

# Glossary

## A

- abiotic** Pertaining to the nonliving components of an ecosystem, such as water, heat, solar radiation, and minerals.
- abscissa** On a graph, the horizontal ( $x$ ) axis or the horizontal coordinate of a point.
- abundance-center relationship hypothesis** The tendency for population densities to be highest near the center of a species' geographic range.
- abyssal plain** The relatively flat floor of a deep ocean, mostly between 4 and 6 km beneath the surface.
- abyssal zone** In deep bodies of water, the zone between 4 and 6 km through which solar radiation does not penetrate (aphotic zone) and in which temperature remains at or slightly below 4°C year-round.
- acid rain** Precipitation with an extremely low pH. The acid condition is caused by the combination of water vapor in the atmosphere with chemicals such as hydrogen sulfide vapor released from the burning of fossil fuels, producing sulfuric acid.
- active dispersal (vagility)** The movement of an organism from one point to another by its own motility, such as by active swimming, walking, or flying, rather than by being carried along by some other force. Compare with *passive dispersal*.
- actualism** The philosophical assumption that the physical processes now operating are timeless, and therefore that the fundamental laws of nature have remained unchanged. Also called *uniformitarianism*.
- adaptation** Any feature of an organism that substantially improves its ability to survive and leave more offspring over that of other ancestral forms or coexisting phenotypes.
- adaptive radiation** The evolutionary and ecological diversification of a monophyletic lineage, which is driven largely by divergent selection caused by competition among closely related species.
- adaptive zone** A way of life, including such properties as ecological preference and mode of feeding, that has been adopted by a group of organisms.
- adiabatic cooling** The decrease in air temperature as a result of a decrease in air pressure (not a loss of heat to the outside) as warm air rises and expands. The rate of cooling is about 1°C per 100 m for dry air and 0.6°C per 100 m for moist air.
- aerial** Occurring in the air.
- aerial plankton** A diverse collection of organisms that are so tiny and light that they are carried by strong winds high above Earth's surface and to places far removed from their natal ranges.
- aeroecology** A relatively new discipline of the natural sciences that uses recent advances in remote sensing, including various forms of radar, infrared imagery, and ultrasound detection, to visualize the three-dimensional movements of organisms through the aerosphere—the relatively thin portion of the troposphere, closest to Earth's surface, that supports life.
- aestivation** A specialized type of animal behavior and physiology in which the organism lives through the summer in a dormant condition.
- age and area hypothesis** According to John C. Willis, a hypothesis stating that the greater the age of a taxon, the larger its distributional
- Age of Exploration** Period from the 15th through the 18th Centuries during which ships from European nations traveled the globe and, although primarily motivated by economic and political gain, enabled the first global-scale views of the natural world.
- albedo** The fraction of solar energy that is reflected from the surface of an object back into the atmosphere, or from Earth back into space.
- allele** One of two or more alternative forms of a gene located at a single point (locus) on a chromosome.
- allelopathy** A type of interspecific interaction in which one species inhibits the growth of another by releasing chemicals into the soil.
- Allen's rule** Among homeotherms, the ecogeographic (morphogeographic) trend for limbs and extremities to become shorter and more compact in colder climates than in warmer ones.
- allochthonous** Having originated outside the area in which it now occurs.
- allochthonous endemic** An endemic taxon that originated in a different location than where it is found today.
- allometry** The manner in which the relative size of one part of an organism increases in relation to the size increase of the entire organism; also known as *scaling*.
- allopatric** Occurring in geographically different places; i.e., ranges that are mutually exclusive.
- allopatric speciation** The formation of new species that occurs when populations are geographically separated.
- allopolyploid** A hybrid polyploid formed following the union of two gametes, usually from distantly related species, with nonhomologous chromosomes.
- alluvial** A large, fan-shaped pile of sand, clay, and other sediments gradually deposited by moving water along the shores of lakes and estuaries, or a river bed that flows onto a flat plain at the foot of a mountain range.
- alpha diversity** The species richness of a local ecological community, i.e., the number of species recorded within some standardized area, such as a hectare, a square kilometer, or some naturally delineated patch of habitat.
- Alpine tundra** Treeless biome found at higher elevations above treeline in montane systems.

- amensalism** A pairwise, interspecific interaction in which one species is adversely affected while the other is not directly affected (allelopathy is one example).
- amphitropical** Occurring in subtropical or temperate areas on opposite sides of the tropics.
- anagenesis** The process of evolution that produces entirely new levels of structural organization (grades) without branching events. Compare with *cladogenesis*.
- ancestor** The individual or population that gave rise to some subsequent individuals or populations with different features.
- ancient DNA** DNA isolated from specimens that have been deceased for hundreds to thousands of generations"
- andesite** Rocks of volcanic origin, often formed from a blend of silica and iron magma at plate margins such as subduction zones and resulting in, for example, intrusions (dikes) and island arcs.
- anemochory** Passive dispersal of propagules by winds.
- aneuploidy** The formation of a new chromosomal arrangement resulting in an increase or decrease of the chromosome number by one pair; often caused by an uneven meiotic division.
- Anthropocene** The current geological period, during which human activities and anthropogenic biomes have expanded to dominate much of Earth's terrestrial realm.
- anthropochory** The intentional transport of disseminules by humans.
- anthropogenic biome** An alternative type of major vegetation that develops and is maintained by activities of human civilizations. The principal anthropogenic biomes include dense settlements, villages, croplands, rangelands, and managed forests, which together cover roughly 75 percent of Earth's ice-free land surface.
- aphotic zone** The lower zone in a water column, usually below 50 to 100 m, in which the intensity of solar radiation is too low to permit photosynthesis by plants.
- apomixis** Reproduction without the union of sexual cells (gametes).
- apomorphy** In a transformation series, the derived character state.
- apterous** Wingless; often used to contrast these forms with their primitive ancestors that had wings and the ability to fly.
- aquatic** Living exclusively or for most of the time in water.
- arboreal** Living predominantly or entirely in the canopies of trees.
- arborescent** Treelike.
- arctic** Pertaining to all nonforested areas north of the coniferous forests of the Northern Hemisphere, especially everything north of the Arctic Circle.
- Arctic tundra** Treeless biome found between boreal forest and the ice caps at both poles.
- area biogeography** The primary goal of an analysis is to reconstruct the biogeographic history of a set of areas of endemism based on the affinities of taxa distributed across those areas.
- area cladogram** A cladogram of relationships among areas, generated variously from a model of geological history (*geological area cladogram*) or taxon history (see *taxon-area cladogram*).
- area of endemism** A geographic region containing two or more endemic taxa, defined and diagnosed using various criteria (see Box 12.2).
- area of occupancy** An alternative conception of the geographic range of a species that attempts to represent or estimate the area within the distributional limits of a species that is actually occupied by its populations. As such, the area of occupancy should almost always be less than the extent of occurrence.
- areography** The study of the structure and dynamics of geographic ranges, including variation in their sizes, shapes, and overlap.
- arid** Exceedingly dry; strictly defined as any region receiving less than 10 cm of annual precipitation.
- assembly rules** Highly nonrandom patterns in the organization and structure of ecological communities resulting from selective immigrations, extinctions or interactions among species.
- asthenosphere** A fluid, viscous zone of the upper mantle on which the continental and oceanic plates float (ride) and over which they move.
- austral** Pertaining to the temperate and subtemperate zones of the Southern Hemisphere. Compare with *boreal*.
- Australasia** The continental fragments of the original Australian Plate, including Australia, New Zealand, New Guinea, Tasmania, Timor, New Caledonia, and several smaller islands.
- Australian Region** The biogeographic region including Australia, New Zealand, and New Guinea, other nearby islands, and the Indonesian islands lying east of Wallace's line.
- autapomorphy** In a transformation series, a derived character state present in a single taxon.
- autochthonous** Having originated in the area in which it presently occurs.
- autochthonous endemic** An endemic taxon that differentiated where it is found today.
- autocorrelation (spatial and temporal)** The tendency for observations that are closer in space or time to be more similar than those that are more removed.
- autopolyploid** A polyploid possessing more than two sets of homologous chromosomes.
- autosome** A chromosome that is not a sex chromosome; a somatic chromosome.
- autotroph** An organism that uses carbon dioxide occurring in the environment as its primary source of cellular carbon.
- avifauna** All the species of birds inhabiting a specified region.
- azonal** Soil types of distinctive chemical composition that develop over unusual types of parent rock material.
- B**
- bajada** A broad, sloping surface deposited at the base of a mountain range in deserts, resulting from the coalescing of alluvial fans.
- balanced (biota)** See *harmonic (biota)*.
- barrier** Any abiotic or biotic feature that totally or partially restricts the movement (flow) of genes or individuals from one population or locality to another.
- basal meristem** A plant whose growth (mitotic) tissues are located in or near the soil layer, thus adapting this plant to continual grazing of its apical tissue.
- basal metabolic rate** A standardized measure of the rate of energy and oxygen requirements of an organism (usually measured at rest and within a range of temperatures at which the organism is not under thermal stress), and indicative of the minimal amount of energy required to maintain vital functions under stress-free conditions.
- basin-and-range topography** Landscapes characterized by many low, flat areas (basins) that are interrupted by isolated mountain ranges. During pluvial times, many of these basins filled with water.

- Batesian mimics** Species/individuals that use a form of mimicry in which a harmless and otherwise palatable species avoids predation by resembling a noxious or dangerous species.
- bathyal zone** The deep sea; in particular, that portion within the aphotic zone but less than 4 km deep.
- bathymetry** The depth and configuration of the bottom of a body of water.
- bauplan** (pl **baupläne**) The body plan or blueprint for how an organism is structured, including such things as its symmetry, number of body segments, and number and relative sizes of limbs, wings, or other appendages.
- Beijerinck's Law (Baas Becking hypothesis)** "*Everything is everywhere, but the environment selects.*" A statement which holds that where the likelihood of dispersal and eventual colonization is relatively high (especially in microscopic organisms with high dispersal capacities), the geographic distributions of these species are largely limited by local environmental conditions and physiological tolerances of the species, not by dispersal.
- Benioff zones** Zones of high earthquake activity located on the back sides of trenches. The earthquakes, which are caused by the subduction of a plate, are shallow near the trench and progressively deeper at greater distances.
- benthic** Living at, in, or associated with structures on the bottom of a body of water.
- Bergmann's rule** The tendency for the average body mass of geographic populations of an animal species to increase with latitude.
- Beringia** The geographic area of western Alaska, the Aleutians, and eastern Siberia that was connected in the Cenozoic by a land bridge when the Bering Sea and adjacent shallow waters receded. Sometimes called the *Bering Land Bridge*.
- beta diversity** The dissimilarity (turnover) in species composition between local ecological communities.
- biogeographic relicts** The narrowly endemic descendants of once widespread taxa.
- biogeography** The science that attempts to document and understand spatial patterns of biological diversity. Traditionally defined as the study of distributions of organisms (both past and present), modern biogeography now includes studies of all patterns of geographic variation in life, from genes to entire communities and ecosystems; elements of biological diversity that vary across geographic gradients including those of area, isolation, latitude, depth and elevation.
- biological diversity (biodiversity)** Although a technical scientific term in origin, this term has acquired ethical and social dimensions in some of its applications, such that its meaning has become extremely broad, and thus vague. In general, we use the term in line with the Convention on Biological Diversity to mean the "*variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.*"
- biological species** A group of potentially interbreeding populations that are reproductively isolated from all other populations.
- biomass** The total body mass of an organism, population, or community.
- biome** A major type of natural vegetation that occurs wherever a particular set of climatic and soil conditions prevail, but that may contain different taxa in different regions; e.g., temperate grassland.
- biosphere** Collectively, all living things of Earth and the areas they inhabit.
- biota** All species of plants, animals, and microbes inhabiting a specified region.
- biotic** Pertaining to the components of an ecosystem that are living or came from a once-living form.
- biotic components** Sets of spatiotemporally integrated taxa that coexist in given areas.
- bipedal** Using two hindlimbs for locomotion, usually by hopping or jumping, such as a kangaroo or a kangaroo rat.
- bipolar** Occurring at both poles, in the cold or sub-temperate zones.
- bivoltine** Breeding twice per year.
- bog (mire)** A peatland that receives most of its water from precipitation, and is characterized by water that tends to be low in nutrients and acidic, and is often covered with a matt of sphagnum moss.
- boreal** Occurring in that portion of the temperate and subtemperate zones of the Northern Hemisphere that characteristically contains coniferous (evergreen) forests and some types of deciduous forests. Compare with *austral*.
- bottleneck** In evolutionary biology, any stressful situation that greatly reduces the size of a population.
- brackish** Having a salt concentration greater than freshwater (>0.5%) and less than seawater (<35%).
- bradytelic** Term used by Simpson (1944) to refer to a slow rate of morphological change through time in a lineage with a fossil record.
- breeding area** In migratory land animals, the area in which populations mate and produce offspring.
- Brooks parsimony analysis (BPA)** Method in historical biogeography that uses parsimony analyses to construct general area cladograms from a set of taxon-area cladograms.
- brower** An animal that feeds on plant materials, especially on woody parts of trees and shrubs.
- Buffon's law** Named in honor of the 18th Century biogeographer Georges-Louis Leclerc, Comte de Buffon (1707-1788) who observed that different regions, even those with similar environmental characteristics, are inhabited by different assemblages of species.
- C**
- calcareous** In soil biology, pertaining to a soil whose horizons are rich in calcium carbonate and have a basic reaction.
- calcification** The formation of a soil under continental climatic conditions of relatively low moisture and hot to cool temperatures, resulting in a soil rich in calcium carbonate ( $\text{CaCO}_3$ ) because rainfall is not sufficient to leach calcium from the upper soil horizons.
- caliche** A hard, often rocklike layer of calcium carbonate that forms in soils of arid regions at the level to which the leached calcium salts from the upper soil horizon are precipitated.
- Cambrian Explosion** Period at the beginning Paleozoic era of the Phanerozoic eon marked by major extinctions of many earlier forms, followed by rapid radiations of many lineages and the origination of most major body plans in modern oceans.
- canonical distribution** A lognormal distribution of the number of individuals or species according to the mathematical formulation of Preston (1962).
- carnivore** An animal that feeds mostly or entirely on animal prey.

- carrying capacity (K)** The maximum number of individuals of a particular species that an environment can support without undergoing deterioration.
- cartograms** Examples of strategic distortion where mapping units (particular grid cells or polygons such as those representing countries or biogeographic regions) are scaled (and distorted), not according to their surface area but in proportion to another theme such as population density or species diversity.
- catastrophic death assemblages** Fossil deposits characterized by large numbers of individuals or species preserved at the same time and informative about biological and ecological characteristics of lineages and biotas.
- catastrophic extinction** See *mass extinction*.
- cenocrons** Sets of taxa that share the same biogeographic history with a shared distributional and evolutionary history.
- census population size** The total number of individuals in a population. Compare with *effective population size*.
- Centinelan extinctions** The loss of species in some unstudied area and time period before they became known to science.
- chaparral** A type of sclerophyllous scrub vegetation occurring in the southwestern region of North America with a Mediterranean climate.
- character** A heritable trait with different *character states* that can be recognized by systematists and used to infer evolutionary relationships and classify organisms into taxa.
- character displacement** The divergence of a feature of two similar species where their ranges overlap so that each uses different resources.
- character state** One of several alternative forms of a character; e.g., the ancestral form or one of several derived forms.
- checkerboard distributions** Mutually exclusive distributions where two species (putative competitors or predator and prey) seldom co-occur across islands or other communities and habitats.
- chorological map** A map that attempts to reconstruct and display the paths of range expansion of species or biotas over their evolutionary history.
- chorology** A term coined by Ernst Haeckel in 1866 to describe the science of the geographic spread of organisms.
- chromosome** A connected sequence of genetic material on long-stranded deoxyribonucleic acid (DNA) wrapped with proteins.
- chronospecies** A recognizable stage along a sequence from ancestral to descendant species through non-branching (anagenetic) evolutionary change. See *phyletic speciation*.
- circumboreal** Occurring in the temperate or subtemperate zones of the New and Old World portions of the Northern Hemisphere.
- clade** Any monophyletic evolutionary branch in a phylogeny, using derived characters to support genealogical relationships.
- cladistic biogeography** See *vicariance biogeography*.
- cladistics** The method of reconstructing the evolutionary history (phylogeny) of a taxon by identifying the branching sequence of differentiation through analysis of shared derived character states. Also called *phylogenetic systematics*. Compare with *evolutionary systematics* and *numerical phenetics*.
- cladogenesis** The process of evolution that produces a series of branching events.
- cladogram** A line diagram derived from a cladistic analysis showing the hypothesized branching sequence (genealogy) of a monophyletic taxon and using shared derived character states (synapomorphies) to determine when each branch diverged.
- classical species concept** See *morphological species concept*.
- climax community** Pertaining to a community that perpetuates itself under the prevailing climatic and soil conditions; therefore, the last stage in secondary succession.
- cline (clinal variation)** A change in one or several heritable characteristics of populations along a geographic transect, attributable to changes in the frequencies of certain alleles and often correlated with a gradual change in the environment.
- coalescence** In a gene tree, the point in time (absolute time or scaled to generations) at which two allelic lineages diverged from an ancestral lineage.
- coenocline** A graphical method developed by Robert H. Whittaker to illustrate changes in local abundances or densities of a group of species along an environmental or geographic gradient.
- coevolution** The simultaneous, interdependent evolution of two unrelated species that have strong ecological interactions, such as a flower and its pollinator or a predator and its prey.
- coexistence** Living together in the same local community.
- cohesion** The array of genetic and ecological components that serve to maintain the integrity of a species; particularly relevant to the cohesion species concept.
- cohesion species concept** A species concept that defines species as "*the most inclusive population of individuals having the potential for phenotypic cohesion through intrinsic cohesion mechanisms [genetic and/or demographic exchangeability]*" (Templeton 1989).
- collision zones** Regions where two tectonic plates converge, resulting either in the subduction of one of the plates beneath the other or, if both are of equal buoyancy (as in convergence of two continental plates), uplift and formation of mountains.
- colonization** The immigration of a species into new habitat followed by the successful establishment of a population.
- commensalism** An interspecific relationship in which one species draws benefits from the association and the other is unaffected.
- community** An assemblage of organisms that live in a particular habitat and interact with one another.
- community assembly hypothesis** The assertion that communities develop nonrandom patterns in their structure (primarily in the combination of particular, co-occurring species) as a result of interspecific differences and ecological interactions.
- community ecology** The study of interactions among co-occurring organisms living in a particular habitat.
- community function** The dynamic properties and activities that affect energy flow and nutrient cycling in a community; e.g., photosynthesis, interspecific interactions, and decomposition.
- community structure** The relatively static properties—including the diversity, composition, and biomass (total quantity of living organic matter)—of the species that comprise a community.
- comparative phylogeography** In phylogeography, the analysis of geographic pattern across multiple co-distributed species or groups of species.
- competition** Any interaction that is mutually detrimental to both participants. Interspecific competition occurs among species that share requirements for limited resources.

