Keeping Wetas in Captivity

A SERIES OF NINE ARTICLES

FOR SCHOOLS AND NATURE-LOVERS

by

Paul Barrett

edited by G.W. Ramsay

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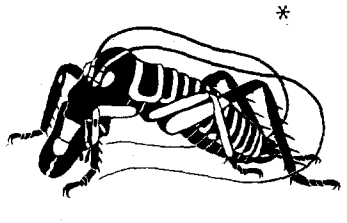

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KEEPING WETAS IN CAPTIVITY

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FOREWORD

The need to survive is an overriding motivation in mankind and indeed in all living creatures. Perhaps it is this urge for survival that is prompting the great upsurge of interest in conservation matters. Mankind is at last beginning to realise that survival is utterly dependent on the well being of the global ecosystem. Whatever the reason, the plight of some New Zealand invertebrates, especially certain wetas, and the real possibility of their extinction is rather belatedly being realised, and they have recently been getting a much higher profile in the news media. This is gratifying, especially as they have been universally regarded as frightening, repugnant and dangerous creatures. In fact they are not aggressive and their frightening behaviour is only defensive.

The need for viable captive colonies of the various species of protected or endangered wetas, as well as of other insects, is increasing and becoming more urgent as habitat is lost and the ecosystem changed through the establishment of additional potential predators and diseases. Observation of captive wetas is an excellent way of gaining the knowledge and information for the operation of viable captive colonies and the management of the species in the wild.

Common wetas that could be kept as pets and ones that would make excellent subjects for captive rearing are:

Hemideina thoracica White, the Auckland weta

Hemideina crassidens (Blanchard), the Wellington weta

Hemideina femorata Hutton, the Canterbury weta

Hemideina maori (Pictet and Saussure), the mountain hemideina.

The widespread cave wetas, especially the larger common species, may be suitable also. All of these except *Hemideina femorata* have been kept by Paul Barrett, who describes how it is done in this publication. He not only provides us with the information necessary to keep and breed wetas successfully in captivity, but also tells of his extremely interesting observations on their behaviour.

Paul Barrett is the Weta Keeper of the Wellington Zoological Gardens and he has a flair and natural aptitude as well as great interest and enthusiasm for the keeping of wetas. These qualities have contributed to the great success he has had with weta breeding and rearing as the following collection of articles, written in his own style, testify.

It is to be hoped that this publication will stimulate New Zealanders to try weta--keeping. This is done overseas where captive colonies of New Zealand wetas are maintained by the London and Cologne Zoos, by the Insect Zoo at the Smithsonian Institution, Washington, and by a private individual in the United Kingdom.

Apart from the common species mentioned above, there are seven more that are rare for one reason or another. These have been granted legal protection, and a special permit is required to collect or keep them in captivity. The seven are: -

Deinacrida parva Salmon - Herekopare weta - confined to Herekopare Island in Foveaux Strait. Now that cats have been eliminated there its chances of survival have improved even though there is only one population. A small species.

Deinacrida fallai Salmon - Poor Knights weta - confined to the Poor Knights Islands, Northland. Reasonably secure but only one population. A very large species.

Deinacrida heteracantha White - weta-punga - found only on Little Barrier Island. Reasonably secure. The Mahoenui weta is similar and comprises two known populations in the King Country. The Department of Conservation is developing a strategy for the management of this weta. A very large species.

Deinacrida parva Buller - Kaikoura weta - limited to several populations in the Kaikoura region. Some of these have declined alarmingly or been lost due to habitat modification and probably, rodent predation. An average-sized species.

Deinacrida rugosa Buller - Stephens Island weta - three populations of this species now exist, one on Stephens Island, one on Mana Island and a recently established one on Maud Island in the Marlborough Sounds. The species is relatively secure. A large and heavy species.

Deinacrida tibiospina Salmon - Nelson alpine weta - found only in areas at and above the bush line in the Nelson and Takaka regions. It is probably reasonably secure as rodent predators do not seem to be able to survive in such places. An average-sized species.

Hemideina ricta Hutton - Banks Peninsula weta - confined to forest remnants on Banks Peninsula only. It may be limit by a paucity of old dead trees which would provide suitable habitat for it. An average-sized species.

There are several others which should be considered for inclusion on the legally protected list.

