

# NECROPHILY VS. NECROPHAGY<sup>1</sup>

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“The sanitary officers of the field are legion.” (Fabre, 1918).

The aptness of Fabre's statement becomes clearly evident upon examination of carrion found lying exposed in the open field. Scarcely has an animal succumbed before it is attacked by scavenger hordes of necrophilous insects, and in a relatively short interval of time it is reduced to an amorphous mat of bones, integument, and vestitures. Contrary to the opinion a few years past, however, a majority of the coleopterous insects found in association with carrion are not necrophagous. Their presence in and about decomposing flesh is attributable to their predatory habit of feeding on the seething abundance of dipterous larvae and other adult or immature insects for which carrion has attractant properties.

This paucity of exact knowledge concerning the insects inhabiting carrion is probably due to their lack of any great economic importance. Only a few species have been studied in detail. Members of the family Silphidae have received the most attention, particularly the species of the genus *Necrophorus*. Their peculiar habit of burying small dead animal bodies in crypts where the eggs are laid and the young mature with an assured food supply has attracted a number of observers. The family Staphylinidae has been almost entirely neglected.

The persistent error in entomological literature revolves about a confusion of habits with habitat. In his delimitation of the coleopterous habitats Hatch (1925) used the suffix “bious” to indicate the presence of a species in a particular environs without regard to whether or not it procures food in that environment. Thus, he designated carrion as a necrobious habitat and categorized the families in accordance with the state of the carrion at the time representatives of those families normally appear. The Histeridae, the Staphylinidae, and the Silphidae are found in most abundance around fresh carrion, whereas the Dermestidae and Trogidae are found primarily around dry carrion.

With regard to necrobious forms, at least, the epitaph “short-winged scavengers” is not generally applicable to the Staphylinidae (Voris, 1934). Scavengerism has not been observed in many cases for Staphylinids, nor has the eating of carrion flesh in any stage of decay been determined as a regular occurrence. Actually, most of the coleopterous insects found in carrion environs are not carrion eaters. They are found in a necrobious habitat, hence, are necrophilous. But they are not normally necrophagous.

It has been generally assumed that beetles found in association with carrion are necrophagous, and this concept has been passed along in both general and specific references. The former group includes such widely used texts as Frost (1942), Folsom (1922), Comstock (1940), and Matheson (1944). The latter is exemplified by the works of Jaques (1915) and Herms (1907), who stated that these coleopterous insects were the responsible agents in getting rid of the quantity of naturally decimated fish washed up on lake shores. It seems probable now that the majority of the species they listed are more of a hindrance to the reduction of organic beach debris, since most coleopterous carrion insects actually prey on the necrophagous dipterous larvae found about decay.

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FOOD HABITS OF *CREOPHILUS MAXILLOSUS* (LINNE)

*Creophilus maxillosus* is conspicuously larger than the majority of beetles found around carrion. It can be distinguished easily from other beetles approximating its size by its Staphylinid characteristic of abbreviated elytra. No other Staphylinids of comparable size are found in such a habitat. Small vertebrate carcasses were employed as lures in obtaining specimens for the following observations.

*Creophilus maxillosus* characteristically demonstrates entomophagus predatism. Despite its occurrence around carrion, it is not normally necrophagus but preys mainly on the dipterous larvae which mature in decomposing flesh. As stated before, this constitutes a departure from the general concept that coleopterous insects found in association with carrion are strictly carrion eaters.

Captive specimens also accepted live ants, termites, earthworms, and adult flies, and one was observed attempting to pierce the hard exoskeleton of *Trox suberosus*. Just how adept they are at capturing such live prey in the field and how frequently it is attempted was not determined, but evidence seemed to indicate that they might do so whenever such prey was encountered in situations from which escape was not particularly easy. On two occasions adult beetles crawling on the outer surface of a carcass were observed attempting attacks on adult Calliphoridae. In both instances, however, the flies escaped easily by flight. Since the beetles usually enter some aperture of the body and work inside the abdominal or head cavities, it does not seem improbable that they might frequently capture flies entrapped by folds of flesh or viscera in such enclosures.

Flies released in the cages where the beetles were captive generally rested on the sides or top of the cages where they were out of reach and remained unmolested. When they were rendered semi-immobile by a removal of one or both wings and several legs so that they could neither fly nor take refuge on the sides of the cage, they were eventually caught and consumed by the beetles.

The beetles indicated no particular concern over the presence of the flies until they chanced to come across them on the bottom of the cage. When the flies were disturbed by the passing of a beetle, they buzzed noisily and scooted clumsily about on the substratum. The beetles began an immediate attack. They rushed forward and seized the bodies of the flies wherever their mandibles first contacted. Usually they rolled over on their sides or onto their backs and held the flies before them, firmly grasped in their mesothoracic and metathoracic legs. The prothoracic legs were utilized in maneuvering the food toward the mouth parts. The crunching of the exoskeleton was clearly audible when the beetles first punctured their prey and began tearing it apart. Only the soft inner portions were consumed.