- competitive exclusion principle** The principle that when two species with similar resource requirements co-occur, one eventually outcompetes and causes the extinction of the other.
- component analysis** An approach in historical biogeography that searches for shared cladogenetic events among a set of partially but not completely congruent taxon-area cladograms by using one or more assumptions to develop rules about how to remove the incongruent parts of the cladograms.
- compositionalist approach** In community ecology, when classification criteria for mapping life on Earth are based on species composition.
- conduction** Direct molecular transfer (e.g., of heat), especially through solid matter.
- congeners** Species belonging to the same genus.
- consensus area cladogram** Summarizes the shared cladogenetic events among a set of taxon-area cladograms.
- conservation biogeography** A newly articulated discipline that applies lessons from biogeographic theory and patterns to conserve biological diversity, and which emphasizes the need to conserve the geographic, ecological, and evolutionary context of nature.
- consilience** The principle that information from unrelated sources or fields, when intersected, provides greater scientific rigor and stronger conclusions.
- constraint line** Lines or curves on bivariate plots that illustrate how observations are constrained from occurring within particular regions of the bivariate space.
- continental drift** A model, first proposed by Alfred Wegener, stating that the continents were once united and have since become independent structures that have been displaced over the surface of the globe.
- continental island** An island that was formed as part of a continent and that has a nucleus of continental (sialic) rocks.
- contour maps** Maps that use isoclines ("contours" of similar levels of a variable) to illustrate changes in characteristics (e.g., population densities of a species or diversity of ecological communities) across a geographic area.
- convection** Transfer of heat via the mass movement of liquid or gaseous matter.
- convergent boundary** In plate tectonics, those areas associated with collision and subduction zones.
- convergent evolution** The development of two or more species with strong superficial resemblances from totally unlike and unrelated ancestors.
- Cope's rule** A trend in directional evolution (orthogenesis) toward increased body size or range in body size of members of a lineage over time. Attributed to American paleontologist Edward Drinker Cope.
- coprolite** Fossil excrement.
- Coriolis effect** A physical consequence of the law of conservation of angular momentum whereby, as a result of Earth's rotation, a moving object appears to veer to the right in the Northern Hemisphere and to the left in the Southern Hemisphere.
- corridor** A dispersal route that permits the direct spread of many or most taxa from one region to another.
- cosmopolitan** Occurring essentially worldwide, as on all habitable landmasses or in all major oceanic regions. Compare with *endemic*.
- craton** The stable crustal nucleus of a continent or continental island, which is older than 600 million years; also called *Precambrian shield*.
- crust** The outermost rock layer of Earth, covering the mantle.
- cryptic species** Species within a genus that are morphologically so similar that they cannot be visually distinguished by superficial features. See *sibling species*.
- cryptoturnover** Biotic turnover (immigrations and extinctions) of species that may go unrecorded because they occur between survey periods.
- Curie point** The temperature at which remnant magnetism develops in cooling minerals; e.g., 680°C for hematite and 580°C for magnetite.
- cursorial** Animals (such as most grazing mammals) that are adapted to run to avoid predation.
- cyclical vicariance model** Also known as the "*speciation-pump model*." A model that attributes the high diversity of tropical communities in South America to repeated fragmentation (and allopatric speciation) and reconnection of tropical forests caused by the 20 or so glacial/interglacial cycles of the Pleistocene.

## D

- deciduous** In plants, having leaves that are shed for at least one season, usually in response to the onset of cold or drought.
- declination** Dipping of magnetic needles, which orient toward Earth's magnetic poles, which lie deep beneath its crust. Thus, declination can be used to estimate latitude, either under existing conditions or in magnetically active rocks that crystallized in ancient periods, but now drifted to distant positions.
- decomposer** An organism (usually a bacterium or fungus) capable of metabolically breaking down organic materials into simple organic and inorganic compounds and releasing them into the ecosystem.
- deconstruction (pattern deconstruction)** An attempt to understand underlying, causal mechanisms for patterns of biodiversity by examining the differences in patterns among functionally different groups of species, or differences among patterns for similar species across different habitats, ecosystems or different regions (see Huston 1994).
- deductive reasoning** A method of analysis in which one reasons from general constructs to specific cases.
- defaunation** The elimination of animal life from a particular area.
- dehiscence** The act of splitting along a natural line to discharge the contents, such as that of an anther to release pollen grains or of a capsule to release seeds.
- deletion** A form of mutation in which one or more nucleotides are eliminated from a DNA sequence.
- delta diversity** The dissimilarity (turnover) in species composition between large, geographic areas.
- density compensation** In island biogeography, an increase in the density of a species inhabiting an island habitat when one or more taxonomically similar competitors are absent.
- density enhancement** The tendency for densities of populations inhabiting relatively small, species-poor islands to increase with island area.
- density inflation** The tendency for densities of populations inhabiting islands of intermediate size and species richness to increase beyond the level of this species on the mainland. The accumulated effects of density inflation over many species is referred to as *density overcompensation*.
- density overcompensation** In island biogeography, a case in which the total densities of a few species inhabiting a small island exceed the combined densities of a much greater number of species of the same taxon occupying similar habitats on a large island or continent.

**density stasis** On islands of intermediate to relatively large area and high levels of species richness, the combined effects of many species interactions may regulate one another's densities such that few, if any, exhibit any consistent trend of population density with species richness or island area.

**desert** A general term for an extremely dry habitat, especially one where water is unavailable for plant growth most of the year; in particular, a habitat with long periods of water stress and sparse coverage by plants, often with perennials covering less than 10% of the total area.

**desertification** The degradation of land in arid, semi arid and dry sub-humid areas into desert.

**deterministic** Determined or controlled by some regulatory force, such as natural selection. Compare with *stochastic*.

**detritivore** An organism that feeds on detritus.

**detritus** Freshly dead or partially decomposed organic matter.

**dew point** The temperature at which air becomes saturated with water vapor and it condenses to form fog or other forms of precipitation.

**diadromous** Referring to an aquatic animal that must migrate between fresh water and seawater to complete its life cycle, such as certain lampreys and eels.

**diapause** An arrested state of development in the life cycle, especially of many insects, during which the organism has reduced metabolism and is more resistant to stressful environmental conditions, such as cold, heat, or drought.

**diaspore** Any part or stage in the life cycle of an organism that is adapted for dispersal.

**diffuse competition** A type of competition in which one species is negatively affected by numerous other species that collectively cause a significant depletion of shared resources.

**diffusion** A form of range expansion that is accomplished over generations by individuals spreading out from the margins of the species' range.

**dimorphic** Having two distinct forms in a population.

**dioecious** Having individuals with only male or only female reproductive systems.

**diplochory** Species that have two modes of dispersal; e.g., strand-line flora that have colonized the Krakatau islands by floating across the sea, yet also have adaptations for inland dispersal aided by birds or bats.

**diploid** Having two sets of chromosomes ( $2n$ ).

**disassembly (community disassembly)** The nonrandom loss of particular species from ecological communities, typically associated with anthropogenic disturbances and resultant, selective extinctions.

**discontinuous** A common pattern of variation in trait characteristics, where some individuals are very similar to one another but separated by other groups of individuals by distinct gaps.

**disharmonic (biota)** A biota that is not a random subset of the mainland or source biota, but one biased in favor of species with superior immigration abilities or abilities to survive on islands.

**disjunct** A taxon whose range is geographically isolated from that of its closest relatives.

**disjunction** A discontinuous range of a monophyletic taxon in which at least two closely related populations are separated by a wide geographic distance.

**dispersal** The movement of organisms away from their point of origin.

**dispersal biogeography** A form of historical biogeography that attempts to account for present-day distributions based on the assumption that they resulted from differences in the dispersal abilities of individual lineages.

**dispersal-vicariance analysis (DIVA)** An event-based approach in historical biogeography that reconstructs ancestral areas at each node in a taxon-area cladogram and infers events based on an a priori assignment of the "cost" of vicariance, dispersal, and extinction events.

**dispersion** The spatial distribution of individual organisms within a local population.

**disruptive selection** Selection that favors extreme and eliminates intermediate phenotypes.

**disseminule** Any part of a plant that is used for dispersal; occasionally restricted to include only seeds and seed-bearing structures. See also *diaspore*.

**distance-decay** The tendency for some property (e.g., species richness) to decline with increasing isolation, or for similarity in characteristics of two or more sites to decrease with increasing distance between those sites.

**distribution function** A method of assessing the relative importance of immigration and extinction as processes influencing community assembly by using a bivariate plot to illustrate the distribution of populations of a focal species on islands of varying isolation and area.

**distributional congruence** Subregions comprised of sets of co-occurring endemic species.

**divergent boundary** In plate tectonics, those areas associated with spreading zones.

**doldrums** A narrow equatorial zone characterized by long periods of calm or light shifting winds, caused by the upward movement of air masses from this region of high atmospheric pressure to higher latitudes with relatively lower pressure.

**dominant** A species having great influence on the composition and structure of a community by virtue of its abundance, size, or aggressive behavior.

**dot maps** Maps depicting the geographic range of a species by place dots at points of documented occurrence of its individuals and populations.

**driftless area** A possible glacial refugium located in what is present day southern Wisconsin and adjacent areas of Illinois and Iowa.

## E

**eccentricity** The degree of ellipticity in Earth's orbit about the sun, which varies in a cyclical manner over a 100,000 year period.

**ecogeographic (morphogeographic) rules** A regular change in characteristics of organisms (in particular, but not limited to, their morphological characteristics) along geographic gradients (e.g., Bergmann's, Allen's, Jordan's, and Thorson's rules).

**ecological biogeography** The study of distributions and geographic variation of extant biotas, with special emphasis on the influences of interactions between organisms and their abiotic and biotic environments.

**ecological differentiation** The differential use of the same set of resources which, under optimal conditions, may result in adaptive radiation.

**ecological naiveté** The tendency for insular biotas to lose the structures and behaviors that enabled their mainland ancestors to avoid predators, parasites, and competitors.

**ecological niche** See *niche*.

- ecological release** The tendency for populations inhabiting species-poor environments such as small or isolated islands to occur in a broader range of habitats, feed on a broader variety of prey, or otherwise occupy a broader range of their fundamental niche than they do in species-rich communities.
- ecological speciation** The development of reproductive isolation between two incipient species as a result of divergent natural selection.
- ecological time** The period during which a population can interact with its environment and respond to environmental fluctuations without undergoing substantial evolutionary modification. Compare with *evolutionary time*.
- ecology** The study of the abundance and distribution of organisms and of the relationships between organisms and their biotic and abiotic environments.
- ecotype** Refers to a distinctive population that occurs in a particular habitat type.
- ecoregions** As defined by Robert G. Bailey, a geographic grouping of landscapes, each comprised of a mosaic of ecosystems.
- ecosystem** The set of biotic and abiotic components in a given environment.
- ecosystem engineer** A species that significantly alters the functioning and environmental characteristics of an ecosystem.
- ecosystem geography** The study of the distribution of ecosystems and the processes that have differentiated them in space and time.
- ecotone** A zone of transition between two habitats or communities.
- ectoparasite** A parasite that lives on the exterior of its host, such as a louse.
- ectotherm** An animal whose body temperature is determined largely.
- edaphic** Pertaining to soil.
- edge effects** In conservation biology, the potential negative effects of exotic species and disturbances that act along the edges of habitat fragments.
- effective population size** The number of breeding individuals in a population. Compare with *census population size*.
- El Niño Southern Oscillation (ENSO)** An approximate 5- to 7-year cycle of regional climatic changes that is caused by variation in sea surface temperatures and oceanic currents in the tropical regions of the Pacific (similar events occur in the tropical Atlantic).
- emigration** Dispersal of organisms away from a region of interest.
- endemic** Pertaining to a taxon that is restricted to the geographic area specified, such as a continent, lake, biome, or island. Compare with *endemism*.
- endemic bird areas** Areas containing the ranges of at least two restricted-range species of birds (i.e., those whose breeding ranges are less than 50,000 km<sup>2</sup>).
- endemism** The number or proportion of a regional biota's species that are endemic to (occur only in) that region. Compare with *endemic*.
- endorheic basin** A drainage basin that lacks outflows (either surface or underground), such that all water that it receives is lost only by seepage or evaporation.
- endotherm** An animal whose body temperature is maintained largely by its own metabolic heat production. Compare with *ectotherm*.
- endozoochory** Dispersal of plant propagules inside the bodies of animals. Some plants adapted for endozoochory require scarification or chemical degradation of their seeds inside the animal's digestive tract for germination.
- entropy** A measure of the unavailable energy in a closed thermodynamic system.
- epeiric sea** A large but relatively shallow body of salt water that lies over a part of a continent.
- epicenter** The point on Earth's surface directly above the origin (focus) of an earthquake.
- epicontinental sea** See *epeiric sea*.
- epifaunal** Living on a substrate, such as a barnacle or coral.
- epipelagic** Living on open water, within the upper 100 m or so (where there is enough sunlight to allow photosynthesis).
- epiphyll** Thin layers of mosses, lichens, and algae that grow along the surfaces of trees in rainforests.
- epiphyllous** Living on a leaf.
- epiphyte** A plant that usually lives on another plant (is not rooted in soil) and derives its moisture and nutrients from atmospheric precipitation and whatever materials are released by the organisms in the immediate vicinity.
- equatorial countercurrent** A small current running west to east along the Equator (i.e., opposite the major oceanic gyres) in the eastern region of the Pacific Ocean (see Figure 3.5).
- equilibrium** A condition of balance between opposing forces, such as birth and death rates or immigration and extinction rates.
- equilibrium theory of island biogeography** The theory proposed by MacArthur and Wilson stating that the number of species on an island results from a dynamic equilibrium between the opposing rates of immigration and extinction.
- equilibrium turnover rate** The change in species composition per unit of time when immigration equals extinction.
- equinox** Either of the two times in a year (around March 21 and September 22) when the sun passes the Equator so that day and night are the same length everywhere on Earth.
- establishment** The successful start or founding of a population.
- estuary** A body of water where fresh water from rivers mixes with salt water from the sea.
- Ethiopian Region** The portion of Africa south of the Sahara Desert, plus Madagascar and other nearby islands.
- euryhaline** Having a tolerance to an extremely wide range of salt concentrations.
- eurythermal** Having a tolerance to a broad range of temperatures.
- eurytopic** Having a tolerance to an extremely wide range of habitats and environmental conditions.
- eustasis** Global fluctuations in sea level resulting from the freezing or melting of great masses of sea ice, thus decreasing or increasing, respectively, the global volume of liquid water.
- eutherian** A placental mammal. Compare with *metatherian*; *prototherian*.
- eutrophic lake** A lake that is rich in dissolved nutrients and highly productive, but that is usually shallow and seasonally deficient in oxygen.
- evapotranspiration** The sum total of water lost through evaporation from land and transpiration by plants.
- evolution** In the strictest sense, any irreversible change in the genetic composition of a population.
- evolutionarily significant units (ESUs)** Defined in several ways, but one that is popular is as "historically isolated sets of populations for which a stringent and qualitative criterion is recip-



*rocal monophyly for mitochondrial DNA [mtDNA] combined with significant divergence in frequencies of nuclear alleles"* (Moritz et al. 1995).