A list of the sources of information about wetas is the 1979 "Annotated bibliography; and index to New Zealand wetas", DSIR Information Series No. 144 (out-of-print

but available in many libraries). A useful and interesting account of wetas is the article "Wetas" in "New Zealand's Nature Heritage" Volume 2, Part 20, pages 554 to 558 by Dr A.M. Richards which was published in 1975. Recently (1990) the booklet "The Weta Book. A Guide to the Identification of Wetas", by M.J. Meads, published by DSIR Land Resources, PO Box 30-379, Lower Hutt, New Zealand, has become available.

As a result of reading and studying Paul Barrett's articles I hope more people wil cease regarding the much-maligned weta with fear and horror, take another look; and become aware of their positive qualities. They are intriguing animals of great interest with much to add to the quality and enjoyment of the New Zealanc ecosystem!

G.W. Ramsay

INTRODUCTION

I began a special programme entitled "Project Weta", which aimed to breed as many weta species in captivity as possible, at the Wellington Zoo in 1986. After several years I have gathered useful information and experience about keeping specimens of these unique insects in captivity which is recorded in the following articles. As "Project Weta" is ongoing, corrections, up-dates and new articles will be produced in due course.

In general I keep my wetas in large containers - reptile cages, aquaria, miscellaneous wooden containers, and so on. All are satisfactory as long as they give plenty of space for the wetas, ventilation, and have at least one glass side for observation. To ensure adequate ventilation I employ metallic rather than plastic gauze because wetas sometimes chew their way through the latter and escape. The lids and ventilation gauze should be tight-fitting and escape-proof. If wood is used it should be untreated as treated wood is impregnated with arsenic or boron and other substances poisonous to insects. Weta containers must not be exposed to sunlight when in use as the ultraviolet light, raised temperature and consequent higher humidity can be fatal to wetas. I always place clean soil, sand, leaf-litter, and so on, on the floor of the container so that the weta's natural environment is replicated as closely as possible. Moisture can then be absorbed and egg-laying sites are present. I provide additional other materials for shelter and so on as appropriate, to meet the special needs of each species.

It is important to remove mouldy or decayed food and faecal pellets every few days or once a week, but certainly not the clean pellets as these contain chemicals and are "beacons" or markers which assist the wetas in navigating about their cage. It is also important to maintain the right temperature and humidity for each species. This I do by spraying the enclosure with water from a mister every second day in dry weather and every fourth or fifth day in cool or damp weather. The enclosures should be kept as close to the outside temperature as possible. Temperatures between 15°C and 20°C seem to be optimum. Below 10°C wetas become inactive and above 25°C the conditions become intolerable to many species. Humidity levels of 60-70% for tree wetas and 40-50 % for giant wetas are optimum. These conditions are also suitable for ground wetas.

Drinking water was provided either in soaked cotton-wool pads (which wetas sometimes chewed), or by misting the foliage in their container or by offering

water in shallow lids. Climbing material is important for *Hemideina* and *Hemiandrus* wetas as well as some *Deinacrida* and the cave wetas, as all of these prefer to shelter off the ground. The setting up of an assortment of branches and other climbing materials is also important in providing sites for the ecdysis or moulting of weta nymphs.

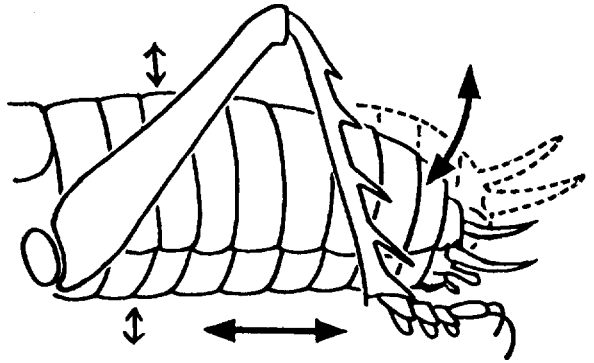
I made shelters for the tree wetas by drilling galleries in logs and by using New Zealand flax flower stems as described in the following articles. Giant wetas were provided with bark shelters which they used readily as did the cave wetas also.

In general wetas should be fed once or twice a week. All food must be clean and free from pesticides and chemical sprays. Small and young wetas are difficult to find in large containers, and cannibalism commonly occurs amongst them. To overcome these problems I usually keep them singly in plastic ice-cream cartons with holes drilled or melted into the lid.

