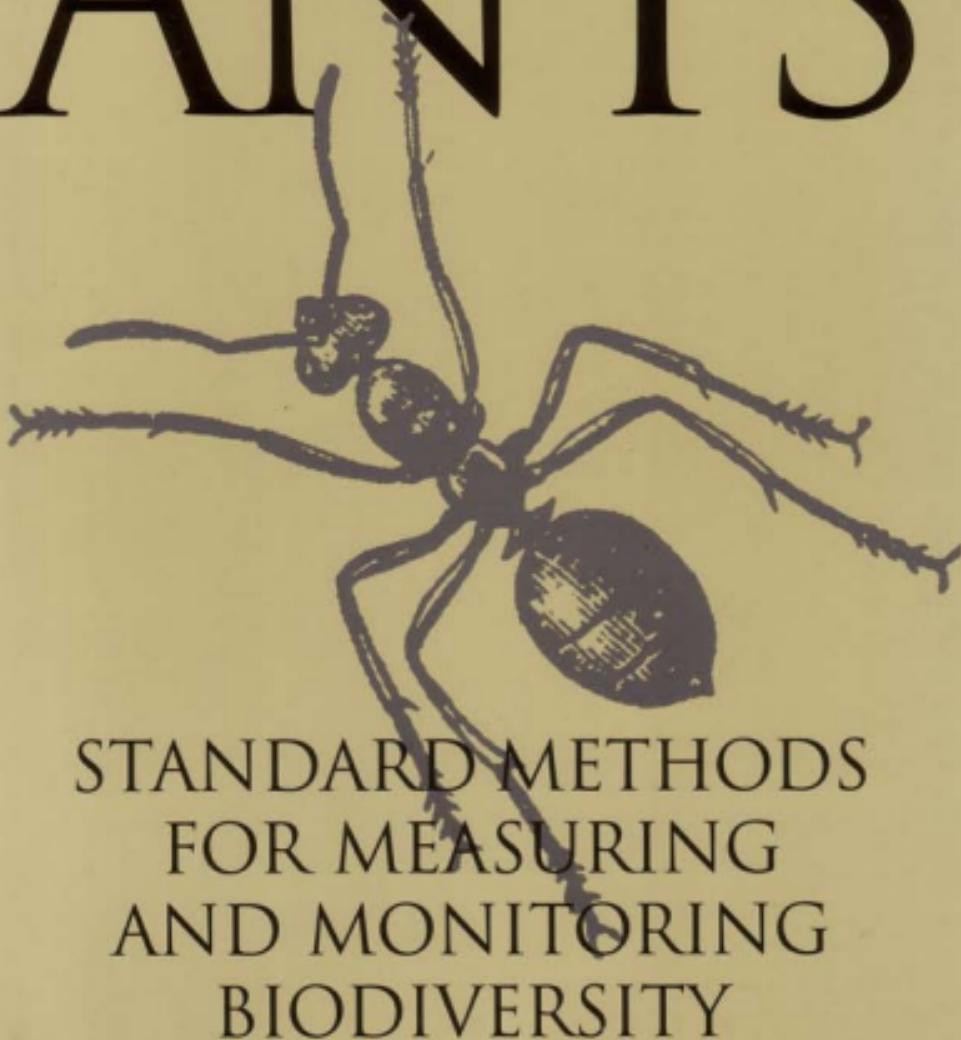


ANTS



STANDARD METHODS
FOR MEASURING
AND MONITORING
BIODIVERSITY

EDITED BY DONAT AGOSTI, JONATHAN D. MAJER,
LEEEANNE E. ALONSO, AND TED R. SCHULTZ

FOREWORD BY EDWARD O. WILSON



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AND MONITORING
BIODIVERSITY



Biological Diversity Handbook Series

Series Editor: Don E. Wilson

This series of manuals details standard field methods for qualitative and quantitative sampling of biological diversity. Volumes focus on different groups of organisms, both plants and animals. The goal of the series is to identify or, where necessary, develop these methods and promote their adoption worldwide, so that biodiversity information will be comparable across study sites, geographic areas, and organisms, and at the same site, through time.

