the magnitude and spatio-temporal pattern of *exposure* developed during the process of ecological *risk assessment*.

After [15]

exposure scenario

Model of the likely *exposure* of selected *population*s following release of a substance into a natural environment.

extinction probability

1. Probability that a *population* will eventually become extinct.
2. Probability that a *population* will become extinct within a specified interval of time.

Note: Very small populations are likely to go extinct just by chance due to *demographic stochasticity*.

extrapolation

Calculation, based on quantitative observations in *exposed* test *species* or *in vitro* test systems, of predicted dose-effect and dose-response relationships for a substance in the same species at other doses or in humans and other species at similar doses.

Note 1: The term may be applied to predictions of such relationships in susceptible groups from knowledge of a group used for testing.

Note 2: The term may also be used for qualitative information applied to species or conditions that are different from the ones in which the original investigations were carried out.

After [1]

extrapolation factor

Quantity used in effect and exposure assessments to adjust estimated exposures or concentrations/doses for uncertainties, to make corrections in the data, or to improve safety.

facilitated diffusion

Passive diffusion down a gradient, not requiring energy, but occurring at a rate faster than expected by simple

diffusion alone.

Note: Facilitated diffusion may involve a membrane channel or a carrier molecule, often a protein. In the latter case, it may be referred to as *facilitated transport*. Both processes exhibit ligand specificity and saturation kinetics.

facilitated transport

See *facilitated diffusion*.

fate

Disposition of a material in various environmental *compartment*s (e.g. soil or *sediment*, water, air, biota) as a result of transport, partitioning, transformation, and degradation.

feasibility study (FS)

Part of a remedial investigation that compares the various options available for remediation and identifies those that are practicable.

fecundation

impregnation

Process of fertilization.

fecundity

1. Ability to produce offspring within a given period of time.
2. Quantity of reproductive output.

Note 1: The potential reproductive capacity of an organism or *population* may be measured by the number of *gametes* (eggs), seed set , or asexual *propagules*.

Note 2: Fecundity is controlled by both genetic and environmental factors, and is the major determinant of *fitness*.

After [1]

fecundity selection

Component of the life cycle of an individual in which natural selection can occur, involving the production of more offspring by matings of certain genotype pairs than are produced by other genotype pairs.

fertilization effect

Enhanced growth of plants as a result of exposure to low levels of pollutants such as nitrogen and sulfur oxides in acid precipitation.

fertilizer

Substance applied to soil or hydroponic systems for improving the root nutrition of plants with the aim of increasing crop yields and (or) controlling production.

FETAX

Assay for *teratogenicity* using embryos of the frog, *Xenopus laevis*. Derived from the first letters of 'frog embryo teratogenesis assay Xenopus'.

filter feeder

Animal that feeds by straining suspended matter and food particles from water, typically by passing the water over a specialized structure, such as the baleen of baleen whales.

Note: Some other animals that use this method of feeding are clams, krill, flamingos, and sponges.

See *suspension feeder*.

final acute value (FAV)

Estimate of the concentration of a substance corresponding to a cumulative probability of 0.05 in the acute toxicity values for all *species* for which acceptable acute tests have been conducted on the material.

After [5]

final chronic value (FCV)

Estimate of the concentration of a substance corresponding to a cumulative probability of 0.05 in the chronic toxicity values for all genera for which acceptable chronic tests have been conducted on the material.

Note: The FCV ean also be calculated by dividing the FAV by the Final ACR.

After [5]

finding of no significant impact (FONSI)

Statement of no significant impact of a major federal action concluded after an environmental assessment (EA).

finite rate of increase

Rate of increase of *population* size measured over set intervals, such as between age classes of a life table or generations of a population with nonoverlapping generations, e.g., an annual plant.

fish acute toxicity syndromes (FATS)

Behavioral, physiological, and biochemical responses of fish used to classify chemicals by mode of action.

[5]

fitness (in ecology)

Capability of an individual to reproduce successfully, i.e., to transfer genes to the next generation.

Note 1: If differences in individual genotypes affect fitness, then the frequencies of genotypes increasing fitness will increase over generations due to natural selection.

Note 2: Darwinian fitness is the lifetime reproductive success of an organism or genotype, indexed by the average number of offspring that it produces, relative to other organisms or genotypes, and hence the relative number of copies of its genes that it passes on to future generations.

Note 3. Absolute fitness (w_{abs}) (of a genotype) is the ratio between the number of individuals with that genotype after selection to those before selection, calculated for a single generation from absolute numbers or from frequencies.

$W_{abs} = N_{after} / N_{before}$

If $w_{abs} > 1.0$, the genotype frequency increases. If $w_{abs} < 1.0$ its frequency decreases.

Note 4: Relative fitness is the fitness of individuals with a genotype (a) relative to fitness of individuals with competing genotypes (b etc).

Wrel (a) = Wabs(a) / Wabs(b)

Relative fitness can therefore take any nonnegative value, including 0.

Note 5: Inclusive fitness is the degree of adaptation of an organism to its environment, estimated from the number of genes belonging to its genotype that are passed on to the next generation, relative to those of other genotypes, counting both genes that it passes on directly and those that it shares with close relatives and passed on by them.

[16]

fitness advantage

Increased *relative fitness* of a resistant genotype in a polluted environment compared to a nonresistant genotype.

fitness cost

Reduced relative *fitness* of a resistant genotype in an unpolluted environment compared to a nonresistant genotype.

See *fitness*.

flocculation

Formation of a light, loose precipitate (i.e., a floc) from a solution.

flow-through system

Exposure system for aquatic toxicity tests in which the test material solutions and control water flow into and out of test chambers on a once-through basis either intermittently or continuously.

[4]

flow-through test

Aquatic toxicity test performed in a flow-through system.

Flory-Huggins theory

Thermodynamic theory of polymer solutions in which the thermodynamic quantities of the solution are derived from entropy of mixing and a reduced Gibbs energy parameter.

After [3]

Note: In environmental toxicology, the theory predicts nonideal behavior resulting in a nonlinear relationship between K_{ow} and lipophilicity for very lipophilic compounds. This explains the nonlinear relationship between K_{ow} and *BCF*.

fluctuating asymmetry

Deviation from perfect bilateral symmetry for a *population* of a bilaterally symmetrical *species* that is thought to reflect developmental instability.

Note : A trait is measured from the right and left sides of each individual , and the variance in the difference (right - left) for the population is a measure of fluctuating asymmetry.

See also *antisymmetry*, *directional asymmetry*.

fluid feeder

Organism that feeds on the fluids of other animals or of plants.

Note: Examples of fluid feeders include: aphids, ticks, mosquitoes, leeches, and hummingbirds

food chain

Hierarchical sequence of transfer of substances from prey organism to predator organism.

Note: Interconnected food chains combine to form a food web in which most organisms consume or are consumed by more than one other type of organism.

food-mass feeder

Animal that feeds on the body parts of other animals.

Note: Examples of food-mass feeders are carnivores (feed on meat), piscivores (feed on fish), insectivores (feed on insects), ophiophagous species (feed on snakes).

fossil

Mineralized or otherwise preserved remnant or trace (such as a footprint) of an animal, plant, and other organism.

free ion activity model (FIAM)

Model for acute metal toxicity to aquatic organisms based on the idea that toxicity occurs when the concentration of the free metal cation in solution reaches a certain level. This model has been developed into the *biotic ligand model*.

Freundlich adsorption isotherm equation

Empirical equation that describes the adsorption of a contaminant to soil. The equation is as follows: x / m = (Kf Ce) exp 1 / n, where x / m is the concentration of the contaminant in soil (mg kg^{-1}), Ce is the contaminant concentration in the aqueous phase at equilibrium (mg / L), Kf is the equilibrium constant (the Freundlich adsorption constant) and l/n is the contaminant-specific exponent.

fugacity, *f*, *p*

1. Of a substance B, f_B or p_B in a gaseous mixture is defined by

   $f_B = \lambda_B \lim p_B / \lambda_B$

   $p \to 0$

   where p_B is the partial pressure of B and λ_B its absolute activity.

[3]

2. The tendency for a substance to transfer from one environmental medium to another.

   Property analogous to chemical potential as it pertains to the tendency of a chemical to escape from a phase (e.g. from water).

fulvic acid

Humic substance that is soluble at all pHs.

Note: Most of the *humic substance* in natural water is fulvic acid.

[5]

functional redundancy

Apparently unaltered maintenance of community function despite changes in structure.

functional response

Change in some predator function, such as prey consumption rate, in response to changes in prey density.

fundamental niche

Environmental conditions under which a *species* can thrive.

See *Hutchinsonian niche*, *niche*.

Gaia hypothesis

Hypothesis proposed by James Lovelock that the Earth's temperature, albedo, and surface chemistry are homeostatically regulated by the sum of all the biota of the Earth.

gametic selection

Natural selection resulting from differential success of gametes produced by heterozygotes.

gastrointestinal excretion

Excretion through the intestinal mucosa by active or passive processes.

Note 1: This may involve loss by normal cell sloughing of the intestine wall.

Note 2: Some chemical *species* of metallic elements such as cadmium and mercury can experience significant levels of gastrointestinal excretion.

general adaptation syndrome (GAS)

Specific syndrome associated with Selyean stress composed of three phases: the alarm reaction, adaptation or resistance, and exhaustion; adaptation in all phases of the GAS results in restoration of homeostasis or reduced deviation from homeostasis.

See also *Selyean stress*.

generation time

Average length of time between the birth of parents and the birth of offspring.

genetic adaptation

Result of random genetic variation due to mutation, and (or) to changes in allele frequencies, causing variation in the survival and reproductive success of individuals and hence of groups of organisms, with the consequence that those best adjusted to their environment flourish.

Note: This process underlies the concept of *natural selection* leading to Darwinian evolution.

genetic drift

Evolutionary process of change in the allele frequencies in a population due to random changes in the frequency by which different alleles are transferred to the next generation.

Note: In small populations, genetic drift may result in extinction of some alleles leading to evolutionary change over time.

genetic equilibrium

See *Hardy-Weinberg equilibrium*.

genetic hitchhiking

Situation in which a scored locus is acting only as a marker for a closely linked gene that is actually responsible for the difference in tolerance among genotypes. More generally, it is the condition 'in which a given allele changes in frequency as a result of linkage or gametic phase disequilibrium with another selected locus' [17].

genetic risk

Risk to the progeny of an exposed individual of an adverse effect associated with heritable genetic damage, e.g., damage to germ cells leading to a nonviable fetus or an offspring with a birth defect.

gen-us, pl. -era

Low-level taxonomic rank used in the classification of living and fossil organisms.

Note: Like almost all other taxonomic units, genera may sometimes be divided into subgenera, singular: subgenus. The largest main taxonomic unit below the genus is the species.

geographic information system (GIS)

Computerized system to handle spatial data at a reasonable cost; most allow one to archive, organize, integrate, statistically analyze, and display many kinds of spatial information using a common coordinate system.

gill purge

See *cough*.

global distillation

Process by which persistent and relatively volatile organochlorine compounds are distilled from warmer regions of use to cooler regions of the globe.

global fractionation

Process by which some persistent organic pollutants (POPs) move more rapidly than others toward the polar regions Because POPs differ in their individual rates of degradation, vapor pressure, and lipophilicity, a fractionation occurs in. The net result is a redistribution of the different POPs from the equator or site of origin toward the cold polar regions of the Earth.

global warming

Heating up of the Earth's climate thought to result from the increased atmospheric carbon dioxide (CO_2) concentrations from fossil fuel burning, release of other greenhouse gases, and the worldwide destruction of forests.

See *greenhouse effect.*

good laboratory practice (GLP) **principles**

Fundamental rules incorporated in OECD guidelines and national regulations concerned with the process of effective organization and the conditions under which laboratory studies are properly planned, performed, monitored, recorded, and reported.

[1]

graded effect

Antonyms: *all-or-none effect*, *quantal effect*, *stochastic effect*

Consequence that can be measured on a graded scale of intensity or severity and its magnitude related directly to the *dose* or *concentration* of the substance producing it.

[1]

grasshopper effect

Global distillation of persistent organic pollutants involving seasonal cycling of temperatures such that movement toward the higher latitudes occurs in annual pulses.

greenhouse effect

The net warming of the Earth resulting from increasing atmospheric concentrations of carbon dioxide, water vapor and other *greenhouse gases*.

Note: Gases and vapors such as carbon dioxide and water vapor are relatively transparent to light but absorb long-wave, infrared radiation radiating back from the Earth's surface. The net balance for sunlight influx, infrared radiation absorption by greenhouse gases, and infrared efflux from the Earth's surface determines the steady state temperature of the Earth.

greenhouse gases

Atmospheric gases that are relatively transparent to sunlight entering the atmosphere but absorb infrared radiation being generated at the Earth's surface. They include water vapor, carbon dioxide, methane, nitrous oxide, CFCs, methylchloroform, carbon tetrachloride, and the fire retardant, halon. Ozone in the troposphere can also act as a greenhouse gas.

growth

Increase in size.

See also *exponential growth*, *intrinsic rate of growth*, *logistic growth*.

growth dilution

Decrease in *contaminant* concentration in a growing organism because the amount of tissue in which the contaminant is distributed is increasing.

guild (ecological)

Group of functionally similar *species* whose members interact strongly with one another but weakly with the remainder of the community.

[18]

Haber-Weiss reaction

The Haber–Weiss cycle consists of the following two reactions:

1. $H_2O_2 + OH^{\bullet} \rightarrow H_2O + O_2^{-} + H^{+}$

2. $H_2O_2 + O_2 \rightarrow O_2 + OH^{-} + OH^{\bullet}$

The second reaction achieved notoriety as a possible source of hydroxyl radicals. However, it has a negligible rate constant. It is believed that iron(III) complexes can catalyse this reaction: first, Fe(III) is reduced by superoxide, followed by oxidation by dihydrogen peroxide.

Note : This reaction may be important as a source of oxidative stress in cells and tissues.

[3]

habitat

1. Spatial area (geographical area) where a particular species population lives, large enough to comprise a breeding population.

   Note: A microhabitat or microenvironment is the immediate surroundings and other physical factors of an individual plant or animal within its habitat.

2. Physical conditions that surround a species, or species population, or assemblage of species, or community.

half life, $t_{1/2}$

half time

Time required for the *concentration* of a reactant in a given reaction to reach a value that is the arithmetic mean of its initial and final (equilibrium) values. For a reactant that is entirely consumed, it is the time taken for the reactant concentration to fall to one-half of its initial value.

Note: The half life of a reaction has meaning only in special cases:

1. For a first-order reaction, the half-life of the reactant may be called the half-life of the reaction.

2. For a reaction involving more than one reactant, with the *concentration*s of the reactants in their stoichiometric ratios, the half-life of each reactant is the same, and may be called the

half-life of the reaction. If the concentrations of reactants are not in their stoichiometric ratios, there are different half-lives for different reactants, and one cannot speak of the half-life of the reaction.

See also *biological half life*, *elimination half life*.

[1]

hard acid

Lewis acid with an acceptor centre of low polarizability.

Note: Other things being approximately equal, complexes of hard acids and bases or soft acids and bases have an added stabilization (sometimes called 'HSAB' rule). For example the hard O- (or N-) bases are preferred to their S- (or P-) analogues by hard acids. Conversely a soft acid possesses an acceptor centre of high polarizability and exhibits the reverse preference for coordination of a soft base. These preferences are not defined in a quantitative sense.

See also *class (a) metal ion*, *class (b) metal ion*.

[3]

hardness

Concentration of all metallic cations, except those of the alkali metals, present in water.

Note: In general, the concentration of calcium and magnesium ions in water, frequently expressed as mg L^{-1} calcium carbonate or equivalent, is used as a measure of hardness.

hard water

Water that contains mineral salts of divalent cations, commonly calcium and magnesium and sometimes ferrous ions, principally as bicarbonates, chlorides, and sulfates.

Note: Hardness caused by calcium bicarbonate is known as temporary, because boiling converts the bicarbonate to the insoluble carbonate; hardness from the other salts is called permanent.

Hardy-Weinberg equilibrium (genetic equilibrium)

State of a population if the frequencies of different allelles of all genes in the genome remain constant between generations.

Note 1: Hardy-Weinberg equilibrium requires the following conditions: (1) the *population* is large ("infinite"), (2) mating is random, (3) there is no selection, (4) the net mutation rate is zero, and (5) there is no migration.