**evolutionary biogeography** An earlier approach in historical biogeography motivated by the search for centers of origin and dispersal over a stable geographic template.

**evolutionary convergence** The process by which taxonomically unrelated species in geographically isolated regions have evolved similar forms and/or similar ecological roles under the influence of similar selective pressures.

**evolutionary species concept** A defining concept that recognizes a species as "*an entity composed of organisms that maintains its identity from other such entities through time and over space and that has its own independent evolutionary fate and historical tendencies*" (Wiley and Mayden 2000).

**evolutionary systematics** A method of reconstructing the evolutionary history (phylogeny) of a taxon by analyzing the evolution of major features along with the distribution of both shared primitive and shared derived characteristics. Compare with *cladistics* and *numerical systematics*.

**evolutionary time** The period during which a population can evolve and become adapted to an environment by means of genetic changes. Compare with *ecological time*.

**evolvability** The capacity of species populations to adapt by mutation and evolution and respond to natural selection.

**excess density compensation** See *density overcompensation*.

**exoskeleton** An external skeleton of an animal, such as that of a clam or insect.

**exozoochory (epizoochory)** Dispersal of plant propagules (e.g., sticky or barbed seeds or fruits) that attach to the skin surfaces of mobile animals.

**exploitative competition** A negative interaction between species or conspecifics in which individuals use up resources and make them unavailable to others.

**exponential growth** In ecology, a population that increases in proportion to its population size and, therefore, at a continually accelerating rate.

**extant** Existing at the present time.

**extent of occurrence** An alternative conception of the geographic range of a species that attempts to represent the distributional limits, measured as the area that lies within the extreme limits of its occurrences. Compare with *area of occupancy*.

**extinct** No longer living.

**extratropical** Occurring outside the tropics.

## F

**facultative relationship** An interaction between two organisms that is not essential to the survival of either.

**family** A taxonomic category above the level of genus and below the level of order.

**fault** In geology, a weakness in Earth's crust along which there can be crustal motion and displacement.

**fen (fenland)** A peatland that receives most of its water from runoff or groundwater. Fens tend to have higher nutrient levels and support more diverse plant and animal communities than bogs.

**filter** A geographic or ecological barrier that blocks the passage of some forms, but not others.

**filter feeder** An aquatic animal that feeds on plankton or other minute organic particles by using one of a variety of filtering mechanisms.

**first law of thermodynamics** Energy is neither created nor destroyed, but can be converted from one form to another.

**fitness** The ability of a genotype to leave offspring in the next generation or succeeding generations as compared with that of other genotypes.

**floristic belts** A series of plant communities that are characterized by different growth forms or physiognomies that occur in predictable series (e.g., deserts, savanna, dry woodlands, coniferous forests and tundra) along elevational and latitudinal gradients.

**flyway** An established air route used by vast numbers of migratory birds.

**food chain** A diagram or list of species that describes predator and prey relationships and the transfer of energy and nutrients within an ecological community.

**food web** Interconnecting, branching patterns in trophic diagrams representing the flow of food and energy through biological communities.

**forest** Any of a variety of vegetation types dominated by trees and usually having a fairly well developed or closed canopy when the trees have leaves.

**Forster's rule** The latitudinal gradient in diversity from the Equator (the region of greatest diversity) to the poles. Named in honor of Johann Reinhold Forster, one of the first naturalists to describe the pattern and provide a cogent, causal explanation.

**fossil** A remnant, impression, or other trace of a living organism from the past.

**fossorial** Referring to an animal that digs and is adapted to life in underground burrows.

**founder effect** Genetic drift that occurs when a newly isolated population is founded, such as on an island, by one or a few colonists (founders). The features of the new population may be markedly different from those of the ancestral population because the gene pool of the founders may be a biased and small sample of the source population.

**fragment** In plate tectonics, a portion of a former landmass.

**fresh water** In the strictest sense, water that has a salt concentration of less than 0.5%.

**frugivore** An animal that feeds mainly on juicy fruits.

**functional biogeography** An emerging line of research that analyzes the patterns, causes, and consequences of the geographic distribution of form and function (trait diversity).

**functional diversity** A species-based measure of biological diversity in that gives weight to ecological importance of the species. Compare with *phylogenetic diversity*.

**functionalist approach** In community ecology, when classification criteria for mapping life on Earth are based on functional properties of species.

**fundamental geographic range** The theoretical distribution that populations of a particular species may achieve based solely on their physiological and abiotic tolerances, assuming that species interactions are unimportant and opportunities of dispersal are unlimited. Compare with *realized geographic range*.

**fundamental niche** The total range of environmental conditions in which a species can (theoretically) survive and reproduce. Compare with *realized niche*.

**fynbos** A type of sclerophyllous scrub vegetation occurring in the region of South Africa with a Mediterranean climate.



## G

- gamete** One of two cells, usually from different parents, that fuse to form a zygote. Most commonly refers to female and male gametes, i.e., egg and sperm.
- gamma diversity** The total species richness of large geographic areas ranging from a combination of local ecological communities to those of entire biomes, continents and ocean basins.
- gene** The small unit of a DNA molecule that codes for a specific protein to produce one of the chemical, physiological, or structural attributes of an organism.
- gene conversion** A process by which damaged genes can be repaired.
- gene flow** The movement of alleles within a population or between populations caused by the dispersal of gametes or offspring.
- gene frequency (allelic frequency)** The proportions of gene forms (alleles) in a population.
- gene tree** The phylogeny of a particular gene or group of tightly linked genes embedded within the phylogeny of a population or species.
- genealogical concordance concept** A species concept that proposes that "*population subdivisions concordantly identified by multiple independent genetic traits should constitute the population units worthy of recognition as phylogenetic taxa*" (Avice and Ball 1990).
- genealogy** The study of the exact sequence of descent from an ancestor to all derived forms.
- general area cladogram** A cladogram summarizing vicariance (and depending on approach, also dispersal, sympatric speciation, and extinction) events from a set of taxon-area cladograms.
- generalized track** In panbiogeography, a line drawn on a map representing the coincident distributions of numerous disjunct taxa.
- genetic drift** Changes in gene frequency within a population caused solely by chance—i.e., which individuals happen to mate and leave offspring in the next generation—without any influence of natural selection.
- genome** A full set of chromosomes.
- genotype** The total genetic message found in a cell or an individual.
- genus** A taxonomic category for classifying species derived from a common ancestor; a level below that of family and tribe.
- geobiotic scenario** The goal of an approach in historical biogeography that integrates "*distributional, phylogenetic, molecular, and paleontological data in order to discover biogeographic patterns and assess the historical changes that have shaped them*" (Morrone 2009).
- geo-dispersal** The concordant dispersal of several species out of an area of endemism following erosion of a dispersal barrier with subsequent re-emergence of a barrier and a new round of speciation.
- geographic coordinate systems** A means of using two geographic variables (e.g., latitude and longitude, or easting and northing [UTM system]) to locate points on a map.
- geographic information systems (GIS)** A system of technologically sophisticated and readily accessible, computer-based tools for visualizing, modifying, and analyzing patterns among spatially referenced observations.
- geographic isolation** Spatial separation of two potentially interbreeding populations; allopatry.

- geographic race** Regional subspecies that are characterized by distinctive phenotypic and genetic traits.
- geographic range** The area over which the populations of a species are distributed.
- geographic speciation** See *allopatric speciation*.
- geographic template** The highly nonrandom, spatial variation of environmental conditions that forms the foundation for all biogeographic patterns.
- glacial-interglacial cycles** The 20 or so repeated cycles of global-scale climatic warming and cooling that occurred during the Pleistocene Epoch and profoundly affected biogeographic patterns of Earth's biotas.
- glacio-isostasy** Depression (downwarping) or rebounding of Earth's crust that is due to formation or melting of ice sheets.
- glacio-pluvial** The alternating "ice" to "rain" (glacial to interglacial) stages of the Pleistocene epoch.
- gleization** The formation of a soil under moist and cool or cold conditions, resulting in an acidic soil with a large amount of organic matter and iron present in a reduced state (FeO).
- Gloger's rule** Named for ornithologist Constantin Gloger, who noted that coloration of pelage (fur or feathers) among closely related endotherms is often correlated with the humidity of their environment, with darker pelage occurring in the more humid tropical environments near the Equator.
- Gondwana** The southern half of the supercontinent Pangaea, consisting of the southern continental landmasses (Australia and nearby islands, Antarctica, and South America) and India. These landmasses were united for at least 1 billion years before breaking up during the late Mesozoic. Compare with *Laurasia*.
- granivore** An animal that feeds mainly on dry seeds and fruits; a subtype of herbivore.
- grassland** Any of a variety of vegetation types composed mostly of grasses and other herbaceous plants (forbs) but few if any trees and shrubs.
- Great American Biotic Interchange (GABI)** Term used by the paleontologist George Gaylord Simpson to describe the waves of biotic exchange of terrestrial organisms between Nearctic and Neotropical Regions (i.e., North and South America) following the emergence of the Central American Land Bridge roughly 3.5 Ma. Also known as the *Great American Interchange*.
- greenhouse effect** The retention of heat in the atmosphere when clouds (water vapor) and carbon dioxide absorb the infrared (heat) radiation reradiated from Earth rather than permitting the heat to escape.
- gross primary productivity (GPP)** The rate of energy fixed by the conversion of CO<sub>2</sub> and water into protoplasm by green plants through photosynthesis.
- grouping rule** Only synapomorphies provide evidence of common ancestry relationships; symplesiomorphies, autapomorphies and homoplasies are uninformative for doing so.
- guide fossil** A fossil used to date the age of a sedimentary stratum; also called an *index fossil*.
- guild** Groups of species that exploit the same class of environmental resources in a similar manner (e.g., desert granivores or foliage-gleaning birds).
- guyot** A flat-topped submarine volcano.
- H**
- habitat island** A geographically isolated patch of habitat, such as a pond, mountaintop, or cave, that can be studied in the same ways as oceanic islands for patterns of colonization and extinction.

- habitat selection** The preference of an organism for a particular habitat type.
- hadal** Of or pertaining to the deepest zones of the ocean, below 6 km, which have nearly constant environments with year-round temperatures near 4°C and no light penetration; e.g., in the oceanic trenches.
- half-life** The amount of time needed for half of the radioactive material in a rock to decay to a stable element.
- halomorphic soil** Soil that is characterized by very high concentrations of sodium, chlorides, and sulfates and which forms in estuaries and salt marshes, and in arid inland basins where shallow water accumulates and evaporates, leaving behind high concentrations of salts.
- halophytic** "Salt-loving" plant species that grow in areas of soils with high salt concentrations, including a variety of taxonomic and functional groups, each with special adaptations for dealing with the problem of maintaining osmotic and ionic balance in these environments (e.g., the ability to excrete salts or store them in special cells and tissues).
- haploid** Having one set of chromosomes ( $n$ ).
- haplotype** A *haploid* allele for a gene or group of tightly linked genes.
- harmonic (biota)** A biota that is similar to a random subset of its source pool.
- harsh/benign range limits hypothesis** The proposition that harsh range boundaries are typically set by abiotic factors, whereas environmentally benign range boundaries reflect biotic controls.
- herbivore** An animal that feeds mostly or entirely on plants.
- hermaphroditic** Having both male and female reproductive structures in the same individual.
- heterogeneity** The state of being mixed in composition, as in genetic or environmental heterogeneity.
- heterotroph** An organism that uses organic carbon (compounds made by living organisms) as its source of cellular carbon.
- historical biogeography** The study of the development of lineages and biotas including their origin, dispersal and extinction.
- history of lineage** The series of changes that have occurred in the intrinsic characteristics of organisms, species, or higher taxa over generations of evolutionary descent.
- history of place** The past environmental conditions, configurations, and locations of landmasses or ocean basins and other bodies of water.
- history of species** The environmental and ecological conditions experienced by the ancestors of a particular species or taxon, which have influenced its evolutionary development and geographic distributions, both past and present.
- histosols** Soils that are characterized by a substantial layer of organic matter (>30%) of more than 40 cm either extending down from the surface or taken cumulatively within the upper 80 cm of the soil. These soils are formed because the production of organic debris exceeds its decay.
- Holarctic region** The extratropical zone of the Northern Hemisphere, which includes both the Nearctic and Palearctic regions.
- homeostasis** The maintenance of a constant internal state despite fluctuations in the external environment.
- homeotherm** An animal that maintains a fairly constant body temperature.
- homologies** Character states shared between two or more taxa because it was inherited from a common ancestor.
- homologous chromosomes** Two chromosomes (in a diploid organism) that have essentially the same gene sequence and that are similar enough to pair during meiosis and mitosis.
- homology** A character shared by a group of organisms or taxa due to inheritance from a common ancestor.
- homoplasy** A character that appears similar among a group of organisms or taxa, but the similarity is due to parallel or convergent evolution rather than inheritance from a common ancestor.
- horizon** In soils, the major stratifications or zones, each of which has particular structural and chemical characteristics.
- horizontal gene transfer** The movement of a piece of DNA or a gene from one species, and incorporation into the genome of a new species, often mediated through an intermediate vector (e.g., bacterium or parasite).
- horotelic** Term used by Simpson (1944) to refer to a moderate rate of morphological change through time in a lineage with a fossil record.
- Horse Latitudes** The zones of dry descending air between 30° and 40° N and S latitude, where many deserts of the world are located.
- hotspot** In plate tectonics, a stationary weak point in the upper mantle that discharges magma (molten rock) as a plate passes over it, producing a narrow chain of islands. In biodiversity studies, an area with a relatively high number of species or high number of endemic species.
- humus** A brown or black organic substance in soils consisting of partially or wholly decayed vegetable or animal matter that provides nutrients for plants and increases the ability of soil to retain water.
- hybrid zone** Relatively narrow geographic zones where one or more phenotypes or alleles exhibit rapid shifts in frequencies as a result of interbreeding and gene flow between otherwise isolated populations or species.
- hybridization** The production of offspring by parents of two different species or dissimilar populations or genotypes.
- hydrochory** Passive dispersal of propagules by water.
- hyperosmotic** Referring to an environment in which water will diffuse from an organism because the external solution has a salt concentration higher than its internal concentration.
- hypersaline** Having a higher salt concentration than normal seawater.
- hypothetico-deductive reasoning** A method of analysis in which one starts with a new, tentative hypothesis and then tests the predictions and assumptions following from it one by one in an attempt to falsify it.
- ichthyofauna** All the species of fish inhabiting a specified region.
- immigrant pattern** The tendency for islands along a gradient of increasing isolation to be inhabited by assemblages of species that represent highly nonrandom subsets of less-isolated communities, in this case biased in favor of species with superior immigration abilities.
- immigration** The arrival of new individuals to an isolated site.
- incidence functions** A method of exploring community assembly by graphing the proportion of islands inhabited by a given species as a function of the number of other species present.

**included niche** A niche of a specialized species characterized by a narrow range of conditions and lying entirely within the larger fundamental niche of a more generalized species.

**index fossil** See *guide fossil*.

**inductive reasoning** A method of analysis in which one uses specific observations to derive a general principle.

**infaunal** Living within a substrate, such as clams that bury themselves in sand or mud and that feed by means of a long siphon.

**ingroup** The focal monophyletic group in a cladistic analysis.

**insectivore** An animal that feeds mainly on insects.

**insertion** A form of mutation in which one or more nucleotides are inserted into a DNA sequence.

**insular distribution functions** Bivariate plots (graphs) used to illustrate the distributions of particular species as a function of area and isolation of islands.

**interference competition** A negative interaction between species in which aggressive dominance or active inhibition is used to deny other individuals access to resources.

**interglacial** Any of several phases during the Quaternary (including the present) when glacial ice sheets retreated and the climate became more equable.

**interpolation (spatial and temporal)** Procedures that provide estimates of the expected value of a variable at an unmeasured point in space or time, based on statistical models that take into account the values of recorded variables at actual observation sites and times, and their distances from the site (or changes from the time).

**intertidal zone** The zone above the low tide mark and below the high tide mark of a body of water; the littoral zone.

**Intertropical Convergence Zone (ITCZ)** See *Tropical Convergence Zone*.

**inversion** A type of mutation in which the orientation of a portion of a chromosome becomes reversed with respect to its former orientation.

**island parasite syndrome** The apparent tendency of parasites to exhibit broader niches and parasitize a relatively high number of atypical hosts on islands in comparison with mainland communities.

**island syndrome** The suite of morphological, physiological, behavioral, demographic, ecological, and evolutionary characteristics shared by many insular biotas that distinguish them from their ancestral mainland assemblages.