Several species of weta are legally protected because they are rare or vulnerable to predation. These species are usually present only on off-shore islands or places that are not often visited, and they cannot be collected or kept without official approval from the Department of Conservation, and a permit. The common wetas found in the vicinity of our towns and cities are not protected and make good subjects for study and rearing (see list of species in Foreword p.3). The more information that can be gathered about the keeping and rearing of wetas the better. Such information may be invaluable should the time ever come when the only way to save a species from extinction is by breeding it in captivity. No specimens should ever be collected in Reserves or National Parks without permission.

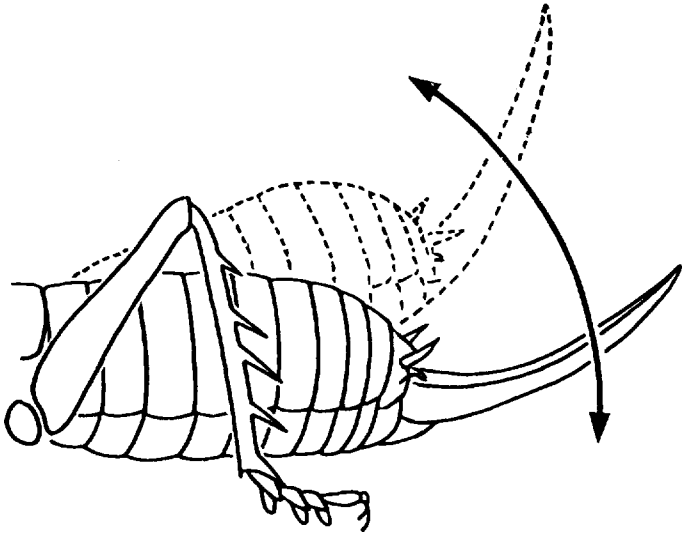
Weta Communication (Stridulation)

Much interesting information can be obtained by observing wetas in captivity. For instance, many wetas (not all species and not cave wetas) have "ears" comprising a flat oval area on each side of the tibia (shank) of the front leg. They communicate with each other by means of the various sounds they make. The rasping or calling of wetas can be heard in the bush at intervals throughout the night, sometimes right until dawn. Sounds are made in three different ways. The first method is to elevate the hind-legs and flick them vigorously down the sides of the abdomen. This action rubs the numerous small spines or pegs of the inner face of the hind-leg over a file or row of ridges on each side of the abdomen. Such a mechanism is characteristic of all *Deinacrida* and *Hemideina* wetas. The behaviour just described is defensive and produces a rasping sound.



"tsit tsit tsit tsit tsit tsit"

Diagram A - Movements involved in producing the rapid stuttering sound by pulling abdominal segments back and forth against the hind-legs.



"ssit ssit ssit ssit ssit ssit"

Diagram B - Movements involved in producing the rapid stuttering sound by quickly raising abdomen up and down against the hind-legs.

This method of stridulation is used only when the weta is under threat. The flicking-down movement of the hind-legs is not used in any other situation.

The second method of sound production involves moving the sides of the abdomen against the inner surface of the hind-legs with these legs stationary in the resting position. The *Hemideina* wetas *H. crassidens, H. crassicruris, H. thoracica,* and *H. maori* (and *H. femorata,* the Canterbury weta) use this method to produce a rapid stuttering sound or call (mentioned in the article on *H. crassidens).* The rapid stutter is produced by two kinds of movement, one involving contraction and slight upward curling of the abdomen (Diagram A), and the other by raising and lowering the abdomen (Diagram B). Both of these are used as eviction or move-along calls by male and female wetas, nymphs and adults. The second kind of movement is more often used by adults.

The ticking sound made by some *Deinacrida* wetas is said to be produced in a similar way.

The third way of producing sound is to suddenly telescope the abdomen so that the surfaces of the segments and membranes between them rub against each other. This produces the hissing sound made by *Deinacrida* wetas but not by *Hemideina* (except *H. crassicruris* in which this sound is weak).

Acknowledgement

I wish to thank Graeme Ramsay, Greg Sherley, and Ron Ordish of DSIR Plant Protection, Department of Conservation, and the National Museum respectively for their assistance and advice in the preparation of these notes; also Ron Goudswaard and Barbara Blanchard, senior keepers Wellington Zoo, and Mike Meads and Allison Balance, DSIR Land Resources for assistance and advice in raising the Stephens Island hemideina and Mahoenui giant weta. The skill and expertise of Mrs Robyn Harding has been invaluable in the typing and formatting of this work and is very gratefully acknowledged and appreciated.