Note 2: Hardy-Weinberg equilibrium is a very rare situation in natural populations. Deviation from the Hardy-Weinberg equilibrium is the basis for *microevolution*.

harm

Adverse effect to an *ecosystem*, *community*, *population*, *species*, individual organism, organ, tissue or cell.

After [1]

hazard

Set of inherent properties of a substance, mixture of substances or a process involving substances that, under production, usage or disposal conditions, make it capable of causing *adverse effect*s to organisms or the environment, depending on the degree of *exposure*; in other words, it is a source of danger.

See also *risk*.

[1]

hazard assessment

Determination of factors controlling the likely effects of a *hazard* such as the *dose-effect* and *dose-response relationships*, variations in target *susceptibility*, *bioaccumulation* potential, *persistence*, and mechanism of *toxicity*.

[1]

hazard evaluation

Identification and assessment of the potential adverse effects that could result from manufacture, use, and disposal of a material in a specified quantity and manner.

hazard identification

Determination of substances of concern, their adverse effects, target *population*s, and conditions of *exposure*, taking into account *toxicity* data and knowledge of effects on human health, other organisms and their

environment.

[1]

hazard index (HI)

Sum of the hazard quotients for substances that affect the same target organ or organ system.

Note: Ideally, hazard quotients should be combined for pollutants that cause adverse effects by the same mechanism. Aggregate exposures below a hazard index of 1.0 are unlikely to result in adverse health effects over a lifetime of exposure. A hazard index greater than 1.0 does not necessarily suggest a likelihood of adverse effects. The hazard index cannot be translated to a probability that adverse effects will occur, and is not likely to be proportional to risk.

[1]

hazard quotient (HQ)

Ratio of toxicant exposure (estimated or measured) to a reference value regarded as corresponding to a threshold of *toxicity*; often this is determined as the predicted environmental concentration (PEC) divided by the predicted no-effect concentration (PNEC).

Note: If the *hazard* quotient exceeds unity, the toxicant may produce an adverse effect but normally this will require a hazard quotient of several times unity; a hazard quotient of less than one indicates that no adverse effects are likely over a lifetime of exposure.

After [1]

hazardous concentration (HC_p, HCS)

Concentration of a substance producing a defined effect on p% (usually 5%) of *species* of concern, derived by means of a statistical extrapolation procedure.

See also *species sensitivity distribution*.

[19]

heat shock proteins (HSP)

Group of proteins transcriptionally activated by hyperthermia, mainly acting as chaperones.

See *stress proteins*.

heavy metal

Term used commonly but erroneously when referring to metal toxicity.

Note: The term is deprecated as it has no generally agreed meaning and sometimes is even applied to nonmetals. It is a source of confusion to be avoided. The term "metal" is often adequate.

After [1]

Henry's law constant (*H*)

Partition coefficient defined as the ratio of a substance's partial pressure in the gas phase above a liquid to its concentration in the liquid at steady state. Rigorously, the Henry's law constant is the limiting value at zero partial pressure.

hermaphrodite

Organism having both male and female characteristics.

Note: If such an organism produces both sperm and eggs, it can function both as male and female in sexual reproduction.

heterosis

See *heterozygote advantage*.

heterotherm n., -al, -ic adj.

Animal that partially regulates body temperature, sometimes maintaining its body temperature at a certain level, e.g. when active, but at other times allowing it to fluctuate with the environment.

heterotroph

Organism obtaining organic food by eating other organisms or their excreta.

Note: Animals, fungi, and most bacteria are heterotrophs.

heterotrophic succession

Temporal sequential appearance of different heterotrophic species at a location, most often decomposer organisms.

See *succession*.

heterozygote advantage

heterosis

Greater *Darwinian fitness* (reproductive output) from heterozygous than from homozygous individuals of a species. This tends to preserve variation in the population gene pool.

homeostasis

Totality of processes occuring in an open system or a closed system, especially a living organism, enabling it to regulate its internal environment to maintain stable, constant conditions or the outcome of these processes.

horme/sis n., **-tic** adj.

Unexpected and unexplained but favorable biological response to low level exposure to a substance or physical agent generally considered to be harmful.

humic substances

Non-volatile organic anionic polyelectrolytes, of biological origin,, in the molecular mass range 500 to 5000, which have complex structures and are variable in composition.

Note: Humic substances occur naturally as deposits on *sediment* and *soil* particles and constitute 30-50% of the *DOC* in natural waters. Humic substances are classified according to solubility and may contain humic acid, *fulvic acid* and humin.

After [4]

Hutchinsonian niche

Intersection of ranges of tolerances for sets of resources utilized by organisms, represented mathematically by a multidimensional hypervolume whose dimensions correspond to environmental variables. Any *species* is considered unimodally distributed, i.e., confined to a *habitat* in the *niche*.

Note 1: This niche concept is quantifiable and therefore particularly useful to ecologists. Hutchinson's niche is the most accepted concept of the niche in use today. In practice it is impossible to identify and quantify all the resources utilized by an organism. Thus, typically

the limiting factors receive most attention.

Note 2: Two aspects of the niche can be visualized: A *realized niche* for a species is the sum of niche dimensions unique to that particular species. A *fundamental niche* is the total sum of the species niche dimensions including parts shared with other species and parts unshared.

See *niche*.

hybrid

1. Result of interbreeding between two animals or plants of different *taxa*.

   Note: Hybrids between different *species* within the same *genus* are sometimes known as interspecific hybrids or crosses. Hybrids between different sub-species within a species are known as intra-specific hybrids. Hybrids between different *genera* are sometimes known as intergeneric hybrids.

2. Crossbreed between populations, breeds or cultivars within a single species.

   Note: Hybridization is often used in plant and animal breeding to obtain desirable characteristics not found or inconsistently present in the parent individuals or populations. (Keeton, William T. 1980. Biological science. New York: Norton. ISBN 0-393-95021-2 page A9).

hybridization (in genetics)

Process of combining different varieties or species of organisms to create a hybrid.

hydrosphere

Water above, on or in the Earth's crust, including oceans, seas, lakes, groundwater, and atmospheric moisture.

hypoxemia

Deficient oxygenation of the blood.

[1]

hypoxia

1. Abnormally low dioxygen content or tension.

2. Deficiency of dioxygen in the inspired air, in blood or in tissues.

See *anoxia*.

[1]

hypoxic

Dioxygen deficient.

[1]

impermeable

Of a membrane, not allowing a given substance to pass through. When applied to nonbiological membranes with no qualification, the term normally refers to passage of water.

imposex

Pseudo-hermaphroditic condition in female gastropods (snails) manifested by the development (imposition) of male characteristics such as a penis or vas deferens.

Note: Quantitation of imposex in the dog whelk (*Nucella lapillus*) is used to monitor *pollution* by the antifouling agent tributyltin oxide (TBTO) in marine environments.

incidence

Number of occurrences of a defined effect, or number of organisms showing the defined effect, during a given period in a specific population, usually expressed as a rate.

Note: When expressed as a rate, it is the number of affected organisms divided by the average number of organisms in the specified population during a defined period, or alternatively divided by the estimated number of organisms at the mid-point of that period.

After [1]

incipient LC_{50}

Concentration of a chemical which is lethal to 50% of the test organisms as a result of exposure for periods long enough for acute lethal action to cease; in other words, the concentration below which 50% of individuals will have a nomal lifespan depspite the previous exposure to a toxicant.

See also *median lethal concentration*.

After [5]

inclusive fitness

See *fitness*.

incremental unit risk estimate

For an air pollutant, the additional lifetime cancer risk occurring in a hypothetical population in which all individuals are exposed continuously from birth throughout their lifetimes to a concentration of 1 microgram per cubic meter ($\mu g\ m^{-3}$) of the pollutant in the air they breathe.

[1]

independent joint action

Production of an effect by each toxicant in a given exposure that is independent of the others and occurs by a different mode of action.

index of biological integrity

Composite index combining 12 qualities of fish communities of warm-water, low-gradient streams to determine the level of stream degradation. This index has been modified and widely used in the United States.

indicator

1. In biology, an organism, species, or community whose presence shows the presence of defined environmental conditions.

   Note 1: Abundance, yield, and age/weight ratios are indicators of population production.

   Note 2: A low cholinesterase level is an indicator of exposure to cholinesterase-inhibiting pesticides.

2. In chemistry, a substance that shows a visible change, usually of color, at a defined point in a chemical reaction.
3. A device that indicates the result of a measurement, e.g., a pressure gauge or a moveable scale.

indicator species

Species whose presence shows the occurrence of defined environmental conditions.

indigenous

Native to a given region or ecosystem.

Note 1: The term is applied to a native *species* to distinguish it from species introduced as a result of human activity.

Note 2: 'Indigenous' is not synonymous with '*endemic*'. In ecology, endemic means exclusively native to the biota of a specific place, whereas an indigenous species may occur in two or more different habitats.

indirect ecological effect

1. Effect resulting from imposed *biotic* or *abiotic* factors which alter *ecosystem* properties that in turn favor or disfavor an ecological component of importance (e.g., a *species*) and thus indirectly lead to improved or reduced *fitness* of that species.
2. Result of imposed biotic or abiotic factors allowing *indigenous* or new species to dominate, thereby affecting *ecosystem* composition.

indirect photolysis

Degradation of a contaminant through interaction with other molecules in solution that have absorbed light energy. This can occur through energy transfer or by chemical reaction with short-lived reactive species.

Note: Dissolved humic and fulvic acids are good examples of photoactive compounds that can increase the degradation of contaminants through indirect photolysis.

indirect toxicity

Adverse effects that result from agent(s) acting on and producing changes in the chemical, physical, and (or) biological environmenl external to the organisms under study (e.g., decrease in food for predatory species due to direct toxicity from a chemical to prey may produce adverse effects in the predator species due to starvation rather than inducing any direct chemical toxicity in predator organisms).

[5]

individual

One whole organism.

Note: Individuals have size, shape, and health or condition. They grow, reproduce and die over time.

individual effective dose (IED)

Concept forming the basis for most dose-response models, which holds that there exists a smallest dose needed to kill any particular individual. The IED is a characteristic of an individual.

industrial ecology

Study of the flows of materials and energy in the industrial environment and the effects of these flows on natural systems.

industrial melanism

Gradual increase to predominance of melanic forms in populations from industrialized regions.

inertia (of a community)

Community's ability to resist change.

infauna

Animals living in the sediment of aquatic systems but not on the surface.

See also *epifauna*.

inhibitory concentration (IC)

inhibition concentration

Concentration of a substance that causes a defined inhibition of a given system.

Note: IC50 is the median concentration that causes 50 % inhibition in a nonlethal biological measurement of the test organisms, such as reproduction or growth.

After [1]

inhibitory dose (ID)

inhibition dose

Dose of a substance that causes a defined inhibition of a given system.

Note: ID50 is the median dose that causes 50 % inhibition.

[1]

inhibitory time (IT)

See *median inhibitory time*.

initiating event

Specific action that results in a risk being incurred.

integrated risk information system (IRIS)

USEPA database containing reference doses, slope factors, and drinking-water health advisories (one-day, ten-day, longer term, and life time advisories), and associated information.

interference competition

Interspecies competition in which one *species* interferes with another, as might occur with territoriality or aggressive behavior.

internal dose

See *absorbed dose (of a substance)*.

interspecies competition

Interference with or inhibition of one *species* by another.

interspecific competition

Competition by different species for the same (limited) resources.

interspecific interaction

Relations between different *species* in a *community*.

interstitial water

Water in *sediment* or soil that surrounds the solid particles. The amount of interstitial water is calculated and expressed as the percentage ratio of the weight of water in the sediment to the weight of the wet sediment.

intraspecific competition

Competition by individuals of the same species (population) for the same (limited) resources.

intrinsic rate of growth, *r*

r = (natality + immigration) - (mortality + emigration)

See *growth*.

intrinsic (Malthusian) rate of increase

Rate of increase in the size of a *population* growing under no constraints.

See *Malthusian theory*.

isobole approach

Approach used to visualize or quantify joint action of chemical mixtures by plotting a graph (isobologram) of equally effective dose pairs (isoboles) for a single effect level. A particular effect level is selected, such as 50% of the maximum, and doses of drug A and drug B (each alone) that give this effect are plotted as axial points in a Cartesian plot. The straight line connecting A and B is the locus of points (dose pairs) that will produce this effect in a simply additive combination. This line of additivity allows a comparison with the actual dose pair that produces this effect level experimentally.

[20]

isotope effect

Effect on the rate or equilibrium constant of two reactions that differ only in the isotopic composition of one or more of their otherwise chemically identical components. It is referred to as a kinetic isotope effect or a thermodynamic (or equilibrium) isotope effect.

[3]

isotopic discrimination

The differential behavior of isotopes occurring if the rate or extent of participation in some biological or chemical process depends significantly on the mass of the isotope. Also called the *isotope effect*.

iteroparous species

Species that reproduces more than once.

Kamofsky's law

Any agent will be teratogenic if it is present at concentrations or intensities producing cell toxicity.

Kaplan-Meier method

See *product-limit method*.

keystone habitat

High quality habitat patch essential to maintaining the vitality of the *metapopulation*.

keystone species

Species, usually a top predator, that influences the ecological community by its activity or role, not its numerical dominance.

K_{oa}

Partition coefficient for a compound between n-octanol and air. Like the K_{ow}, it is a measure of lipophilicity.

K_{ow}

See *octanol-water partition coefficient.*

k-strategy

Equilibrium strategy for *species* involving effective interactions with each other in the community, allowing coexistence of many species. Equilibrium species are more effective competitors than opportunistic species.

larva

Recently hatched insect, fish or other organism that has different physical characteristics than those seen in the adult, requiring metamorphosis to reach the adult body structure.

law of frequence

According to this 'law', there are comparatively many rare (low abundance) species, and possibly comparatively many common (high abundance) species, but relatively few in the middle (of medium abundance).

Note: Thus if one collects data on species presence/absence in a set of quadrats, one tends to find a J-shaped pattern in the distribution of species frequencies.

[21]

leachate

Water or wastewater that has percolated through a column of soil or solid waste in the environment.

lentic

Related to standing water *riparian*-wetland areas such as lakes, ponds, seeps, bogs, and meadows.

lentic water

Non-flowing or still inland water; e.g. lakes, ponds.

Leslie matrix

Square matrix used in *population* biology to predict population growth. The top row of the matrix is the fecundity for each age class of mothers and a sub-diagonal is constructed from the number of individuals surviving from age class x to x + 1. Multiplied by the population vector of the number of female offspring in each age class x at time t, it predicts the age distribution of the population at the next time step t+1, corresponding to the age class interval x+1.

lethal

Deadly; fatal; causing death.

[1]

lethal body burden (LBB)

Total body uptake of a substance that is associated with mortality in short-term exposures.

[5]

lethal concentration (LC)

Concentration of a substance in an environmental medium that causes death following a certain period of *exposure*.

Note: LC50 is the median concentration that causes death in 50% of the test population.

[1]

lethal dose (LD)

Amount of a substance or physical agent (e.g. radiation) that causes death when taken into the body.

Note: LD50 is the median dose that causes death in 50% of the test population.

[1]

lethal time (LT)

Time taken for a defined percentage, usually 50%, of a test *population* to die.

Note: The median lethal time (MLT) for 50% of the test population is referred to as the MLT_{50}.

See also *effect time*, *median inhibitory time*.

lethality

Ability to cause death.

Liebig's law of the minimum

Observation that a *population*'s size (number of individuals or biomass) is limited by some essential factor in the environment that is scarce relative to the amount of other essential factors, e.g., phosphorus-limited algal growth in a lake.

life cycle

Series of stages, from a given point in one generation to the same point in next generation, e.g. egg-larva-adult-egg (hyphenated when used as an adjective, e.g. life-cycle strategy).

See also *life-cycle study*, *life history*.

life-cycle study

Comprehensive study to determine the impact of a substance or mixture on the survival, growth, reproduction, development, or other important qualities at all stages of a *species* life cycle.

life history

Description of *life cycle* events through which an organism passes, with particular reference to those events that influence survival and reproduction.

life table (in actuarial science)

Statistical table that follows a hypothetical cohort of 100,000 persons born at the same time as they progress through successive ages, with the cohort reduced from one age to the next according to a set of *death rates* by age until all persons eventually die.

Note 1: In *ecology*, *fertility* for each age class is normally included in the tables.