**island rule** A graded trend in insular vertebrates from gigantism in the smaller species to dwarfism in the larger species.

**isocline** Contours or lines on map that indicate sites of similar levels of a particular variable.

**isolating mechanism** Any structural, physiological, ecological, or behavioral mechanism that blocks or strongly interferes with hybridization or gene exchange between two populations.

**isostasy** In geology, describes how continental blocks float on a viscous layer of the Earth's mantle. While doing this, the block may rise or fall to achieve an equilibrium.

**isotherm** A line on a map connecting all locations with the same mean temperature.

## J

**Jordan's rule (law of vertebrae)** The tendency for the number of vertebrae in marine fish to increase along a gradient from the warm waters of the tropics to cooler waters of the high latitudes.

**jump dispersal** Long-distance dispersal that is accomplished by movement of individuals within a relatively short period.

## K

**karyotype** The morphological appearance and characteristic number of a set of chromosomes in a cell, and generally conserved across a population or species.

**kettle lake** Lakes that formed during the onset of an interglacial period when large blocks of ice separated from the melting glaciers and formed deep, persistent depressions that later filled with runoff from ice-melt and precipitation.

**key innovation** Evolution of a new trait that confers a strong adaptive advantage and is often associated with an adaptive radiation.

**keystone species** A species whose activities have a disproportionate effect on the structure and function of ecological communities.

**kriging** A statistical means of estimating the value of a particular variable at an unsampled location by calculating a moving-average from data collected at other locations.

**K-selection** Selection favoring a more efficient utilization of resources, which is more pronounced when the species is at or near carrying capacity (*K*). Compare with *r*-selection.

**K-strategists** Species whose life-history and ecological characteristics are adapted to selective pressures associated with populations near carrying capacity (*K*) of an environment.

## L

**Lack's rule** The empirical pattern articulated by ornithologist David Lack, where clutch or litter sizes are related to latitude, with larger clutches or litters generally occurring at higher latitudes.

**Last Glacial Maximum (LGM)** The period ~26.5–19 ka when ice sheets extending from the Arctic southward covered most of North America and central Asia to approximately 45° N latitude.

**laterite** In tropical soils, a hard, rocklike layer composed principally of ferric oxide, produced when this compound accumulates in high concentration in the soil.

**laterization** The formation of a soil under conditions of abundant moisture, warm temperatures, and high decomposer activity, resulting in a soil from which bases and silica have been removed (leached), leaving behind a clay rich in ferric and aluminum oxides.

**Laurasia** The northern half of the supercontinent Pangaea, including North America, Europe, and parts of Asia. Compare with *Gondwana*.

**leaching** In soil science, the removal of soluble substances by water.

**lentic** Referring to standing freshwater habitats, such as ponds and lakes. Compare with *lotic*.

**leptokurtic** A mathematical distribution characterized by a sharply peaked curve with a long tail.

**Lessepsian exchange (Lessepsian migration)** The biotic exchange that took place after construction of the Suez Canal connected the Mediterranean and Red Seas.

**liana** A climbing woody or herbaceous vine that is especially common in wet tropical forests.

**Liebig's law of the minimum** An early ecological generalization, now discredited or greatly modified, which stated that abundance and distribution are limited by the single factor in the shortest supply. See also *limiting factor*.

**life zones** The characteristic changes in vegetation composition and form that occur along an elevational or latitudinal gradient.

**likelihood ratio test** A statistical test used to compare two scenarios, one of which (the null model) is an alternative case of the other (the alternative model); a means of testing for homogeneity versus heterogeneity of evolutionary rates among different lineages in a phylogeny.

**Lilliputian effect** The tendency evidenced in the fossil record for extinctions to be species selective, resulting in differential survival of the smaller life-forms.

**limiting factor** The resource or environmental parameter that most limits the abundance and distribution of a population.

**limnetic zone** The offshore waters of a lake that receive light sufficient to support photosynthesis of their plant (macrophyte and phytoplankton) communities.

**limnologist** A scientist who studies the physical, chemical and biological characteristics of freshwater systems, especially lakes, rivers and ponds.

**lineage sorting** In a gene tree, the loss of ancestral polymorphism within a population or species as a consequence of stochastic effects influencing the probability of an allele either being retained or lost during genetic transmission across generations.

**Linnaean shortfall** The disparity between the number of described species and the total number of species in existence.

**lithosphere** Earth's crust, exclusive of water (the *hydrosphere*) and living organisms (the *biosphere*).

**littoral zone** The marginal zone of the sea; i.e., the intertidal zone. In fresh water, the shallow zone that may contain rooted plants.

**living fossils** An extant taxon that has changed very little morphologically from ancestral taxa in the fossil record.

**log-transformed** Referring to the change of values in a data set by taking the logarithm of each.

**long-distance (jump) dispersal** The movement of an organism across inhospitable environments to colonize a favorable distant habitat.

**lotic** Referring to moving freshwater habitats, such as brooks and rapids. Compare with *lentic*.

## M

**macchia** A type of sclerophyllous scrub vegetation occurring in regions of the Old World with a Mediterranean climate.

**macroecology** A multi-scale or broad-scale approach to investigating the assembly and structure of biotas.

**macroevolution** A general term for evolution above the population level. Compare with *microevolution*.

**macro-refugia** During Pleistocene glacial periods, these were large expanses of non-glaciated land beyond the margins of the ice sheets. Compare with *micro-refugia*.

**magma** The molten rock material under the Earth's crust, from which igneous rock is formed by cooling.

**magnetic reversals** In geology, episodes during which the direction of Earth's magnetic field has been reversed, occurring approximately twice every million years.

**magnetic stripes** In geology, long alternating stripes of normally and reversely magnetized basaltic rock on the ocean floor.

**malacofauna** All the species of mollusks inhabiting a specified region.

**mangrove swamp** A wetland found in tropical climates and along coastal regions that is dominated by mangrove trees

and shrubs, particularly red mangroves (*Rhizophora*), black mangroves (*Avicennia*) and white mangroves (*Laguncularia*).

**mantle** The second and thickest layer of the Earth.

**mantle drag** One of the forces responsible for continental drift, in this case resulting from the tendency of the crust to ride the gyres of circulating mantle beneath it much like boxes on a conveyor belt.

**maquis** A type of sclerophyllous scrub vegetation occurring in portions of the Mediterranean region with its characteristic climate.

**marginal population** A population that has difficulty in surviving as a result of limiting abiotic or biotic factors.

**marine** Living in salt water.

**maritime climate** In general, a coastal or island environment with little or no freezing, much cloud cover and fog, and less variance in temperature, and thus a milder year-round climate, than nearby inland or mainland localities.

**marsh (moor)** A wetland that is dominated by herbaceous vegetation.

**marsupials** Mammals that nourish their developing young within the mother's ventral pouch. Most marsupial species are found on the Gondwanan continents of Australia/New Guinea and South America, although there are several Central American species and one (Virginia opossum, *Didelphis virginiana*) in North America. Compare with *monotremes*; *placental*.

**mass extinction** A major episode of extinction for many taxa, occurring fairly suddenly in the fossil record.

**materral** A type of sclerophyllous scrub vegetation occurring in the region of Chile with a Mediterranean climate.

**Mediterranean climate** A semiarid climate characterized by mild, rainy winters and hot, dry summers.

**megafauna** A general term for the large terrestrial vertebrates inhabiting a specified region.

**mesic** Relatively moist and equable.

**mesophytes** Land plants that grow in environments with an average ("mesic") supply of water.

**Messinian crisis** The sudden draining of the Mediterranean Sea that occurred during the Cenozoic.

**metabolic theory of ecology** An extension of Kleiber's law (the scaling of physiological properties to body size) that posits that the metabolic rate of organisms is the fundamental biological rate that governs most observed patterns in ecology.

**metabolism** The sum total of the positive and negative chemical reactions in an organism or a cell that provide the energy and chemical substances necessary for its existence.

**metadata** Detailed descriptions of methods used to record and store a particular data set, along with the relevant characteristics of those data.

**metamorphosis** A major change in the form of an individual animal during development; e.g., a caterpillar becomes a moth or a butterfly and a tadpole becomes a frog or a toad.

**metapopulation** A set or constellation of local populations of a particular species that are linked by dispersal among those populations.

**metatherian** A marsupial mammal.

**microallopatric** Refers to spatially small forms of allopatric divergence, such as might occur among different volcanoes on a single oceanic island.

**microclimate** The fine-scale environmental regime.

**microcosm** A small community that represents in miniature the components and processes of a larger ecosystem.

**microevolution** Evolution below the species level, i.e., within and among populations. Includes changes in gene diversity and gene frequencies resulting from mutation, genetic drift, natural selection, and gene flow. Compare with *macroevolution*.

**microhabitat** The fine-scale environment that often determines the presence or absence of each kind of organism.

**microphyllous** Having small, narrow leaves; characteristic of many plants in very dry habitats.

**micro-refugia** Isolated and geographically restricted habitats that were occupied by particular populations during glacial periods of the Pleistocene. Compare with *macro-refugia*.

**microvicariance** Vicariance at a relatively small spatial scale (e.g., on a single island, or between small peripheral versus large core populations).

**midden** A solid mass of collected organic debris left by an animal such as a pack rat.

**midoceanic ridge** In plate tectonics, a submarine mountain chain, within which seafloor spreading of the oceanic plates occurs.

**migration** Dispersal from and return to an area, typically a breeding site, by an individual or its immediate descendants.

**Milankovitch cycles** Named in honor of their discoverer, Serbian astrophysicist Milutin Milankovitch, the cyclical changes in the characteristics of Earth's orbit about the sun. See *eccentricity*; *obliquity*; *precession*.

**mimicry** The marked resemblance of an organism to another organism or a background (e.g., a leaf, tree bark, or sand) to deceive predators or prey by "disappearing" (crypsis) or by causing the predator or prey to confuse the mimic with something it is not.

**mitochondrial DNA (mtDNA)** Extranuclear, closed circular DNA of the eukaryotic mitochondrion, transmitted through the cytoplasm (in humans, through the maternal cytoplasm) from one generation to the next.

**mobility** The ability to move or be moved.

**Modern Synthesis** The synthesis of advances in genetics and other biological disciplines that took place during the first half of the 20th Century and formed the current paradigm of evolutionary biology.

**molecular phylogenetics (systematics)** A subdiscipline of phylogenetic systematics that employs characters derived from DNA sequences, protein electrophoresis, protein immunology, etc.

**monoecious** In botany, having separate male and female flowers on the same plant.

**monomorphic** Having only one form in a population.

**monophyletic** A group, or clade, of organisms that includes an ancestral taxon and all of its descendant taxa.

**monospecific** Having only one species in the genus.

**monotypic** Having only one species in the taxon.

**monotreme** An egg-laying mammal. Found only in Australia and New Guinea, there are five extant species of monotremes: the duck-billed platypus and four species of echidna. Compare with *marsupial*; *placental*.

**monsoon** Predictable, typically intense summer rains that occur in tropical and subtropical regions where heat and rising air masses over the land surface draw in moisture-laden air from the adjacent oceans. As this air rises over land, it cools, reaches its dew point, and results in heavy precipitation.

**monsoon forest** Tree-dominated ecosystems, sometimes called the "layperson's jungle," that develop in areas with intense seasonal rainfall (summer monsoons) and are dominated by trees with large leaves and a luxuriant undergrowth of shrubs and small trees.

**morphogeographic rule** See *ecogeographic rule*.

**morphological species concept** A species concept that proposes that "*species are the smallest groups that are consistently and persistently distinct, and distinguishable by ordinary means*" (Cronquist 1978).

**motility** The ability to move under one's own power, as by wings or a flagellum.

**mutation** Any change in the genetic information that results in either the alteration in a gene (e.g., point mutation, insertion, or deletion) or a major modification in the karyotype (chromosomal mutation), neither of which is usually reversible in the strictest sense.

**mutualism** An interspecific relationship in which both species receive positive benefits from their interaction.

**mycorrhiza** A symbiotic relationship between a fungus and a plant root that benefits the plant by providing a source of useful nitrogen, which is manufactured by the fungus.

## N

**natural selection** The process of eliminating from a population through differential survival and reproduction those individuals with inferior fitness.

**neap tide** A lower than average tide occurring at the first and third quarters of the moon. Compare with *spring tide*.

**Nearctic region** The extratropical region of North America.

**nectarivore** An animal that feeds on plant nectar.

**nekton** Organisms that are free-swimming in the upper zone of open water and strong enough to move against currents.

**neoendemic** An endemic that evolved in fairly recent times. Compare with *paleoendemic*.

**Neotropical Region** The region from southern Mexico and the West Indies to southern South America.

**neritic zone** The shallow water adjoining a seacoast, especially the zone over a continental shelf.

**nested clade analysis (NCA)** A method in phylogeography that converts a statistical haplotype network into a hierarchically nested set of clades based on measures of geographical distribution of clades and nested clades relative to one another.

**nested clade phylogeographic analysis (NCPA)** See *nested clade analysis*.

**nestedness** The tendency for ecological communities from species-poor sites to form proper subsets (include only those species) found in richer sites.

**net primary productivity (NPP)** The rate of formation of plant tissue in an ecological community that represents the rate of energy made available for consumption by herbivores (equal to gross primary productivity minus total respiration of all plants in that community).

**next-generation sequencing (NGS)** A term describing several different technologies developed in the 1990s that allow rapid (and relatively inexpensive) sequencing of DNA and RNA.

**niche** The total requirements of a population or species for resources and physical conditions.

**niche breadth** The range of resources and physical conditions used by a particular population relative to that of other populations.

**niche conservatism** The tendency of species to retain ancestral characteristics.

**niche expansion** An increase in the range of habitats or resources used by a population, which may occur when a potential competitor, predator or other interacting species is absent.

**nomadic** Having no fixed pattern of migration.

**nonadaptive radiation** Diversification of a monophyletic lineage that is not accompanied by substantial differentiation in ecological niches of the species.

**non-analogue assemblage** A past assemblage of species for which there is no modern-day equivalent.

**non-shivering thermogenesis** A process of heat production in certain mammals (especially newborns and small mammals) involving the breakdown of chemicals such as fatty acids found in muscle, liver, and brown adipose tissue (heavily vascularized and rich in mitochondria), which results in the production of large amounts of heat instead of ATP.

**nonsynonymous (amino acid replacement) mutation** Within a DNA sequence, a single nucleotide substitution that changes the amino acid specified by a codon (e.g., AAC (asparagine) → AAG (lysine). Compare with *synonymous mutation*.

**non-volant** An organism that is unable to fly (e.g., rodents versus bats).

**nuclear DNA (nucDNA)** DNA contained within the nucleus; accounts for the vast majority of the DNA in a eukaryotic cell. Compare with *mitochondrial DNA*.

**null hypothesis** A statistical hypothesis stating what would be expected by chance alone, which can be tested in order to determine whether an observation could be a result of chance or is instead the result of some directing force.

**null phenetics** The method of classifying a taxon by using quantitative measures of a large number of characters to assess its overall character similarity to other related taxa. Compare with *evolutionary systematics* and *cladistics (phylogenetic systematics)*.

**numerical phenetics** A taxonomic approach for classifying organisms based on their overall similarity in morphological or other observable traits.

**nunatak** An area in a glaciated region surrounded but not covered by an ice sheet; may serve as a refugium.

**O**

**obligate relationship** An interaction between species in which at least one of the species cannot survive or reproduce without the other; e.g., many host-parasite relationships, in which a single species of host is required.

**obliquity** The tilt of Earth on its axis, which varies between 22.1° to 24.5° over a 41,000-year period.

**oceanic** In marine ecology, of or pertaining to open ocean with very deep water.

**oceanic island** An island that was formed *de novo* from the ocean floor through volcanic activity and that has never been attached to a continent.

**oceanographer** A scientist who studies the physical, chemical, and biological characteristics of marine systems.

**oligotrophic lake** A deep lake with low primary productivity.

**omnivore** An animal that feeds on both plants and other animals.

**order** A taxonomic category above the level of family and below the level of class.

**ordinate** On a graph, the vertical (y) axis or the vertical coordinate of a point.

**Oriental Region** The tropical zone of Southeast Asia eastward to the margin of the continental shelf (Wallace's line).

**orogeny** The process of mountain building resulting from the upward thrust of Earth's crust due to volcanic or tectonic activity.

**orthogenesis** The supposed intrinsic tendency of organisms to evolve steadily in a particular direction, e.g., to become larger or smaller.

**osmoconformer** An organism that does not osmoregulate, but instead has internal salt concentrations in osmotic balance with its environment.

**osmoregulation** The physiological processes of maintaining homeostasis by maintaining a constant internal concentration of body fluids in changing external solutions.

**outbreak area** In organisms that irrupt, the area into which populations expand during peak population densities.

**outcrossing** Having gametes that are exchanged between different genotypes.

**outgroup** A taxon related to the ingroup, used in a cladistic analysis to infer primitive and derived character states in a transformation series.

