NATURALIST AT LARGE

From Gravedigger to Assassin

How the habits of one species of burying beetle have changed

By Stephen T. Trumbo

Female burying beetle (Nicrophorus pustulatus) *attends to five offspring inside a parasitized snake egg.*

Your everyday burying beetle is an upstanding ecological citizen, a consummate recycler. It will clear the fields and woods of small dead rodents and songbirds, turning those nutrients into new life. Usually the clearing process involves digging beneath a small carcass so that it sinks below the soil surface—hence the common name of "burying" beetles for all members of the genus *Nicrophorus*. Interring the tiny corpse—baby food for larvae soon to come—helps to get the prize out of sight and out of smell of scavengers, carrion flies, and competing burying beetles.

Sounds benign, right? I thought so for the first eighteen years I studied the habits of these creatures. Then I realized that there was at least one species that had more sinister aims: to inhabit, consume, and eventually kill a vertebrate host.

In 2000, herpetologists Gabriel Blouin-Demers and Patrick J. Weatherhead of Carleton University in Ottawa were monitoring nests of black rat snakes (*Elaphe obsoleta*). They discovered larvae of burying beetles inside hollow snake eggs, whose contents appeared to have been devoured. Burying beetle adults were nearby, raising suspicions. Had the beetles and larvae chanced upon broken snake eggs and, being meat eaters, scavenged the contents? Or had the parent beetles sought out viable snake eggs, deposited their spawn nearby, and then opened the eggs so their young could crawl inside and gorge? Blouin-Demers and Weatherhead suspected the latter. A number of black rat snake and fox snake nests turned up the same species of burying beetle, *Nicrophorus pustulatus,* hinting that the relationship was not merely casual.

What Blouin-Demers and Weatherhead were suggesting was very un-burying beetle-like behavior. Had a species of the beetles begun to seek out living flesh? When I came across the report of those observations, I was intrigued by a possible case study in evolutionary transition—and one with obvious implications for the conservation of reptiles.

Burying beetles work in mated pairs from late spring to early fall. Typically, a male and female will move a small carcass underground and then diligently remove any hair or feathers, round the resource into a ball, and preserve it with antibiotic secretions from their hindgut. The female lays between twenty and forty eggs in the surrounding soil. After only a few days the eggs hatch, and the emerging larvae crawl to the nest to be cared for by their parents, which first nourish them with regurgitated food. That pattern has been observed in the field for every one of the burying beetle species studied except *N. pustulatus*. Thousands of *N. pustulatus* individuals have been trapped at black lights or feeding on blowfly-ridden carcasses (the main fare for adults) throughout their range, over the eastern half of North America from Nova Scotia to Florida. Yet no one had caught the enigmatic species preparing a small carcass for reproduction in the field. Snake eggs now seemed the place to look.

I wanted to test the idea that *N. pustulatus* had made an evolutionary shift from breeding on carrion to breeding on snake eggs. For starters, herpetologist Neil B. Ford at the University of Texas at Tyler supplied my animal-behavior laboratory with eggs from brown house snakes. A graduate student, Garrison Smith (who was working in my lab at the University of Connecticut while getting his degree from the University of Arizona), began by presenting burying beetles with from one to five snake eggs. He offered the eggs to male–female pairs of *N. pustulatus*, as well as to pairs from two related species, *N. orbicollis* and *N. defodiens*. Those other burying beetles ignored any and all intact snake eggs, oblivious to potential resources inside.

However, pairs of *N. pustulatus* clearly became excited in the presence of snake eggs. The beetles intently crawled over the eggs, and would even open a small hole in the shell to sample the contents. Within twelve hours the female would lay her own eggs nearby, forgoing the elaborate burying and preparation behaviors that were adaptations for working with a carcass. When the larvae hatched, they instinctively crawled inside a snake egg (opened for them ahead of time by the adults) and began to feed. The adults attentively stayed near, producing a soft chirping sound that may be a signal to the young.

Smith also found that parents adjust the size of their brood to match the number of snake eggs by killing some of their offspring. Other burying beetles will make the same kind of adjustment when resources are limited, ensuring that surviving offspring will have enough to eat.

The adaptation to feed on snake eggs makes *N. pustulatus* a type of parasite known as a "parasitoid." Parasitoids are relatively large with respect to their host; they are only parasitic as larvae, live only within a single host, and eventually kill the host. So marked a change, from breeding on small vertebrate carcasses to parasitizing viable snake eggs, seems almost too great an evolutionary leap. But *N. pustulatus* is clearly descended from more conventional burying beetles. Its body form and DNA point to its ancestry within burying beetle stock, as shown by entomologist Derek S. Sikes, now at the University of Alaska Museum of the North.

The behavior of *N. pustulatus* also provides evidence of its ancestry. If you present it with a mouse carcass in the laboratory, it will demonstrate burying, rounding, and hair-removing habits—though the hair is not always completely removed, and the carcass is not formed into as tight a ball as it is by other burying beetle species, in which natural selection continues to mold their skills. In fact, *N. pustulatus* has retained many similarities to its fellow buriers. In addition to regulating the size of its brood and regurgitating food to its young, it defends them against insect predators, and the male adopts a handstand posture when emitting a sex pheromone to attract the female—all characteristic of the genus.

One novel adaptation of *N. pustulatus* may be that when it flies in search of a resource on which to breed, it no longer responds to the odor of decaying flesh. Instead, it uses a different set of cues, still unknown, to locate snake nests. Understanding those cues is essential to knowing what egg-laying animals are susceptible to parasitism by *N. pustulatus*.

Adult burying beetle, N. orbicollis, *regurgitates to a larvae atop a mouse, whose death was unrelated to the beetles.*

PHOTOS: STEPHEN T. TRUMBO

Dead mouse—before and after being prepared by N. orbicollis. *That work is typical of burying beetles, though* N. pustulatus *will not round a carcass as neatly.*

The black rat snake that we know is being victimized is listed as a threatened species in several U.S. states and Canadian provinces. In six of the first seven snake nests Blouin-Demers and Weatherhead checked, they found evidence of marauding—with up to 100 percent of eggs affected. And, as black rat snakes can nest communally, a large number of eggs can be vulnerable at one location. Up to the challenge, *N. pustulatus* produces as many as 200 young at a time, five times the fecundity of a typical burying beetle.

Other egg-laying reptiles on the federal list of endangered and threatened species may be at risk. In the laboratory *N. pustulatus* will parasitize eggs of turtles, but this has not been looked for yet in the field. Because its parasitic habits were but recently discovered, and reptile nests are not easily inspected, there could be many more species affected. (Randolf F. Lauff of St. Francis Xavier University in Nova Scotia has even found evidence that these beetles are making their way into tree canopies, perhaps in search of abandoned bird eggs.) Although loss of habitat is the primary threat pushing several North American reptiles toward the brink of extinction, an oddball burying beetle could well roll them over the edge.

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