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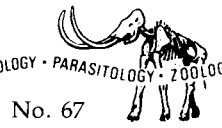
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A Matter of Taste OR The Natural History of Carrion Beetles

by Brett C. Ratcliffe
 Curator of Insects, University of Nebraska State Museum

"One man's meat is another man's poison"—Popular saying
 "Bon appetit"—Julia Child

Variety is the Spice of Life

Beetles that eat writhing maggots and the decaying flesh and putrefaction of dead animals . . . what could be more macabre, repulsive, and in poor taste? [Well, possibly beetles that eat feces and have a rolling good time doing it (see my January *Museum Notes*).] Carrion beetles are an important part of a vast host of scavengers that are responsible for breaking down and recycling back into the ecosystem the basic elements locked inside each one of us. If it were not for these industrious scavenger beetles, we might all be surrounded by the partially decayed and mummified remains of wildlife and domestic livestock that die each year.

The decay process is an efficient and natural system whereby the raw materials of dead organisms are returned directly into the energy budgets of living organisms which consume these raw materials or into the soil where the decay occurs. Were it not for the life-giving nutrients supplied by the bodies of dead animals, many beautiful and interesting scavengers would no longer grace our planet, and we would all be the poorer for it.

It is a truism indeed that what passes for food to some is absolutely repulsive to others. This is due, in part, to a by-product of culture, familiarity, and available food resources because, after all, various foods are composed of the same basic set of proteins, fats, and carbohydrates. Fortunately, carrion beetles have no culture, and they dig in (literally) with a necessary haste that reflects a competitive principle of "better to eat quickly than to let the flies have it."

Have you ever wondered what happens to an animal's body after it has died? The clean, white skeletal remains are not simply due to the activities of the wind and rain alone. Once an animal dies, its remains are ravenously set upon by a diverse array of food-seeking predators and scavengers that are attracted by the ripe odors of decay. Assuming that vertebrate scavengers such as coyotes do not find and consume the carcass first while it is still fresh, it will become a valuable food resource for a reasonably orderly progression of bacteria and fungi (the microconsumers) and insects (the macroconsumers).

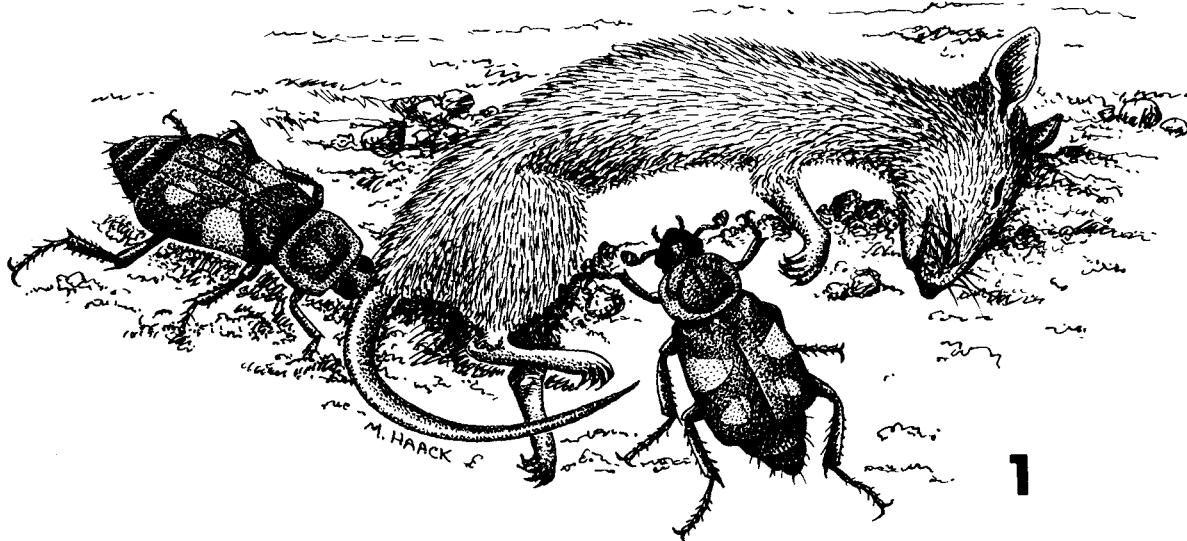


Fig. 1, silphid beetles (*Nicrophorus* species) burying a dead rodent.

The progression of insect diversity is somewhat predictable because certain insects are attracted to a cadaver only after certain levels of decay have occurred. These various stages of decay (and associated fauna) are influenced by season, weather, size of carcass, and activity of the carrion-feeding organisms. This food resource partitioning reduces competition among the insect scavengers by spacing them out through time and thus enables increased use of a limited resource by more organisms. It is not all altruistic sharing, however, as a great many of the eaters get eaten.