**outline maps** A map depicting the geographic limits (range boundary) of a particular population or species.

**overkill hypothesis** A theory that attributes the mass extinctions of many megafaunal species during the late Pleistocene and early Holocene to hunting and other forms of over-exploitation by humans.

**overturn** Vertical mixing of the water column in a lake caused by temperature changes over the seasons.

**P**

**Pacifica** A hypothesized ancient continent that may have existed somewhere in the Pacific basin.

**Palearctic region** The region of extratropical climates in Eurasia and in the coastal area of northernmost Africa.

**paleocirculation** The ocean currents of the past.

**paleoclimatology** The study of past climates, as elucidated mainly through the analysis of fossils.

**paleoecology** The branch of paleontology that attempts to reconstruct the structure of and the processes affecting ancient populations and communities.

**paleoendemic** An endemic that evolved in the distant past. Compare with *neoendemic*.

**paleoflora** All the species of plants inhabiting a specified region in the past.

**paleomagnetism** The magnetism or magnetically induced orientation of microstructures that has existed in a rock since its origin.

**paleontology** The field of study devoted to describing, analyzing, and explaining the fossil record.

**paleotropical** Occurring in the Old World tropics and subtropics; i.e., in Africa, Madagascar, India, and Southeast Asia.

**panbiogeography** An approach in historical biogeography, developed by Croizat, that attempts to reconstruct the events leading to observed distributions of taxa by drawing lines on a map (tracks) connecting known distributions of related taxa. Unlike cladistic vicariance biogeography, panbiogeography does not require phylogenies of the focal taxa.

**Pangaea** In plate tectonics, the supercontinent of the Permian that was composed of essentially all the present continents and major continental islands.

- panmixis** The condition whereby interbreeding within a large population is totally random.
- Panthalassa** The great global ocean that existed during the Permian coincident with the supercontinent Pangaea.
- pantropical** Occurring in all major tropical areas.
- paradigm** A unifying principle, pattern or theory, such as MacArthur and Wilson's equilibrium theory of island biogeography, or Darwin's theory of natural selection.
- parallel evolution** The evolution of species with strong resemblances from fairly closely related ancestors; hence the evolution of two or more taxa in the same direction from related ancestors.
- paralogy-free subtrees** An approach in historical biogeography that modifies component analysis by removing geographic paralogy (repetition of geographic areas resulting from sympatric or embedded allopatric speciation) prior to analysis of congruence among taxon-area cladograms.
- páramo** Tropical alpine vegetation, characteristic of high mountains at the Equator, that has a low and compact perennial cover as a response to the perpetually wet, cold, and cloudy environment.
- parapatric** Having contiguous but narrowly overlapping distributions.
- parapatric speciation** A mode of speciation in which differentiation occurs when two populations have contiguous but narrowly overlapping ranges, often representing two distinct habitat types.
- paraphyletic** In phylogenetic systematics, referring to taxa that include an ancestral taxon and some, but not all, of its descendant taxa; an artificial taxon.
- parasitism** An interspecific relationship in which one species (the parasite) draws nutrition from or is somehow dependent for survival on the other species (the host), which is negatively affected by the interaction.
- parsimony** In phylogenetic analysis, provides a "rule" stating that the tree requiring the fewest number of character state changes is preferred over more complex trees.
- parthenogenesis** The development of eggs without fertilization by a male gamete.
- partitioning** Sorting characters in a molecular genetic-based study into separate categories (e.g., coding vs. noncoding stretches of DNA; synonymous vs. nonsynonymous substitutions; transition vs. transversion substitutions; first, second, or third codon positions) with different evolutionary properties (e.g., different rates of substitution).
- passive dispersal (pagility)** The movement of an organism from one location to another by means of a stronger force, such as wind or water currents, or via a larger animal. Compare with *active dispersal (vagility)*.
- pattern** Nonrandom, repetitive organization.
- peatland** A freshwater ecosystem that develops in cool temperate regions in sites where drainage is blocked, resulting in saturation of soils and accumulation of partially decomposed plant and other organic material—called "peat."
- pedogenic regimes** The soil-forming processes; e.g., laterization, podzolization, calcification, and gleization.
- pelagic** Occurring in open water and away from the bottom.
- peninsula (peninsular) effect** The hypothesized tendency for species richness to decrease along a gradient from the axis to the most distal point of a peninsula.
- peripheral population** Any population of a species that occurs along or near the edges of its geographic range, around either the perimeter or the elevational limit. Not synonymous with *marginal population*.
- perturbation** Any event that greatly upsets the equilibrium of or alters the state or direction of change in a system.
- petrocalcic horizon** See *caliche*.
- phenetics** The study of the overall similarities of organisms. Compare with *phylogeny*.
- phenotype** The expression of the genetic message of an individual in its morphology, physiology, and behavior.
- phoresy** The phenomenon where relatively small animals depend on larger animals for dispersal.
- photic (euphotic) zone** The uppermost zone in a water column where solar radiation is adequate to permit photosynthesis by plants.
- photoautotroph** An organism that uses light as the energy source and carbon dioxide as the carbon source for its basic metabolism; hence, an organism that is photosynthetic.
- photosynthesis** The chemical process of using pigments to capture sunlight and then using that energy, along with water and carbon dioxide, to make organic compounds (sugars), releasing oxygen in the process.
- phyletic gradualism** An evolutionary process whereby a species is gradually transformed over time into a different organism. Compare with *punctuated equilibrium*.
- phyletic speciation** The transformation of one ancestral species into a single descendant species through non-branching (anagenetic) evolutionary change.
- phylogenesis** The phylogenetic diversification of a lineage that in some cases, such as on relatively large, isolated, and persistent islands and archipelagoes, can create hotspots of diversity and endemism, sometimes rivaling or exceeding those found in continental systems.
- phylogenetic analysis for comparing trees (PACT)** A method for biogeographic analysis that builds upon secondary Brooks parsimony analysis (BPA) with the goal of generating area cladograms that provide accurate representation of information contained in taxon-area cladograms.
- phylogenetic biogeography I** An earlier approach in historical biogeography that used Hennig's phylogenetic methods, but also incorporated his progression rule under the assumption of a history of sequential dispersal and speciation events as a lineage expanded out of a center of origin.
- phylogenetic biogeography II** An approach in historical biogeography that searches for shared cladogenetic events among a set of taxon-area cladograms, but also explains incongruent events in terms of post-vicariance dispersal, peripheral isolates speciation, sympatric speciation, and extinction.
- phylogenetic diversity** species-based measure of biological diversity that gives weight to the evolutionary distinctiveness of the species. Compare with functional diversity.
- phylogenetic niche conservatism** See *niche conservatism*.
- phylogenetic systematics** See *cladistics*. Compare with *evolutionary systematics* and *numerical phenetics*.
- phylogenomics** The approach to systematics that samples many genes from across a genome to reconstruct evolutionary histories.
- phylogeny** The evolutionary relationships between an ancestor and all of its known descendants.
- phylogeography** An approach in biogeography that studies the geographic distributions of genealogical lineages, within species and among similar species, and attempts to differenti-



- ate between historical and ongoing processes leading to the development of observed patterns.
- phylogroup** A term used in phylogeography to define a population or species whose alleles within a given gene tree form a monophyletic lineage with respect to other populations or species.
- physiognomy** The external aspect of a landscape; e.g., the topography and other physical characteristics of a land form and its vegetation.
- physiological ecology** The study of how the physiological characteristics of organisms relate to the abundances and distributions of those organisms in their natural habitats.
- phytogeography** The study of the distribution of plants.
- phytoplankton** The collection of small or microscopic plants that float or drift in great numbers in freshwater or marine environments, especially at or near the surface, and serve as food for zooplankton.
- phytosociology** The quantitative study of the composition and interrelationships of plant communities and how these relate to environmental factors.
- pioneer species** Plant species that colonize early successional ecosystems and are then replaced by later colonists.
- placentals** Mammals in which the fetus is connected to the mother by a placenta, through which the fetus receives nourishment and excretes wastes. The majority of mammal species are placentals. Compare with *marsupials*; *monotremes*.
- plankton** Small organisms (especially tiny plants, small invertebrates, and juvenile stages of larger animals) that inhabit water and are transported mainly by water currents and wave action rather than by individual locomotion.
- planktotrophic** Refers to aquatic larvae that have no long-term storage of nutrients and so must feed on small organisms in the plankton during their development.
- plate** In plate tectonics, a portion of Earth's upper surface, about 100 km thick, that moves over the asthenosphere during seafloor spreading.
- plate tectonics theory** The study of the origin, movement, and destruction of plates and how these events have been involved in the evolution of Earth's crust.
- plesiomorphy** In a transformation series, the primitive character state.
- plunge pool** A relatively deep, roughly circular lake which formed as glacial meltwaters flowed over the surface of a glacier and then plunged off its edge to carve a basin in the Earth some 2 to 3 km below.
- pluvial** Referring to periods of high rainfall and water runoff.
- podzolization** The formation of a soil under conditions of adequate moisture and low decomposer activity, resulting in a soil in which the bases, humic acids, colloids, and ferric and aluminum oxides have been removed (leached) from the upper horizon.
- poikilotherm** An animal with a relatively variable body temperature, often ectothermic; i.e., relying on the external environment to control its body temperature.
- pollination** The transfer of pollen grains to a receptive stigma, usually by wind or flower-visiting animals.
- polyclimax** Alternative climax communities that may develop in the same region and under the same climatic conditions.
- polymorphic** Having several distinct forms in a population.
- polyphagous** Feeding on a variety of different kinds of food.
- polyphyletic** A group of organisms that does not include their common ancestor; an artificial taxon.
- polyploid** Any organism or cell that has three or more sets of chromosomes.
- population bottleneck** Reduction in effective population size, often through the founding of a new population via jump dispersal of one or a few individuals across a barrier; a general result is loss of genetic variation.
- Precambrian shield** See *craton*.
- precession** Cyclical changes ("wandering") of Earth's orientation, whereby the axis of the North Pole shifts from one "north star" (presently Polaris of Ursa Minor) to another (Vega of Lyra) with a periodicity of approximately 22,000 years.
- precinctiveness** The tendency for organisms of some species to exhibit relatively strong site fidelity and remain in their natal range.
- predation** The act of feeding on other organisms; an interspecific interaction that has negative effects on the species that is consumed or used.
- predation escalation hypothesis (of Vermeij)** Morphological structures associated with predatory defense in marine invertebrates tend to increase from polar to tropical waters. Geerat Vermeij hypothesized that this is a result of the latitudinal cline in predation pressures, which, like the cline in species diversity in general, tend to increase toward the tropics.
- predator** In a predatory relationship, the species that consumes other organisms.
- predator mediated coexistence** Coexistence of two intense competitors which results from the actions of a predator that preys most heavily on the more abundant or otherwise dominant competitor, therefore preventing populations of either competitor from increasing to the point where it can exclude the other.
- prey** In a predatory relationship, the species that is consumed or used by another organism.
- prezygotic isolating mechanism** An attribute that serves as a form of reproductive isolation between separate biological species prior to the formation of a viable zygote.
- primary BPA** See *Brooks parsimony analysis*.
- primary consumer** An organism that consumes plants.
- primary division freshwater fish** Any fish that is totally intolerant of salt water.
- primary production** The production of biomass by green plants.
- primary succession** The gradual transformation of bare rock or another sterile substrate into a soil that supports a living ecological community.
- priority effects** As applied to biogeography, the concept that holds that what is there now and how it will change in the future depends on what was there in the past.
- profundal zone** The deepwater zone of lakes where light is insufficient to support photosynthesis.
- progression rule** The idea that a primitive form remains in the center of origin, whereas progressively more derived forms are found at progressively greater distances.
- projections (geographic projections)** A means of using light projected through plastic models of Earth (traditionally), or the use of various mathematical formulae to transform spatial data from the curved, 3-dimensional surface of Earth to a two-dimensional map.
- propagule** Any part of an organism, or group of organisms, or stage in the life cycle that can reproduce the species and thus establish a new population.

**prototherian** A monotreme mammal. Compare with *eutherian*; *metatherian*.

**provincialism** The coincident occurrence of large numbers of well-differentiated endemic forms in an area; regional or provincial distinctiveness.

**pseudo-congruence** Superficially congruent taxon-area relationships that in fact have developed at different times in response to different vicariance or dispersal events.

**pseudoreplication** A source of error in statistical analyses that tends to overestimate the sample size and statistical significance of tests, primarily because of sampling observations that are not independent (e.g., repeated sampling of the same individual or group of related individuals).

**pseudoturnover** An overestimate of biotic turnover resulting from failure to detect a species that was actually present during a biological survey, and was therefore either recorded as an immigration or an extinction in subsequent surveys.

**punctuated equilibrium** The hypothesis that evolution occurs during periods of rapid differentiation (often accompanying speciation), which are followed by long periods in which few if any characters evolve. Compare with *phyletic gradualism*.

## Q

**quadrupedal** Having four limbs for locomotion. Compare with *tetrapods*.

## R

**radiation** In evolutionary biology, a general term for the diversification of a group, implying that many new species have been produced.

**radiation zone** As MacArthur and Wilson (1967) defined it, a zone near the edges of the distribution of a taxon where immigration from the mainland and other archipelagoes is so rare that speciation and diversification occur easily.

**rafting** The transport over water of living organisms on large floating mats of debris.

**rain-green forest** The dominant vegetation of tropical-dry forests characterized by trees that leaf out during the first heavy rains following the dry season.

**rain shadow** More generally, a "precipitation shadow," which is a relatively dry region typically found along the leeward side of a mountain range where the relative humidity of the descending air decreases as it becomes adiabatically warmed.

**range maps** Maps depicting the geographic distribution of particular species (includes dot, contour and outline maps).

**Rapport's rule** The tendency for geographic range size to increase with latitude.

**raster-based GIS** An alternative platform for geographic information systems that is composed of a system of cells (typically, rectangular units) that tessellate, each cell having a unique identity so that it can be assigned attributes corresponding to a variety of local characteristics representative of that cell.

**realized geographic range** The actual distribution of populations of a species, which is restricted to only a subset of the (theoretical) *fundamental geographic range* as a result of interactions with other species and limited opportunities for dispersal.

**realized niche** The actual environmental conditions in which a species survives and reproduces in nature; a subset of the *fundamental niche*.

**reciprocally monophyletic** Two populations or species are reciprocally monophyletic if, for a given gene tree, the alleles within each population have coalesced to a monophyletic lineage with respect to the other population.

**recombination** The exchange of genetic material between parental (male/female) chromosomes, resulting in new and unique combinations of the genetic material transmitted to the offspring.

**reconciled tree** A method in historical biogeography that reconstructs historical events (sympatric speciation, dispersal, vicariance, extinction) in order to "reconcile" phylogenetic and geographic incongruence between co-distributed taxa.

**Red Queen hypothesis (principle)** Borrowing from Lewis Carroll's *Through the Looking-Glass* and the Red Queen's warning that "it takes all the running you can do, to keep in the same place," Leigh Van Valen (1973c) developed this principle to emphasize that, rather than evolving toward a static optimal phenotype, species are always changing as they adapt to other species, which themselves must change to keep up.

**refugium** An area where climate and vegetation type has remained relatively unchanged while areas surrounding it changed markedly, and which has thus served as a refuge allowing the survival of species requiring the specific habitat or conditions found there. See also *macro-refugium*; *micro-refugium*.

**reinforcement** At a contact zone between differentiated populations, the process of selection for prezygotic mechanisms that completes the reproductive isolation between two new *biological species*.

**relative apomorphy rule** Homologous characters found within members of a monophyletic group that are also found in the sister group are plesiomorphic, while homologous characters found only in the ingroup are apomorphic.

**relative rate test** A method used in molecular systematics to determine whether two clades are evolving at a similar rate relative to a more distantly related third clade.

**relaxation model** An explanation for nonrandom assembly of ecological communities inhabiting ecosystems that have decreased in size over time (due to natural or anthropogenic changes) which holds that as the area of these ecosystems decreased, their communities lost the most resource-intensive species and began to converge on a similar set of species, i.e., those with relatively low resource requirements.

**relict** A surviving taxon from a group that was once widespread (biogeographic relict) or diverse (taxonomic relict).

**relict pattern** In island biogeography, Philip Darlington's prediction that ecological communities from relatively small ecosystems would represent a random subset of those found on the mainland or source pool.

**remnant magnetism** The property of rocks containing iron and titanium oxides to become magnetized as they solidify and cool, thus recording the magnetic fields in their crystalline structure. Such rocks can later serve as a "fossil compasses" indicating both the direction and declination of the magnetic fields at the sites and periods the rocks originally solidified.

**remote sensing** Any means of collecting data where the recorder or sensing device is not in direct contact with the area or objects of interest. In biogeographic applications, this typically includes the use of technologically sophisticated sensing devices operated from especially remote platforms, including aircrafts, ships, and satellites.