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This book is dedicated to the memory of William L. Brown Jr.,
with affection, respect, and gratitude. For the inspiration you provided,
for the firm foundation you built for ant systematics, and especially
for your generous soul and irreverent good humor, we will never forget you, Bill.

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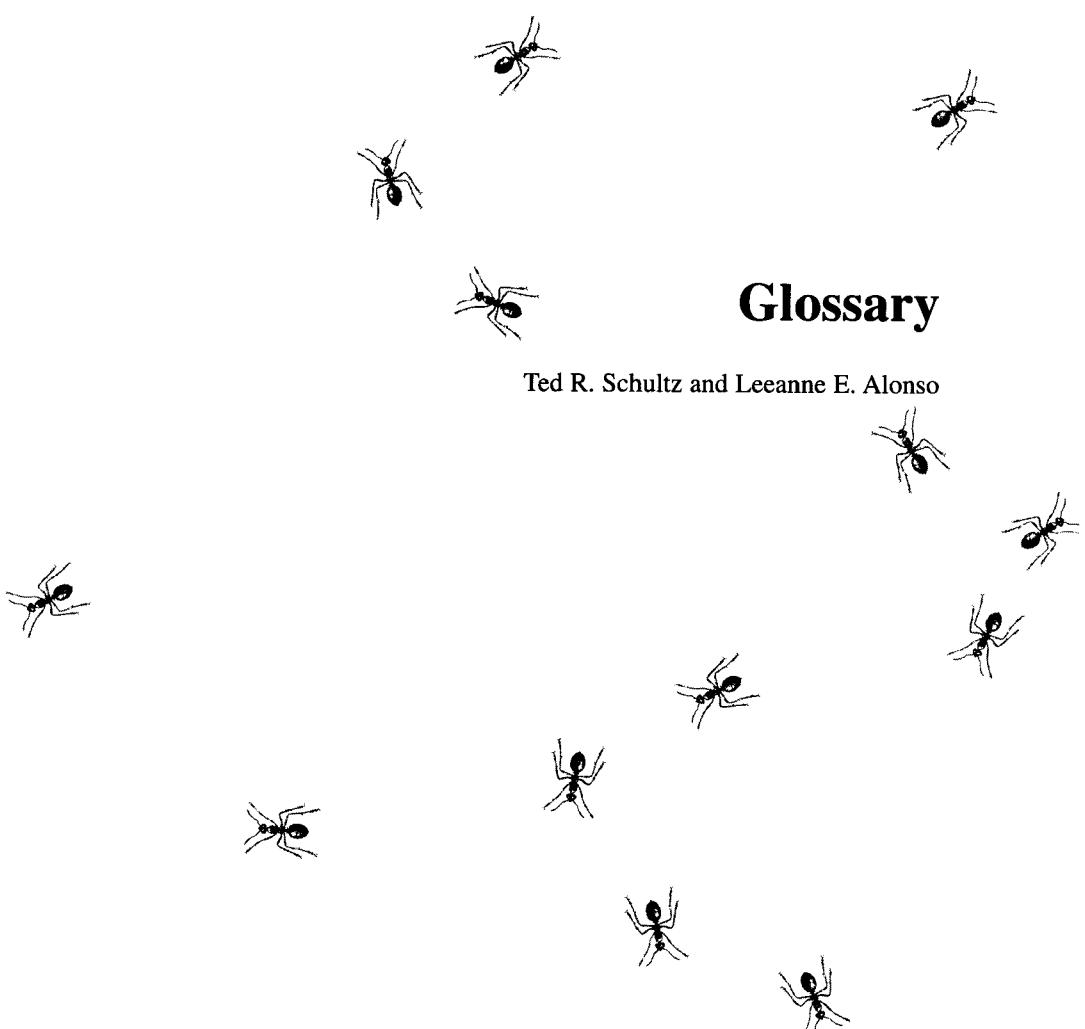
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Glossary

Ted R. Schultz and Leeanne E. Alonso



This glossary is included to enable readers to use this manual without necessarily referring to additional references. It relies heavily on a number of works, all of which are recommended, including Jaeger (1955), Lincoln and Boxshall (1987), Torre-Bueno (1989), Hölldobler and Wilson (1990), and Bolton (1994).

acidopore The orifice of the formic acid-projecting system peculiar to the ant subfamily Formicinae.