The illustrations comprising Figures 1 to 8 are by the author.

Further articles in this series may be published from time to time in "THE WETA", Newsbulletin of the Entomological Society of New Zealand (Inc.).

ARTICLE 1. Keeping the Wellington weta, *Hemideina crassidens* (Blanchard, 1851)

Hemideina crassidens is a typical New Zealand tree weta. Fig. 1 illustrates the male and female of this species.

I began the Wellington Zoo programme entitled 'Project Weta' with this species in 1986 and the information in this article is based on the maintenance of a colony over a period of four years. As the programme expanded to include other species I kept this one on the 'back burner' as it has always been a personal favourite of mine.

It is an average-sized weta ranging from 40 mm to 70 mm long. A 70 mm specimen would be a large one. The species can weigh between 3 and 6g when adult.

This weta occupies a wide range of holes and crevices in live and dead trees. Holes are usually enlarged from other wood-boring insects, although *H. crassidens* is capable of making its own holes also. The species forms harems consisting of an adult male and up to 10 adult females.

Hemideina crassidens is an arboreal species essentially. Other than harem-holding males it is a wanderer.

Individuals can sometimes be found in a variety of places other than in trees. Although this species returns to the same hole no matter what its size or age, individuals are constantly displaced by others, hence the wandering. *Hemideina crassidens* is omnivorous, feeding on a wide range of foliage, bark, insects, and fruit on occasion.

Housing

This species was the first I designed an enclosure for. The other species of weta were housed using this one as a base with regards to food and conditions. I simply observed the particular requirements of the other species beyond those of this species.

I used glass tanks (previously used as aquaria) with galvanised metal lids. The tanks varied from 60 cm by 30 cm by 30 cm up to 120 cm by 48 cm by 48 cm. In the largest tank I satisfactorily kept two harems, comprising a total of 10 wetas. The smaller tanks housed no more than 5 specimens. The lids were metal with steel insect mesh which the wetas were unable to attack. I have experienced individuals

