Notes on Food and Cannibalism in *Macropathus filifer* Walker, 1869 (Rhaphidophoridae, Orthoptera)

By Aola M. Richards, M.Sc.,
Department of Zoology, Victoria University College, Wellington.

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Abstract

Examination of the alimentary tract of specimens of *Macropathus filifer* collected from Karori, Stephens Island, Ruakokopatuna and Trio Islands show it to be an omnivorous insect, although from evidence obtained in the laboratory there is a marked preference for animal tissue. This agrees with observations made on other members of the Rhaphidophoridae in America and Europe. Cannibalism is quite common, particularly during the mating season, when the opposite sex is attacked; but it may also occur just after an ecdysis. The actual amount of the body eaten varies from victim to victim. Three cases of autophagy are recorded here for the first time.

During the course of a study of the cave-weta, *Macropathus filifer* the author attempted to ascertain what these insects feed on in the native state and also what they would thrive on in captivity. Although some cave-wetas are found in the bush under stones or in rotten logs, the natural habitat of *M. filifer* is primarily caves, where there is practically no plant or animal life.

Small samples of several native shrubs from near the mouth of a cave at Karori, as well as moss and bryophyte from the rocks at the entrance, were given in the laboratory to wetas from this cave to see which plants they preferred to feed on. From *Brachyglottis rangiora, Macropiper excelsum, Melicytus ramiflorus, Geniostoma ligustrifolium* and *Coprosma* species the only plants eaten were *Melicytis ramiflorus* and *Macropiper excelsum.* Later only *Melicytus* was touched. In all places where *M. filifer* has been collected, *Melicytus* has been present in the vicinity.

Evidence has been obtained from Karori, Stephens Island, Ruakokopatuna and Trio Islands that *M. filifer,* living under natural conditions, is an omnivorous insect feeding on leaves, grass, the remains of dead insects and sometimes living prey.

In July, 1952, both animal and plant tissue were found in the faeces and gut content of two female cave-wetas from Karori, showing them to be omnivorous in their diet. Small pieces of epidermal tissue covered with setae were undoubtedly animal in origin, while numerous long fibres belonged to plants. Scattered throughout the solid material were thousands of basidiospores and some basidia. On examining another weta in February, 1953, basidiospores were again present from crop to anus, but as no sporophores or mycellia could be found it was impossible to identify the fungus. It is known that basidiospores may pass through the alimentary tract of some animals for the completion of their life history, or as a means of becoming dispersed. Hence *M. filifer* must eat and digest the mycelium and hymenium of the fungus, to release the basidiospores which so far have been found only in wetas collected from Karori.

The presence of basidiospores in the alimentary tract has been recorded from other members of the Rhaphidophoridae. Hubbell (1936) examined the crop content of *Ceuthophilus,* a North American relative of *Macropathus,* and found that the occurrence of fungal spores and mycelia were quite common. He also observed several species of *Ceuthophilus* feeding on mushrooms at night. The larger material in the Karori cave-weta's crop contained large cells and three stomata which identified it as belonging to either a leaf, a fern, or a moss capsule.

In March, 1953, the gut content of a male cave-weta from a water tank on Stephens Island was examined. This gizzard contained plant tissue among which were small insect eggs possessing opercula. The rectum contained plant tissue with long hairs protruding from the epidermis. Five stomata arranged in a longitudinal row identified this tissue as monocotyledonous and therefore it seems probable it belonged to a member of the Gramineae. Examination of the gut content of cave-wetas from Ruakokopatuna gave the same result. When grass was put into the troughs in the laboratory the wetas began to feed on it, bury themselves in it, or swing head-down from the blades.

As during the daytime, cave-wetas remain motionless on walls of caves, in hollow logs, or under stones, it has been suggested that they must come out at night to feed on the surrounding vegetation. On a trip to Trio Islnads in April, 1953, I confirmed this. When night fell I found *Macropathus filifer* on the branches of *Melicytus ramiflorus* feeding on the bark and leaves. They were either singly or in pairs on each tree, and I particularly noted that they were on no other plant. By dawn they had all returned to the cover of bird or tuatara burrows. This agrees with Remy's (1931) observations on the European members of the Rhaphidophoridae. He showed that nearly half of the specimens of *Troglophilus, Dolichopoda* and *Diestrammena* taken in caves had been outside to feed He considered that as most members of the family eat almost anything organic, food could be obtained within a limited radius of the cave mouth. Thus the individuals which issue forth during the night may retreat once more into the cave at daybreak. From this it appears that most of the habits of the Rhaphidophoridae throughout the world conform to a fairly constant pattern.

Banta (1907) discussing the food of *Ceuthophilus stygius* from the Mayfield's Cave, Indiana says, " This *Ceuthophilus* feeds upon organic matter It was seen feeding upon the decaying carcass of a mouse, and on several occasions was found feeding upon cheese left as bait It is sometimes found near decaying organic matter of any sort . . . Light disturbs these creatures, so that it is well-nigh impossible directly to observe their feeding in the cave, but all have been so nearly caught in the act of feeding that the case is practically proven." From Banta's account there would seem to be no need for these insects to come out of the cave at night to feed, and therefore fresh vegetative material evidently does not form a part of their diet as it does with *M. filifer.*

A colony of *M. filifer,* consisting of a mature male and female and over a dozen offspring of various sizes, was found in the basement of a house at Karori Their faeces on examination contained numerous long thin fibres identical with those in the building paper which lined the walls, showing that the wetas had fed on this paper.