Eat, Drink, and Be Merry

Carrion beetles is the term applied, in the strict sense, to a single family of beetles, the Silphidae or silphids. Silphids are also known as burying beetles or sexton beetles, based on the behavioral adaptation of some species to inter small vertebrates in the ground (Fig. 1). In a broader sense, the term carrion beetles applies to a number of beetles in various families that are frequently found in a close feeding association with vertebrate remains: Staphylinidae (rove beetles), Histeridae (hister beetles), Dermestidae (skin beetles), and numerous members of the Scarabaeidae (scarabs).

Most silphids occur in north temperate regions partially because they are simply "out-competed" by more efficient carrion-feeding ants and vultures in the tropics. The majority of silphids are scavengers on carrion, dung, and decaying plant materials, although some prey on snails. A few eyeless forms have been reported from caves where they are scavengers, occasionally feeding on bat feces. The larvae (Figs. 4-6) are elongated, tapering, and flattened. Dorsal-ventral flattening is advantageous for moving and living under things such as bark or stones and, in this case, a body.

The two principal genera of silphids are *Silpha* (Fig. 2) and *Nicrophorus* (Fig. 3). *Silpha* are flattened, generally dark in color, and feed beneath a carcass. *Nicrophorus*, on

the other hand, are more cylindrical and usually colored with bright orange cross bands on the wing covers. The bright bands of *Nicrophorus* may warn other insect-eating animals during the day. The warning coloration advertises to a potential predator that this beetle is intensely unsavory because it tastes like what it eats: putrefaction. On a more practical level, the beetle may also harbor extremely toxic (to a vertebrate predator) bacteria such as *Clostridium botulinum*, *C. perfringens*, *Salmonella typhi*, and others which are acquired from a rotting carcass.

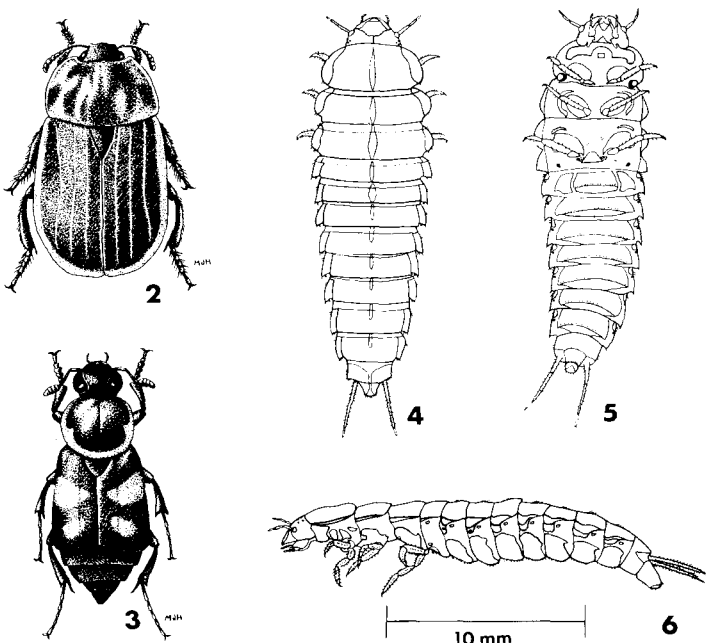
Many species of both genera seem to be active at twilight or at night, which reduces competition from numerous flies which are inactive at night. In the course of just a few days, a carcass may become an incredible seething mass of fly larvae (generally unfit for use by *Nicrophorus*) if it cannot be spirited away and buried during darkness.

Nicrophorus are renowned for their habit of burying small vertebrate carcasses several inches beneath the surface of the soil. Milne and Milne (1944) observed the following scenario for burying beetles at carrion: On a warm day or night, *Nicrophorus* can find a freshly killed mouse within an hour, although more normally they are attracted two to five days subsequent to death. Silphid adults probably notice the foul odor of decay (who wouldn't) and locate the carcass using their sense of smell.

They first examine the body and test the size of the carcass by trying to move it. Less interest seems to be shown if a carcass is too large for burial. If, after an exploration of the surrounding soil, the ground beneath the carcass is found to be too hard or compacted for immediate burial, a pair of beetles working together may transport a full grown mouse or shrew three to four feet per hour for as much as two to three hours until a suitably soft substrate is found. A carcass is moved by these beetles which crawl beneath it and lift as best they can. It remains unclear how a pair of beetles can "agree" on a burial site or how they are able to keep the carcass moving so uniformly in one direction.