Aculeata The group of apocritan Hymenoptera, which includes the ants, in which the ovipositor is modified into a sting.

adventive A nonnative species present in a given area because of accidental introduction (e.g., human transport).

Afrotropical Region Sub-Saharan Africa south of the Sahara Desert and the southern half of the Saudi Arabian peninsula, but variously including or excluding Madagascar and nearby islands, which are sometimes referred to separately as the Malagasy Region.

alate In ants, a winged male or winged female (gyne).

alitrunk (mesosoma) In apocritan Hymenoptera, the middle body region from which arise the legs and wings (when present), posterior to the head and anterior to abdominal segment 2 (the petiole in ants). It is formed from the fusion of the thorax and the first abdominal segment.

ALL protocol Ants of the Leaf Litter protocol, the standardized method for sampling ground-dwelling ants described and recommended in this volume. The protocol employs Winkler litter extraction as the primary tool, pitfall trapping as a secondary tool, and other subsidiary methods depending on conditions. See particularly Chapters 9 and 14.

antennal segments The separate sclerotized units into which the antennae are subdivided, connected

to each other by flexible membranes. In ants and most other aculeate Hymenoptera, they primitive-ly number 12 in the females and 13 in the males.

anterad Toward the anterior; on an insect body, directed toward the head.

anthropogenic Caused by humans.

Apocrita A suborder of Hymenoptera, including all Hymenoptera except suborder Symphyta, in which segment 1 of the abdomen has become fused with the thorax to form the propodeum and in which the larvae are apodous. Ants are members of the Apocrita.

apodeme A chitinous ingrowth of the arthropod exoskeleton to which muscles are attached.

arbicolous Nesting and/or foraging in trees.

aspirator A suction device for picking up insects.

autapomorphy In phylogenetic systematics, a derived character or character state.

basal At or pertaining to the base or point of attachment nearest the main body of an organism.

basidiomycete A member of a taxonomic subdivision of fungi (the Basidiomycotina) that includes those fungi that produce basidiocarps, or true mushrooms.

Berlese funnel A device for collecting small litter- or soil-dwelling arthropods, consisting of an electric lamp mounted above a funnel containing a piece of screen, hardware cloth, or other mesh. Litter is placed over the mesh and, driven downward by the heating and drying agency of the lamp, arthropods fall into the funnel and thence into a collecting jar filled with alcohol or other killing agent (see Fig. 9.6, page 137).

biocontrol Control of pestiferous organisms through the use of their natural enemies (e.g., predators, parasites, fungal diseases)

biodiversity “The variety of life forms, the ecological roles they perform, and the genetic diversity they contain” (Wilcox 1984:640); the number of species or higher taxa in a given region.

biogeography The study of the geographical distributions of organisms and their habitats, and of the historical and biological factors that produced them.

bioindicator In ecology, an aspect of the environment, usually a species or group or species, of use in monitoring biodiversity, ecological status, or other biological attributes of a particular area.

biomass The mass (including or excluding water weight, as specified) of a circumscribed biological entity or collection of entities (e.g., of a single ant, of all ants in a given location, or of all organisms in a given locality).

bivuoac In army ants, the mass of workers that serve as a protective refuge for the queen and brood.

carina An elevated ridge or keel on the insect integument.

carton In myrmecology, a cardboard-like construction material manufactured by some ants using bits of wood, wood pulp, dried plant matter, and soil, generally used to form protective enclosures around their nests. The resulting structures are referred to as “carton nests.”

caste In social insects, any set of individuals in a given colony that is both morphologically distinct and specialized in behavior (morphological castes); more broadly, any set of individuals of a particular morphological type or age group, or both, that performs specialized labor in the colony.