Note 2: The life table is used mainly to indicate expectation of life at various ages. However, it also provides information on numbers of individuals who survive to various ages, median age at death, *age-specific death rates*, and the probability of dying at certain ages.

life table response experiment (LTRE)

Retrospective comparison of two or more populations in which the response variable is a life table or a complete set of stage-specific vital rates.

(Caswell 2001: Chapter 10) reference at end of glossary

limit test

Acute *toxicity* test in which, if no ill-effects occur at a pre-selected maximum dose, no further testing at greater *exposure* levels is required.

[1]

limit value (LV)

Limit concentration at or below which Member States of the European Community must set their *environmental quality standard* and *emission standard* for a particular substance according to Community Directives.

[1]

limited life span paradigm

Model based on the assumption that the maximum life span of an individual organism is an inherent, genetically defined property of that organism.

limnocorrals

Artificial enclosures placed in the *pelagic* region of ponds, lakes, or marine environments. These systems vary in size from as little as 2 L to over 2.5 million liters; however, most of these systems have a volume between 1000 and 10,000 L.

Note: These systems may or may not be in contact with the profundal region. Fish are generally excluded from these test systems.

[5]

limnology

Study incorporating the study of all aspects of inland freshwater habitats including lakes, ponds, rivers, streams, swamps, wetlands, groundwaters, and reservoirs that make up inland water systems

linear free energy relationship (LFER)

An empirical relationship in which numerical parameters are associated with small perturbations in a parent molecule and are subsequently correlated with the change in the free energy of a certain reaction of the parent molecule versus the perturbed molecules. A classical example is the well-known Hammett equation, in which sigma values are constructed for specific substituents on a benzoic acid parent molecule. The linear correlation is then between the (summed) sigma values for a set of compounds and the pKa (free energy of acid

dissociation) of those compounds.

linear solvation energy relationship (LSER)

Class of quantitative structure-activity relationships based on molecular volume, ability to form hydrogen bonds, and polarity or ability to become polarized.

Litchfield method

Simple, semigraphical method for analyzing survival time data and estimating LT50 values.

Litchfield-Wilcoxon method

Semigraphical method for estimating a median lethal concentration (LC_{50}), median lethal dose (LD_{50}), or median effective concentration (EC_{50}). Although very easy to perform, it is the most subjective method for such estimations because it involves fitting a line to data by eye.

littoral

1. Belonging to the shore of a lake, river, pond, or especially the sea.
2. Intertidal zone, sometimes referring specifically to the shallow well-lit region along the shore.

littoral enclosures

Isolated shore regions of freshwater ponds separated from the main body of water by plastic dividers used for ecotoxicological testing. These test systems generally have a volume of 1000 L to 50 000 L and a maximum depth of 2 m.

[5]

loading

Ratio of animal biomass to the volume of test solution in an exposure chamber.

logistic curve

Function, often applied to growth curves, fitting the general equation:

$y = k / (1 + e^{a+bt})$

where *t* represents time, y the body weight or *population* size, *k* is the rate of growth, a and b are constants, and b is greater than 0. In the logistic equation the percentage rate of increase decreases linearly as size increases. The resulting curve continually rises, slowly at first, more rapidly in the middle phase and slowly again near the end of growth.

logistic growth

Growth of a *population* under environmental constraints that set a maximum population size, giving an S-shaped curve.

See *carrying capacity*, *growth*.

logit

Natural logarithm of the quotient of a probability, *P*, and its complement, i.e., ln[*P*/(1-*P*)].

logit transformation (in toxicology)

In competitive binding assays, the *logit*-log *dose* relationship, in which the *response* is defined by:

$R = \text{logit}\,(y) = \ln\,[y / (1 - y)]$

where $y = b/b_0$ with b = fraction of tracer bound and b_0 = value of b with no unlabelled ligand in the system.

Note: Logit-transformed assay data frequently yield straight-line dose–response data, amenable to statistical analysis. More generally in toxicology, the transformation is applied to dose–response data where *b*0 denotes the maximum response in the absence of a toxic substance.

After [1]

log-normal distribution

Distribution function $F(y)$, in which the logarithm of a quantity is normally distributed, i.e.,

$F(y) = f\text{gauss}(\ln y)$

where $f\text{gauss}(x)$ is a Gaussian (or normal) *distribution*.

[4]

log-normal transformation

Transformation of data with a logarithmic function that results in a normal *distribution*.

[3]

Lorax incongruity

Delusion of selfless motivation in environmental stewardship or advocacy. The Lorax is a character in a popular children's book by Dr. Seuss who 'speaks for the trees, for the trees have no tongues'.

lordosis

Extreme and abnormal forward curvature of the spine.

See also *scoliosis*.

loss of life expectancy (LLE)

Calculated estimate of loss in life time associated with a risk factor; it is estimated as the simple difference between life expectancy without the risk factor and life expectancy with the risk factor.

lotic

Related to flowing continental waters, such as rivers and streams.

lotic mesocosms or microcosms

Streams of various sizes used to evaluate the effects of substances. Unlike lentic systems, no standardized design has been developed for flowing-water test systems.

[5]

lotic water

Flowing continental waters, such as rivers and streams.

lowest effective dose (LED)

Lowest dose of a chemical inducing a specified effect in a specified fraction of exposed individuals.

[1]

lowest lethal concentration found

See *minimum lethal concentration*.

[1]

lowest-observed-adverse-effect level (LOAEL)

Lowest concentration or amount of a substance (dose), found by experiment or observation, which causes an adverse effect on morphology, functional capacity, growth, development, or life span of a target organism distinguishable from normal (control) organisms of the same *species* and strain under defined conditions of exposure.

[1]

lowest observed effect concentration (LOEC)

Lowest concentration of a material used in an aquatic toxicity test that has a statistically significant adverse effect on the exposed population of test organisms compared with controls.

Note: When derived from a life cycle or partial life cycle test, it is numerically the same as the upper limit of the MATC. Also called lowest observed adverse effect level (LOAEL).

lowest-observed-effect level (LOEL)

Lowest concentration or amount of a substance (dose), found by experiment or observation, that causes any alteration in morphology, functional capacity, growth, development, or life span of target organisms distinguishable from normal (control) organisms of the same *species* and strain under the same defined conditions of *exposure*.

[1]

See also *lowest-observed-effect concentration*.

lx life table or schedule

Life table that summarizes mortality data for *population*s.

Note: 'lx' is the number of individuals in a cohort alive at age or stage class, x.

lxmx life table

Life table that summarizes both mortality and natality data for *population*s.

Note: 'lx'is the actual number or the proportion (as a decimal or percentage) of survivors at the beginning of age interval x. Since several samples are often averaged together, the lx values may not always be whole numbers. 'mx' is the number of female births to each age group of 'mothers'; the number of eggs or young which are female (in a species with a 1:1 sex ratio, this = Mx/2 where Mx = total eggs or young produced per female at age x.). Since, for most organisms, one male can fertilize a number of females, the size of the population is more dependent on the number of females present, and the calculations are usually done using only females.

lysimeter

Laboratory column of selected representative soil or a protected monolith of undisturbed field soil with facilities for sampling and monitoring the movement of water and chemicals.

MacArthur-Wilson model

Model of island colonization giving the mathematical relationship

$S_t = S_{EQ}(1 - e^{-Gt})$

where S_t = the number of *species* present at time t, S_{EQ} = the equilibrium number of species for the island, and G = the rate constant for colonization of the island.

macrocosm

Large multi-*species* test system.

See also *mesocosm, microcosm*.

macronutrient

Imprecise term referring to a *nutrient* required for survival, or present in biological fluids or compartments at a level easily measured by existing analytical techniques.

macrophyte

Aquatic plant large enough to be seen easily with the naked eye (as distinct from phytoplankton and small algae).

Note: The term aquatic macrophyte has no taxonomic significance.

male-mediated toxicity

Disease or birth defects produced by a father's exposure to a physical or chemical agent.

Malthusian theory

Model, developed by Thomas R. Malthus (1766-1834), implying that, unchecked by environmental or social constraints, human populations would double every twenty-five years, regardless of the initial population size. Thus, if X_i denotes the population size during time period *i* and *r* denotes the population growth rate per unit time, the Malthusian population model gives the relationship:

$$X(i+1) = (1+r)X_i.$$

See *intrinsic (Malthusian) rate of increase*.

mass balance equation

Equation that expresses the total mass of a chemical in terms of all the various forms and concentrations in different environmental compartments (including biota) in which it occurs.

maturity index

Index for pollution based on the proportions of *species* in a soil nematode community that fall into various categories ranging from colonizers (r-strategists) to persisters (k strategists).

See also *k-strategy*, *r-strategy*.

maulstick incongruity

Assignment of ecological or biological significance of a contaminant's effect based primarily on statements of statistical significance but contrary to biological probability.

maximum acceptable toxicant concentration (MATC) (in ecology)

Geometric mean of the lowest exposure concentration that causes a statistically significant adverse effect (LOEC) and the highest exposure concentration where no effect is observed (NOEC) in a life cycle (full chronic) or partial life cycle (partial chronic) test.

Note: Calculation of an MATC requires quantitative life cycle toxicity data on the effects of a material on survival, growth, and reproduction.

[5]

maximum allowable (admissible, acceptable) concentration (MAC)

Regulatory value defining the concentration that if inhaled daily (in the case of work people for 8 hours with a working week of 40 hours, in the case of the general *population* 24 hours) does not, in the present state of knowledge, appear capable of causing appreciable harm, however long delayed during the working life or during subsequent life or in subsequent generations.

See also *lowest observed effect concentration*, *no observed effect concentration*.

maximum likelihood estimation (MLE)

Parametric method used to fit dose- or concentration-effect data to the log-normal, log-logistic, or other models. Probit and logit approaches are most often applied with MLE methods.

mean absorption time (MAT)

Mean time required for absorption of a drug or contaminant calculated as the difference in mean residence time (MRT) of the material introduced by the (noninstantaneous) route of interest and the MRT for the same material injected intravenously.

mean generation time (Tc)

Average time interval required for a bacterial cell to divide or for the population to double under a defined set of conditions.

mean residence time (in pharmaco- and toxicokinetics) (MRT)

Average time a substance remains in an animal body or an organ after rapid intravenous injection.

Note 1: Like clearance, its value is independent of dose in most cases.

Note 2: After an intravenous bolus:

$t_r = A_m / A$

where t_r is the MRT, A is the area under the plasma concentration-time curve, and A_m is the

area under the moment curve.

Note 3: For a drug with one-compartment distribution characteristics, MRT equals the reciprocal of the elimination rate constant.

After [1, 3]

measurement endpoint (in ecological risk assessment)

Measurable response to a stressor (e. g., fledglings produced per nest each year) that is related to the valued qualities of the assessment endpoint (e.g., reproductive success of bald eagles).

median effective concentration (EC_{50})

Statistically derived median concentration of a substance in an environmental medium expected to produce a certain effect in 50% of test organisms in a given *population* under a defined set of conditions.

Note: EC_n refers to the median concentration that is effective in *n* % of the test population.

[1]

median effective time (ET50)

For sublethal or ambiguously lethal effects, the median time until 50% of the exposed individuals respond.

median effective concentration (EC_{50})

Statistically derived median concentration of a substance in an environmental medium expected to produce a certain effect in 50% of test organisms in a given *population* under a defined set of conditions.

Note: EC_n refers to the median concentration that is effective in *n* % of the test population.

[1]

median effective dose (ED_{50})

Statistically derived median dose of a chemical or physical agent (radiation) expected to produce a certain effect in 50% of test organisms in a given *population* or to produce a half-maximal effect in a biological system under a defined set of conditions.

Note: ED_n refers to the median dose that is effective in *n* % of the test population.

[1]

median inhibitory time (IT_{50})

inhibitory time

Time required for a toxicant to inhibit a specified process in 50% of a *population* under test conditions.

See also *effect time*, *lethal time*.

median lethal concentration (LC_{50})

Statistically derived median concentration of a substance in an environmental medium expected to kill 50% of organisms in a given *population* under a defined set of conditions.

[1]

median lethal dose (LD_{50})

Statistically derived median dose of a chemical or physical agent (radiation) expected to kill 50% of organisms in a given *population* under a defined set of conditions.

[1]

median lethal time (TL_{50})

Statistically derived median time interval during which 50% of a given *population* may be expected to die following *acute* administration of a chemical or physical agent (radiation) at a given *concentration* under a defined set of conditions.

[1]

median teratogenic concentration (TC_{50})

Median concentration resulting in developmental malformations for 50% of the exposed individuals within a predetermined time, e.g., 96 h.

median time to death (MTTD)

Median time resulting in death for 50% of the exposed organisms.

See also *median lethal time*.

median tolerance limit (TL_m or TL_{50})

Concentration of a substance in air, water, *sediment* or soil at which 50% of the test organisms survive after a specified time of exposure. The TL50 (equivalent to the TLm) is usually expressed as a time-dependent value (e.g. 24-h or 96-h TL50; the estimated concentration at which 50% of test organisms survive after 24 or 96 h of exposure). Unlike lethal concentration and lethal dose, the term tolerance limit is applicable in designating the level of any measurable lethal condition (e.g., extremes in pH, temperature, dissolved oxygen). TLm and TL50 have been replaced by median lethal concentration (LC50) and median effective concentration (EC50).

medi/um, pl. **-a** (in environmental science)

Surrounding environment (air, water, soil or *sediment*) in which living organisms function and thrive.

meiofauna

Small benthic invertebrates living in interstices of *soil* or *sediment* or in aquatic systems.

Note: The term loosely defines a group of organisms by their size, larger than microfauna but smaller than macrofauna. In practice these are usually organisms that can pass through a 1 mm mesh but will be retained by a 45 μm mesh, but the exact dimensions varies from researcher to researcher. Whether an organism will pass through a 1 mm mesh may depend upon whether it is alive or dead at the time of sorting.

meiosis

Process of "reductive" cell division, occurring in the production of gametes, by means of which each daughter nucleus receives half the number of chromosomes characteristic of the somatic cells of the species.

[1]

meiotic drive

Any process which causes some alleles to be over-represented in the gametes which are formed during meiosis.

Note: With normal Mendelian segregation at a genetic locus, on average half of an organism's offspring inherit one of the alleles and the other half the other allele. This term refers to rare cases in which Mendel's laws are broken, and one of the alleles is consistently found in more than half the offspring.

melanic forms

Individuals or subspecies with increased dark pigmentation.

melanism

Increased black or nearly black pigmentation of skin, feathers, or hair of an organism, resulting from (increased) synthesis of melanin.

See *industrial melanism*.

Mendelism

Fundamental principles of inheritance (especially the laws of segregation and independent assortment and the existence of dominant and recessive characters), propounded originally by Mendel and forming the basis for the science of classical genetics.

[4]

mesocosm

Enclosed and essentially self-sufficient (but not necessarily isolated) experimental environment or ecosystem that is on a larger scale than a laboratory microcosm.

[4]

Note: A mesocosm is normally used outdoors or, in some manner, incorporated intimately with the ecosystem that it is designed to reflect.

See also *macrocosm*, *microcosm*.

meta-analysis

Process of using statistical methods to combine the results of different studies. In the biomedical sciences, the systematic evaluation of a problem using information (commonly in the form of statistical tables and other data) from a number of independent studies.

Note 1: A common application is the pooling of results from a number of small randomized controlled trials, none in itself large enough to demonstrate statistically significant differences, but, capable of doing so in aggregate.

Note 2: Meta-analysis has a qualitative component, i.e. application of predetermined quality criteria

(e.g. completeness of data, absence of bias) and a quantitative component, i.e. integration of numerical information.

Note 3: Meta-analysis includes overview and data pooling aspects, but implies more than either of these processes. Meta-analysis carries the risk of several biases reinforcing each other.

metallothionein

Relatively small (6.5-7 KDa) protein with approximately 25 to 30% of its amino acids being cysteine, having no aromatic amino acids or histidine, and having the capacity to bind several metal atoms per molecule.

metallothionein-like proteins

Poorly characterized, cysteine-rich metal-binding proteins or proteins not conforming precisely to the classic properties of metallothioneins.

metameter

Measurement or a transformation of a measurement used in the analysis of biological tests, e.g., the probit metameter.

metapopulation

Set of local *population*s which interact via dispersing individuals among local populations; though not all local populations in a metapopulation need interact directly with every other local population.

[22]

Note 1: A metapopulation is generally considered to consist of several distinct populations together with areas of suitable habitat which are currently unoccupied. Each population cycles in relative independence of the other populations and eventually goes extinct as a consequence of *demographic stochasticity*.