Although all the captive cave-wetas fed on *Melicytus,* this plant did not seem to provide sufficient nourishment for them, as most of them died. When raw meat

was given to them, in an attempt to supply the animal portion of their diet, the wetas immediately showed a marked liking for it, and were fed on it once a week. The meat is chewed into very small pieces, the juice sucked out, and then very often the pieces are ejected, though sometimes quite a large portion of the meat is eaten too. As soon as meat is placed in the trough the wetas wave their maxillary and labial palps in the air, walk straight over to it, and start eating. Sometimes the meat is held firmly by the mouth parts and dragged all round the trough while the weta nibbles at it, and sometimes I have seen two wetas fight over one special piece.

In 1894 Blatchley successfully fed caged *Ceuthophilus* on meat, fruit and vegetables. Hubbell (1936) also kept *Ceuthophilus* in captivity. He found that starchy foods and vegetables were rejected, but cheese, meat and sweet foods, especially peanut butter, were eaten with avidity. Cheese was given to *Macropathus* for a change of diet, but unlike *Ceuthophilus* it showed no interest in it. Peanut butter was also supplied but, although it was eaten, meat was definitely their favourite food. Maskell (1927) had fed *Hemideina thoracica* successfully in captivity on apples and sugar, but it was found that though cave-wetas showed a marked liking for sugar, they ate very little apple and soon died

Among the Rhaphidophoridae the habit of attacking and eating one another is quite common Although cannibalism can occur at any time of the year, my observations show that it happens most frequently during the mating season. This may be partly attributed to sexual stimulation as males are found to attack females, or females to attack males. At first I thought cannibalism might be due to the conditions of captivity, wherein the insects were confined together in close quarters It might also be due to their not receiving their proper food, or enough of it; but in May, 1953, while on a collecting trip to Percy's Reserve, Petone, I found a mature cave-weta lying on the floor of the cave with a hole in the side of its abdomen and all the gut eaten out As the only other animal inhabiting the cave is *Neonetus,* a smaller member of the Rhaphidophoridae, this shows that cannibalism does take place in the native state Although I have not seen any remains of cave-wetas during my visits to the Karori cave, they have been observed by other people, so it would seem cannibalism also occurs there, especially since the gut content and faeces of cave-wetas collected from Karori contained little pieces of epidermal tissue covered with setae. However, Hubbell (1936) regards the frequent occurrence of *Ceuthophilus* spurs in the gut of other members of the same species not as evidence of widespread cannibalism, but rather as due to the habit of eating the exuviae The same thing could also apply to *Macropathus.*

Hubbell (1936) considers cannabalism in *Ceuthophilus* often takes place just after some of the insects have moulted. He says, " In colonies of *Ceuthophilus* there is heavy mortality when ecdysis occurs, for the soft, helpless teneral insects are eaten by their cannibalistic mates. Only a small proportion of the individuals in a crowded cage survive to reach maturity." This habit is not of such frequent occurrence in *Macropathus,* although it has been observed. On one occasion a male weta was moulting and was unable to completely free itself from its exuvia While caught in this attitude and defenceless, a female attacked it and ate the head, prothoracic muscle and part of the gut.

I found that three wetas could never be kept together in a trough in the laboratory when two were of one sex and one of another. Invariably on the

following morning the remains of the odd one would be lying scattered round the trough having been literally torn to pieces. This is probably due to sex instinct of the males fighting for the female or vice versa because when the sexes were segregated cannibalism did not occur.

The actual process of one weta killing another has never been observed although on several occasions I have found the conqueror feeding on the remains of its victim. It always takes place at night when the wetas become more active, and, judging by the remains I have examined, conforms to a fairly constant pattern. One insect stalks the other, driving it into a corner to attack it, and tear off either one or both hind legs. The chitinous exoskeleton of the hind femur is bitten off on the retrolateral side and the muscle of the leg is eaten, leaving only an empty chitinous shell. Sometimes also, a middle or fore leg is removed but never eaten. This practice not only disables the insect so that it cannot escape but exposes the vulnerable side of the abdomen to the attacker, who tears a hole in the victim's side, usually the left one, and eats the gut, muscles, fat body and, in the case of the female, all the eggs. This procedure in *Macropathus* differs from that in the *Henicidae* where cannibalism also occurs but where, according to Maskell (1927), the ventral surface of the abdomen is the part usually attacked.

The amount of the victim eaten varied from individual to individual. In one case I observed the hind legs were eaten and all that remained was part of the head and the fore and middle legs. In another case there remained only the two mandibles, the two antennae, the lower half of the abdomen, the ovipositor and the six legs. On another occasion one hind leg was torn off and eaten and one side of the body bitten into and part of the gut eaten, yet the victim was still alive. When four males and four females shared the same container two of the females were killed and eaten and all that remained were twelve legs, two ovipositors and the top of one head.

I have observed several curious cases of wetas eating parts of themselves The first case, a female from the Karori cave, kept alone in a trough with water in the bottom, was fed on *Melicytus* and raw meat. One day I found she had broken off one of her hind legs and eaten the muscle from the fleshy part of the femur. Seven days later she broke off the other hind leg and again ate the muscle from the femur. Eight days later she was dead. Several months later a similar case of autophagy was observed in a male weta. Another female weta ate the muscle of her hind femur while the leg was still attached to the body This would lead one to suppose that pain perception in *Macropathus* is poorly developed. Other wetas in captivity have broken off their hind legs and left them lying discarded in their troughs, but they have never eaten them

In late June all the fully mature cave-wetas disappear. The Maori guide at Waitomo accounts for their disappearance from the Aranui Cave on the grounds of cannibalism. He claims that the wetas eat each other, until only enough remain to propagate a new colony for the following year. It seems more probable to me that the animals breed, lay their eggs, and then, their life cycle being over, die. The one fact in support of the Maori's theory is that no remains of dead wetas have been found. However it is also possible that wetas die naturally and are then eaten by others in the colony.

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