**reproductive isolation** Inability of individuals from different populations to produce viable offspring. The primary basis of the biological species concept.

**rescue effect** The tendency for extinction rates to be relatively low on less-isolated islands because their relatively high

immigration rate tends to supplement declining populations before they suffer extinction.

**resident** A species that lives year-round in a particular habitat or location.

**respiration (community respiration)** In ecology, the rate of chemical breakdown of organic material in an ecological community.

**reticulate evolution (reticulate speciation)** The formation of new evolutionary lineages of species by the hybridization of dissimilar populations, for example, through interspecific hybridization.

**ridge push** One of the forces responsible for continental drift, in this case resulting from the rise of hot magma toward and then outward from Earth's surface.

**rift zone** A region where one or more continental plates are separating, thus forming a low-lying, tectonically active area (spreading zone). Examples include those that in the past created the Red Sea and the great, deep lakes of the Baikal rift zone and the East African Rift Valley.

**ring species** A species complex that is situated in a ringlike fashion around a central barrier (e.g., a desert, mountain range, lake), where interbreeding readily occurs between adjacent populations, but those of the two terminal and sometimes overlapping populations are so distinct as to become reproductively isolated.

**riparian** Relating to wetlands adjacent to rivers or streams.

**Rodinia** An ancient supercontinent that formed between 1.3–0.9 billion years ago and broke up 750–600 million years ago.

**r-selection** Selection that favors high population growth rate ("r"), which is more prominent when population size is far below carrying capacity.

**r-strategists** Species whose life-history and ecological characteristics are adapted to selective pressures associated with relatively low population levels.

## S

**saline** Having high concentrations of salts, especially ions of chloride and sulfate.

**salt marsh** A wetland dominated by herbaceous vegetation and characterized by its relatively high salinity and salt adapted inhabitants.

**savanna** Biome dominated by a nearly continuous layer of xerophytic perennial grasses and sedges, with sparsely distributed, fire-resistant trees or shrubs.

**scaling** See *allometry*.

**scavenger** An animal that feeds on carrion.

**scientific crises** Those critical, formative periods in scientific development when the prevailing paradigmatic explanation seems so fraught with exceptions and inconsistencies that it no longer serves to guide scientific inquiry and discovery.

**sclerophyllous** Having tough, thick, evergreen leaves.

**scrub** Any of a wide variety of vegetation types dominated by low shrubs; in exceedingly dry locations, scrub vegetation has few or no trees and widely spaced low shrubs, but in areas of fairly high rainfall, scrub has trees and grades into either woodland or forest.

**seafloor spreading** In plate tectonics, the process of adding crustal material at a midoceanic ridge and thus displacing older rocks, usually on both sides, away from their point of origin.

**seamount** A peaked submarine volcano.

**second law of thermodynamics** As energy is converted into different forms, its capacity to perform useful work diminishes, and the disorder (entropy) of the system increases.

**secondary BPA** A method in historical biogeography that duplicates areas on a primary BPA tree only as much as required to remove all homoplasy; the resulting tree includes area relationships that are the results of vicariance, post-speciation dispersal, peripheral isolates speciation, and extinction.

**secondary consumer** An animal that consumes herbivorous animals (i.e., a predator).

**secondary division freshwater fishes** Any fish that prefers fresh water but can live for short periods in salt water.

**secondary succession** A series of changes in the vegetational composition of an environment in response to disturbance, involving the gradual and regular replacement of species and ending, at least hypothetically, with the return to a stable state (climax).

**secular migration** A means of geographic range expansion which is so slow (i.e., over many generations) that it is often accompanied by substantial evolutionary changes in the populations en route, i.e., as they expand to colonize new regions.

**selective sweep** Rapid differentiation of populations resulting from the fixation of a new mutation with a strong positive fitness effect.

**self-incompatible** Requiring two individuals to exchange gametes in order to produce offspring.

**semiaquatic** Living partly in or adjacent to water.

**semiarid** Having a fairly dry climate with low precipitation, usually 25 to 60 cm per year, and a high evapotranspiration rate, so that potential loss of water to the environment exceeds the input.

**semidesert** A semiarid habitat characterized by low vegetation; e.g., small, widely spaced shrubs.

**seral stage** One of the stages in the ecological succession of communities.

**sere** A series of stages in community transformation during ecological succession.

**serpentine** A rock or soil type rich in magnesium but deficient in calcium.

**sessile** Remaining fixed in the same spot throughout adulthood; e.g., most plants and certain benthic aquatic invertebrates.

**sexual selection** A form of natural selection whereby individuals with particular traits, especially those involved in attracting a mate (secondary sexual characteristics), are more likely to be chosen as mates, and therefore their genes are preferentially maintained in the next generation.

**shrubland** Any of a wide variety of vegetation types dominated by shrubs, which may form a fairly solid cover; e.g., sclerophyllous scrub (chaparral), or sparse cover; e.g., desert scrub.

**sial** Rock rich in silica-aluminum; the principal component of continental rocks.

**sibling species** Different species that are difficult to delineate with morphological traits (also called *cryptic species*).

**siliceous** Containing silica.

**sim** Rock rich in silica-magnesium; the principal component of basalt and of oceanic plates.

**similarity index** An estimate of the similarity or relatedness of two communities, biota, or taxa.

**sink habitats** Environments where the birth rate of a particular species is exceeded by its death rate and, therefore, the

- presence of this species indicates that most individuals are derived from dispersal from other ("source") habitats.
- sister group** In a phylogeny, the group or clade most closely related to the focal group, and therefore the most useful out-group for rooting the phylogeny.
- sister taxa** In cladistics, the two taxa that are most closely (and therefore most recently) related.
- slab pull** One of the forces responsible for continental drift, in this case resulting from the tendency for portions of a plate to adhere to the leading, subducting edge of that plate.
- small island effect** The tendency for species richness to vary independently of island area on relatively small islands.
- solstice** Either of the two times in a year (around June 22 and December 22) when the sun reaches its highest latitude (23.5° N and S, the Tropics of Cancer and Capricorn, respectively), resulting in the greatest disparity between night and day length.
- source habitats** Environments in which the birth rate of a particular species exceeds its death rate, resulting in a surplus of individuals which contributes to dispersal to other ("sink") habitats.
- spatial autocorrelation** The tendency for points closer in space to be more similar.
- speciation** The process in which two or more contemporaneous species evolve from a single ancestral population.
- speciation-pump model** See *cyclical vicariance model*.
- species** The fundamental taxonomic category for organisms; variously defined and diagnosed using different species concepts (see Box 7.1 and Figure 7.4).
- species complex** A group of closely related species that are morphologically similar and therefore difficult to distinguish as separate species.
- species composition** The types of species that constitute a given sample or community.
- species concept** Any one of many criteria and approaches (see Box 7.1 and Figure 7.4) used to delineate separate species.
- species density** The number of species per standardized sample area.
- species pool** All the organisms present in neighboring source areas that are theoretically available to colonize a particular habitat or island.
- species richness** A relatively simple, but important measure of diversity representing the number of species in an ecological community.
- species selection** An analogue of natural selection at the species level, in which some species with certain characteristics increase while others decrease or become extinct.
- species turnover** The replacement of recently extinct species by new colonists to the community or assemblage.
- species-area relationship** The very general tendency for the number of species inhabiting islands or other ecosystems to increase with the area of those systems.
- species-isolation relationship** The tendency for the number of species on islands or other ecosystems to decrease with isolation of those systems.
- spreading zone** A region where two or more continental plates are separating, often associated with the formation of a new ocean basin (sea-floor spreading) or rift valleys on the continents.
- spring tide** A greater than average tide occurring during the new and full moons. Compare with *neap tide*.
- stable isotopes** Alternative forms of an element that have different masses (i.e., the same number of protons but different numbers of neutrons) that are not subject to radioactive decay. These chemicals have played an increasingly important role in biogeography because the combination of stable isotopes varies among regions of the terrestrial and aquatic realms, thus providing a geographic signature when integrated into the tissues of organisms.
- stasipatric speciation** See *parapatric speciation*.
- statistical phylogeography** The framing of phylogeographic investigations within a rigorous statistical framework, either through development of alternative hypotheses that are evaluated with coalescence-based statistics; or through a nested clade phylogeographic analysis (see *nested clade analysis*).
- stenohaline** Having a tolerance for only a narrow range of salt concentrations.
- stenothermal** Having a tolerance for only a narrow range of temperatures.
- stenotypic** In ecology, refers to a species with a relatively narrow niche or a highly specialized association with another species.
- stochastic** Random, expected (statistically) by chance alone. Compare with *deterministic*.
- strand-line species** Species found along beachfronts that are deposited as debris along the shoreline at high tide.
- stratigraphy** The branch of geology dealing with the sequence of deposition of rocks and fossils as well as their composition, origin, and distribution.
- strike-slip fault** See *transform zone*.
- subduction** In plate tectonics, the movement of one plate beneath another, leading to the heating and subsequent remelting of the lower plate.
- subduction zone** A region where one relatively dense tectonic plate (oceanic plate, composed *sima*) slides beneath a less dense (continental, *sial*) plate.
- subfamily** A taxonomic category used for grouping genera within a family.
- sublittoral zone** The coastal marine zone below the intertidal zone and therefore below the point at which the sea bottom is periodically exposed to the atmosphere.
- subpopulation** Geographically separated demographic units that are connected with others by dispersal, together comprising a metapopulation.
- subspecies** A taxonomic category used by some systematists to designate a genetically distinct set of populations with a discrete range.
- substitution** A form of DNA mutation in which one nucleotide base is replaced by one of the three other nucleotide bases.
- subterranean** Underground.
- summer-green forest** An alternative name for temperate deciduous forests because of their tendency to grow wherever there is sufficient water during the summer growing season to support large trees.
- supercontinent** An ancient landmass formed by the collision and connection of most, if not all, of the present global landmasses (e.g., Pangaea).
- superfamily** A taxonomic category used for grouping families within a suborder.
- super-generalist** On remote, species-poor islands, some of the inhabitants may increase their niche breadths and symbiotic capacities to adapt and interact with a relatively high number of species (e.g., as generalist pollinators and seed dispersers) in comparison with their mainland ancestors.

**superpáramo** A vegetation type of high elevations in the equatorial Andes mountains.

**superspecies** A group of closely related species.

**supertramps** Species that are relatively common on relatively small and isolated islands (i.e., those with few ecologically similar species), but are absent from islands with more diverse communities.

**swamp (marl)** A wetland dominated by woody vegetation.

**sweepstakes route** A severe barrier (unlikely dispersal route) that results in the partly stochastic dispersal of some elements of a biota, and the establishment of a disharmonic biota.

**symbionts** Two or more species that occur in the same community and interact as competitors, predators, parasites, mutualists, amensals, or commensals.

**symbiosis** A long-term interspecific relationship in which two unrelated and unlike organisms live together in close association so that each receives some adaptive benefit.

**sympatric** In the strictest sense, living in the same local community, close enough to interact; in the more general sense, having broadly overlapping geographic ranges.

**sympatric speciation** The differentiation of two reproductively isolated species from one initial population within the same local area; hence, speciation that occurs under conditions in which much gene flow potentially could or actually does occur. Compare with *allopatric speciation*; *parapatric speciation*.

**symplesiomorphy** In a transformation series, a character state shared by taxa in a focal clade, but also shared by other clades at more basal nodes in a phylogeny and therefore not useful in diagnosing the focal group as being monophyletic. See *grouping rule*.

**synapomorphic** In a transformation series, a derived character state shared by taxa because of inheritance from a common ancestor and therefore useful in diagnosing a monophyletic group or clade.

**synapomorphy** In a transformation series, a derived character state shared by taxa due to inheritance from a common ancestor and therefore useful in diagnosing a monophyletic group or clade. See *grouping rule*.

**synonymous (silent) mutation** A nucleotide substitution within a DNA sequence that does not change the amino acid specified by the codon; e.g., AAA → AAG (both of which specify lysine). Compare with *nonsynonymous mutation*.

**systematic biogeographic maps** Maps that attempt to describe the distinctiveness of and/or similarities among biotas from local (or provincial) to global (continental or oceanic) scales.

**systematics** The study of the evolutionary relationships between organisms. Includes *phylogenetics* and *taxonomy*.

## T

**tachytelic** Term used by George Gaylord Simpson (1944) to refer to a rapid rate of morphological change through time in a lineage with a fossil record.

**taphonomy** A subdiscipline of paleontology concerned with the processes by which remains of living things become fossilized, and the ways in which these processes can bias the fossil record or cause problems of interpretation.

**target area effect** The tendency for larger islands to attract or intercept more immigrants.

**taxon** (pl. **taxa**) A convenient and general term for any taxonomic category; e.g., a species, genus, family, or order.

**taxon-area cladogram** An area cladogram generated by replacing the taxa on a taxon cladogram with their areas of occurrence.

**taxon biogeography** The primary goal of an analysis is to reconstruct the biogeographic history of a single taxon.

**taxon cycle** A series of ecological and evolutionary changes in insular populations from their colonization of early successional sites along the beachfronts, to their expansion and increased specialization for interior habitats, and their eventual extinction and replacement by subsequent waves of colonists and their descendents.

**taxonomic relicts** The sole survivors of once diverse taxonomic groups.

**taxonomy** In the strictest sense, the study of the names of organisms, but often used for entire process of classification. See *systematics*.

**TECO events** Paleontological "shorthand" for the sum total of Earth's dynamic history; stands for plate tectonics, eustatic changes in sea level, climatic change, and oceanographic processes.

**tectonic** Referring to any process involved in the production or deformation of Earth's crust.

**temporal autocorrelation** The tendency for points that are sampled closer in time to be more similar.

**terrane** An accumulation of fragments of lithosphere that accrete onto other plates.

**terrestrial** Living on land.

**tetrapods** The four-limbed vertebrates, including the amphibians, reptiles, birds, and mammals. The wings of birds and bats are modified forelimbs. Some reptiles (notably the snakes) and amphibians have secondarily lost their limbs (as have the cetacean mammals—whales and dolphins) but are nonetheless classified as tetrapods. Compare with *quadrupedal*.

**thermal stratification** The tendency for waters in lakes of temperate regions to form distinct layers based on the relationship between density and temperature.

**thermocline** In a water column, the subsurface zone in which the temperature drops sharply.

**thorn scrub** A relatively xeric (dry) ecosystem typically receiving less than 30 cm of annual rainfall, experiencing a 6-month dry season, and dominated by sparse woody vegetation.

**Thorson's rule** The tendency for waters in polar regions to be dominated by invertebrates that produce relatively few, but large, eggs and that exhibit higher frequencies of viviparity, ovoviviparity, egg brooding, and direct development.

**three-item statement analysis** An approach in historical biogeography that modifies component analysis by converting taxon-area cladograms to subsets of three-area relationships prior to analysis of congruence.

**tidal force** The net effects of the centrifugal force of the Earth and moon revolving around their common center of mass, and the gravitational forces of the moon and sun.

**tillites** Glacial rock deposits.

**timberline** The upper elevational limit of trees on mountains.

**time dwarfing** The tendency for some initially large animals (in particular, large marsupials of Australia; Flannery 1994) to decrease in size over time, especially following significant reduction and isolation of their native habitats.

**tokogenetic** Reticulate (netlike or interwoven) relationships between individuals within a sexual species.

**total evidence** An approach in systematics that combines characters drawn from different sources (e.g., morphological and molecular characters) into a single data set for phylogenetic analyses.

**trace fossils** Taxa known only from their activities (e.g., tracks or burrows).

**track** In panbiogeography, a line drawn on a map connecting the geographically isolated ranges of the species in a taxon that are closest relatives (vicariants).

**Trade Winds** Winds blowing toward the Equator between the Horse Latitudes and the doldrums in the Northern and Southern Hemispheres.

**transform fault** A fault in an oceanic plate, perpendicular to the midoceanic ridge, that divides the plate into smaller units.

**transform zone** A region where two tectonic plates slide against each other but in opposite directions. Also known as a *strike-slip fault*.

**transformation series** For a character, two or more *character states*, assumed to be products of evolutionary changes and therefore used by systematists to infer evolutionary relationships and classify organisms into taxa.

**translocation** A kind of chromosomal mutation in which a segment of one chromosome becomes attached to a different chromosome.

**transition mutation** Within a DNA sequence, the substitution of one purine (A or G) for the other, or of one pyrimidine (C or T) for the other. Compare with *transversion mutation*.

**transpiration** The loss of water vapor from plants through pores called stomates.

**transposable elements** Nucleotide sequences that promote their own movement between chromosomal sites.

**transversion mutation** Within a DNA sequence, the substitution of a purine (adenine or guanine, A or G) with a pyrimidine (cytosine or thymine, C or T) or vice versa. Compare with *transition mutation*.

**treeline** The upper elevational limits of patches of trees.

**trench** In plate tectonics, an exceedingly deep cut in the ocean floor where the subduction of an oceanic plate is occurring.