Note 2: Individuals may immigrate into to a small metapopulation and rescue that population from extinction.

See *rescue effect*.

method of multiple working hypotheses

Method proposed to reduce precipitate explanation by considering all plausible hypotheses simultaneously in testing so that equal amounts of effort and attention are provided to each.

[23]

microcosm

Artificial multi-*species* test system that simulates major characteristics of the natural environment for the purposes of ecotoxicological effects and risk assessment; such systems are normally terrestrial or aquatic and may contain plants, animals (vertebrates and invertebrates) and microorganisms.

Note: The terms *mesocosm* and *macrocosm* are used to refer to larger and more complex systems than microcosms but the distinction is often not clearly defined.

microevolution

Evolutionary change below the species level; a small change in the genetic make-up of a population from generation to generation.

micronutrient

See *trace nutrient*.

microphyte

Plant of microscopic size.

Microtox® test

Test involving luminescent marine bacteria of the *Vibrio sp.* (eg., *V. (Photobacterium) phosphoreum*, *V. fischeri*, *V. harveyi*). A decrease in bioluminescence is thought to reflect toxic action.

migration (of a population)

Movement of an individual or group into or out of a new *population* or geographical region.

mineral

Naturally occurring crystalline substance which has a particular chemical composition and specific physical

properties.

mineralization

1. Complete conversion of organic substances to inorganic derivatives, often visible as microscopic deposits that may be associated with damage to soft tissue, e.g., in the kidney.

[1]

See *biomineralization*.

2. Processes (e.g., fossilization) after death and burial of organisms within sediments involving the total replacement of the organic material with various minerals, frequently calcite or quartz, although many other minerals, such as pyrite, may be involved.
3. in geology. The hydrothermal deposition of economically important metals in the formation of ore bodies.
4. in soil science. The release of inorganic compounds during complete microbial decomposition of organic materials in the soil.

minimum significant difference (MSD)

Difference between groups (in tests with e.g., salmonid fish, the difference in average weights or average mortality) that would have to occur before it could be concluded that there was a significant difference between the groups.

Note: The MSD is provided by Dunnett's multiple range test.

minimal time to effect or response

Minimum time required to get an effect or response. Regardless of the toxicant concentration, the effect, or response, cannot occur any faster than this minimum time.

minimum viable population (MVP)

Smallest population size of a species allowing survival in the wild.

Note 1: More specifically MVP is the smallest possible size at which a biological population can exist without facing extinction from natural disasters or demographic or environmental changes, or genetic drift.

Note 2: MVP is used in the fields of biology, ecology and conservation biology/ecology.

mixing zone

Area where an effluent discharge undergoes initial dilution and is extended to cover the secondary mixing in the ambient water body.

Note: A mixing zone is an allocated impact zone where water quality criteria can be exceeded as long as acutely toxic conditions are prevented.

[5]

model

Formal representation of some component of the world or a mathematical function with parameters that can be adjusted so that the function closely describes a set of empirical data.

Note 1: A mathematical or mechanistic model is usually based on biological, chemical or physical mechanisms, and its parameters have real world interpretations. By contrast, statistical or empirical models are curve-fitted to data where the mathematical function used is selected for its numerical properties.

Note 2: Extrapolation from mechanistic models (e.g. pharmacokinetic equations) usually carries higher confidence than extrapolation using empirical models (e.g. the logistic extrapolation models).

Note 3: A model that can describe the temporal change of a system variable under the influence of an arbitrary "external force" is called a dynamic model. To turn a mass balance model into a dynamic model, theories are needed to relate the internal processes to the state of the system, expressed e.g. in terms of concentrations. The elements required to build dynamic models are called process models.

model error

Elements of uncertainty associated with the discrepancy between the model and the real world.

modifying factor (MF)

See *uncertainty factor*.

monitoring

Continuous or repeated observation, measurement, and evaluation of health and (or) environmental or technical data for defined purposes, according to prearranged schedules in space and time, using comparable methods for sensing and data collection.

Note: Evaluation requires comparison with appropriate reference values based on knowledge of the probable relationship between ambient exposure and adverse effects.

See also *biological monitoring*.

[1]

monitoring test

Test designed to be applied on a routine basis, with some degree of control, to ensure that the quality of an environmental *compartment*, biological endpoint or *effluent* has not exceeded some prescribed criteria range. In a biomonitoring test, organisms are used as "sensors" to detect changes in the quality of water or effluent. A monitoring test implies generation of information, on a continuous or other regular basis.

Monte Carlo simulation

Analysis of a sequence of events using random numbers to generate possible outcomes in an iterative process.

After [3]

Montreal Protocol

Officially the Protocol on Substances That Deplete the Ozone Layer, a treaty signed on Sept. 16, 1987, at Montreal by 25 nations; there are now 168 subscribing nations. The protocol set limits on the production of chlorofluorocarbons (CFCs), halons, and related substances that release chlorine or bromine to the ozone layer of the atmosphere.

morphodynamics

Study of the interaction and adjustment of the seafloor topography and fluid hydrodynamic processes, seafloor morphologies and sequences of change dynamics involving the motion of *sediment*.

[1]

mortality

Death rate, the number of dead individuals per unit time (see *carrying capacity*).

Note:Natality and mortality graphs together form a life table.

[1]

most-sensitive-species approach

Ecotoxicological approach in which results for the most sensitive of all tested *species* are used as an indicator of the toxicant concentration below which the entire community is protected from adverse effects.

moving average method

Method of estimating LC50, EC50, or LD50. It can be implemented with straightforward equations if the toxicant concentrations are set in a geometric series and there are equal numbers of individuals exposed in each treatment.

See also *median effective concentration*, *median lethal concentration*, *median lethal dose*.

multigeneration study

1. *Toxicity* test in which two to three generations of the test organism are exposed to the substance being assessed.
2. *Toxicity* test in which only one generation is exposed and effects on subsequent generations are assessed.

[1]

multiple heterosis

Higher fitness of an individual as a composite or summed effect of heterozygote superiority (heterosis) at each of a series of loci.

multiplicative growth factor per generation

See *finite rate of increase*.

mutualism

Interaction between two or more species, giving fitness benefit to all the involved species, e.g. increased

carrying capacity.

Note 1: Similar interactions within one species is called co-operation.

Note 2: Symbiosis is the form of mutualism leading to the closest spatial or physical association. The process may be obligate, meaning the involved species cannot survive alone. Examples include cleaner fish, pollination and seed dispersal, gut flora and nitrogen fixation by fungi.

narcosis

1. In ecotoxicology, see *baseline toxicity*.
2. In human toxicology, state of insensibility or stupor.

After [1]

National Academy of Sciences (NAS) **paradigm of risk assessment**

Model for risk assessment with 4 components - hazard identification, exposure assessment, dose-response assessment, and risk characterization.

Note: This model is used for both human and ecological risk assessments.

natural selection

Evolutionary theory, originally proposed by Darwin, of the preferential survival and reproduction of organisms better adapted to their environment as a result of *genetic adaptation*.

natality

Rate of birth, the number of newborn individuals per unit time.

Note: Natality and mortality graphs together form a life table.

[1]

natural radiation background

Cosmic radiation emitted from stars and long-lived terrestrial radionuclides that are ubiquitously present in the Earth's soils.

nekton

Aggregate of actively swimming animals in a body of water ranging from microscopic organisms to whales.

neo-Darwinism

Theory of biological evolution (widely accepted since the 1920s) based on Darwin's theory of natural selection but incorporating the theories of later biologists regarding genes, inheritance, and mutation, particularly those of Weismann and Mendel. (see *Mendelism, Weismannism*).

[4]

neonat/e n., **/al** adj.

Newborn animal or human infant during the first 4 weeks of postnatal life

Note: For statistical purposes some scientists have defined the period as the first seven days of human postnatal life. The precise definition varies from *species* to species.

After [1]

neophyte

Plant found newly in an area where it had not been recorded previously.

net reproductive rate (R_o)

Expected number of females to be produced during the lifetime of a newborn female as estimated with a life table.

niche (in ecology)

Group of conditions and resources, facilitating but limiting survival, growth and reproduction of a defined group of organisms or *species*.

Note 1: The niche influences how a population responds to the abundance of its resources and enemies.

Note 2: The niche is influenced by its inhabiting populations.

Note 3: The abiotic or physical environment is part of the niche because it influences how populations affect, and are affected by, resources and enemies.

See also *complimentary niche*, *fundamental niche*, *Hutchinsonian niche*, *niche preemption*, *realized niche*.

niche preemption

Rapid use and preemption of resources by a *species* that exploits them to the exclusion or severe disadvantage of another species.

See also *niche*.

niche width

Term referring to the area which a species could physically inhabit.

Note: This area is defined by suitable climate and available food sources appropriate to that species as well as other factors such as temperature and air or water pressure levels. The niche width often differs from the *realized niche*.

NIMBY principle

Public acceptance of necessary provisions (e.g. waste incinerators) provided they do not affect the individual's quality of life.

Note: Derived from the first letters of "not in my backyard".

nine aspects of disease association

Nine aspects of evidence, defined by Bradford-Hill (1965), fostering the accuracy of linkage between a risk factor and disease: strength of association, consistency of association, specificity of association, temporal association, biological gradient (dose-response) in the association, biological plausibility, coherence of the association, experimental support of association, and analogy.

'no action' alternative (to remediation of the site)

Scenario in which one assesses if the contaminants at the waste site pose, or will pose in the future, a risk if left alone.

nonstochastic health effects

Effects that are dependent on the magnitude of the dose in excess of a threshold.

non-target organisms

Organisms that are not the intended targets of a particular use of a pesticide.

no-observed-adverse-effect level (NOAEL)

Greatest concentration or amount of a substance, found by experiment or observation, which causes no detectable adverse alteration of morphology, functional capacity, growth, development, or life span of the target organism under defined conditions of exposure.

Note: When derived from a life cycle or partial life cycle test, it is numerically the same as the lower limit of the *maximum acceptable toxicant concentration*.

After [1]

no-observed-effect concentration (NOEC) (in aquatic toxicology)

Special case of the *no-observed-effect level*, commonly used in aquatic toxicology.

Note: When derived from a life cycle or partial life cycle test, it is numerically the same as the lower limit of the MATC.

no-observed-effect level (NOEL)

Greatest concentration or amount of a substance, found by experiment or observation, that causes no statistically significant alterations of morphology, functional capacity, growth, development, or life span of target organisms distinguishable from those observed in normal (control) organisms of the same *species* and strain under the same defined conditions of exposure.

[1]

no-response level (NRL)

Maximum dose of a substance at which no specified response is observed in a defined *population* and under defined conditions of exposure.

[1]

normal equivalent deviation (NED)

Proportion dying in a toxicity test expressed in terms of standard deviations from the mean of a normal curve.

normit

Metameter equal to the *normal equivalent deviation* (NED). The resulting analysis of dose- or concentration-effect data with the normit metameter is often called normit analysis and is essentially equivalent to probit analysis.

numerical response

Change in predator or grazer number through increased reproductive output, decreased mortality, or increased immigration in response to changes in prey or food densities.

nutrient

See *essential nutrient*.

octanol-water partition coefficient (P_{ow}, K_{ow})

Ratio of the solubility of a chemical in octanol to its solubility in water at equilibrium.

Note: Measure of lipophilicity, used in the assessment of both the uptake and physiological distribution of organic chemicals and prediction of their environmental fate.

After [1]

octaves (in environmental science)

Log2 classes (e.g., 1-2, 2-4, 4-8, 8-16, 16-32, ... individuals) used in *species*-abundance curves and representing doublings of the numbers of individuals in a species.

Oklo natural reactors

Naturally occurring nuclear reactors arising through biogeochemical processes approximately 1.8 billion years ago in Oklo (Gabon, Africa).

oligotrophic

Describing an environment having a low concentration of nutrients.

Note: The term is usually used to describe bodies of water or soils with very low nutrient levels and low rates of biological production.

See also *eutrophic*.

oligotrophy

1. State of being oligotrophic.
2. Obligate or facultative capacity to live in low-nutrient habitats.

See also *eutrophy*.

optimal-foraging theory

Theory that the ideal forager will obtain a maximum net rate of energy gain by optimally allocating its time and energy to the various components of foraging.

optimal stress response

Optimal stress response involves a shift in the balance in energy allocation between somatic growth rate and longevity (survival) to optimize Darwinian fitness under stressful conditions.

ozone hole

Extreme thinning of ozone above the Antarctic due to the combined effects of circulation patterns above the Antarctic and ozone destruction; thought to be largely a consequence of CFC accumulation in the stratosphere.

ozone layer

ozonosphere

Part of the Earth's atmosphere, mainly located in the lower portion of the stratosphere, approximately 15 km to 35 km above the Earth's surface, containing relatively high concentrations (a few micromoles per litre) of ozone (O_3) which is higher than concentrations in the lower atmosphere. The thickness varies seasonally and geographically.

ozonosphere

See *ozone layer*.

paradigm

1. Model or template

2. Body of concepts that, in a particular branch of science, has withstood rigorous testing, and is generally accepted by scientists working in that field as offering true explanations of fact and observation.

Note: This usage is derived from the work of the philosopher Thomas Kuhn in his book *The Structure of Scientific Revolutions* (1962).

parthenogenesis

Growth and development of an embryo or seed without male fertilization.

Note 1: Occurs in lower plants, invertebrate species (water fleas, aphids, some bees and parasitic wasps), vertebrates (some reptiles, fish, and, very rarely, birds and sharks).

Note 2: Also used to describe reproduction in self-fertilizing hermaphroditic species.

partial kill

Treatment in a toxicity test in which some, but not all, exposed individuals are killed.

partition coefficient

Concentration of a substance in one phase divided by its concentration in the other phase when the heterogeneous system of two phases is in equilibrium.

Note 1: The ratio of concentrations (or, strictly speaking, activities) of the same molecular *species* in the two phases is constant at constant temperature.

Note 2: The *octanol-water partition coefficient* K_{ow} is often used as a measure of the *bioconcentration* factor for modeling purposes.

Note 3: This term is in common usage in toxicology but is not recommended by IUPAC for use in chemistry and should not be used as a synonym for partition constant, partition ratio, or distribution ratio.

[1]

partition ratio, K_D

Ratio of the concentration of a substance in a single definite form, A, in the extract to its concentration in the same form in the other phase at equilibrium, e.g. for an aqueous/organic system:

$K_D(A) = [A]^{org} / [A]^{aq}$

[1]

pathway

Sequence of enzymatic or other reactions by which one biological material is converted to another.

pedosphere

Part of the Earth made up of soils and where important soil processes are occurring.

pelagic

Of or relating to the open sea, as distinguished from the shallow water near the coast; dwelling on or near the surface of the open sea or ocean; oceanic. Now chiefly: (*Ecol.*) designating, relating to, or inhabiting that region of the sea which consists of open water of any depth, away from or independent of both the shore and the sea floor (and so contrasted with the littoral and benthic regions).

[4]

per capita birth rate, *b*

Average number of offspring per population member per time unit. Calculated from birth rate *B* and population size *N* as

$b = B / N$

See also *population growth*, *per capita rate of increase*.

per capita death rate, *m*

Average number of deaths per population member per time unit. Calculated from death rate *D* and population size *N* as

$m = D / N$

See also *population growth*, *per capita rate of increase*.

per capita rate of increase, r

Relative increase, r, in the *population* per unit of time expressed *per capita*.

$r = b - m$

where b is *per capita birth rate* and m is *per capita death rate*.

periphyton

Matrix of algae, microbes, and *detritus* attached to submerged surfaces in aquatic ecosystems.

See *aufwuchs*.

persistence

Attribute of a substance that describes the length of time that the substance remains in a particular environment before it is physically removed or chemically or biologically transformed.

[1]

persistent inorganic pollutant (PIP)

Inorganic substance that is stable in the environment, is liable to long-range transport, may bio-accumulate in human and animal tissue, and may have significant impacts on human health and the environment.

Note 1: Examples are arsenides, fluorides, cadmium salts and lead salts.

Note 2: Some inorganic chemicals, like crocidolite asbestos, are persistent in almost all circumstances, but others, like metal sulfides, are persistent only in unreactive environments; sulfides can generate hydrogen sulfide in a reducing environment or sulfates and sulfuric acid in oxidizing environments. As with organic substances, persistence is often a function of environmental properties.