The soil of the burial site is loosened by "plowing" through it. The head of the beetle is pressed into the earth and then forced forward much like a bulldozer; earth is forced upwards and crumbles. Roots are forced aside or chewed through, but if these are too numerous a new site may be chosen. Beetles then plow under the carrion from one side to the other, and on each emergence at the side of the body a substantial amount of earth is forced out which accumulates in a pile around the cadaver. Gradually, the soil from beneath the carcass is displaced to the side, and the carcass settles into the ground to be eventually covered with soil. The burial process is normally completed within one to several hours, but the beetles may work for several days if obstructions slow the work. In some instances, two or three pairs of beetles (occasionally of different species) may work together to bury a carcass, whereas in other instances the original pair of beetles will chase away or even fight off interlopers in a display of territorial imperative.

After the burial, the beetles make a chamber adjacent to the carrion, where they remain for some time feeding on the decomposing body and on any fly larvae that may have been placed there by adult flies during interment. Actually, a great many silphids prey on maggots (Fig. 7), and maggots are preferred over carrion by some species which consume these fly larvae in prodigious numbers. My own studies have shown this to be particularly true when silphids are visiting a carcass too large for burial. The beetles also lay eggs at this time on or near the buried remains,



Figs. 2-6, silphid beetles. Fig. 2, *Silpha* sp.; Fig. 3, *Nicrophorus* sp.; Figs. 4-6, larva of *Necrodes surinamensis*.

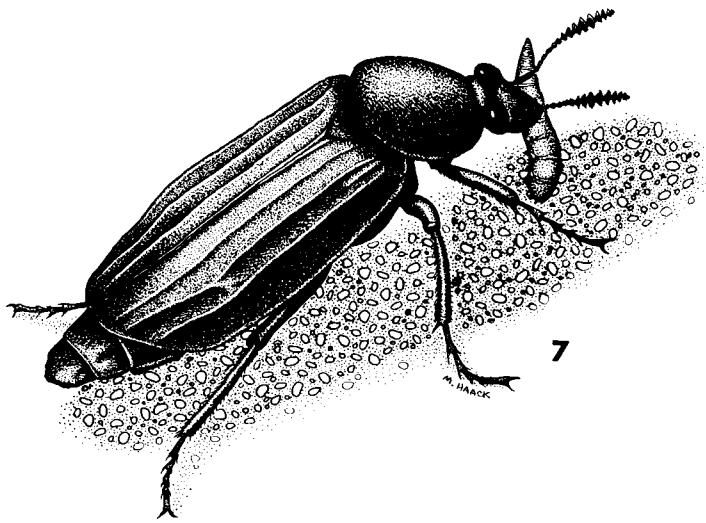


Fig. 7, a silphid, *Necrodes surinamensis*, eating a fly larva.

and the developing silphid larvae appear five to seven days after mated pairs of adults. The young stay with the carrion for three to four weeks where they feed on the body tissues which are decomposing to a slate-gray, pasty mass—baby food, if you will.

The burial of their food source is important to these beetles and their young because it effectively removes the food from the arena of intense competition by maggots and other carrion-feeding insects. *Nicrophorus* are unique among silphids because they are the only ones attempting to break the cycle of competition at a food source. At the same time they provide their larvae with a much safer underground environment in which to develop that is relatively free from predators.

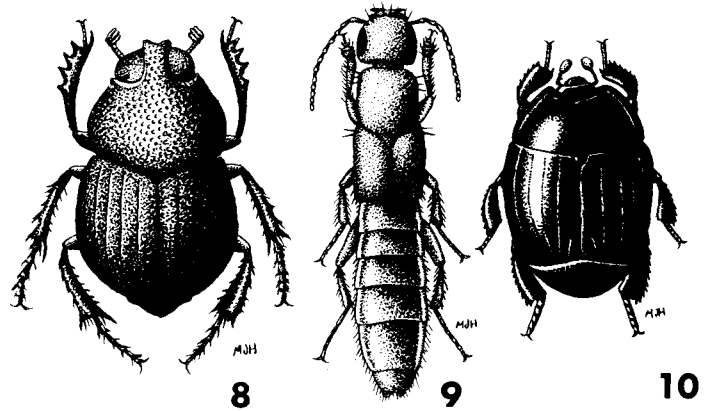
The Third Estate

While silphids are usually considered the dominant form of carrion beetle, other types of beetles are also commonly found at carrion. Several genera of carrion-feeding scarabs (Scarabaeidae) (Fig. 8) frequent decomposing cadavers during the earlier stages of decay. This is especially true in the tropical Americas where necrophagy is well developed in the Scarabaeidae, particularly in forested areas where large herbivores (and hence, dung) do not occur. An evolutionarily adaptive shift has occurred in forested regions in that the more normal habit of dung feeding by many of these scarabs has been replaced by that of feeding on carrion.