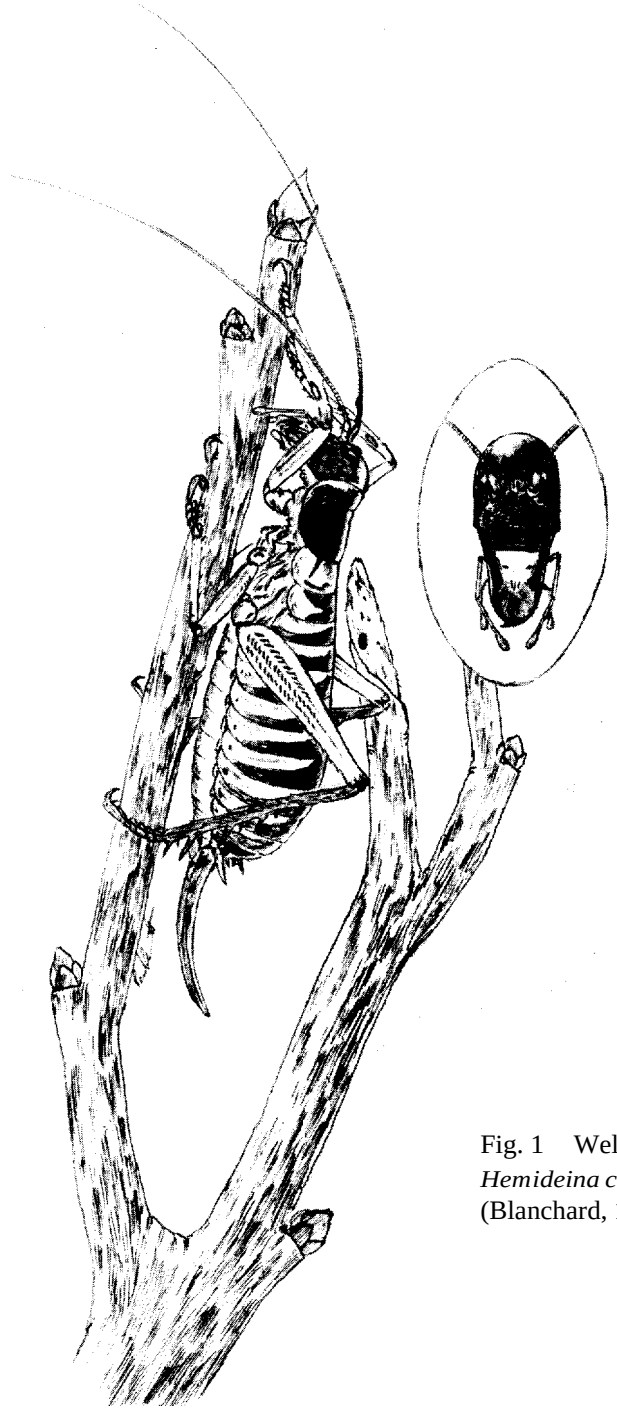


Fig. 1 Wellington weta *Hemideina crassidens* (Blanchard, 1851)

chewing their way out of plastic ice-cream and margarine containers. Females were particularly likely to do this.

Habitat

As this species lays its eggs in the ground, I supplied soft friable soil. This was spread to a depth of 50 mm and mounded in the middle to assist drainage. Leaf litter was sprinkled on top for two reasons. Firstly, the bare soil would be compacted by the weta's activity so that damage to the claws on the tarsi would result. A white fungus would invade the damaged part and subsequently progress up the leg. This occurred twice before the leaf litter was put in to prevent it. The second reason was that the wetas displayed less inclination to climb the glass (which added to the problem regarding the tarsi) if the leaf litter was present. This and climbing material gave the wetas 'occupational therapy'.

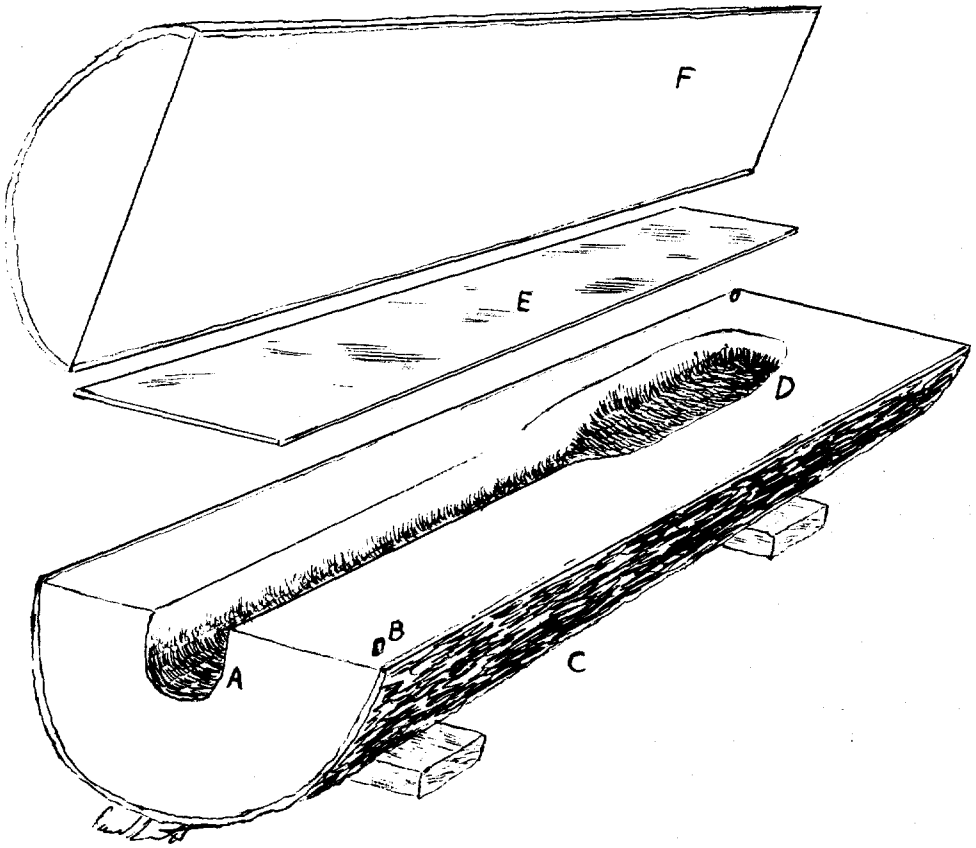
Climbing material consisted of twigs of *Coprosma* and ngaio which the wetas used to good advantage. This species is a capable climber and had no trouble reaching the lid of the enclosure via the climbing material. This material provided bark to chew and a good site for mating to occur.