[1]

persistent organic pollutant (POP)

Organic chemical that is stable in the environment, is liable to long-range transport, may *bioaccumulate* in human and animal tissue, and may have significant impacts on human health and the environment. Examples: dioxin, PCBs, DDT.

[1]

pesticide

Substance intended to kill pests.

Note: In common usage, any substance used for controlling, preventing, or destroying animal, microbiological or plant pests.

[1]

phenology

Life history.

phenotype

Observable structural and functional characteristics of an organism determined by its genotype and modulated by its environment.

[1]

phocomelia

Developmental abnormality in which the individual is born with extremely short limbs because the long bones have failed to develop properly.

photochemical smog

summer smog

Mixture of highly reactive and toxic substances, including ozone, produced by the action of sunlight on hydrocarbons, nitrogen oxides, and other *pollutant*s.

[1]

photodegradation

Any breakdown reaction of a chemical that is initiated by sunlight (ultraviolet light), or more accurately, by the influence of a high-energy photon. This can be either by direct photodegradation, in which the photon photolyses or ionizes the relevant molecule itself, which then reacts with other *species* in its vicinity, or by

indirect photodegradation, in which the relevant molecule reacts with ions or radicals created by *photolysis* of other species.

See *indirect photolysis, photolysis*.

photo-induced toxicity

Toxicity of a chemical in the presence of light due to the production of toxic photolysis products.

photolysis

Cleavage of one or more covalent bonds in a molecular entity resulting from absorption of light, or a photochemical process in which such cleavage is an essential part.

See *indirect photolysis*, *photodegradation*.

[1]

photoperiod

The duration of illumination and darkness over a 24-h day.

photosensitivity

Sensitivity of cutaneous tissues to the effects of light, when the effects are evoked by a chemical.

pH-partition hypothesis

Hypothesis that bioavailability is governed by the diffusion of the unionized form of an ionizable substance through the gastrointestinal lumen, as determined by pK_a and pH.

phylogenetic tree

See *cladogram*.

phylogenetics

Branch of biology that deals with *phylogeny*, esp. with the deduction of the historical relationships between groups of organisms.

[4]

See *phylogenetic systematics, cladistic*

phylogeny

phylogenesis

1. Pattern of historical relationships between species or other groups resulting from divergence during evolution.

2. = *cladogram*.

3. = *phylogenetics*

[4]

Note 1: Phylogenetic relationships are shown in diagrams (*cladograms*, phylogenetic trees, evolutionary trees).

Note 2: *Paleontology* is important for understanding phylogeny. Without the *fossils* of the many groups of organisms now extinct, it could not be understood how present life forms are interrelated.

Note 3: Phylogenetics, the science of phylogeny, is part of the larger field of systematics, also including taxonomy.

phylum

Taxonomic rank at the level below Kingdom and above Class

*Note: F*ormally a phylum can be used for any biological domain, but traditionally it was always used for animals, whereas "division" was traditionally often used for plants, fungi, etc.

physiological adaptation

1. Change in an organism, in response to changing conditions of the environment, which takes place without any irreversible disruptions of the given biological system and without exceeding normal (homeostatic) capacities of its response.

2. Process by which an organism stabilizes its physiological condition after an environmental change.

Note: If this process exceeds the homeostatic range, it becomes pathological and results in symptoms of disease (adverse effects).

Formatted: English (U.K.)

phytochelatin

Class of cysteine-rich peptides in plants that are induced by and bind to metals. They can function in the regulation and detoxification of metals by plants.

See *metallothionein-like proteins*.

phytoestrogen

"dietary estrogen"

Diverse group of naturally occurring non steroidal plant compounds with structural similarity to estradiol (17β-estradiol) and able to cause estrogenic and (or) antiestrogenic effects.

(Yildiz, Fatih (2005). Phytoestrogens in Functional Foods. Taylor & Francis Ltd, pp 3-5, 210-211. ISBN 978-1574445084.

phytoplankton

Photosynthesizing organisms found in the *plankton*.

[1]

phytotoxic

Toxic to plants.

Pielou's *J*

Measure of *species evenness* for a sample from a community.

pinnipeds

Seals, sea lions and walruses.

planktivorous

Feeding on *plankton*.

[1]

plankton

Organisms living suspended in the water column and incapable of moving against water currents.

[1]

planktotrophic larva

Planktonic-dispersing larva that derives its nourishment by feeding in the *plankton*.

[1]

poikilotherm

ectotherm

'Cold blooded organism' (such as an amphibian, reptile or fish) with a body temperature varying with, but usually slightly higher than, the temperature of its environment.

See *endotherm*, *exotherm*.

poikilothermic

poikilothermous

See *heterothermal*.

point source

Single *emission* source in a defined location.

[1]

Pollutant should be distinguished from contaminant; the latter implies presence above background due to human activities; the former implies that the substance also is causing adverse effects.

pollutant

Any undesirable solid, liquid or gaseous matter occurring, as a result of human activities, in a solid, liquid, or gaseous environmental *medium* and causing adverse effects.

Note 1: 'Undesirability', like toxicity, is concentration-dependent, low concentrations of most substances being tolerable or even essential in many cases.

Note 2: A primary pollutant is one emitted into the atmosphere, water, *sediments* or soil from an identifiable source.

Note 3: A secondary pollutant is a pollutant formed by chemical reaction in the atmosphere, water, sediments, or soil.

Modified from [1]

See *contaminant*.

pollution

Introduction of *pollutants* into a solid, liquid, or gaseous environmental *medium*; the presence of pollutants in a solid, liquid, or gaseous environmental medium; or any undesirable modification of the composition of a solid, liquid or gaseous environmental medium.

[1]

pollution-induced community tolerance (PICT)

Increase in tolerance to *pollution* resulting from *species* composition shifts in the *community*, *acclimatization* of individuals, and genetic changes in *population*s in the community.

pollution tolerance index (PTI)

Means of measuring environmental quality, usually water quality, by determining the presence of indicator species, classified into 3 groups, sensitive, facultative, and tolerant. Each group is assigned an index value 1, 2, and 3, with the sensitive group having the highest index value. The number of species present from the list included in each group is identified in a representative environmental samples and the group index multiplied by the number of species in the group. The scores for each group are finally added to give the pollution tolerance index for the environmental medium under consideration. The environmental quality is directly proportional to the value of the index.

polygenic control

Control of a phenotypic trait by several genes.

polyploidy

Chromosomal alteration in which the organism possesses more than two complete chromosome sets.

(30)

population

In ecology, any group of interacting and interbreeding organisms of the same *species* occupying a given area at the same time.

population biomass

Total mass or weight of organisms in a *population*, given by the sum of the masses (or weights) of all the individual members of the population.

population cycle

Changes in the numbers of individuals in a population that repeatedly oscillate between periods of high and low density.

population density, PD

Number of individuals per unit area (m^{-2}) or volume (m^{-3}).

population dynamics

Variations in time and space in the sizes and densities of populations.

population ecology

Study of the variations in time and space in the sizes and densities of populations, and of the factors causing these variations.

population fluctuation

Variations over time in the size of a population.

population growth rate

Change in population size ΔN during a specified time period Δt:

$\Delta N/\Delta t = (b - d)N$

where N is population size, b is *per capita birth rate* and d is *per capita death rate*.

See *per capita rate of increase*.

population pyramid

Diagrammatic illustration of the age structure of a population by depicting the youngest age class at the base and stacking successive age classes above it.

population size

Total number of organisms in a *population*.

pore water

See *interstitial water*.

porous pot test

Biodegradation test that simulates the continuous activated sludge (sewage treatment) system.

potentiation

Dependent action in which a substance or physical agent at a *concentration* or *dose* that does not itself have an *adverse effect* enhances the harm done by another substance or physical agent.

See also *synergism*.

[1]

precautionary principle

Approach to risk management that can be applied in circumstances of scientific uncertainty, reflecting a

perceived need to take action in the face of a potentially serious risk without waiting for definitive results of scientific research.

[1]

predicted environmental concentration (PEC)

estimated environmental concentration (EEC)

expected environmental concentration (EEC)

Concentration of a substance likely to be found in an environmental *compartment* calculated from estimates of quantities released, discharge patterns and inherent disposition of the substance (fate and distribution) as well as the nature of the specific receiving ecosystems.

Note: EEC models for pesticides assume a maximum number of applications per growing season at the maximum rate of application according to the application methods stated on the product label.

After [1]

predicted no-effect concentration (PNEC)

Concentration that is expected to cause no adverse effect to any naturally occurring *population* in an environment at risk from exposure to a given substance.

[1]

predictive risk assessment

prospective risk assessment

Risk assessment performed for a proposed future action, such as the use of a new chemical or the release of a new *effluent*.

preliminary test

See *screening test*.

prevalence

Number of instances of existing cases of a given disease or other condition in a given *population* at a designated time; sometimes used to mean *prevalence rate*.

Note: When used without qualification, refers usually to the situation at a specified time (point prevalence).

[1]

prevalence rate (ratio)

Total number of individuals who have an attribute or disease at a particular time (or during a particular period) divided by the *population* at *risk* of having the attribute or disease at this point in time or midway through the period.

[1]

primary lamellae

filaments

Gill structures extending outward at right angles from the branchial arches.

primary producer

Organism capable of using the energy derived from light or a chemical substance in order to manufacture energy-rich organic compounds.

[1]

primary succession

Sequential colonization by species which begin to colonize the bare ground and modify the environmental conditions after a region is completely denuded; e.g., behind a retreating glacier, early colonizing organisms provide the soils needed by succeeding organisms.

See *succession*.

principle of allocation

Concept that there exists a cost or trade-off to every allocation of energy resources. Energy spent by an individual organism on one function, process, or structure cannot be spent on another. Optimal allocation of resources enhances Darwinian fitness.

probit

Probability unit obtained by adding 5 to the normal deviates of a standardized normal distribution of results from a dose response study.

Note 1: Addition of 5 removes the complication of handling negative values.

Note 2: A plot of probit against the logarithm of *dose* or *concentration* gives a linear plot if the response follows a logarithmic normal distribution. Estimates of the LD_{50} and ED_{50} (or LC_{50} and EC_{50}) can be obtained from this plot.

[1]

See *probit (log) transform*.

probit (log) transform

Probability unit obtained from the standardized normal distribution plotted against the logarithm of the concentration or dose of a substance when a *quantal* or *graded response* has been measured. A linear plot provides evidence that the distribution is lognormal. Estimates of the L(E)C50 and L(E)D50, as well as the standard deviation for the distribution, can then be made.

problem formulation (in ecological risk assessment)

Planning and scoping phase that establishes the framework around which the *risk assessment* is done.

productivity

The rate at which biomass is produced per unit area by any class of organisms.

product-limit (Kaplan-Meier) method

Nonparametric method for analyzing time-to-death or survival-time data that does not require a specific model for the survival curve.

proliferation

Multiplication, i.e., an increase by frequent and repeated reproduction or growth by cell division.

propagule

1. Portion of a plant, fungus, etc., that is capable, when detached, of giving rise to a new individual by asexual reproduction (e.g., a cutting, leaf bud, bulbil, seed, or spore).

2. Less commonly, any of the products of asexual reproduction in certain invertebrates.

After [4]

propagule rain

Relative to *metapopulation* dynamics, the presence of a seed bank or dormant stage for a *species* that continually introduces individuals to the patch regardless of the density of occupancy in the surrounding patches. This propagule rain increases the likelihood of *population* reappearance and decreases the likelihood of patch extinction.

prospective risk assessment

See *predictive risk assessment.*

Ptolemaic incongruity

False assertion that any particular level of biological organization holds a more central or important role than any other in the science of ecotoxicology.

pyrogenic

1. Describing anything that causes fire.
2. Describing products of fire; e.g., organic compounds produced by the high-temperature combustion of complex organic substances are pyrogenic compounds.

   Note: The polycyclic aromatic hydrocarbons (PAH) are examples of pyrogenic compounds.
3. Describing a substance that produces fever.

quality criteria

Quality guidelines based on the evaluation of scientific data.

quality guidelines

Numerical limits or text statements established to support and maintain designated uses of the environment or

to protect human health.

quality objectives

Numerical limits or narrative statements established to protect and maintain human health or designated uses of the environment at a particular site.

quality standards

Fixed upper limits for exposure to certain chemicals recognized under law by one or more levels of government. Well-known examples include the air, water and soil quality standards, as well as *threshold limit value*s for air *pollutant*s in the workplace.

quantal effect

Antonym *graded effect.*

all-or-none effect

Condition that can be expressed only as 'occurring' or 'not occurring', such as death or occurrence of a tumor. [1]

quantitative structure-activity relationship (QSAR)

1. Quantitative *model* relating chemical structure of organic compounds to biological activity (including toxicity), derived using regression analysis and containing as parameters physicochemical constants, indicator variables or theoretically calculated values.

   Note 2: QSAR is used as a method of predicting toxicity. It is also used to design molecules with a defined biological activity prior to their synthesis for use as drugs, pesticides etc, and for assessing environmental fate of chemicals.

2. Quantitative *model* relating chemical structure of compounds to chemical activity in the environment.

   Note 1: The term is extended by some authors to include chemical reactivity, i.e., activity and reactivity are regarded as synonyms. This extension is discouraged.

After [1]

quantitative structure metabolism relationship (QSMR)

Quantitative association between the physicochemical and (or) the structural properties of a substance and its metabolic behavior.

[1]

quotient method

Calculation of the quotient of the measured or predicted environmental concentration (PEC) of a *contaminant* and the predicted no-effect level (PNEC), used as an expression of *hazard* or *risk*. Higher quotients constitute greater evidence of a hazard or a greater risk.

See also *hazard quotient*.

rain-out

Removal of pollutants from air by incorporation into developing rain droplets of rain clouds.

range-finding test

See *screening test*.

rarefaction estimate of richness

Estimate of *species richness (S)* expressed relative to that of a sample having a standard number of individuals.

rate constant-based model

Compartment model that employs rate constants to quantify the rate of change in concentration or amount of toxicant.

rate-of-living theory of aging

Theory that the total metabolic expenditure of a genotype is generally fixed, and longevity depends on the rate of energy expenditure.

rate ratio (in epidemiology) (RR)

Value obtained by dividing the rate in an exposed *population* by the rate in an unexposed population.

[1]

realized niche

Portion of a *species*' fundamental *niche* that it actually occupies.

Note: The realized niche is narrower than the fundamental niche due to pressure from, and interactions with, other organisms (e.g. superior competitors).

See *Hutchinsonian niche*, *niche*.

reasonable worst case

Semiquantitative term referring to the lower portion of the high end of the exposure, dose, or risk distribution.

reasonable maximum exposure (RME)

Highest exposure that is reasonably expected to occur.

Note: Typically the 95 % upper confidence limit of the toxicant distribution is used: if only a few data points (6-10) are available, the maximum detected concentration is used.

[1]

receiving water

Surface water (e.g., in a stream, river, or lake) that has received, or is about to receive, a discharged waste (i.e., the surface water immediately around the discharge point).

receptor

Molecular structure in or on a cell that specifically recognizes and binds to a compound and acts as a physiological signal transducer or mediator of an effect.

[1]

recommended limit

Maximum concentration of a potentially toxic substance that is expected to be safe.

Note: Such limits are rarely defined as legal limits to be enforced. They are analogous to guidelines, which have only advisory status.

reconstituted water

De-ionized or glass-distilled water to which reagent-grade chemicals have been added. The resultant synthetic fresh water is expected to be free from contaminants and have the desired pH and hardness characteristics.

redundancy hypothesis

Hypothesis that many *species* are redundant, and their loss will not influence the *community* function as long as crucial (e.g., keystone and dominant) species *population*s are maintained.

reference dose (RfD)

Estimate (with uncertainty spanning perhaps an order of magnitude) of a daily exposure of a defined substance to the human *population* (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime.

Note 1: It can be derived from a *NOAEL*, *LOAEL*, or benchmark dose, with uncertainty factors generally applied to reflect limitations of the data used. It is generally used in EPA's noncancer health assessments.

Note 2: The RfD is reported in units of mg of substance / kg body weight / day for oral exposures.

After [1]

reference environment

Generalized description of the environment into which *contaminant*s will be released and in which organisms will be exposed. Reference environments are used when there is no specific site at risk.

reference material

Material, sufficiently homogeneous and stable regarding one or more properties, used in *calibration*, in assignment of a value to another material, or in quality assurance.

[24]

reference sediment

Whole sediment near an area of concern used to assess sediment conditions in the absence of substances of concern.