The rove beetles (Staphylinidae) (Fig. 9) are nearly always present at carrion. They are not scavengers and do not feed on the carcass itself, but instead hunt for maggots and other soft bodied insects on which to feed. Rove beetles are long and slender with very short wing covers which expose most of the abdomen. With their sickle-shaped mandibles and swift movements, they are the predatory tigers in the busy world of a carcass in decay. The color pattern of many species gives them a wasp-like appearance, and their penchant for curling the abdomen upwards when alarmed heightens this effect. Their wasp-like mimicry and ability to emit foul or caustic odors

frequently protect them from other large, insect-eating predators.

Hister beetles (Histeridae) (Fig. 10) that visit carrion are small, compact beetles which eat carrion-feeding insects, primarily maggots. Adult histerids are very adept at feigning death when alarmed by drawing in all their appendages and lying motionless. This enables them to usually avoid being seen and subsequently eaten by larger insect-feeding animals. As we can see, there seem to be as many insects consuming their near relatives at carrion as there are insects actually feeding on the carrion itself. Not only is a rotting carcass a highly valuable food resource for scavengers, it is also a paradise for predators.



Figs. 8-10, beetles commonly found at a carcass in active decay. Fig. 8, scarab; Fig. 9, rove beetle; Fig. 10, hister beetle.

Waste Not, Want Not

During the decay cycle virtually nothing is wasted as there always seems to be some consumer ready to eat something. And so it is even after a carcass has been stripped of flesh, viscera, and body fluids, and nothing remains but skin, bones, connective tissue, and a few shreds of meat here and there. The primary consumers (flesh-eating beetles and flies, insect-eating beetles) have completed their frenzied feasting and reproducing. What is left of the cadaver is, by previous comparison, still and strangely quiet. It is during this time that the dermestids and trogids begin to feed on the remains of the remains.

Skin beetles (Dermestidae) (Fig. 11) are small, drab-colored scavenger beetles. Many species feed on the dried skin, fur, and feathers of vertebrate cadavers where the hairy larvae are commonly found scraping and gnawing at the last vestiges of what remains edible at the carcass. These beetles are, in fact, so efficient at cleaning skeletons that they are routinely kept in artificial colonies to clean the bones of museum specimens. Unfortunately, other species of dermestids are serious museum pests and eat insect collections (including themselves). Others are common household pests feeding on a variety of stored products and items of animal origin.

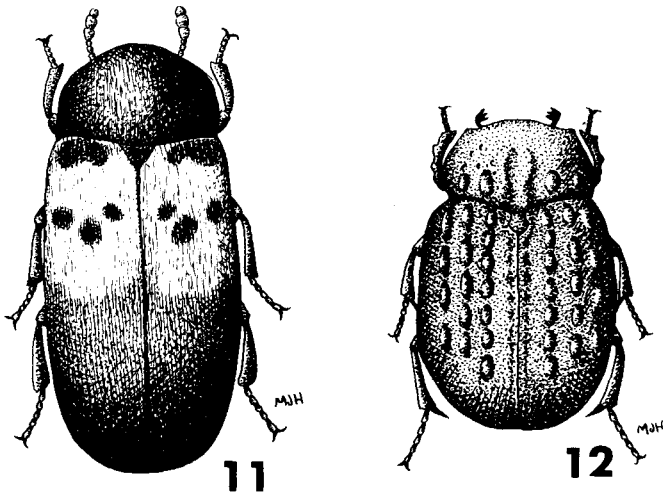
Trox species (Scarabaeidae) (Fig. 12) are scarab beetles that resemble small clumps of dirt because of their dirty gray or black color, lumpy shape, and frequent presence of encrustations and debris adhering to their bodies. Trogids, like hister beetles, are very adept at feigning death when alarmed and so become extremely difficult to see because of their cryptic form and lack of movement. They too, like dermestids, are found scavenging in old,

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Figs. 11-12, beetles commonly found at the dry remains of a carcass. Fig. 11, dermestid beetle; Fig. 12, trogid beetle.

dry animal carcasses where the adults and larvae feed on anything that is left except bone. They seem to fulfill much the same role as dermestid beetles. Many other trogids live in mammal burrows or bird nests where they feed on fur, feathers, and other animal derived debris.

It behooves us all, I think, to keep in perspective the life-styles of creatures that are very unfamiliar to us. For example, we may judge too quickly that carrion beetles are repulsive and vile things because of their habits. But remember what our environment would probably look like without this cleaning up and recycling—something out of a grade B horror movie. Man has always been self-confidently egocentric about how the world should be and his role in it, but to a mosquito, man is merely something to eat. As Kuan-Tzu once said, "If you plan for one year, plant rice. If you plan for ten years, plant trees. If you plan for one hundred years, educate mankind." *Bon appetit!*

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