clade A monophyletic group.

cladistic analysis Phylogenetic analysis in which monophyletic groups (clades) are identified based on synapomorphies (shared, derived characters or character states assumed to have been present in a shared common ancestor).

cladogram A branching diagram, most commonly interpreted as a phylogenetic tree, constructed using cladistic analysis.

clypeus That part of the insect head below the frons to which the labrum is attached anteriorly; in most ants, the portion of the “face” (dorsum) of the head capsule that borders the mouth parts, bounded by the antennal sockets and tentorial pits above, the genae (cheeks) on the sides, and the anterior edge of the head capsule below.

coevolution The interdependent evolution of two or more species having an obvious ecological relationship, usually restricted to cases in which interactions are mutually beneficial (mutualisms), but occasionally used more loosely to refer to symbiotic evolution in general.

commensalism A symbiosis in which one partner benefits and the other is neither harmed nor benefited.

complementarity In ecology, the relationship of two habitats that have similar species richnesses but very few species in common.

conspecific Of or pertaining to the same species (opposite of heterospecific).

cotype An imprecise term not recognized by the International Code of Zoological Nomenclature, formerly used to refer to a paratype or syntype.

covariate Of or pertaining to the quality in which two or more quantities vary in a way that preserves a mathematical relationship.

- coxa** The basal segment of the arthropod leg.
- curation** The art and science of preserving biological specimens and organizing, caring for, and maintaining collections of such specimens.
- cuticle** A secretion of the epidermis covering the entire body of an arthropod as well as lining ectodermal invaginations, such as the proctodaeum, stomodaeum, and tracheae.
- denticle** A small tooth.
- dichthadiigyne queen (dichthadiiform ergatogyn, dichthadiiform queen)** In army ants, a member of an aberrant reproductive caste characterized by a wingless alitrunk, a huge gaster, and an expanded postpetiole.
- disarticulation** The separation of one sclerotized component of the arthropod skeleton from a neighboring component to which it was previously attached.
- distal** At or pertaining to the free end of a morphological structure, farthest away from the main body of the organism.
- domatia (myrmecodomatia)** Specialized structures, such as inflated stems or hollow thorns, used by ant plants for the housing of ant colonies.
- dulosis** *See slavemaking*
- ecological succession** The chronological distribution of organisms within an area.
- elaiosome** An ant-attractive nutritive attachment on seeds manufactured by some plants to encourage dispersal.
- endemism** The quality of being native to and exclusively restricted to a particular geographical region.
- energetics** The study of energy transformation within a community or system.
- epigaeic** Living, or at least foraging, above the surface of the ground (opposite of hypogaeic).
- epinotum** *See propodeum.*
- ergatogyn** *See ergatoid.*
- ergatoid (ergatogyn)** In ants, any form intermediate between the worker and the queen.
- eusociality (true sociality, higher sociality)** The condition in which the following three traits are present: cooperation in caring for the young; reproductive division of labor, with more or less sterile individuals working on behalf of individuals engaged in reproduction; and overlap of at least two generations of life stages capable of contributing to colony labor. All ants are eusocial.
- Fluon** A liquid form of Teflon that, when painted onto vertical surfaces and allowed to dry, forms an effective climbing barrier to most insects, including ants.
- Formicidae** The family of Hymenoptera that comprises the ants, characterized by the presence of the metapleural gland (secondarily absent in some groups), petiole, and eusociality.
- formicosis** A disease of the lungs brought on by excessive inhalation of formic acid vapors (produced by ants in the subfamily Formicinae), usually as a result of ant collecting using an aspirator.
- foundress** In ants, the newly fecundated gyne (queen) that begins the colony life cycle.
- frass** Solid larval insect excrement.
- frons** In insects, a sclerite of the head immediately posterior to the clypeus.
- fungivorous** Feeding on fungi.
- furcula** In the aculeate hymenopteran sting, a small, forked apodemal sclerite positioned dorsobasally, to which important muscles of the sting attach.
- gaster (metasoma)** The posterior region of the body in apocritan Hymenoptera; in ants, the portion posterior to the petiole (i.e., true abdominal segments 3–10) or, if a postpetiole is present, the portion posterior to the postpetiole (i.e., true abdominal segments 4–10).
- gena** The insect “cheek,” the area of the head below the eye.
- granivorous** Feeding on grain, i.e., on the seeds of grasses.
- gular teeth** *See* (more correctly) **hypostomal teeth.**
- gyne (queen)** In ants, the female reproductive caste.
- habitus** Overall general form or appearance.
- head capsule** The fused sclerites of the arthropod head, which form a hardened, compact case, the cranium.
- heterospecific** Of or pertaining to a different species (opposite of conspecific).
- Holarctic Region** The region containing both the Palearctic and Nearctic Regions.
- holotype** In taxonomy, a single specimen designated as the name-bearing type of a species or subspecies when it was established, or the single specimen on which the taxon was based when no type was specified.
- homonym** In species-level taxonomy, each of two or more available names established for different nominal taxa having the same spelling or spellings deemed to be the same by the International Code of Zoological Nomenclature. Homonymy is the problematic situation in which two or more species in the same genus have the same name.