Note: Such sediment is collected near a site of concern and should represent the background conditions.

After [4]

reference site

Relatively unpolluted site used for comparison with *polluted* sites in environmental monitoring studies, often incorrectly referred to as a control site.

reference toxicant

Chemical used in an aquatic toxicity test as a positive control in contrast to the negative control provided by exposure water without the test chemieal. Information collected is used to determine the general health and viability of the test organisms and assess consistency in testing protocol implementation.

Note: In this definition, the term 'positive control' is used to describe a procedure that is very similar to the actual experimental test and which is known from previous experience to give a positive result.

[5]

reference toxicity test

Test conducted in conjunction with sediment tests to determine possible changes in condition of the test species.

Note 1: Deviations from an established normal range indicate a change in the condition of the test organism population. Reference toxicant tests are most often acute lethality tests performed in the absence of sediment

Note 2: Sediment spiked with a toxicant might also be included as a positive control for the sediment toxicity test.

[5]

region (in geography)

Area of the Earth's surface differentiated by its specific characteristics.

relative bio-availability

Bio-availability estimated for a dose administered by any route or formulation relative to a dose administered in a reference (or alternate) route or formulation.

relative fitness

See *fitness*.

relative risk (RR)

risk ratio

1. Ratio of the *risk* of disease or death among the exposed to the risk among the unexposed.
2. Ratio of the cumulative incidence rate in the exposed to the cumulative incidence rate in the unexposed.

[1]

remedial investigation (RI)

Study that has three parts: characterization or the type and degree of the *contamination*, human *risk assessment*, and ecological risk assessment.

After [25]

remedial investigation and feasibility study (RI/FS)

For an EPA Superfund site, a study that has as its goal the implementation of 'remedies that reduce, control, or eliminate risks to human health and the environment' or, more specifically, the accumulation of 'information sufficient to support an informed risk management decision regarding which remedy appears to be most appropriate for a given site'.

After [25]

remediation

1. Giving a remedy.
2. Removal of *pollution* or *contaminant*s from environmental media such as soil, groundwater, *sediment*, or surface water for the general protection of human health and the environment.

[1]

remote sensing

Technologies that allow the acquisition and analysis of data without requiring physical contact with the land or water surface being studied. Most determine qualities or characteristics of areas of interest based on measurements of visible light, infrared radiation, or radio energy coming from them.

renewed static test

See *static-renewal test*.

reproductive value (V_A)

Expected contribution of offspring during the life of an individual of an age class x in a *life table*.

rescue effect

Increased probability of a vacated-patch reoccupation in a *metapopulation* as the number of nearby, occupied patches increases.

resilience (of a community)

Ability of a community to maintain its structure and function in the face of disturbance, and to re-organize following disturbance-driven change.

resistance (in physiology and toxicology)

Ability to withstand the effect of various factors including potentially *toxic* substances.

Note: The term resistance is often reserved for the enhanced ability to cope with a factor due to genetic adaptation. The term tolerance is often reserved for enhanced abilities associated with physiological *acclimatization*. Tolerance can be used for both acclimatization and genetic adaptation.

See also *tolerance*.

respiratory lamellae

See *secondary lamellae*.

retention effect

Observed effect of the properties of *persistent organic pollutants (POPs)* with high lipophilicity which causes them to be bound more firmly than less lipophilic POPs in solid phases such as soil and vegetation; consequently, they spend less time in the atmosphere and are less available for transport in that medium.

retroactive risk assessment

See *retrospective risk assessment.*

retrospective risk assessment

retroactive risk assessment

Risk assessment dealing with an existing condition.

ring test

Part of an external quality assurance programme for assessment of an analytical method or test. A reference institute sends identical samples, which have to be analysed or tested for specified parameters, to a number of different laboratories. The laboratory has a deadline before which to provide results. Statistical evaluation and interpretation of the results permits assessment of the reliability of the methods used and a comparison of the laboratories' proficiency.

Note: For accreditation of laboratories, regular participation in ring tests is obligatory, but accreditation is not essential for participation in the tests.

riparian

Interface between land and a flowing body of surface water.

Note: Plant communities along the river margins are called riparian vegetation.

risk

1. Probability of *adverse effect*s caused under specified circumstances by an agent in an organism, a population or an ecological system.

2. Probability of a hazard causing an *adverse effect*.

3. Expected frequency of occurrence of a harmful event arising from such an *exposure*.

[1]

risk analysis

Process for controlling situations where an organism, system or (sub) population could be exposed to a hazard.

Note 1: The risk analysis process consists of three components: risk assessment, risk management and risk communication.

Note 2: The term is misleading since 'analysis' has the fundamental meaning 'resolution or breaking up of anything complex into its various simple elements, the opposite process to synthesis; the exact determination of the elements or components of anything complex (with or without their physical separation)' – see [4]. The usage defined here originates with the WHO Joint Expert Committee on Food Additives and has been accepted in this context in spite of objections from terminologists.

[26]

risk assessment

Identification and quantification of the *risk* resulting from a specific use or occurrence of a chemical or physical agent, taking into account possible harmful effects on individuals or populations *exposed* to the agent in the amount and manner proposed and all the possible routes of *exposure*.

Note 1: Risk Assessment is generally considered to involve four steps: hazard identification, hazard characterization, exposure assessment, and risk characterization.

Note 2: Quantification ideally requires the establishment of *dose-effect* and *dose-response* relationships in likely *target* individuals and populations.

After [1]

risk characterization

Outcome of *hazard* identification and risk estimation applied to a specific use of a substance or occurrence of an environmental health hazard.

Note: Risk characterization requires quantitative data on the exposure of organisms or people at *risk* in the specific situation. The end product is a quantitative statement about the proportion of organisms or people affected in a target *population*.

risk hypotheses (in ecological *risk assessment*)

Clear statements of postulated or predicted adverse effects of a toxicant on an *assessment endpoint*.

risk management

Decision-making process involving considerations of political, social, economic, and engineering factors with relevant *risk* assessments relating to a potential *hazard* so as to develop, analyze, and compare regulatory options and to select the optimal regulatory response for safety from that hazard.

Note: Essentially risk management is the combination of three steps: *risk evaluation*; *emission* and *exposure* control: *risk monitoring*.

[1]

risk ratio

See *relative risk (RR)*.

risk source

Agent, medium, process, procedure, or site with the potential to cause an adverse effect or effects.

risk quotient

Ratio of *predicted exposure concentration* to *predicted no effect concentration*.

Note: The higher this value is above one, the greater the risk. If the value is below one, there should be no risk as a result of the predicted exposure.

[1]

risk reduction

Taking measures to protect humans or the environment against identified risks.

rivet popper hypothesis

Hypothesis that each *species* in a *community* contributes to its proper functioning.

Note: Derived from the metaphor that the species can be compared to rivets that hold an airplane together, and the loss of each rivet weakens the structure.

[27]

round-robin test

See *ring test*.

r-strategy

Opportunistic strategy favoring *species* that establish themselves quickly, grow quickly to exploit as many resources as possible, and produce many offspring.

rules of practical causal inference

Fox's rules of practical causal inference that are used in ecotoxicology (environmental epidemiology) to infer causality for toxicant exposure / effect scenarios.

[28]

run-off (in ecology)

Portion of the wet precipitation on the land that ultimately reaches streams and, eventually, the sea.

saddle back

See *lordosis*.

safe concentration

Concentration of a substance to which prolonged exposure will cause no adverse effect.

safety factor

See *uncertainty factor*.

salinity

Total amount of salts dissolved in water.

Note: It is determined after all carbonates have been converted to oxides, all bromide and iodide have been replaced by chloride, and all organic matter has been oxidized. Salinity can be measured directly using a refractometer, salinity/conductivity meter, or by other means. It is usually reported in g/kg or less desirably in parts per thousand.

salt tolerance index (STI)

Quotient calculated as total plant (shoot + root) dry mass at different salt concentrations compared to the total plant dry mass obtained for the controls, as indicated below:

STI = (TDM at Sx / TDM at Si) x 100 where: TDM = total dry mass; Si = control treatment and Sx = x (defined salt treatment)

After [29]

saprobic

Living in or being an environment rich in organic matter but lacking oxygen.

saprobic index

Means of classifying the saprobic state of running waters, covering the full range from unpolluted to extremely *polluted* waters.

saprobic water classification

Biological classification of water quality according to five categories:

(a) oligosaprobic: clear, with no or only slight *pollution* and high dissolved oxygen (DO) content;

(b) p-mesosaprobic: moderately polluted with still high DO content;

(c) x-mesosaprobic: polluted with not very high DO content;

(d) polysaprobic: strongly polluted, with negligible DO content; and

(e) antisaprobic: so polluted that no living organism is capable of living in the water.

saprobien spectrum

Characteristic change in community composition at different distances below the discharge of putrescible organic waste to a river or stream.

saprophyte

Organism that carries out external digestion of non-living organic matter and absorbs the products across the plasma membrane of its cells (e.g., fungi).

satellite groups

Organisms or groups of organisms treated in a similar fashion to those in standard toxicity tests for the purpose of special additional studies.

scaling

Transformation of allometric data to produce a quantitative relationship between organism (or *species*) size and some characteristic such as metabolic rate, gill surface area, lung ventilation rate, or biochemical activity.

scoliosis

Lateral curvature of the spine.

See also *lordosis*.

scope of activity

Difference between the rates of oxygen consumption of an organism under maximal and minimal activity levels.

Note: It reflects the respiratory capacity available for the diverse demands on and activities of an organism.

scope for growth

Index (P = production) calculated as the amount of energy taken into the organism in its food (A) minus the energy used for respiration (R) and excretion (U): P = A – R - U.

Note: It is an indicator of the amount of energy available for growth or production of offspring.

screening

1. *(adj)* Describing a testing procedure designed to separate people or objects according to a fixed characteristic or property.
2. *(vb)* Carrying out test(s), examination(s) or procedure(s) in order to expose undetected abnormalities, unrecognized (incipient) diseases, or defects: examples are mass X-rays and cervical smears.

Note: Pharmacological or toxicological screening consists of a specified set of procedures to which a substance is subjected in order to characterize its pharmacological and toxicological properties and to establish *dose-effect* and *dose-response* relationships.

After [1]

screening level

Decision limit or cut-off point at which a *screening* test is regarded as positive.

screening test (preliminary test or range-finding test)

1. Test conducted to estimate the concentrations to be used for a definitive test.
2. Acute test used early in a testing program to evaluate the potential of a substance to produce a given adverse effect (e.g., *mortality*).

secondary lamellae (respiratory lamellae)

Parallel rows of projections on the dorsal and ventral sides of each primary lamella of the fish gill. They are the primary sites of gas exchange of the gills.

secondary poisoning

Poisoning of a predator as a result of eating prey that has accumulated a toxicant as a result of biomagnification through its food chain.

secondary substrate metabolism

Microbial growth on a nutrient substrate while transforming another substrate without gaining energetic benefit.

Note: Although it must occur, secondary substance metabolism is very difficult to demonstrate in

nature, but it can be demonstrated in pure cultures.

See *cometabolism*.

secondary succession

Sequential appearance of species following major changes to an established ecosystem.

Note: Catastrophic weather events, fire, or human activities all disturb the environment. After such an event on land, well-developed soil remains, giving pioneer species an easy foothold; similar changes occur in abandoned agricultural areas.

See *succession*.

sediment

1. Matter that settles to the bottom of a liquid.
2. In geology, matter deposited by water or wind.

selection components

Components of the life cycle of an individual upon which natural selection can act. They are *viability selection*, *sexual selection*, *meiotic drive*, *gametic selection*, and *fecundity* selection.

Selyean stress

Named syndrome which consists of all the nonspecifically induced changes within a biological system following and during environmental stress.

[30]

semelparous species

Species that reproduces once.

semi-continuous activated sludge (SCAS) **test**

Test for inherent biodegradability of organic substances in activated sludge by measurement of the decrease in *dissolved oxygen content (DOC)* in the test system.

semi-static test

See *static-renewal test*.

sentinel species

Feral, caged, or endemic *species* used in measuring and indicating the level of *contamination* or effect during a *biomonitoring* exercise.

seston

Minute living organisms and particles of nonliving matter which float in water and contribute to turbidity.

sexual selection

Natural selection involving differential mating success of individuals.

Shannon-Wiener diversity index, *H*

Index based on the assumption that all species are represented in the sample studied and that the sample was obtained randomly, giving the following mathematical relationship:

$$H = -\sum_{i=1}^{S} p_i \log p_i$$

where p_i is the fraction of individuals belonging to the i-th *species*.

Note 1: The Shannon index is affected by both the number of species and their equitability, or evenness. Both a greater number of species and a more even distribution increase diversity as measured by *H*.

Note 2: The most important source of error in this index is failure of sampling to include all species from the community of interest.

See also *diversity index*.

Shelford's law of tolerance

Species' tolerance(s) along an environmental gradient (or series of environmental gradients) will determine its *population* distribution and size in the environment.

silt

Sediment particles with a grain size between 0.004 mm and 0.062 mm, i.e. coarser than clay particles but finer than sand.

Simpson's diversity index, *D*

Dominance index weighted towards the abundance of the most common species, giving the probability of any two individuals drawn at random from an infinitely large community belonging to different species. The bias corrected mathematical form of Simpson's Index is:

$$D = \sum_{i=1}^{S} p_i^2$$

where p_i is the fraction of all organisms which belong to the i-th *species*.

Note: Since *D* and diversity are negatively related, Simpson's index is usually expressed as either a reciprocal or a complementary form (1/D or 1 -*D*) so that as the index goes up, so does measure of diversity.

See also *diversity index*.

simulated field studies

Experimental ecosystem which should be: physically confined; self-maintaining; multitrophic; have a duration time exceeding the generation time of the penultimate trophie level present; and of size sufficient to enable pertinent sampling and measurements to be made without seriously influencing the structure and dynamics of the system.

After [5]

sister chromatid exchange (SCE)

Reciprocal exchange of chromatin between two replicated chromosomes that remain attached to each other until anaphase of mitosis; used as a measure of mutagenicity of substances that produce this effect.

[1]

smog

Mixture of smoke and fog.

Note:Term is used to describe city fogs in which there is a large proportion of particulate matter and

also a high concentration of sulfur and nitrogen oxides.

soil

Naturally occurring, unconsolidated mineral and (or) organic material at the surface of the earth that is capable of supporting plant growth. It extends from the surface to 15 cm below the depth at which properties produced by soil-forming processes can be detected.

Note 1: Soil-formation results from an interaction between climate, living organisms, and surface relief acting on soil parent material.

Note 2: Unconsolidated material includes material cemented or compacted by soil-forming processes. Soil may have water covering its surface to a depth of 60 cm (or less in the driest part of the year).

solute

Minor component of a *solution* that is regarded as having been dissolved by the *solvent*.

[3]

solution

Liquid or solid phase containing more than one substance, when for convenience, one (or more) substance, which is called the *solvent*, is treated differently from the other substances, which are called *solutes*.

[3]

solvent

See *solute*, *solution*.

solvent drag

Movement of a solute (e.g., a *contaminant*) along with the bulk movement of the solvent.

somatic death

Death of an individual organism.

somatic risk

Risk of an adverse effect to the exposed individual associated with genetic damage to somatic cells, e.g., damage leading to cancer.

sorbate

Noncommittal term used instead of *adsorbate* or *absorbate* when the *sorption* process is undefined.

sorbent

Noncommittal term used instead of *adsorbent* or *absorbent* when the *sorption* process is undefined.

sorption

Process whereby a solute becomes physically or chemically associated with a sorbent regardless of the mechanism (*absorption*, *adsorption*, *chemisorption*).

Note: Sometimes used instead of adsorption or absorption when it is difficult to discriminate experimentally between these two processes.

sorption constant

Quantity describing the distribution of a substance between a solvent and a sorbent, typically water and sediment, at equilibrium,

e.g., K_d= [*C*(sediment)] / [*C*(water)]

After [5]

source term

Estimate of the total amount released, or the temporal pattern of the rate of release, of a *pollutant* from a source.

spawning

1. (vb) The release of eggs or sperm from mature adult fish.
2. (adj) Behavior related to the readiness of mature adult fish to release gametes.

Spearman-Karber method

Nonparametric method to estimate the LC50, EC50, or LD50 when it is difficult or unnecessary to assume a specific *model* for the dose- or concentration effect data.