Shelter was provided in two forms. I designed a special harem gallery for the male and his group of females. This is illustrated in Fig 2. It is a small log cut in half horizontally with a channel and chamber cut into the bottom half. This is covered by a sheet of perspex on which is placed the top half of the log. The whole unit is held together with rubber bands. This shelter I termed a gallery. The other kind of shelter was the use of flax *(Phormium tenax)* flower stalks. These were cut into 150 mm lengths, split in half and the material inside excavated out. I left 30 mm of material at the end of the halves. The pieces were then put together and held with rubber bands. The shelters were pushed into the soil against the harem gallery. These shelters were useful when the females chose to hide elsewhere, other than in the gallery, and the wetas liked them.

Environmental Conditions

Hemideina crassidens is tolerant of a fairly wide range of environmental conditions. In captivity, I found the optimum temperature requirements to be between 10°C and 25°C. Below 10° the wetas were quite inactive although they would still leave their shelter and feed periodically. They did not enter diapause like the giant wetas under 10°C. If temperatures rose above 20°C the wetas would become restless and would retreat under the gallery. They would also lose weight which suggests desiccation. If the temperature was kept between 10° and 25° the wetas behaved normally.

Fig. 2. Shelter used for harem of tree wetas



A. Entrance to shelter. 20 mm wide for Hemideina crassidens
B. Cut off nail used to hold lid secure.
C. Logs made from ngaio, Coprosma, elderberry and pine.
D. Gallery widened to allow changing of position and mating.
E. Perspex sheet fitted between lower half of gallery and lid.
F. Lid.

Notes: This type of shelter was used for both *H. crassidens* and *H. crassicrurus*.
1. The entrance hole needed to be increased to 25 mm wide for *H. crassicrurus.*
2. The logs were 450 mm long for *H. crassidens* and 530 mm long for *H. crassicrurus*.
3. The perspex sheet allowed the wetas to be stock-checked without disturbing them unduly by removing the lid.

I found this species was most content with a humidity level of 60% to 80%. The wetas would abandon the gallery to hide in the flax shelters, or under the gallery if conditions were much lower than 60%. The gallery would get too damp and soiled above 80% humidity.

At 60-60% humidity, the wetas were content. This humidity range was easily maintained by misting the enclosure every second day in dry weather and every 4 to 5 days in damp weather.

Food

I found this species to be variable in preferences and intake. A wide range of food items were eaten but consumption varied between individuals. Food items which I fed and which were eaten by the wetas in my care were natural plant food including the foliage of taupata, karamu, ngaio, malice, *Buddliea,* willow, plantain, puha, lacebark, kowhai, kanuka, *Euonymus*, *Hebe* and pear. This weta consumed dead foliage in the leaf litter and regularly chewed bark of *Coprosma* and ngaio. It ate apples and cherries. Unnatural plant food included cabbage and carrot.

Insect food given to and eaten by this weta consisted of crickets, caterpillars, moths, locust nymphs, cicadas, katydids, aphids, mealworms, and spiders. Unnatural animal protein eaten comprised oxheart, new born mice, and dog sausage. The regime of feeding was to supply 1 or 2 fresh sprigs of foliage with 5 to 8 leaves. This was renewed every day in summer and every second to third day in winter. Along with this an insect or animal protein item was added. This was placed on a conspicuous leaf in the leaf litter so the amount eaten could be accurately monitored.

Water was supplied by providing soaked cotton wool wads in the climbing material and also by misting the food plants before placing them in the enclosure. Both methods proved acceptable but the wads needed changing every day as the wetas soiled them with brown saliva.

Behaviour

Hemideina crassidens was an interesting weta to study at night whilst in captivity. It was the least prone to disturbance of all the species I have cared for, and adapted well to captive life.

Activity

At night the females were far more active than the male. They left the gallery after the male usually but were out for longer periods. The male, although out earlier usually returned sooner possibly to guard his gallery. His activity was largely centred around the gallery and the

females. When in the gallery the male would sit at the entrance with the end of his abdomen and his hind tibiae protruding. Wetas of all ages assume this position when in their holes or shelters as a way of keeping out intruders.

Movement

This weta can jump but not nearly so well as *Hemideina thoracica.* Nymphs jump quite well, being lighter in weight than adults. *H. crassidens* will jump up over and down to the place it wishes to go. The species will go to great lengths to reach out to a twig before jumping. This differs from *H. thoracica* which will jump with considerably more confidence.