**triple junction** In plate tectonics, a point at which three oceanic plates meet; the position of the junction shifts because each of the plates drifts at a different rate.

**trophic level** A functional, ecological classification of organism based on their primary source of energy (including primary producers = plants and photosynthetic microorganisms; primary consumers = herbivores; secondary consumers = predators; tertiary and in some cases, higher order consumers; and decomposers).

**trophic status** The position or role of an organism in the nutritional structure of a community; e.g., primary producer, herbivore, or top carnivore.

**tropical alpine scrubland** Vegetative communities found above the timberline in equatorial regions and dominated by relatively sparse, low-growing vegetation including tussock grasses and bizarre, erect rosette perennials with thick stems.

**Tropical Convergence Zone (TCZ)** The zone along tropical regions of Earth's surface that receive the most direct sunlight and most intense heating; associated with rising air masses and high precipitation. The TCZ shifts with the seasons between the Tropic of Cancer (23.5° N latitude) and the Tropic of Capricorn (23.5° S latitude). Also called the *Inter-Tropical Convergence Zone*.

**species turnover** The rate of replacement of species in a particular area as some taxa become extinct but others immigrate from outside.

## U

**undersaturated** Having fewer taxa of a particular kind than expected on the basis of an equilibrium between colonization, speciation, and extinction.

**unequal crossover** An asymmetric exchange of genetic material between a chromosome pair during recombination.

**uniformitarianism** See *actualism*.

**upwelling** The vertical movement of deep water, containing dissolved nutrients from the ocean bottom, to the surface.

## V

**vagility (active dispersal)** The ability to move actively from one place to another.

**vagrancy** Unpredictable movements of individuals outside their normal range or migration route (i.e., "accidental" or extralimital occurrences), often in response to extreme weather.

**variety** In formal taxonomics, a term often used for a subspecies.

**vector-based GIS** An alternative platform for geographic information systems that is composed of a system of points and vectors (lines or curves) and polygons to represent features of interest (e.g., roads, rivers, lakes, and other features to be mapped), each of which has a unique identity so that it can be assigned attributes corresponding to a variety of local characteristics representative of that element (point, vector or polygon).

**vicariance biogeography** An approach in historical biogeography that attempts to reconstruct the historical events that led to observed distributional patterns based largely on the assumption that these patterns resulted from the splitting (vicariance) of areas and not long-distance dispersal. Compare with *dispersal biogeography*.

**vicariant events** Tectonic, eustatic, climatic, or oceanographic events that result in the geographic isolation of previously connected populations.

**vicariants** Two disjunct and phylogenetically related species that are assumed to have been created when the initial range of their ancestor was split by some historical event.

**Viking funeral ship** A term coined by McKenna for a landmass, such as a fragment, containing fossils that were laid down when the land was in one location, but that were transported to a completely different locality via continental drift.

**visualizations** Illustrations such as maps, graphs, or conceptual diagrams that purposely simplify, exaggerate, or distort relevant features of a subject (landscape, seascape, satellite imagery, ecological or evolutionary model) to convey its salient features in terms of general patterns or underlying causal mechanisms.

**volant** Able to fly (e.g., bats, birds, many insects).

## W

**waif** In dispersal biogeography, a diaspore or any type of individual that is carried passively by waves or air currents to a distant place; e.g., most colonizers of oceanic island beaches.

**Wallace's line** The most famous biogeographic line, running along a line of deep water between Borneo and Celebes and between Bali and Lombok; marks the boundary between the Oriental and Australian Regions.

**Wallacean Shortfall** The paucity of information on geographic distributions of species (past and present), and on the geo-

graphic dynamics of extinction forces, especially the dynamic geography of humans, their commensals and other anthropogenic threats.

**Wegenerism** The general idea of continental drift according to Alfred Wegener.

**Westerlies** Prevailing winds in the temperate regions (between 30° and 60° latitude of both hemispheres) which, as a result of the Coriolis effect, have a strong west-to-east component.

**wintering area** In migratory land animals, the area where populations spend the cold season and feed, but do not breed.

**woodland** Any of a variety of vegetation types consisting of small, widely spaced trees with or without substantial undergrowth.

## X

**xerophytes** Land plants that grow in relatively dry (xeric) environments.

## Z

**zonal soils** Soils that have distinctive characteristics and are formed by the actions of climate and organisms on the so-called "typical" rocks (sandstone, shale, granite, gneiss and slate).

**zoochory** Transport of propagules by animals.

**zoogeography** The study of the distributions of animals.

**zooplankton** The collection of small or microscopic animals that float or drift in great numbers in fresh or salt water, especially at or near the surface, and serve as food for fish and other larger organisms.



# Glossary

## A

**adaptive management** Implementing a management plan and monitoring how well it works, then using the results to adjust the management plan.

**adaptive radiation** An evolutionary process whereby different populations of a species adapt to local conditions, followed by speciation.

**adaptive restoration** Using monitoring data to adjust management plans to achieve restoration goals.

**additionality** The net positive difference that results from taking an action compared to not taking one.

**affluenza** The unsatisfying and unending pursuit of increasing material wealth.

**Allee effect** Inability of a species' social structure to function once a population of that species falls below a certain number or density of individuals.

**alleles** Different forms of the same gene (e.g., different alleles of the genes for certain blood proteins produce the different blood types found among humans).

**alpha diversity** The number of different species in a community or specific location; species richness.

**amenity value** Recreational value of biodiversity, including ecotourism.

**Anthropocene** Unofficial term for the present geological period in which people significantly affect ecosystem processes.

**arboretum** Specialized botanical garden focusing on trees and other woody plants.

**artificial incubation** Conservation strategy that involves humans taking care of eggs or newborn animals.

**artificial insemination** Introduction of sperm into a receptive female animal by humans; used to increase the reproductive output particularly of endangered species.

**artificial selection** Selective breeding by humans to produce desired and useful characteristics in domesticated plants and animals.

**assisted colonization** People establish populations of rare and endangered species at new, suitable localities outside of their current range; may be done because climate change is rendering their current habitats unsuitable.

## B

**beneficiary value** *See* bequest value.

**bequest value** The benefit people receive by preserving a resource or species for their children and descendants or future generations, and quantified as the amount people are willing to pay for this goal. Also known as beneficiary value.

**beta diversity** Rate of change of species composition along a gradient or transect.

**binomial nomenclature** The unique two-part Latin name taxonomists bestow on a species, such as *Canis lupus* (gray wolf) or *Homo sapiens* (human).

**biocultural restoration** Restoring lost ecological knowledge to people to give them an appreciation of the natural world.

**biodiversity** The complete range of species, biological communities, and their ecosystem interactions and genetic variation within species. Also known as biological diversity.

**biodiversity indicators** Species or groups of species that provide an estimate of the biodiversity in an area when data on the whole community is unavailable. Also known as surrogate species.

**biodiversity offsets** *See* compensatory mitigation.

**biological community** A group of species that occupies a particular locality.

**biological definition of a species** Among biologists, the most generally used of several definitions of "species." A group of individuals that can potentially breed among themselves in the wild and that do not breed with individuals of other groups. Compare with morphological definition of species.

**biological diversity** *See* biodiversity.

**biomagnification** Process whereby toxins become more concentrated in animals at higher levels in the food chain.

**biomass** Total weight of living material in a place; often expressed as weight per unit area.

**biomes** Ecosystems characterized by the structure and characteristics of their vegetation, which support unique biological communities.

**biophilia** The postulated predisposition in humans to feel an affinity for the diversity of the living world.

**biopiracy** Collecting and using biological materials for commercial, scientific, or personal use without obtaining the necessary permits.

**bioprospecting** Collecting biological materials as part of a search for new products.

**bioregional management** Management system that focuses on a single large ecosystem or a series of linked ecosystems, particularly where they cross political boundaries.

**biosphere reserve** One of the protected areas established as part of a United Nations program to demonstrate the compatibility of biodiversity conservation and sustainable development to benefit local people.

**Biosphere Reserves Program** See biosphere reserve.

**biota** A region's plants and animals.

**Bonn Convention** Treaty to protect European species, particularly migratory species. Also called the Convention on the Conservation of Migratory Species of Wild Animals.

**bushmeat** Meat from any wild animal.

**bushmeat crisis** The sharp decline in wild animal populations caused by humans hunting for food.

**bycatch** Animals, including marine mammals, sea turtles, and fish of no commercial value, killed unintentionally during large-scale fishing operations.

## C

**carnivore** An animal species that consumes other animals to survive. Also called a secondary consumer or predator. Compare with primary consumer.

**carrying capacity** The number of individuals or biomass of a species that an ecosystem can support.

**census** A count of the number of individuals in a population.

**CITES** See Convention on International Trade in Endangered Species.

**class** Unit of classification; related orders of species are contained in a class.

**clonal repositories** Special botanical gardens or facilities that preserves genetic variation for plants with seeds that cannot be stored or for plants that are long-lived. Also known as clonal orchards.

**clone banks** Cuttings and families of closely related seeds taken from the best plants to establish plantations of superior genetic varieties; used by foresters to conserve genetic variation in tree species.

**co-management** Local people working as partners with government agencies and conservation organizations in protected areas.

**commodity value** See direct use value.

**common property** Natural resources that are not controlled by individuals but collectively owned by society. Also known as open-access resources or common-pool resources.

**community conserved area** Protected area managed and sometimes established by local people.

**compensatory mitigation** When a new site is created or rehabilitated in compensation for a site damaged or destroyed elsewhere. Also known as biodiversity offset.

**competition** A contest between individuals or groups of animals for resources. Occurs when individuals or a species use a limiting resource in a way that prevents others from using it.

**complementary areas** Conservation strategy in which each newly established protected area adds additional species or other aspects of biodiversity to an existing system of protected areas.

**conservation banking** A system involving developers paying landowners for the preservation of an endangered species or protected habitat type (or even restoration of a degraded habitat) to compensate for a species or habitat that is destroyed elsewhere.

**conservation biology** Scientific discipline that draws on diverse fields to carry out research on biodiversity, identify threats to biodiversity, and play an active role in the preservation of biodiversity.

**conservation concession** Method of protecting land whereby a conservation organization pays a government or other landowner to preserve habitat rather than allow an extractive industry to damage the habitat.

**conservation corridor** Connection between protected areas that allows for dispersal and migration. Also known as habitat corridor, or movement corridor.

**conservation development** See limited development.

**conservation easement** Method of protecting land in which landowners give up the right to develop or build on their property, often in exchange for financial or tax benefit.

**conservation leasing** Providing payments to private landowners who actively manage their land for biodiversity protection.

**conservation planning software** Used to help design networks of protected areas.

**conservation psychology** The scientific study of human relationships with nature, and how to motivate people to value and protect biodiversity.

**conservation units** Species, ecosystems, and physical features of a region; data about them are gathered and stored by conservation organizations.

**consumptive use value** Value assigned to goods that are collected and consumed locally.

**Convention Concerning the Protection of the World Cultural and Natural Heritage** See World Heritage Convention.

**Convention on Biological Diversity (CBD)** A treaty that obligates countries to protect the biodiversity within their borders, and gives them the right to receive economic benefits from the use of that biodiversity.

**Convention on the Conservation of Migratory Species of Wild Animals (CMS)** See Bonn Convention.

**Convention on International Trade in Endangered Species (CITES)** The international treaty that establishes lists (known as Appendices) of species for which international trade is to be prohibited, regulated, or monitored.

**cost-benefit analysis** Comprehensive analysis that compares values gained against the costs of a project or resource use.

**cross-fostering** Conservation strategy in which individuals from a common species raise the offspring of a rare, related species.

**cryptic biodiversity** The existence of one or more genetically distinct species that look similar to, and consequently have been mistaken for, a described species.

**cultural eutrophication** Algal blooms and associated impacts caused by excess mineral nutrients released into the water from human activity.

## D

**debt-for-nature swap** Agreement in which a developing country agrees to fund additional conservation activities in exchange for a conservation organization canceling some of its discounted debt.

**decomposer** A species that feeds or grows on dead plant and animal material. Also called a detritivore.

**deep ecology** Philosophy emphasizing biodiversity protection, personal lifestyle changes, and working towards political change.

**degazettement** Government actions taken to remove the legal status of protected areas.

**demographic stochasticity** Random variation in birth, death, and reproductive rates in small populations, sometimes causing further decline in population size. Also called demographic variation.

**demographic study** Study in which individuals and populations are monitored over time to determine rates of growth, reproduction, and survival.

**demographic variation** See demographic stochasticity.

**desertification** Process by which ecosystems are degraded by human activities into man-made deserts.

**detritivore** See decomposer.

**direct use value** Value assigned to products, such as timber and animals, that are harvested and directly used by the people who harvest them. Also known as commodity value or private goods.

**discount rate** Method for reducing the current value of a resource that is going to be used at some point in the future.

**disease-causing organisms** Bacteria, viruses, and other species that cause diseases.

**DNA barcoding** A system that will identify the species based on the DNA from a tissue sample.

## E

**Earth Summit** An international conference held in 1992 in Rio de Janeiro that resulted in new environmental agreements. Also known as the Rio Summit.

**ecocolonialism** Practice of governments and conservation organizations disregarding the land rights and traditions of local people in order to establish new conservation areas.

**ecological economics** Discipline that includes valuations of biodiversity in economic analyses.

**ecological footprint** The influence a group of people has on both the surrounding environment and locations across the globe as measured by global hectares per person.

**ecological restoration** Altering a site to reestablish an indigenous ecosystem.

**ecologically extinct** A species that has been so reduced in numbers that it no longer has a significant ecological impact on the biological community.

**ecologically functional** A species that is sufficiently abundant to have a significant impact on other species in an ecosystem.

**economic development** Economic activity focused on improvements in efficiency and organization but not necessarily on increases in resource consumption.

**economic growth** Economic activity characterized by increases in the amount of resources used and in the amount of goods and services produced.

**economic impact assessment** Evaluation of a project that considers its possible present and future impacts on the economy.

**ecosystem** A biological community together with its associated physical and chemical environment.

**ecosystem diversity** The variety of ecosystems present in a place or geographic area.

**ecosystem engineers** Species which modify the physical structure of an ecosystem.

**ecosystem integrity** The state of an ecosystem when it is complete and functional and has not been damaged by human activity.

**ecosystem management** Large-scale management that often involves multiple stakeholders, the primary goal of which is the preservation of ecosystem components and processes.

**ecosystem services** Range of benefits provided to people from ecosystems, including flood control, clean water, and reduction of pollution.

**ecotourism** Tourism, especially in developing countries, focused on viewing unusual and/or especially charismatic biological communities and species that are unique to a country or region.

**edge effect** Altered environmental and biological conditions at the edges of a fragmented habitat.

**effective population size ( $N_e$ )** The number of breeding individuals in a population.

**embryo transfer** The surgical implantation of embryos into a surrogate mother; used to increase the number of individuals of a rare species, with a common species used as the surrogate mother.

**endangered species** A species that has a high risk of extinction in the wild in the near future; a category in the IUCN system and under the U.S. Endangered Species Act.

**Endangered Species Act (ESA)** An important U.S. law passed to protect endangered species and the ecosystems in which they live.

**endemic** Occurring in a place naturally, without the influence of people (e.g., gray wolves are endemic to Canada).

**endemism** Species found in one place and nowhere else (e.g., the many lemur species found only on the island of Madagascar).

**environmental economics** Discipline that examines the economic impacts of environmental policies and decisions.

**environmental DNA (eDNA)** DNA occurring in the environment (e.g., in water); currently being used to detect the presence of rare and invasive species.

**environmental ethics** Discipline of philosophy that articulates the intrinsic value of the natural world and people's responsibility to protect the environment.

**environmental impact assessment** Evaluation of a project that considers its possible present and future impacts on the environment.

**environmental justice** Movement that seeks to empower and assist poor and politically weak people in protecting their own environments; their well-being and the protection of biological diversity are enhanced in the process.

**environmental stochasticity** Random variation in the biological and physical environment. Can increase the risk of extinction in small populations.

**environmentalism** A widespread movement, characterized by political activism, with the goal of protecting the natural environment.

**eutrophication** Process of degradation in aquatic environments caused by nitrogen and phosphorus pollution and characterized by algal blooms and oxygen depletion.

**evolutionary definition of a species** A group of individuals that share unique similarities of their DNA and hence their evolutionary past.

**ex situ conservation** Preservation of species under artificial conditions, such as in zoos, aquariums, and botanical gardens.

**existence value** The benefit people receive from knowing that a habitat or species exists and quantified as the amount that people are willing to pay to prevent species from being harmed or going extinct, habitats from being destroyed, and genetic variation from being lost.

**exotic species** A species that occurs outside of its natural range due to human activity. Compare with endemism.

**extant** Presently alive; not extinct.

**externalities** Hidden costs or benefits that result from an economic activity to individuals or a society not directly involved in that activity.

**extinct** The condition in which no members of a species are currently living.

**extinct in the wild** A species no longer found in the wild, but individuals may remain alive in zoos, botanical gardens, or other artificial environments.