homoplasy The apparent independent evolution (by parallelism or convergence) of characteristics that are indistinguishable.

humisol A type of soil that is rich in organic material.

hypogaeic Living primarily below the surface of the ground, or at least beneath cover such as leaf litter, stones, and dead bark (opposite of epigaeic).

hypostoma The anteroventral region of the head; the area of cuticle immediately behind the buccal cavity and forming its posterior margin.

hypostomal teeth (gular teeth) In ants, one or more pairs of triangular or rounded teeth that project forward from the anterior margin of the hypostoma.

inflorescence The arrangement and sequence of development of flowers on a flowering shoot.

infrabuccal pocket In ants, a cavity on the floor of the buccal chamber in which, in most species, indigestible material accumulates and is compacted for later disposal; in ants of the subfamily Pseudomyrmecinae infrabuccal pocket contents are fed to larvae, and in fungus-growers the infrabuccal pocket is used by gynes to transport fungus-garden mycelium.

insolation Exposure to solar radiation

instar In insects, the stage between moults in a nymph or larva.

integument The outer layer of an arthropod, including the basement membrane, epidermis, and cuticle.

interspecific competition Simultaneous demand for limited resources between members of different species.

intraspecific competition Simultaneous demand for limited resources between members of the same species.

karyology The branch of cytology dealing with the study of nuclei, especially the structure of chromosomes.

labrum The “upper lip” of the insect mouth, arising anterior to the clypeus.

latosol A type of soil, occurring primarily in tropical regions, in which plant detritus decays rapidly, leaching silica from the soil in the process known as laterization.

lectotype In taxonomy, one of a series of syntypes that, subsequent to the publication of the original description, is selected and designated through publication to serve the same function as the holotype specimen for the species.

lineage A group of organisms descended from a common ancestor. *See clade.*

mandibles The first pair of jaws in insects. In ants, the organs for cutting and otherwise processing food, for biting enemies, for carrying brood, for nest construction, and for generally manipulating the environment, usually stout and jawlike, but variously modified and elongate in some species.

mesocoxa The coxa of the middle leg (i.e., the leg arising from the mesothorax).

mesonotum The dorsal part of the mesothorax (thorax segment 2).

mesosoma *See alitrunk.*

mesothorax The middle member of the three main subdivisions of the insect thorax, from which the anterior pair of wings and the middle legs arise.

metacoxa The coxa of the hind leg (i.e., the leg arising from the metathorax).

metanotum The dorsal part of the metathorax (thorax segment 3).

metapleural gland An antibiotic-producing exocrine gland peculiar to ants located at the posteroventral corner of the metapleuron.

metapleuron The lateral region of the metathorax.

metasoma *See gaster.*

metathorax The posterior member of the three main subdivisions of the insect thorax, from which the posterior pair of wings and the rear legs arise.

midden A refuse heap.

monophyletic Describing a group consisting of an ancestral species and all of its descendants.

morphocline One of a graded series of states within a morphological character.

morphospecies A temporary grouping created to distinguish morphologically distinct clusters of specimens from one another prior to rigorous identification (where possible) with nominal species.

mutualism A symbiosis in which both parties benefit.

mycorrhizal fungi Fungi that grow in obligate association with the roots of plants.

myrmecodomatia *See domatia.*

myrmecologist A student of myrmecology.

myrmecology The study of ants (family Formicidae).

myrmecophyte A higher plant that lives in obligatory, mutualistic association with ants.