Navigation

H. crassidens probably uses pheromones or chemicals in its faecal material for location of the shelter and of other individuals. This is done by the wetas using the position of the droppings around the enclosure. I proved this by accident. If one removed all faeces, the wetas abandoned the gallery and hid in other parts of the enclosure. When only the mouldy faeces were removed leaving the fresh ones, the wetas behaved normally and returned to the gallery. Certainly, in the field, droppings can be found accumulated near major harem galleries provided the branch or topography of the tree enables the droppings to become trapped.

Harems

Although the male forms a harem of females, the term harem is correct only in that the females are resident with the male. The females come and go as they please and the male has no real control over their movements. The adult male is the owner of the gallery and to prove this I placed two galleries each housing a harem, in the large enclosure. The males readily guarded their own gallery and would fight if one entered the other's gallery intentionally or otherwise. The females of both harems entered either gallery without hesitation, although a male could evict a female without too much difficulty if he wanted to.

Aggression

Fighting between males is quite ritualised, the outcome being based on which male can gape his mandibles the widest. The aim is to gape wide and lunge over the opponents' gaping mandibles. Within this lunge the aggressor will often lock his mandibles onto those of this opponent or lock them on to the hardened cuticle just above the opponents' mandibles. Normally a lunge will be all that is required to settle a dispute. The opponent, deciding that his aggressor can gape wider than he, will flee. If the opponent was particularly determined or was of equal size to the aggressor, prolonged "tug-o-wars" took place.

Stridulation

Stridulation is very important to *Hemideina crassidens.* A call comprising a distinct rapid succession of rasping (almost stuttering) sounds (made by sudden contractions of the abdomen causing its sides to rub against the hind legs (see Diagram A p. 8)) is produced after mating and during eviction of opponent wetas. The call is used by nymphs whilst occupying holes or during eviction. An eleven-stroke call is used by the male to attract females to the harem gallery. Two other different sharp calls are also used - one as a warning to other wetas that danger is present, and the other used when the weta is threatened or attacked. The call used whilst under threat is the only one generated by striking the legs swiftly down on the stridulatory apparatus on the abdomen. The other calls are made by small movements of the hind legs or by lifting and lowering the abdomen or telescoping the abdomen. This species has prominent auditory pits on the front tibiae and responds to sound well. Females are attracted to the male's gallery by his calls.

Mating

The females are receptive to mating from September on through summer. This may be earlier depending on how mild the winter has been. The male will mate throughout summer with females of his harem and any other female which is adult that may be located. I have noticed a strong urge in the male to copulate with new females put in the enclosure. The female adopts a passive role during mating.

The mating procedure for this species is brief but quite complex. Some time is spent by the male to investigate the female and ensure she is receptive. The male will move over the female carefully, palpating her with antennae and palps. He also carries out a curious shuddering movement. He will stop palpating momentarily, shudder his whole body with a fine vibration and then continue palpating the female. All this appears to pacify the female. If she moves the male will sometimes endeavour to hold her back with his front legs. After some minutes preparing the female, the male will then move backwards feeling for the female's genital region with the end of his abdomen.

Once locating the end of her abdomen the male will then connect with her. He will usually be almost hanging from the female and the branch on which she is sitting whilst copulating.

Coition is brief - I have seen it last almost two minutes but no longer. The male will release the female's abdomen and then becomes aggressive towards her. He will threaten to bite and will stridulate with a series of short calls. The female usually runs or jumps away. This may be a method of ensuring the female does not turn on him or of ensuring she moves off in case another male may be present. In any case it happens after most mating procedures in *Hemideina crassidens.*

Eggs and Egg Laying

The females of *H. crassidens* in my programme laid during April and May. I did not disturb the eggs as they were laid throughout the soil on the floor of the enclosures. The female tests a large area of soil before satisfying herself but will often lay where other females have oviposited before. The eggs are black, cigar- shaped and range in size between 5 and 6.5 mm long. They are laid vertically in the soil at various depths. Some are laid at the full length of the ovipositor, i.e. 19 to 23 mm, or only a few millimetres deep. Nymphs hatch from October to December in the year they were laid. More details on nymph management are given in article No. 5 (page 30) of this series - raising *Hemideina* wetas from egg to adult. Adults were removed during the hatching period.

