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The Biology of the Silphidae (Coleoptera): A Coded Bibliography

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The Biology of the Silphidae (Coleoptera): A Coded Bibliography

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Introduction

The family limits for the Silphidae have been variously defined for many years and only in the last 20 years or so has a more restricted definition become generally accepted. It was decided to follow the recent delineation of the family Silphidae by Madge(1980), which includes only the traditional subfamilies Silphinae, Nicrophorinae and Agyrtinae. Excluded from the Silphidae are the Bathysciinae, Camiarinae, Catopinae, Coloninae and Leptininae, groups now relegated to the families Leiodidae or Leptinidae. As constituted by Madge (1980), the family Silphidae worldwide contains 70 genera and approximately 250 species.

Summary of Biology

Although members of the Silphidae are usually called "carrion beetles" (e.g. Dillon and Dillon, 1961), such a designation requires some conditional statements. Species in the subfamily Agyrtinae are poorly known and the meager biological information available suggests that they are found in the leaf litter and/or soil of forested habitats and consume carrion, dung, fungi, decaying vegetation and/or the organisms associated with such materials.

More is known of members of the Silphinae, a group which shows some diversity of food use. Species such as Blitophaga opaca, B. undata and Silpha bituberosa are primarily plant feeders, and can cause economically significant damage on crops such as spinach and beets (Martin, 1945). More typical, perhaps, are Silpha americana and S. novaboracensis, which feed on dipterous larvae found on carrion. Species specialized for preying on land

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snails include Ablattaria laevigata and Phosphuga subrotundata. One species, Xylodrepa quadripunctata, is an arboreal predator which feeds primarily on caterpillars. At one time it was introduced into the United States as a predator on the Gypsy Moth (Burgess and Crossman, 1929).

Members of the subfamily Nicrophorinae are the well known "burying" beetles which, besides interring vertebrate carcasses as food for their young, consume dipterous larvae, vertebrate flesh and dead arthropods (Pukowski, 1933).

The life history of members of the Silphinae is relatively simple. Mating usually occurs in the spring or early summer; eggs are laid shallowly in soil and hatch in 5 to 7 days. Larvae pass through three instars in 12 to 22 days, consuming the same types of food as adults. Pupation occurs in the soil in a pupal cell, with the prepupal/pupal stages lasting 9 to 30 days. Emergence of adults occurs in mid to late summer, usually after the previous year's adults have died, with subsequent hibernation as unmated adults (Balduf, 1935).

The life history of members of the Nicrophorinae illustrates the most advanced degree of parental care in Coleoptera and has been described in detail by Pukowski (1933) and discussed by Wilson (1971). A pair of adult beetles bury a vertebrate carcass or a portion thereof, form a food ball by masticating and manipulating it, lay eggs in a depression on top of the ball and feed the young by regurgitation in the early stages of development. Larvae are protected from predators by the adults. The larvae, although able to feed on the food ball when mature, have a high mortality in the absence of adults. Pupation occurs in the original chamber, at which time the adults either die or leave.

Coverage of Bibliography

An investigator who wishes to survey the literature for information on silphid biology presently has few options. Commonly used bibliographic files stored in computers, such as AGRICOLA, BIOSIS and CAB, do not contain material prior to 1969. The most recent bibliography of the world Silphidae is the Coleopterorum Catalogus of 1928 by M. H. Hatch. This work primarily covers taxonomy and distribution and contains few other types of citations. The most recent bibliography of silphids in the United States is contained in C. W. Leng's Catalogue of the Coleoptera of America, 1920, with supplements covering the period from 1920 to 1947. The Leng catalog also primarily covers taxonomy and distribution, with some biology references. Unfortunately, both the Leng and Hatch citations are abbreviated, without

titles, and are thus of reduced value. Fortunately a catalogue of American Silphidae north of Mexico is in press (Peck and Miller), which should bring the taxonomy and distribution literature on this topic up to date.

Given the coverage of the various catalogues, it was decided to include in this bibliography of Silphidae through 1981:

1. Publications in the United States containing information other than taxonomy and distribution.
2. Non-United States publications after 1927 containing any information on silphids.
3. Non-United States publications prior to 1928 containing information other than taxonomy and distribution.

Several exceptions to this coverage have been made to allow for inclusion of major reference works, such as catalogues, manuals for identification, general bibliographies, etc.

Because of the author's particular interests in behavior and ecology, certain subject areas may be more completely covered than others. A concerted effort was made to survey the literature involving ground beetles, inhabitants of nests and burrows, disease transmission, stomach analyses of vertebrate predators and medico-legal entomology. Taxonomic works and faunal lists generally were avoided; only those that either had identification keys or information on behavior-ecology were cited.

Format of Citations

The Harvard system of citation was employed with several refinements. Foreign language references are presented in both the original language and in English translation, with the exception of Russian and Chinese, which are listed only in English. An English summary contained in a foreign language publication is so indicated. If a reference is a book, the pages containing silphid information are listed.

Certain parenthetical information appears at the end of each citation. When three or fewer species are mentioned in the reference, they are listed, using the following generic abbreviations:

A = Ablattaria	N = Necrophorus
Aca = Acanthopsilus	P = Phosphuga
Ac = Aclypea	Pt = Pteroloma
Ag = Agyrtes	Pto = Ptomaphila
Ap = Apteroloma	S = Silpha
B = Blitophaga	T = Thanatophilus
Nc = Necrodes	X = Xylodrepa
Ne = Necrophilus	

If more than three species are mentioned, only the number of species is indicated. When species are not identified, they are then indicated as "Silphidae spp.". The information in each reference is additionally coded by subject according to the following scheme:

1. SYSTEMATICS. Taxonomy, geographic distribution, evolution, speciation, diagnostic aids to identification, fossils.
 - 1A. Keys for identification
 - 1B. Fossils
2. MORPHOLOGY. Descriptions of internal and external structures, histology, cytology, pathology, genetics, internal and external parasites.
 - 2A. Parasites
3. PHYSIOLOGY. Neural, metabolic, sensory processes; organ and system functions; biochemistry and toxicology.
4. LIFE HISTORY AND HABITS. Life cycle, phenology, growth and development, biological rhythms, feeding and oviposition habits.
 - 4A. Nests and burrows of vertebrates
 - 4B. Stomachs of vertebrate consumers
 - 4C. Human cadavers (medico-legal entomology)
 - 4D. Disease transmission
5. POPULATION PARAMETERS. Population dynamics and modeling; effects of biotic factors on natality, mortality, survivorship and fecundity.
6. BEHAVIOR. Descriptive and experimental; foraging, feeding, reproductive, antipredator; locomotory, orientation, communication.
7. ECOLOGY. Effect of physical environmental factors on species survival parameters.
8. METHODS. Sampling, trapping, rearing techniques, equipment.

A particular reference may be coded in several subject areas. Only those publications that have been personally examined are coded.

Index

Each citation is assigned a unique number. A subject index is presented at the end of the bibliographic listings with citations listed by number under the appropriate subject heading. Included in the bibliography are citations that were not obtainable but are listed because their titles indicated silphid information. These titles have not been assigned a number and thus have not been coded or included in the index.

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