Nearctic Region The northern regions of the New World, including North America and the Central Mexican Plateau.

Neotropical Region The tropical region of the New World (i.e., of Central and South America).

ocellus In insects, a simple eye distinct from the paired compound eyes; in ants, an eye occurring in

- a group of three on the vertex, present in males and gynes but frequently absent in workers.
- oviposition** The act of depositing eggs.
- Palaearctic Region** The northern regions of the Old World, including Europe, Africa north of the Sahara, and Asia as far south as the southern edge of the Yangtse-kiang watershed and the Himalayas.
- Paleotropical Region** The entire tropical region of the Old World, including the Afrotropical, Malagasy, Oriental, and Indo-Australian tropical regions.
- palp** One of the paired appendages of the maxillary and labial mouth part segments; in ants, the maximum number of maxillary palpal segments is six, the minimum number (rarely seen) is zero; the maximum number of labial palps is four, the minimum number is one.
- pan-tropical** Of or pertaining to the tropical regions of the entire world.
- paraphyletic** Of or pertaining to a taxonomic group that does not include all the descendants of a common ancestor.
- parasitism** A symbiosis in which one partner benefits at the expense of the other.
- paratype** In taxonomy, each specimen of a type series other than the holotype; one of the series of specimens examined during the formulation of the original description of the species.
- parthenogenesis** The development of an individual from a female gamete without fertilization by a male gamete.
- patchiness** Heterogeneity within an environment with respect to ecological conditions of interest (e.g., those that might favor one species over another or that might subdivide populations with regard to gene flow).
- petiole** In ants, the second abdominal segment (i.e., the segment immediately posterior to the alitrunk), which is constricted both anteriorly and posteriorly.
- phylogram** A phylogenetic tree; often used to refer specifically to a phylogenetic tree in which relative branch lengths are specified.
- pilosity** A covering of hair.
- pitfall trap** A steep-sided container sunk into the ground so that the opening is even with the surface, often containing a small amount of liquid preservative; used to trap ground-dwelling animals, which fall in and cannot escape.
- plicae** Folds, wrinkles, or pleats; in the ant proventriculus, the relatively narrow, longitudinal strips of thin, flexible cuticle that connect the broad, sclerotized, cuticular plates of the proventricular bulb.
- polydomy** The condition in which a single ant colony simultaneously has more than one nest.
- polymorphism** In social insects, the condition of having more than one caste within the same sex; in ants, the condition of having workers of distinctly different proportions (e.g., minima and maxima workers or soldiers).
- polyphyletic** Of or pertaining to a taxonomic group that contains members derived from two or more ancestral sources (i.e., that are not part of an immediate line of descent).
- postera**d Toward the posterior; on an insect body, directed toward the rear of the abdomen.
- postpetiole** The modified form of the third abdominal segment (i.e., the segment immediately posterior to the petiole) present in some ant groups, in which this segment is constricted posteriorly to form what is essentially a second petiole.
- predation** The consumption of one animal by another.
- presclerite** In ants, the distinctly differentiated anterior section of an abdominal sclerite, separated from the remainder of the sclerite by a ridge, constriction, or both.
- presternite** In ants, a presclerite derived from a sternite.
- pretergite** In ants, a presclerite derived from a tergite.
- proctodeum** The insect hindgut.
- promesonotum** The fused pronotum and mesonotum.
- pronotum** The dorsal part of the prothorax (thorax segment 1).
- propodeum (epinotum)** In apocritan Hymenoptera, the first abdominal segment, which has become fused with the thorax to form the alitrunk.
- prothorax** The anterior member of the three main subdivisions of the insect thorax, from which the front legs arise.
- proventriculus** In insects generally, the valve separating the crop (anteriorly) and the midgut (posteriorly); in ants, the proventriculus regulates whether food is consumed by the individual (allowed to pass into the midgut) or whether it is retained in the “social stomach” that consists of the combined crops of all colony members.
- queen** *See* gyne.
- relictual** Of or pertaining to persistent remnants of formerly widespread species or higher taxa currently restricted to certain isolated areas or habitats.