See also *median effective concentration*, *median lethal concentration*, *median lethal dose*.

speciation (in chemistry)

Distribution of an element amongst defined chemical *species* in a system.

[1]

speciation analysis (in chemistry)

Analytical activities of identifying and (or) measuring the quantities of one or more individual chemical *species* in a *sample*.

[1]

species

1. (in biology) Group of organisms of common ancestry that are able to produce fertile progeny only among themselves.
2. (in chemistry, of an element) Specific form of an element defined as to isotopic composition, electronic or oxidation state, and (or) complex or molecular structure.

After [1]

species-area relationship

Common pattern in which the number of *species* on islands decreases as island area decreases.

species assemblage

Operationally defined subset of the entire community.

species-deletion stability

Tendency in a model community for the remaining *species* to remain at locally stable equilibria after a species is made extinct.

species differences in sensitivity

Quantitative or qualitative differences of response to the action(s) of a potentially *toxic* substance on various *species* of living organisms.

[1]

species diversity

Heterogeneity of an ecological community, considering both *species richness (S)* and *species evenness*.

species evenness

Degree to which the individuals in the community are evenly or uniformly distributed among *species*.

species imbalance

Change in the species numbers or diversity in an *ecosystem*, or in their interactions, which results in change in ecological character and its functions and attributes.

See also *ecological imbalance*.

species richness (*S*)

Total number of *species* in an ecosystem.

Note: This index makes no use of relative abundances.

See *biodiversity*.

species sensitivity distribution (SSD)

Statistical relationship between exposure concentration and a defined effect derived from a combination of single-species test data to predict concentrations affecting only a certain percentage of the total number of species in a defined community.

Note: Single-species data (e.g., median lethal concentration (LC_{50}) or no-observed-effect concentration (NOEC) values) for many species are fitted to a distribution relationship such as the lognormal or log-logistic curve. From this distribution of species sensitivities, a *hazardous concentration* (HCp) is identified at which a certain percentage (p) of all species is likely to

be affected. The most conservative form of this approach uses the lower 95% tolerance limit of the estimated percentage to ensure that the specified level of protection is achieved

[31]

species-specific sensitivity

Quantitative and qualitative features of response to the action(s) of a potentially *toxic* substance that are characteristic for a particular *species* of living organism.

[1]

specific action concept (assumption in radiotracer usage)

Assumption of specificity of action of a radionuclide used to trace or quantify the movement of a stable nuclide (e.g., ^{14}C for stable C), implying that the radionuclide behaves identically in chemical and biological processes to its nonradioactive analog (e.g., stable C).

Note: Sometimes confusingly called the 'specific activity concept'.

spiked bioassay approach (SB)

Sediment toxicity test method to generate a concentration response model for effects to individuals placed in sediments spiked with different amounts of toxicant.

Note: The method may also be used to test hypotheses regarding the mechanism of production of previously observed effects.

spillover hypothesis

Hypothesis that toxic effects of metals will begin to occur after the metal concentration exceeds the capacity of the amount of *metallothionein* present to bind the metal. The unbound metals then "spill over" to interact at sites of adverse action. This is based on the assumption that binding by metallothionein sequesters toxic metals away from sites of action.

stable age distribution

Abundance of relative age classes that a *population* approaches if it is allowed to grow exponentially.

stable population

Population with a constant distribution of individuals among the various age classes and a zero growth rate.

Note: Stable populations do not change in size over time if environmental conditions do not change.

standard (general definition)

That which is established as a measure or *model* to which others of a similar nature should conform.

See *environmental quality standard*.

standard (in law or regulation)

technical directive

Technical specification, usually in the form of a document available to the public, drawn up with the consensus or general approval of all interests affected by it, based on the consolidated results of science, technology and experience, aimed at the promotion of optimum community benefits and approved by a body recognized on the national, regional or international level.

standard (in analytical chemistry)

See *reference material*.

static-renewal test

batch replacement test

renewed static test

renewal test

semi-static test

static replacement test

Modified static aquatic toxicity test in which solutions are completely or partially replaced with new solutions at set periods during exposures or in which organisms are periodically transferred to new solutions.

static replacement test

See *static-renewal test*.

static toxicity test

Aquatic toxicity test in which the exposure water is not changed during the test.

steady state (in chemistry and toxicology)

State of a system in which the conditions do not change in time.

Note:For further information, see [3].

[1]

stratification

Process by which materials form or are deposited in layers, as in sedimentary rocks and some igneous rocks. The atmosphere and the ocean also exhibit stratification, with the warmer air or water occupying the upper layers.

stratified sampling

Sampling of individual subgroups (strata) of a *population* after its division into homogeneous strata.

stress (in biology)

Any condition that results in reduced growth of an organism or that prevents an organism from realizing its 'genetic potential'.

stressor

Any physical, chemical, or biological factor causing an adverse response on any component of an *ecosystem*.

stress protein fingerprinting

Proposed use of the patterns of stress-protein induction seen in the field to suggest the particular toxicant inducing the response, after patterns from organisms sampled in the field are compared with those obtained with single-candidate toxicants in the laboratory.

stress proteins

Several classes of proteins coded by genes transcriptionally activated by acute stresses, generally serving a

protective or adaptive function.

Note 1: These proteins include chaperones such as the *heat shock proteins*, enzymes protective against oxidative stress, *metallothioneins* etc.

Note 2: Stressors include physical agents such as heat and radiation, infection and inflammation, oxidative stress and hypoxia, desiccation and starvation, metals, xenobiotics etc.

See also *heat shock proteins*.

stress theory of aging

Theory that stress shortens longevity by accelerating energy expenditure. Selection takes place for resistance to stress, and as an epiphenomenon, individuals resistant to stress will predominate in extreme age classes of a *population*. The diminution of *homeostasis* under stress with age should be slowest in individuals with highest longevity.

See also *rate-of-living theory of aging*.

structural diversity

Range of types of physical structure in a community that may provide habitats for species.

structure activity relationship (SAR)

Association between specific aspects of molecular structure and defined biological action.

See also *quantitative structure-activity relationship.*

[1]

structure-metabolism relationship (SMR)

Association between the physicochemical and (or) the structural properties of a substance and its metabolic behavior.

[1]

Sturm test

Biodegradation test based on the measurement of CO_2 production.

stygobiont

Organism which lives only in groundwater.

stygophile

Organism which lives in groundwater and in surface water.

subcooled liquid vapor pressure (P_L)

Liquid-vapor pressure corrected or adjusted for the heat of fusion, the energy needed to convert a mole of a compound from a solid to a liquid phase. Its use allows the expression of liquid vapor pressures at a specific temperature for organic compounds with widely varying melting temperatures.

sublimation

Direct transition of a solid to a vapor without passing through a liquid phase.

[3]

succession

Orderly sequential progression of changes in community composition that occurs during development of new *populations* in any area, from initial colonization to the attainment of the *climax* typical of a particular geographic area.

See also *allogenic succession*, *autogenic succession*, *autotrophic succession*, *heterotrophic succession*, *primary succession*, *secondary succession.*

surfactant

surface active agent

Substance which lowers the surface tension of the medium in which it is dissolved, and (or) the interfacial tension with other phases, and, accordingly, is positively adsorbed at the liquid / vapor interface and (or) at other interfaces.

Note: Surfactants facilitate dispersion of other substances in water.

See *detergent*.

[3]

surrogate organism

Test organism, or *population* that is cultured under laboratory conditions to serve as a substitute in toxicity testing for indigenous organisms, communities or populations.

surrogate toxicant

Relatively well studied substance whose properties are assumed to apply to an entire chemically and toxicologically related class; e.g., benzo(a)pyrene data may be used as toxicologically equivalent to that for all carcinogenic polynuclear aromatic hydrocarbons.

[1]

surveillance

Systematic ongoing collection, collation, and analysis of data and the timely dissemination of information to those who need to know in order that action can be taken to initiate investigative or control measures.

[1]

survival time

Time interval between initial exposure of an organism to a harmful substance and death.

survivorship

Proportion of animals surviving between two specified ages.

survivorship curve

Graph showing how survivorship from birth varies with age.

susceptibility

Condition of an organism or ecological system that makes it more vulnerable to a given exposure than the majority of the *population* or group of ecological systems to which it belongs.

Note: Susceptibility is inversely proportional to the magnitude of the exposure required to cause a toxic effect.

suspension feeder

filter feeder

Animal that feeds by straining suspended matter and food particles from water, typically by passing the water over a specialized structure, such as the baleen of baleen whales.

Note 1: Some animals that use this method of feeding are clams, barnacles, krill, mysids, sponges, whale sharks, and flamingoes.

Note 2: Other methods of feeder are *deposit feeder*, *fluid feeder*, and *food-mass feeder*.

syngenetic

Describing mineral deposits formed at the same time as the enclosing rocks; characterized by or pertaining to a formation contemporaneous with the enclosing or surrounding rock.

[4]

systematics

1. = taxonomy

2. Study of the diversity of past and present life forms and of relationships among them through time.

Note: Relationships are visualized in *cladograms* (evolutionary trees, phylogenetic tree phylogenies).

Systematics is used to understand the evolutionary history of life on Earth.

taxocene

Taxonomically defined subset of an entire community.

tax/-on, pl. **-a**

taxonomic unit,

Name given to designate an organism or group of organisms.

Note: In biological nomenclature according to Carl Linnaeus, a taxon is assigned a taxonomic rank and can be placed at a particular level in a systematic hierarchy reflecting evolutionary relationships.

taxonomy

Science applied to the allocation of biological names and the rules of naming.

Note: Classification (systematics) is the process of rank ordering of taxa according to presumptive evolutionary (phylogenetic) relationships.

teratogen

Agent that, when administered prenatally (to the mother), may induce nonheritable permanent structural malformations or defects in the offspring.

After [1]

teratogenic

Capable of causing nonheritable permanent structural malformations or defects in the offspring of an exposed parent.

teratogenicity

1. Potential to cause the production of nonheritable structural malformations or defects in offspring.
2. Production of nonheritable structural malformations or defects in offspring.

[1]

teratogenic index (TI)

Mortality of eggs expressed as an LC_{50} divided by the TC_{50} (EC_{50}) for production of abnormal embryos with nonheritable permanent structural malformations or defects following exposure to a teratogen. The TI is thought to reflect the developmental *hazard* of a *contaminant*.

teratogenesis

Process resulting in permanent structural malformations or defects in the offspring of a parent exposed to a teratogen.

teratology

Study of the production and consequences of permanent structural malformations and (or) defects in the

offspring of a parent exposed to a teratogen.

After [1]

terrestrial

Relating to land, as distinct from water or air.

threshold-effect concentration (TEC)

Concentration calculated as the geometric mean of *NOEC* and *LOEC*.

Note 1: 'Chronic' or 'subchronic' may be added as qualifiers dependent on the duration of exposure in the test.

Note 2: The TEC is equivalent to the maximum acceptable toxicant concentration (MATC) used in some countries.

threshold theory

Theory that, for a given substance, no toxic effect can occur below a defined low dose.

tiered testing

Structured approach to assessment of the fate and effects of substances, where a tier of relatively simple tests is used initially to select substances of concern and to define their toxicity. If the information from these tests is inadequate for regulatory decisions, further more complex tests (higher tier tests) may be required. For example, under a tiered structure, testing might progress from acute studies to chronic laboratory studies to field studies.

time-independent (TI) **test**

Acute toxicity test with no predetermined temporal end point.

Note: This type of test, sometimes referred to as a "threshold" or "incipient" lethality test, is allowed to continue until acute toxicity (mortality or a defined sublethal effect) has ceased or nearly ceased and the toxicity curve (median survival time versus test material concentration) indicates a threshold or incipient concentration. With most test materials, this point is reached within 7-10 d, but it may not be reached within 21 d. Practical or economic reasons may

dictate that the test be stopped at this point and a test be designed for longer duration.

[5]

tolerance

1. Adaptive state characterized by diminished effects of a particular dose of a substance: the process leading to tolerance is called “adaptation”.
2. In food toxicology, dose that an individual can tolerate without showing an effect.
3. Ability to experience exposure to potentially harmful amounts of a substance without showing an adverse effect.
4. Ability of an organism to survive in the presence of a toxic substance: increased tolerance may be acquired by adaptation to constant exposure.
5. In immunology, state of specific immunological unresponsiveness.

[1]

tolerance index (TI)

Quotient of an adequate parameter acquired under treated and control environments, multiplied by 100, thus:

TI = (parameter treated / parameter control) x 100

Note: This index was originally defined in terms of root growth.

See *air pollution tolerance index*, *pollution tolerance index*, *salt tolerance index*.

[32]

top-down ecotoxicological study

Approach to investigating ecotoxicological effects that starts with a determination of the presence and nature of any adverse effects via responses at community and ecosystem levels of organization rather than the suborganismal levels of organization.

See also *bottom-up ecotoxicological study*.

[5]

total organic carbon (TOC)

Organic matter content of soil, *sediment*, or water determined by measurement of organic carbon as the ratio of

mass of organic carbon / mass of solid or of water.

Note 1: TOC is determined by oxidation of the organic matter into carbon dioxide (CO_2) after removal of inorganic carbon such as carbonate or bicarbonate. TOC includes all the carbon atoms covalently bonded in organic molecules.

Note 2: Most of the organic carbon in water is dissolved organic carbon, with the remainder referred to as particulate organic carbon. In natural waters, total organic carbon is composed primarily of nonspecific humic materials.

See *dissolved organic carbon.*

toxic

Able to cause injury to living organisms as a result of physicochemical interaction.

toxicant

See *toxic substance*.

toxic chemical

See *toxic substance.*

toxic metal

See *toxic substance*.

toxic substance

poison

toxicant

toxic chemical

Substance causing injury to living organisms as a result of physicochemical interactions.

Note 1: All substances are toxic above a certain dose (or exposure). Thus, the term is normally applied only to those substances causing toxicity at relatively low doses.

Note 2: Toxicity of any substance varies from organism to organism. Thus, this term should be accompanied by the name of the organism to which it applies, but this is rare. In common use,

the term refers to toxicity to humans and related mammals.

Note 3: In ecotoxicology, great care should be taken in using this term because of the variation in susceptibility of different species, some of which have adapted to survive, and even benefit from, exposure to substances which are very toxic to many other species.

After [1]

toxic unit (TU)

toxicity unit

Dose or concentration of a toxicant expressed in units of lethality such as units of LD_{50} or LC_{50}.

Note: For example, if toxic units are based on the LC_{50}, a chemical with an LC_{50} of 20 mg L^{-1} would be present at 0.5 TU in a 10 mg/L solution. In combined exposures, the toxicities of the individual components can be expressed in toxic units.

See *median lethal concentration*, *median lethal dose*.

toxicity curve

Curve obtained by plotting the median survival times of a group of test organisms against the concentration of a substance on a logarithmic scale.

toxicity equivalency factor (TEF, *f*)

1. Ratio of the toxicity of a chemical to that of another structurally related chemical (or index compound) chosen as a reference.
2. In *risk assessment* - ratio of the toxicity of a chemical to that of another structurally related chemical (or index compound) chosen as a reference. Factor used to estimate the toxicity of a complex mixture, commonly a mixture of chlorinated dibenzo-*p*-dioxins [oxanthrenes], furans, and biphenyls: in this case, TEF is based on relative toxicity to 2,3,7,8-tetrachlorodibenzo-*p*-dioxin [2,3,7,8-tetrachlorooxanthrene] for which the $f = 1$.

[1]

toxicity equivalent (TEQ, T_{xe})

Contribution of a specified component (or components) to the toxicity of a mixture of related substances.

Note 1: The amount-of-substance (or substance) concentration of total toxicity equivalent is the sum of that for the components B, C … N.

Note 2: Toxicity equivalent is most commonly used in relation to the reference toxicant 2,3,7,8-tetrachlorodibenzo-*p*-dioxin [2,3,7,8-tetrachlorooxanthrene] by means of the *toxicity equivalency factor* (TEF, *f*) that is 1 for the reference substance. Hence, where c is the amount-of-substance concentration:

$$T_{eq} = \sum_{i=B}^{N} f_i c_i$$

[1]

toxicity identification and evaluation (TIE)

Systematic pre-treatment (e.g. pH change, filtration, or aeration) of a sample to obtain defined fractions which are subsequently tested for their toxicity. This fractionation is designed to separate out defined substances and thus to identify the agent(s) primarily responsible for lethal or sublethal toxicity of a complex mixture.

toxicity value (T_x)

Factor used to estimate risk. It may be a *reference dose* or it may be calculated from the following equation:

$T = m \times C$

where m is the slope of a published dose-effect relationship. C= toxicant concentration

trace element (in biology)

Element required in very small quantities by an organism to maintain health.

