The Underground Life of the Trinidad Worm-Lizard *Amphisbaena alba*

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AMPHISBAENIANS, popularly known as worm-lizards (or in Trinidad, two-headed snakes), belong to the reptile order Squamata where they share an equivalent status with snakes and lizards. There are about 140 species, found mainly in the Americas and Africa, and all are blind burrowing animals. Many posses keel- or shovel-snouted heads to facilitate movement through soils and, although very little is known of their ecology, most appear to exploit the properties of tunnel systems, feeding on a variety of animal prey species such as worms and arthropods.

Two amphisbaenians, *Amphisbaena alba* and *A. fuliginosa*, occur on the island of Trinidad and also on the mainland of South America. They are unlikely to be confused as adults since *A.. alba* is up to 70 cm in length, creamy white, pink or red-brown in colour, whereas *A. fuliginosa* is usually no longer than 30 cm and is strikingly blotched in a random black and white pattern.

Amphisbaena alba, the subject of this communication, is one of the world's largest worm-lizards and, though much feared in Trinidad, is entirely without vemon. However, it does possess powerful jaws and will bite if carelessly handled although only able to inflict superficial wounds. Despite its large size and uniform colouration it is rarely seen in Trinidad: it can occasionally be glimpsed crossing roads or jungle paths, particularly during the wet season, and its unusual mode of progression makes it instantly recognizable. It does not wriggle; instead, waves of muscle contraction pass along the body enabling it to progress in a straight line. This type of rectilinear locomotion is unique amongst the vertebrates and allows amphisbaenians to move backwards or forwards with equal facility. If annoyed or alarmed the head and tail are held aloft. Since both are bluntly rounded and the eyes are scarcely developed, this behaviour is thought to confuse an aggressor into attacking the "wrong end" so that the head can then be used in defence.

A search of the scientific literature revealed that virtually nothing is known of the habits of *A. alha,* apart from two very obscure references to its possible association with the nests of leaf-cutting (bachac) ants. Subsequent conversation with Trinidadians well acquainted with the jungle confirmed this fact and accordingly, in 1980, we began a study of this animal by (in the first instance) attempting to dig it out of ant nests.

The ant in question, *Atta cephalotes,* builds large nests, up to 30 m across, that appear in the jungle as conspicuous mounds of excavated earth often covered by defoliated vegetation. The ants cut leaves of forest plants into fragments and take them into the nest where they use them to make a compost upon which a special fungus is cultivated; the fungus is used by the ants as their sole food source. Fungus cultivation is carried out in numerous underground chambers interconnected by wide passageways (a large nest can contain several hundred chambers, each as big as a football) and, as the compost becomes exhausted it is cut up and stored in even larger underground chambers which serve as refuse dumps.

An early dig (by hand) of an *Atta* nest in the Maracas Valley produced a clear and unmistakable sighting of a large amphisbaenian travelling rapidly along a gallery beyond a fungus chamber which had just collapsed. Although we failed to catch it, it seemed that the story of an association with ants was true. In a subsequent excavation in the Arima Valley, this time with an overloader driven by Krishna Ramdial of the SRC Quarry, Blanchiseusse Road, another large specimen was dug out unharmed. In all, seven excavations have yielded 3 worm-lizards.

These findings raise an obvious question; simply put, What is *A. alba* doing in ant nests? Is it feeding on ants and their grubs? To answer these questions we began a careful analysis of the intestinal contents, or faeces, of several amphisbaenians derived from a variety of sources (road kills, excavated specimens, and preserved museum specimens). Ants are frequently found in the intestines of these animals (in 7 out of 11 specimens) but usually in very low numbers and they do not seem to be a significant food item. Beetles and their larvae, by contrast, were quite commonly found and these comprise an important part of their diet.

Further research showed that certain of the beetles found in the intestines of *A. alba* (most notably the three-horned rhinoceros beetle *Coelosis biloba.* L.) only occur in the nests of leaf-cutting ants where they apparently feed on the spent compost stored in the underground refuse chambers. Our evidence indicates that the worm-lizbrds inhabit ant nests because these sites support this protected food source of beetles and their larvae. The ants themselves appear to be consumed only accidentally by the worm-lizards. Other surface-dwelling beetles are also preyed upon and we surmise that the animals also occasionally forage above ground.

The eyes of *Amphisbaena alba* are vestigial and the question of how the worm-lizard locates ant nests was solved by an interesting series of experiments. In 1983 three specimens were caught whilst on the surface in a cocoa plantation in the Maracas Valley and they were kept in captivity for some months in order to study their behaviour: they readily adapt to captivity and can be maintained on a diet of liver. We were able to show that the lizards could follow the foraging trails of ants by using odours liberated by the ants themselves.

The worker ants of *Atta cephalotes* do not forage in the jungle at random but follow well defined trails, which are normally kept free of debris, to specific feeding sites. Ants lay down a chemical trail, secreted from special glands in the tail, which is followed and reinforced by other workers. In the dry season ants forage mainly at night and by day the trails, are deserted, although the chemical trail apparently still persists. We were able to show, quite conclusively, that worm-lizards placed near to such trails could detect chemical scent using their tongues and were able unerringly to follow the ant trails. They could even follow the trails by day when ants were absent. Simulated trails, made by scraping a cutlass through forest floor litter, were not followed and the worm-lizards sought immediate escape. Ant foraging trails radiate out from large *Atta* nests for distances of several hundred metres and we imagine that worm-lizards move from nest to nest using these chemical highways.

Clearly much work remains to be done on the nature of the interaction between *A. alba* and *Atta cephalotes* but we have been able to uncover a further piece of evidence which suggests that the association is regular. *A. alba* is commonly infected with an arthropod parasitic lungworm called *Raillietiella gigliolii.* By monitoring the faeces of worm-lizards for parasite eggs we have shown that the parasite produces very few eggs; a mere 100 per parasite per day. Yet over 85% of amphisbaenians are infected which suggests a high transmission efficiency. In related parasites insects are used as intermediate hosts (this means that the parasite eggs passed out in the host faeces are eaten, usually accidentally, by an insect in which larval development occurs. Only if an infected insect is eaten by the final host can the parasite develop to maturity and begin laying eggs again).

Ants cannot fulfill the role of intermediate hosts because they can only suck fungus sap and are incapable of ingesting the parasite eggs even though these measure only 0.1 3 mm in diameter. Bu t we have demonstrated experimentally that *A. alba* faeces, introduced into laboratory colonies of *Atta cephalotes,* are rapidly cut up and thrown onto the refuse dump. Here, under natural circumstances, they will be accidentally eaten by beetle larvae. We fed larvae of the three-horned rhinoceros· beetle *(Coelosis biloba)* on faecal material contaminated with parasite eggs and recovered the infective larval stages from the body cavity 100 days l;::.tc::;:. Ll!rvae will not deveiop in cockroaches and it seems that only *Coelosis* larvae offer the correct conditions for the development of the parasite to a stage which can then infect the worm-lizard. Ants play an essential part in transmission by removing parasite eggs to the refuse dumps. This in turn enhances the probability that they will be picked up by *Coelosis* larvae which in turn are a prey item of *A. alba.* The strong ecological links in the various components of this life-cycle offset a very low parasite egg production.

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