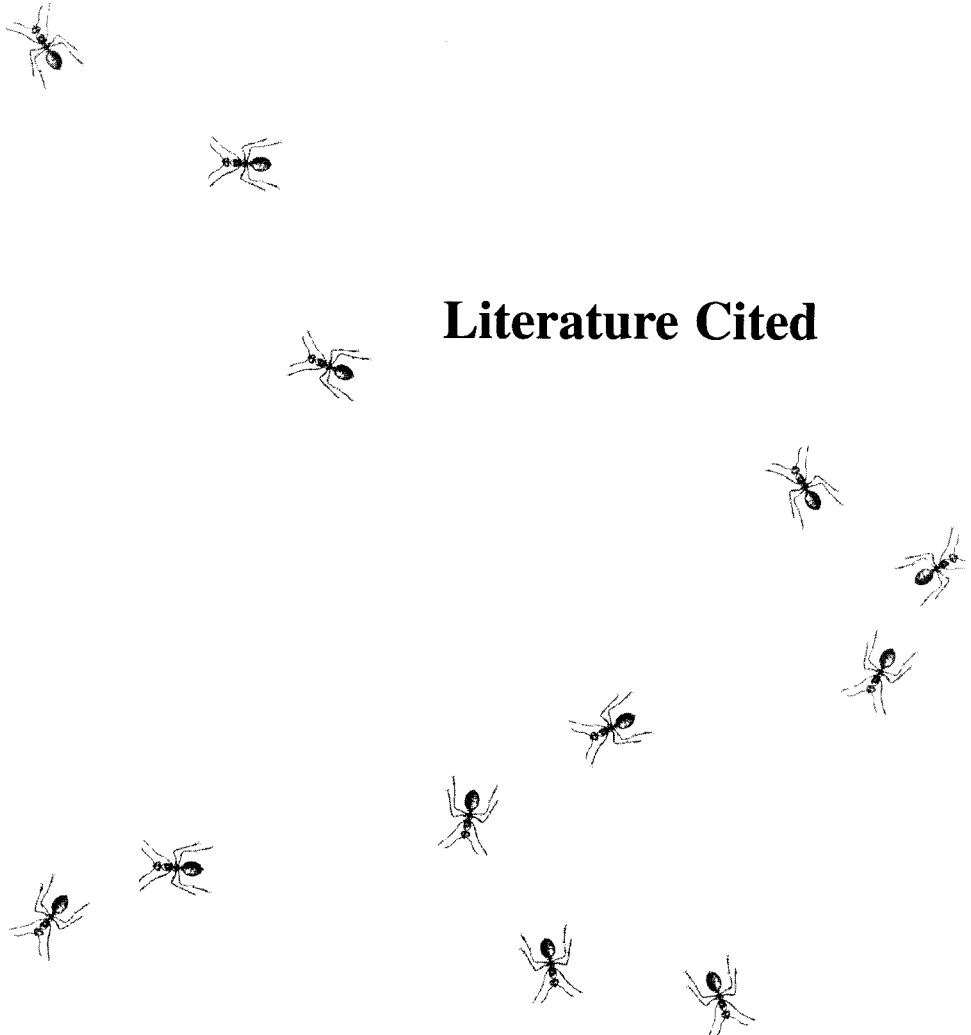
- remediation** In ecology, the act of returning a disturbed habitat to its natural state.
- replete** An individual ant worker that functions as a living reservoir, having a crop so distended with liquid food that the abdominal segments are pulled apart and the intersegmental membranes stretched tight.
- ruderal** Pertaining to or living among rubbish or debris, or inhabiting disturbed sites.
- scape** The basal antennal segment.
- sclerite** Any plate of the arthropod body wall bounded by membrane or by sutures.
- sclerotization** Hardening of cuticle to form the arthropod exoskeleton, as compared with the more flexible, nonsclerotized, membranous cuticular areas.
- slavemaking (slavery, dulosis)** The condition in which workers of a parasitic (slavemaking) ant species raid the nest of another species, capture brood (usually pupae), and rear them as enslaved nestmates.
- slavery** *See slavemaking*
- speciation** The process by which novel species arise.
- species richness** The absolute number of species in an ecological assemblage or community.
- speciose** Of or pertaining to a clade containing a relatively large number of species.
- sternite** *See sternum.*
- sternum (sternite)** The ventral (lower) sclerite of a segment.
- stomodeum** The insect foregut.
- subpetiolar process** An anteroventral projection on the petiole or its peduncle.
- sulcus** A groove with a purely functional (rather than developmental) origin.
- suprageneric** In taxonomy, of or pertaining to taxonomic ranks above the genus level (e.g., subtribe, tribe, subfamily, family).
- suture** On the insect integument, a groove marking the line of fusion of two developmentally distinct cuticular plates.
- symbiont** A member of a symbiosis.
- symbiosis** The living together of two organisms.
- synonym** In taxonomy, each of two or more scientific names of the same rank used to denote the same taxon.
- syntype** In taxonomy, each specimen of a type series from which neither a holotype nor a lectotype has been designated.
- systematics** The classification of living organisms into hierarchical groups emphasizing their phylogenetic relationships.
- taxon** A defined and named unit consisting of a group of related organisms (e.g., species, genus, tribe, subfamily, family).
- tentorial pits** The external depressions in the exoskeleton of the head at which corresponding to the roots of the tentorial arms.