**extinction cascade** A series of linked extinctions whereby the extinction of one species leads to the extinction of one or more other species.

**extinction debt** The inevitable extinction of many species in coming years as the result of current human activities.

**extinction vortex** Tendency of small populations to decline toward extinction.

**extirpated** Local extinction of a population, even though the species may still exist elsewhere.

**extractive reserve** Protected area in which sustainable extraction of certain natural products is allowed.

## F

**family** A unit of classification; related genera are contained in a family.

**50/500 rule** Proposed rule that at least 50 and up to 500 reproductive individuals are needed to prevent the loss of genetic variability in a population; larger numbers are now considered necessary for wild populations.

**fitness** An individual's ability to grow, survive, and reproduce.

**flagship species** A species that captures public attention, aids in conservation efforts, such as establishing a protected area, and may be crucial to ecotourism.

**focal species** A species that provides a reason for establishing a protected area.

**food chain** Specific feeding relationships between species at different trophic levels.

**food web** A network of feeding relationships among species.

**founder effect** Reduced genetic variability that occurs when a new population is established ("founded") by a small number of individuals.

## G

**gamma diversity** The number of species in a large geographic area.

**gap analysis** Comparing the distribution of endangered species and biological communities with existing and proposed protected areas to determine gaps in protection.

**gap species** A species that is not protected in any part of its range.

**gene** A unit (DNA sequence) on a chromosome that codes for a specific protein. Also called a locus.

**gene flow** The transfer of new alleles and genetic combinations between populations that results from the movement of individuals.

**gene frequencies** Percentage of different allele forms within a population.

**gene pool** The total array of genes and alleles in a population.

**genetic diversity** The range of genetic variation found within a species.

**genetic drift** Loss of genetic variation and change in allele frequencies that occur by chance in small populations.

**genetic swamping** Differences between species becoming blurred when invasive species hybridize with native species.

**genetically modified organism (GMO)** An organism whose genetic code has been altered by scientists using recombinant DNA technology.

**genome resource bank (GRB)** Frozen collection of DNA, eggs, sperm, embryos, and other tissues of species that can be used in breeding programs and scientific research.

**genotype** Particular combination of alleles that an individual possesses.

**genus** (plural, genera) Unit of classification that includes one or more species.

**geographic information systems (GIS)** Computer analyses that integrate and display spatial data; relating in particular to the natural environment, ecosystems, species, protected areas, and human activities.

**global climate change** Climate characteristics that are changing now and will continue to change in the future, resulting in part from human activity.

**Global Environment Facility (GEF)** A large international program involved in funding conservation activities in developing countries.

**global warming** The current and future increases in temperatures caused by higher atmospheric concentrations of carbon dioxide and other greenhouse gases produced by human activities.

**globalization** The increasing interconnectedness of the world's economy.

**globally extinct** No individuals are presently alive anywhere.

**greenhouse effect** Warming of the Earth caused by carbon dioxide and other "greenhouse gases" in the atmosphere that allow the sun's radiation to penetrate and warm the Earth but prevent the heat generated by sunlight from re-radiating. Heat is thus trapped near the surface, raising the planet's temperature.

**greenhouse gases** Gases in the atmosphere, primarily carbon dioxide, that are transparent to sunlight but that trap heat near the Earth's surface.

**guild** A group of species at the same trophic level that use approximately the same environmental resources.

## H

**habitat conservation plans (HCPs)** Regional plans that allow development in designated areas while protecting biodiversity in other areas.

**habitat corridor** See conservation corridor.

**habitat fragmentation** Process whereby a continuous area of habitat is both reduced in area and divided into two or more fragments.

**hard release** In the establishment of a new population, when individuals from an outside source are released in a new location without assistance.

**healthy ecosystem** Ecosystem in which processes are functioning normally, whether or not there are human influences.

**herbivore** A species that eats plants or other photosynthetic organisms. Also called a primary consumer.

**heterosis** See hybrid vigor.

**heterozygous** Condition of an individual having two different allele forms of the same gene.

**homozygous** Condition of an individual having two identical allele forms of the same gene.

**hotspot** Region with numerous species, many of which are endemic, that is also under immediate threat from human activity.

**hybrid** Intermediate offspring resulting from mating between individuals of two different species.

**hybrid vigor** Increased fitness of offspring resulting from mating of unrelated individuals. Also known as heterosis.

## I

**in situ conservation** Preservation of natural communities and populations of endangered species in the wild.

**inbreeding** Self-fertilization or mating among close relatives.

**inbreeding depression** Lowered reproduction or production of weak offspring following mating among close relatives or self-fertilization.

**indicator species** Species used in a conservation plan to identify and often protect a biological community or set of ecosystem processes.

**indirect use value** Value provided by biodiversity that do not involve harvesting or destroying the resource (such as water quality, soil protection, recreation, and education). Also known as public goods.

**integrated conservation development project (ICDP)** Conservation project that also provides for the economic needs and welfare of local people.

**Intergovernmental Panel on Climate Change (IPCC)** A group of leading scientists organized by the United Nations to study the impacts and implications of human activity on climate and ecosystems.

**International Union for the Conservation of Nature (IUCN)** See IUCN.

**intrinsic value** Value of a species and other aspects of biodiversity for their own sake, unrelated to human needs.

**introduction program** Moving individuals to areas outside their historical range in order to create a new population of an endangered species.

**invasive species** An introduced species that increases in abundance at the expense of native species.

**island biogeography model** Formula for the relationship between island size and the number of species living on the island; the model can be used to predict the impact of habitat destruction on species extinctions, viewing remaining habitat as an "island" in the "sea" of a degraded ecosystem.

**IUCN** The World Conservation Union, a major international conservation organization; also known as the International Union for the Conservation of Nature.

## K

**keystone resource** Any resource in an ecosystem that is crucial to the survival of many species; for example, a watering hole.

**keystone species** A species that has a disproportionate impact (relative to its numbers or biomass) on the organization of a biological community. Loss of a keystone species may have far-reaching consequences for the community.

**kingdom** A large unit of classification; for example, the Animal kingdom includes all animals.

## L

**land ethic** Aldo Leopold's philosophy advocating human use of natural resources that is compatible with or even enhances ecosystem health.

**land sharing** Land use which combines resource use and conservation.

**land sparing** Land which is protected when other lands are used more intensively.

**land trust** Conservation organization that protects and manages land.

**landrace** A variety of crop that has unique genetic characteristics.

**landscape ecology** Discipline that investigates patterns of habitat types and their influence on species distribution and ecosystem processes.

**leakage** In conservation biology, the indirect loss of biodiversity that results from taking a positive action to protect it.

**legal title** The right of ownership of land, recognized by a government and/or judicial system; traditional people often struggle to achieve this recognition.

**limited development** Compromise involving a landowner, a property developer, and a conservation organization that combines some development with protection of the remaining land.

**limiting resource** Any requirement for existence whose presence or absence limits a population's size. In the desert, for example, water is a limiting resource.

**Living Planet Index** A measure of the conservation status of species, based on the IUCN categories.

**locally extinct** A species that no longer exists in a place where it used to occur, but still exists elsewhere.

**locus** (plural, loci) *See* gene.

**Long-Term Ecological Research (LTER)** A U.S. government program to study gradual changes in ecosystems.

## M

**management plan** A statement of how to protect biodiversity in an area, along with methods for implementation.

**marine protected area (MPA)** Protected area of ocean and/or coastline established to rebuild and maintain marine biodiversity.

**market failure** Misallocation of resources in which certain individuals or businesses benefit from using a common resource, such as water, the atmosphere, or a forest, but other individuals, businesses or the society at large bears the cost.

**maximum sustainable yield** Greatest amount of a resource that can be harvested each year and replaced through population growth without detriment to the population.

**metapopulation** Shifting mosaic of populations of the same species linked by some degree of migration; a "population of populations."

**minimum dynamic area (MDA)** Area needed for a population to have a high probability of surviving into the future.

**minimum viable population (MVP)** Number of individuals necessary to ensure a high probability that a population will survive a certain number of years into the future.

**mitigation** Process by which a new population or habitat is created to compensate for a habitat damaged or destroyed elsewhere.

**morphological definition of a species** A group of individuals, recognized as a species, that is morphologically, physiologically, or biochemically distinct from other groups. Compare with biological definition of species.

**morphospecies** Individuals that are probably a distinct species based on their appearance but that do not currently have a scientific name.

**movement corridor** *See* conservation corridor.

**multilateral development banks (MDBs)** The World Bank and other regional banks established by developed countries to promote economic development in developing countries.

**multiple use habitat** An area managed to provide a variety of goods and services.

**mutations** Changes that occur in genes and chromosomes, sometimes resulting in new allele forms and genetic variation.

**mutualistic relationship** A biological interaction between two organisms that is beneficial to both.

## N

**national environmental fund (NEF)** A trust fund or foundation that uses its annual income to support conservation activities.

**natural history** The ecology and distinctive characteristics of a species.

**natural selection** Genetic changes that occur in a population as it adapts over time to its environment; a key mechanism of evolution.

**neoendemics** Species that occupies a small area because it has only recently evolved from a closely related species.

**no-take zone** Part of a protected area in which nothing can be removed; in a marine protected area, a zone in which no fishing is allowed.

**non-use value** Value of something that is not presently used; for example, existence value.

**nongovernmental organization (NGO)** A private organization that acts to benefit society in some way; many conservation organizations are NGOs.

**nonpoint source pollution** Pollution coming from a general area rather than a specific site.

**normative discipline** A discipline that embraces ethical commitment rather than ethical neutrality.

## O

**omnivore** A species that eats both plants and animals.

**open-access resources** Natural resources that are not controlled by individuals but are collectively owned by society.

**option value** Value of biodiversity in providing possible future benefits for human society (such as new medicines).

**order** Unit of classification; an order includes one or more related families.

**outbreeding** Mating and production of offspring by individuals that are not closely related, as in individuals from different populations of the same species. In general outbreeding leads to heterosis, a level of genetic variation that improves individual evolutionary fitness.

**outbreeding depression** Lowered fitness that occasionally occurs when individuals of different species or widely different populations mate and produce offspring.

**overexploitation** Intense harvest of a resource or species that results in its decline or loss.

## P

**paleoendemic** Ancient species with a narrow geographical range and no closely related extant species.

**payment for ecosystem services (PES)** Direct payment to individual landowners and local communities that protect species or critical ecosystem characteristics.

**perverse subsidies** Government payments or other financial incentives to industries that result in environmentally destructive activities.

**phenotype** The morphological, physiological, anatomical, and biochemical characteristics of an individual that result from the expression of its genotype in a particular environment.

**photochemical smog** Visible air pollution resulting from chemicals released from human activities being transformed in sunlight.

**photosynthetic species** *See* primary producer.

**phyletic evolution** Gradual transformation of one species into another over time.

**phylum** (plural, phyla) Large unit of classification; a phylum contains related classes of species.

**polymorphic gene** Within a population, a gene that has more than one form or allele.

**polyploids** Individuals with an extra set of chromosomes; important in the evolution of new plant species.

**population** A geographically defined group of individuals of the same species that mate and otherwise interact with one another. Compare with metapopulation.

**population biology** Study of the ecology and genetics of populations, often with a focus on population numbers.

**population bottleneck** A radical reduction in population size (e.g., following an outbreak of infectious disease), sometimes leading to the loss of genetic variation.

**population viability analysis (PVA)** Demographic analysis that predicts the probability of a population persisting in an environment for a certain period of time; sometimes linked to various management scenarios.

**precautionary principle** Principle stating that it may be better to avoid taking a particular action due to the possibility of causing unexpected harm.

**predation** Act of killing and consuming another organism for food.

**predator** *See* carnivore.

**preservationist ethic** A belief in the need to preserve wilderness areas for their intrinsic value.

**primary consumer** *See* herbivore.

**primary producers** Organisms such as green plants, algae, and seaweeds that obtain their energy directly from the sun via photosynthesis. Also known as autotrophs.

**private goods** *See* direct use value.

**productive use value** Value assigned to products that are sold in markets.

**protected area** A habitat managed primarily or in large part for biodiversity.

## R

**Ramsar Convention on Wetlands** A treaty that promotes the protection of wetlands of international importance.

**rapid biodiversity assessments (RBAs)** Species inventories and vegetation maps made by teams of biologists when urgent decisions must be made on where to establish new protected areas. Also known as rapid assessment plans (RAPs).

**recombination** Mixing of the genes on the two copies of a chromosome that occurs during meiosis (i.e., in the formation of egg and sperm, which contain only one copy of each chromosome). Recombination is an important source of genetic variation.

**reconciliation ecology** The science of developing urban places in which people and biodiversity can coexist.

**Red Data Books** Compilations of lists ("Red Lists") of endangered species prepared by the IUCN and other conservation organizations.

**Red List criteria** Quantitative measures of threats to species based on the probability of extinction.

**Red List Index** Measure of the conservation status of species based on the IUCN categories.

**Red Lists** Lists of endangered species prepared by the IUCN.

**Reducing Emissions from Deforestation and Forest Degradation (REDD)** Program using financial incentives to reduce the emissions of greenhouse gases from deforestation.

**reference site** Control site that provides goals for restoration in terms of species composition, community structure, and ecosystem processes.

**regionally extinct** A species is no longer found in part of its former range but still lives elsewhere.

**reinforcement program** Releasing new individuals into an existing population to increase population size and genetic variability.

**reintroduction program** The release of captive bred or wild-collected individuals at a site within their historical range where the species does not presently occur.

**replacement cost approach** How much people would have to pay for an equivalent product if what they normally use is unavailable.



**representative site** Protected area that includes species and ecosystem properties characteristic of a larger area.

**resilience** The ability of an ecosystem to return to its original state following disturbance.

**resistance** The ability of an ecosystem to remain in the same state even with ongoing disturbance.

**resource conservation ethic** Natural resources should be used for the greatest good of the largest number of people for the longest time.

**restoration ecology** The scientific study of restored populations, communities, and ecosystems.

**rewild** Returning species, in particular large mammals, to landscape to approximate its natural condition prior to human impact.

**Rio Summit** See Earth Summit.

## S

**secondary consumer** See carnivore.

**seed bank** Collection of stored seeds, collected from wild and cultivated plants; used in conservation and agricultural programs.

**shifting cultivation** Farming method in which farmers cut down trees, burn them, plant crops for a few years, and then abandon the site when soil fertility declines. Also called "slash-and-burn" agriculture.

**sink population** A population that receives an influx of new individuals from a source population.

**SLOSS debate** Controversy concerning the relative advantages of a single large or several small conservation areas.

**social value of carbon** The negative effects of added carbon dioxide emissions on human society.

**soft release** In the establishment of a new population, when individuals are given assistance during or after the release to increase the chance of success. Compare with hard release.

**source population** An established population from which individuals disperse to new locations.

**speciation** Process whereby one species is transformed into one or more new species.

**species-area relationship** The number of species found in an area increases with the size of the area; i.e., more species are found on large islands than on small islands.

**species diversity** The entire range of species found in a particular place.

**species richness** The number of species found in a community.

**stable ecosystem** An ecosystem that is able to remain in roughly the same compositional state despite human intervention or stochastic events such as unseasonable weather.

**stakeholders** People who have a compelling interest in some project, place, or process.

**stochasticity** Random variation; variation happening by chance.

**succession** The gradual process of change in species composition, vegetation structure, and ecosystem characteristics following natural or human-caused disturbance.

**survey** Repeatable sampling method to estimate population size or density, or some other aspect of biodiversity.

**sustainable development** Economic development that meets present and future human needs without damaging the environment and biodiversity.

**sympiotic relationship** A mutualistic relationship in which neither of the two species involved can survive without the other.

## T

**taxonomist** Scientist involved in the identification and classification of species.

**taxonomy** Science of identifying and classifying living things.

**threatened** Species that fall into the endangered or vulnerable to extinction categories in the IUCN system. Under the U.S. Endangered Species Act, refers to species at risk of extinction, but at a lower risk than endangered species.

**tragedy of the commons** The unregulated use of a public resource that results in its degradation.

**trophic cascade** Major changes in vegetation and biodiversity resulting from the loss of a keystone species.

**trophic levels** Levels of biological communities representing ways in which energy is captured and moved through the ecosystem by the various types of species. See primary producer; herbivore; predator; detritivore.

## U

**umbrella species** Protecting an umbrella species results in the protection of other species.

**UNESCO World Network of Biosphere Reserves** See biosphere reserve.

**use value** The direct and indirect value provided by some aspect of biodiversity.

## W

**World Bank** International bank established to support economic development in developing countries.

**World Heritage Convention** A treaty that protects cultural and natural areas of international significance.

**World Heritage site** A cultural or natural area officially recognized as having international significance.

## Z

**zoning** A method of managing protected areas that allows or prohibits certain activities in designated places.

**zooplankton** Single-celled, heterotrophic (nonphotosynthetic) organisms that drift in bodies of both fresh and salt water.