Note : This often has an operational definition as an element present in body fluids or compartments near the detection limits of standard analytical techniques.

trace element (in geology)

Element having an average concentration in a given sample of less than about 100 atoms per million atoms (ppma) or less than 100 μg g^{-1}.

After [3]

trace metal

See *trace element*, *trace nutrient*.

trace nutrient

micronutrient

Substance required in very small quantities by a defined organism to maintain health.

Note: Use of the term is often misleading since it is meaningless unless accompanied by a statement of which organisms show a requirement for the nutrient.

tracer

1. Entity by which something may be followed; for example a radioactive isotope may replace a stable chemical element in a *toxic* compound enabling the toxicokinetics to be followed.

[1]

2. Foreign substance mixed with or attached to a given substance to enable the distribution or location of the latter to be determined subsequently.

[3]

3. Labeled member of a *population* used to measure certain properties of that population.

[1]

trade-off (in population ecology)

Exchange of one advantageous character for another. For example, rapid growth in insects living in an agricultural area may be replaced by resistance to a pesticide because some of the energy otherwise available for growth is used to degrade the pesticide. The result may be reduced *fitness*.

trigger values

Criteria applied to results from tests (for fate or effects) which prompt further studies, e.g. moving to the next tier of tests (see *tiered testing*), which are generally more complex.

trophic

Relating to nutrition.

trophic cascade

Situation arising when predators in a food chain suppress the abundance of their prey, thereby releasing the next lower trophic level from predation (or herbivory if the intermediate trophic level is an herbivore).

Note 1: For example, if the abundance of large piscivorous fish is increased in a lake, the abundance of their prey, zooplanktivorous fish, should decrease, large zooplankton abundance should increase, and phytoplankton biomass should decrease.

Note 2: Trophic cascades may also be important for understanding the effects of removing top predators from food webs, as humans have done in many places through hunting and fishing activities.

trophic dilution

Decrease in contaminant concentration as trophic level increases; this results from a net balance of ingestion rate, uptake from food, internal transformation, and elimination processes favoring loss of contaminant that enters the organism via food.

trophic enrichment

See *biomagnificatio*n.

trophic level

trophic position

Position in a food chain, assessed by the number of energy-transfer steps to reach that level.

See *ecological energetics.*

trophic position

See *trophic level.*

trophic structure

Organization of an ecological community described in terms of energy flow through its various trophic levels.

trophic transfer

Transfer of a substance from one trophic level to another.

trophic transfer factor

Ratio between the concentration of a compound in a predator and in its prey.

turbidity (in light scattering, τ)

Apparent absorbance of incident radiation due to scattering. For small particles, direct proportionality exists between turbidity and the Rayleigh ratio.

[3]

turbidity (of water)

Extent to which the clarity of water is reduced by the presence of suspended or other matter that causes light to be scattered and absorbed rather than transmitted (in straight lines) through the sample.

twin-tracer technique

Experimental method for evaluating assimilation that introduces simultaneously a radiotracer of the substance being assimilated and an inert tracer that will not be assimilated, thus providing a basis for evaluating the assimilation.

type A organism (in relation to *sediment*)

Animal or plant living in contact with sediments but unable to ingest particulates.

Note: The classification implies that such organisms take up substances from interstitial water but not from sediment-associated particulates; examples of such organisms are rooted macrophytes and benthic algae.

See *Type B organism*.

[33]

type B organism (in relation to *sediment*)

Animal or plant living in contact with sediments and capable of ingesting particulates.

Note: The classification implies that such organisms take up substances from both interstitial water and from sediment-associated particulates; examples of such organisms are *detritivorous* organisms and suspension feeders.

See *Type A organism*.

[33]

uncertainty factor (UF)

1. In assay methodology, confidence interval or fiducial limit used to assess the probable precision of an estimate.
2. In *toxicology*, value used in extrapolation from experimental animals to man (assuming that man may be more sensitive) or from selected individuals to the general *population*. For example, a value applied to the *no-observed-effect-level* (NOEL) or *no-observed-adverse-effect-level* (NOAEL) to derive an *acceptable daily intake* (ADI) or tolerable daily intake (TDI).

   Note: The NOEL or NOAEL is divided by the value to calculate the ADI or TDI.

[1]

upstream water

Water in a rivulet, river or lake that is situated above a defined point, in a direction opposite to that of the current flow.

Note: Upstream water is not influenced by incoming effluent at or below the defined point because the effluent is carried away by the flow**.**

uptake

Entry of a substance into the body, into an organ, into a tissue, into a cell, or into the body fluids by passage through a membrane or by other means.

Note: The term may also be applied to *sorption* of a substance onto the outside of an organism, e.g., the shell of a mollusk or the exoskeleton of an insect even without any entering the body or its cells.

After [1]

See also *absorption (in biology)*.

uptake rate constant

First-order one-compartment constant to describe the uptake of a substance by an organism from water.

viability selection

Component of the *life cycle* of an individual in which natural selection can occur through the differential survival of individuals. It begins at the formation of the zygote and continues throughout the life of the individual.

vital rates

Measures of how fast vital statistics change in a *population* (usually expressed per 1000 individuals).

Note: There are two categories within vital rates - crude rates referring to change in the whole population, e.g., overall change in births and deaths per 1000, and refined rates referring to change in a specific demographic such as age, sex, race, etc.

vitellogenin

Protein that forms part of the yolk of egg-laying vertebrates.

vulnerability (in toxicology)

Susceptibility to *harm* by *toxicants*.

Wahlund effect

Net deficit of heterozygotes when two *populations*, each in *Hardy-Weinberg equilibrium* but with different allele frequencies, are mixed and the genotype frequencies quantified in a combined population sample.

waldsterben

Widespread and substantial decline in growth and the change in behavior of many softwood and hardwood forest ecosystems in central Europe.

[34]

wash-out

Removal of air pollutants by falling rain or snow.

waste-water

General term describing *effluent*s, *leachate*s and *elutriate*s which enter the natural environment.

watershed

See *drainage basin*.

weakest-link incongruity

Questionable extension of the critical life stage concept that protection of the most sensitive life stage will ensure protection of all life stages; it assumes that exposure of field *population*s to concentrations identified in laboratory testing as causing significant mortality at a critical stage of life will result in significant impact on the field population.

weathering

Degradation of materials by *abiotic* environmental forces and associated *biotic* processes.

Note: Examples include the breakdown of rocks and other solid materials into smaller and smaller fragments; and the combined effects of evaporation, dissolution, UV degradation, and bacterial *mineralization* of complex mixtures, e.g., oil.

Weibull model

Dose-response model of the form

$$P(d) = \gamma + (1 - \gamma)(1 - e^{-\beta d^{\alpha}})$$

where $P(d)$ is the probability of a tumor (or other response) from lifetime, continuous exposure at dose d until age t (when tumor is fatal), α is a fitted dose parameter (sometimes called the Weibull parameter), β is a fitted dose parameter, and γ is the background response rate.

[1]

weight composition

Distribution of organisms among the various weight classes present in a *population*.

Note: The sum of individual weights over all weight classes equals the *population biomass*.

weight of evidence

1. (in general) Quantitative, semiquantitative, or qualitative estimate of the degree to which the evidence supports or undermines a given conclusion.
2. (in toxicology) Estimate of the extent to which the available biomedical data support the hypothesis that a substance causes a defined toxic effect such as cancer in humans.

After [1]

Weismannism

Theory of evolution and heredity propounded by the German biologist, August Weismann, especially in regard to the continuity of the germ-plasm and the non-transmission of acquired characteristics.

[4]

wet deposition

Transfer of chemicals from the atmosphere to the earth's surface in atmospheric water precipitation, e.g., rain, snow, or hail, of pollutants that occur in the precipitation, e.g., as a result of Brownian capture, nucleation, dissolution, or impaction.

wetland

Area of land consisting of soil that is saturated with moisture, such as a swamp, marsh, or bog.

Note 1: As defined in terms of physical geography, a wetland is an environment "at the interface between truly terrestrial ecosystems and aquatic systems making them inherently different from each other yet highly dependent on both"

Note 2: Wetlands are *ecotones*. Wetlands often host considerable biodiversity and *endemism*.

Note 3: In many locations such as the United Kingdom and USA wetlands are the subject of conservation efforts and *Biodiversity Action Plans*.

[34]

whole-effluent toxicity (WET)

Total toxic effect of an *effluent* measured directly with aquatic organisms in a toxicity test.

[5]

whole sediment

Sediment and associated pore water that have had minimal manipulation.

[5]

xenobiotic

Compound with a chemical structure foreign to a given organism.

Note: Frequently restricted to man-made compounds.

After [1]

zooplankton

Small floating or weakly swimming animals that drift with water currents and which, with *phytoplankton*, make up the planktonic food supply upon which almost all oceanic organisms ultimately depend.

See also *plankton*.

ANNEX 1: ABBREVIATIONS AND ACRONYMS USED IN ECOTOXICOLOGY

AchE	Acetylcholinesterase
ACR	Acute-to-chronic toxicity ratio
AEC	Adenylate energy charge
AF	Accumulation factor, application factor
AHH	Aryl hydrocarbon hydroxylase
ALAD	Aminolaevulinic acid dehydrase
ALARA	As low as reasonably achievable
ATCN	Asymptotic threshold concentration
AVS	Acid volatile sulfide
B	Biomagnification factor
BAF	Bioaccumulation factor
BCC	Bioaccumulative chemicals of concern
BCF	Bioconcentration factor
BF	Bioaccumulation factor
BI	Bioavailability index
BLM	Biotic ligand model
BOD	Biochemical (biological) oxygen demand)
BSAF	Biota-sediment accumulation factor
BSF	Biota-sediment factor
CBA	Cost-benefit analysis
CBR	Critical body residue
CF	Concentration factor
CFC	Chlorofluorocarbon.
ChE	Cholinesterase
CMPP	2-Methyl-4-chloro-phenoxy propionic acid
COPC	Contaminants of potentian concern
COD	Chemical oxygen demand)
CSM	Conceptual site model

2,4-D	2,4-Dichlorophenoxyacetic acid
2,4-DB	2,4-Dichlorophenoxybutyric acid
p,p' -DDT	p,p' -Dichlorodiphenyltrichloroethane.
DEB	Dynamic energy budget
DNOC	Dinitro-orthocresol.
DO	Dissolved oxygen
DOC	Dissolved oxygen content, Dissolved organic carbon
DOM	Dissolved organic matter
DT	Depuration time
DU	Dobson unit
EA	Environmental assessmen
EBI	Ergosterol biosynthesis inhibitor (fungicide)
EC	Effective concentration
ED	Effective dose
EFcrust	Enrichment factor (for the earth's crust)
EEC	Estimated (expected) environmental concentration
EIA	Environmental impact assessment
EIS	Environmental impact statement
ELS	Early life stage
EQO	Environmental quality objective
EQS	Environmental quality standard
EROD	Ethoxyresorufin O-deethylase
ET	Effect time
FATS	Fish acute toxicity syndromes
FAV	Final acute value
FCV	Final chronic value
FIAM	Free ion activity model
FONSI	Finding of no significant impact
FS	Feasibility study
GABA	Gamma-aminobutyric acid

GAS	General adaptation synddrome
GIS	Geographic information system
GEMs	Genetically engineered microorganisms
GLP	Good laboratory practice
GMO	Genetically modified organism
HCB	Hexachlorobenzene
HC_p, HCS	Hazardous concentration
HEDSET	Harmonized electronic data set
HI	Hazard index
HMO	Hepatic microsomal monooxygenase
HPVC	High production volume chemical
HQ	Hazard quotient
IC	Inhibitory concentration
ID	Inhibitory dose
IT	Inhibitory time
IED	Individual effective dose
IRIS	Integrated risk information system
IT_{50}	Median inhibitory time
Kow	Octanol water partition coefficient
LBB	Lethal body burden
LC	Lethal concentration
LED	Lowest effective dose
LLE	Loss of life expectancy
LOEC	Lowest observed effect concentration
LOEL	Lowest observed effect level
LT	Lethal time
LV	Limit value
MAC	Maximum allowable concentration
MAT	Mean absorption time
MATC	Maximum acceptable toxicant concentration

MCPA	2-Methyl 4-chloro-phenoxyacetic acid
MIC	Minimum inhibitory concentration
MIT	Median inhibitory time
MLE	Maximum likelihood estimation
MO	Monooxygenase
MRT	Mean residence time
MSD	Minimum significant difference
MTTD	Median time to death
NED	Normal equivalent deviation
NOEC(D)	No observed effect concentration (dose)
NOEL	No observed effect level
NRL	No response level
OC	Organic carbon, organochlorine compound
OP	Organophosphorous compound
Pow	Octanol water partition coeficient
PAH	Polycyclic aromatic hydrocarbon
PBT	Persistent, bioaccumulative, and toxic
PCB	Polychlorinated biphenyl
PCDD	Polychlorinated dibenzodioxin
PCDF	Polychlorinated dibenzofuran
PEC	Predicted environmental concentration
PFOS	Perfluorooctyl Sulfonate
PFOA	Perfluorooctanoic Acid
PICT	Pollution-induced community tolerance
PIP	Persistent inorganic pollutant
PNEC	Predicted no effect concentration
POM	Particulate organic matter
PMN	Pre-manufacture notification
POP	Persisten organic pollutant
PSD	Prevention of significant deterioration

QSAR	Quantitative structure-activity relationship
QSMR	Quantitative structure metabolism relationship
RfD	Reference dose
RfD_{dt}	Developmental reference dose
RI / FS	Remedial investigation and feasibility study
RME	Reasonable maximum exposure
RR	Rate ratio, relative risk
SAM	Standardized aquatic microcosm
SAR	Structure activity relationship
SB	Spiked bioassay
SCAS	Semi-continuous activated sludge
SMR	Structure metabolism relationship
SSD	Species sensitivity distribution
STP	Sewage treatment plant
2,4,5-T	2,4,5-Trichlorophenoxyacetic acid
T_x	Toxicity value
TL_m (TL_{50})	Median tolerance limit
TBT	Tributyl tin
TC	Threshold concentration
TCDD	Tetrachlorodibenzodioxin
TEC	threshold-effect concentration
TEF	Toxicity equivalency factor
TEQ	Toxicity equivalent
TI	Teratogenic index, time independent
TIE	Toxicity identification and evaluation
TL	Threshold level
TOC	Total organic carbon
TU	Toxicity unit
WET	Whole-effluent toxicity
WHAM	Windermere Humic Aqueous Model

WWTP	Waste water treatment plant

ANNEX 2: ABBREVIATIONS AND ACRONYMS OF NAMES OF INTERNATIONAL BODIES AND LEGISLATION

AFNOR	Association Francaise de Normalisation
APHA	American Public Health Association
ASTM	American Society for Testing and Materials.
CEQ	Council on Environmental Quality
EEA	European Environmental Agency
ECETOC	European Centre for Ecotoxicology and Toxicology of Chemicals
ECHA	European Chemicals Agency
EINECS	European Inventory of Existing Commercial Chemical Substances
EMPA	Eidgenössische Materialprüfungs- und ForschungsAnstalt (Swiss Federal Laboratories for Materials Testing and Research)
EPA	(US) Environmental Protection Agency
EPPO	European and Mediterranean Plant Protection Organization
FAO	Food and Agriculture Organization (of the United Nations)
FDA	(US) Food and Drug Administration
IPCS	International Programme on Chemical Safety
IRPTC	International Register of Potentially Toxic Chemicals
ISO	International Organization for Standardization
IUPAC	International Union of Pure and Applied Science
OECD	Organization for Economic Co-operation and Development
PAR COM	Paris Commission
SARA (US)	Superfund Amendment and Reauthorization Act.
SCAS test	Semi-continuous activated sludge biodegradation test
STP	Sewage treatment plant
TSCA (US)	Toxic Substances Control Act
UNCED	United Nations Conference on Environment and Development (held in Rio de Janeiro (Brazil) in 1992)
USEPA	United States Environmental Protection Agency

USES	Uniform System for the Evaluation of Substances
USFDA	United States Food and Drug Agency
VIM	Vocubulaire Internationale de Metrologie (International Vocabulary of Basic and General Terms in Metrology)
WHO	World Health Organization

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