The major diet noted in the field as well as in the laboratory consisted of maggots. When the maggots were introduced in the cages of specimens which had not been fed for some time, the beetles became obviously excited and began searching about over the surface of the cage with their antennae quivering rapidly. This suggested a response to an olfactory stimulus. Within a very few minutes the beetles would collect about the supply of maggots and would begin selecting and devouring their prey. Often as many as ten or twelve maggots were eaten in rapid succession.

The adult beetles also demonstrated a remarkable degree of cannibalism. They were quick to pursue and eat the larvae of their own species. The smaller first and second instar larvae attempted escape by burrowing into the loose dirt of the cages, but they seldom succeeded in gaining their freedom. Only the mature third instar larvae, which attained a maximum length of 25 millimeters, were able to ward off the adults with any degree of success. They snapped at the adults ferociously with their mandibles and often discouraged attacks. Sometimes

two beetles would seize the same larva, pulling and tugging at it until it was torn into two portions or until one succeeded in pulling the larva away from its competitor.

All parts of the first two instar larvae were eaten except the head capsules and exoskeletons of the thoraxes. The larger third instar larvae were punctured and the internal contents sucked out.

In addition to consuming the larvae of their own species, the adults attacked one another. They often engaged in fights over the same morsel of food and emerged from such fights with severed antennal segments, tarsi, or entire legs. Such fights or repeated battering against the sides of the cages in escape attempts weakened some of the specimens so that they were no longer able to resist the attacks of their companions. These hapless individuals were pounced upon by one or more of the other adults and dismembered as were the flies. The soft, non-sclerotized portions were eaten. This high degree of cannibalism was also noted by Abbott (1937; 1938).

Although the adults most commonly exhibited predatism and cannibalism, they could also be induced to eat carrion in the absence of their preferred food. If other food was provided, they fed on various dead animals placed in the cages; for example, small fish, lizards, bits of decomposing rabbits and rats, and small pieces of beef. Their liking for such flesh seemed to diminish as the flesh became more decomposed, and they never displayed an immediate enthusiasm for it but only attacked it after a thorough search of the cage yielded food of no other sort. They climbed about over the flesh testing it here and there with their mouth parts before selecting a spot into which they would sink their mandibles. Rau (1922) determined that the specimens he had in captivity preferred raw to cooked meat but would eat cooked meat to sustain life. When bits of flesh infested with maggots were placed in the cages, the beetles consumed the maggots crawling about without attempting to eat the decaying meat. Likewise, adults which were busily consuming carrion would abandon it in preference for dipterous larvae introduced nearby.

Maggots being consumed by the beetles were seized forcefully in their mandibles which were moved pincerlike until the cuticle of the prey was broken or punctured. While feeding, the beetles stood on their mesothoracic and metathoracic legs, using their prothoracic legs to help hold the maggot and to feed it through the mouth parts. Once the cuticle was ruptured, the maggot was fed back and forth through the mandibles and maxillae, which squeezed and mashed it until all the soft parts were extracted and nothing remained but the exoskeletal portions. If the beetle was a particularly small specimen or the maggot large and vigorous, the position assumed was often like that attained in the struggles with flies; that is, the beetle would roll over on its side or on its back holding the maggot before it. In such a position, the prey could not get traction on the substratum, and its struggling was in vain.

Examination of the feeding process under a binocular microscope revealed that the beetles secreted a brownish fluid on their food, and portions of exposed flesh on which the beetles had been feeding became discolored and contrasted from their surroundings. This suggested an extra-intestinal digestion such as Pukowski (1933) reported for species of *Necrophorus* and a means of partially breaking down the food before ingestion.

#### OBSERVATIONS ON OTHER SPECIES

Clark (1895) recognized that there could be a categorical classification of carrion inhabiting beetles with regard to their food habits and that some species are almost wholly concerned with dipterous larvae encountered in carrion invirons. For example, he classified *Creophilus maxillosus* as primarily a feeder on dipterous

larvae. Various other observations on carrion species in general have supported this early report. Selous (1911) observed that a number of the so-called carrion beetles are not strictly necrophagous at all. Davis (1915) noted the species *Silpha surinamensis* and *Creophilus villosus* consuming fly maggots at a dead porcupine carcass. Steele (1927) tested a number of species in the genera *Silpha* and *Necrophorus* of the family Silphidae to determine their food preferences. From his laboratory experiments he determined a decided preference for dipterous larvae. Other investigators have supplemented and further verified these observations on the Silphidae. Excellent summaries of these have been presented by Voris (1934) and Balduf (1935).

## SUMMARY

Necrophily is often confused with necrophagy, and many reports indicate that the majority of coleopterous insects found in association with carrion are predatory, feeding on the dipterous larvae common to carrion, and that slightly decomposed carrion is preferred to that which is strongly decomposed. *Creophilus maxillosus* demonstrates a high degree of cannibalism, attacking and devouring both mature and immature forms. Similar observations have been made on a number of species in the family Silphidae.

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