- tentorium** The internal skeleton of the insect head. The points at which the tentorium is confluent with the exoskeleton are marked by the tentorial pits.
- tergite** *See tergum.*
- tergosternal fusion** A condition of the ant abdominal segments in which the tergite and sternite are continuously fused rather than connected by membrane, so that they are incapable of independent movement relative to each other, occurring in some or all of abdominal segments 2 (petiole) to 4.
- tergum (tergite)** The dorsal (upper) sclerite of a segment.
- termitarium** A nest, natural or artificial, or a colony of termites. Frequently used to refer specifically to nest structures constructed by termites.
- termitotheorous** Hunting and preying upon termites.
- thermophilic** Preferring warm temperatures.
- thermoregulation** The physiological processes, behavioral processes, or both by which an organism adjusts its body temperature to a level different from the ambient temperature.
- thorax** The second major subdivision of the insect body, bearing the legs and wings. The thorax is posterior to the head and anterior to the abdomen, and consists of three subdivisions, the prothorax, mesothorax, and metathorax.
- trachea** A spirally reinforced, elastic air tube that is the principal component of the insect respiratory system. A system of tracheae connects the outside atmosphere with the internal tissues and organs.
- tribe** The taxonomic rank above genus and below family (i.e., a group of genera).
- trophallaxis** The exchange of alimentary liquid among colony members and guest organisms.
- trophic** Pertaining to nutrition.
- trophic eggs** A nonviable egg laid by an ant queen to serve as food for other members of the colony, usually her offspring.
- vertex** The top of the insect head between the eyes and posterior to the frons.
- Winkler sack (Winkler bag, Winkler elector, Winkler extractor)** A device for collecting

small litter- or soil-dwelling arthropods, consisting of one or more bags constructed from cloth mesh. The mesh bags are filled with litter and suspended within an outer cloth enclosure, which includes a funnel that catches insects escaping through the mesh and directs them into a collecting receptacle,

usually filled with alcohol (see Figs. 9.4 and 9.5, pages 134 and 135).

xeric Having very little moisture; tolerating or adapted to dry conditions.

zoogeography The branch of biogeography dealing specifically with the distribution of animals.



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