ARTICLE 2. Keeping the Stephens Island hemideina

Hemideina crassicruris Salmon, 1950

In 1987 1 was given the opportunity to care for a group of large tree wetas from Stephens Island. These wetas were brought off the Island by Dr Mike Thompson of Victoria University, Wellington. By 1988 I had successfully bred this species. It is very similar to *Hemideina crassidens* and may be simply an island race of that species. The specimens in my group ranged from 73 mm to 80 mm long, and can attain a weight of 12.6 g. This may be achieved by males and females. Although very similar to *H. crassidens,* there are some important differences.

This weta can stridulate by telescoping its abdomen, an ability usually associated with *Deinacrida* wetas. The legs are also darker in colour and thicker, particularly the hind tibiae. The body is more robust and considerably darker than *H. crassidens.* This weta is less active and more docile than the mainland species.

Behaviour is very similar to *H. crassidens.* This weta lives in the same type of hole in trunks and branches of trees. On Stephens Island, kohekohe and ngaio trees are favourites for shelter, ngaio particularly. Like *H. crassidens,* the adult male forms a harem. The males can develop enormous heads by the time they have reached adulthood and two of my adult males had massive heads 30 mm long. This weta is omnivorous and is arboreal.

Housing and Habitat

I employed the same methods and materials as used for *H. crassidens* to keep this weta. This included the use of glass tanks measuring 60 cm by 30 cm by 30 cm. Another tank measured 120 cm by 43 cm by 43 cm. The tanks were furnished with soil laid at 60 mm deep and sprinkled with leaf litter. Climbing material consisted of *Coprosma* and ngaio twigs as well as some thicker branches. As this weta is less agile, heavier material was necessary. A harem comprising one male and three to four females was kept in each enclosure. Galleries (Fig. 2, p.13) were used for this species also.

Environmental Conditions

This weta preferred the same temperature and humidity levels as *H. crassidens,* a temperature range of 10°C and 25°C being the best. It did not become quiescent at low temperatures and was distinctly uncomfortable at temperatures above 25°C. This is the same as with *H. crassidens.* The enclosures were kept in a room which was on average 5°C above the temperature outside. This weta was less willing to abandon its gallery under adverse conditions but the gallery would become badly soiled if humidity rose above 80%. A level of 60% to 80% was quite acceptable and achieved by misting the soil and leaf litter every 2 days in dry weather and every 5 days in damp weather.

Food

Caring for *Hemideina crassidens* prior to having this species was very helpful. The same food was provided for this weta. Favourites were taupata, ngaio, mahoe and various *Hebe* species. Owing to its larger size and greater strength this weta was more willing to eat through main stems and veins of leaves than was *H. crassidens.* Dead foliage of all kinds, bark, flower petals and fruit were all consumed in varying amounts. Apple was very popular but, as with *H. crassidens,* it was used in moderation because this species became "addicted" to it.

Insects of various species were popular and this weta ate more insect food than *H. crassidens.* As with its mainland sister species, females ate more insects than males. Aphids, caterpillars, locust nymphs, crickets, mealworm larvae, moths and flies were eaten as well as unnatural foods such as dog sausage, newborn mice and ox heart.

Water was accepted from soaked cotton wool wads and water present on misted food plants. Feeding methods were the same as *H. crassidens* (see article No. 1 page 10).

Abnormality

An interesting example of an abnormality was observed with one of the 22 wetas used in this breeding programme - a male had three instead of two abdominal cerci. These are the curved, finger-like projections at the tip of the abdomen. In this example the right-hand cercus was duplicated, the additional member being quite normal in appearance. I have not seen this in any of the 650 Wellington wetas I have weighed and measured or in any other weta for that matter.

Behaviour

Most of the information pertaining to *H. crassidens* applies to this species with regard to its nocturnal behaviour. This weta displayed similar courtship, fighting, mating and egg-laying behaviour.

Activity

Although less energetic than *H. crassidens,* I found this weta to be an alert and interesting species to observe especially at night. It is a less active weta than other *Hemideina* species and more patience is required when observing it at night. It is often a later riser than *H. crassidens.* Males fight over harem galleries and will follow females around the enclosure.

Feeding

H. crassicruris was quite carnivorous. It displays this in two ways. First, it ate more insect and animal products than most wetas except perhaps *Hemiandrus* species. This was the case with both adults and nymphs. Secondly it actually caught and held live insects ensuring that they did not escape. Most wetas when catching live insects simply kill their victim by biting repeatedly. This quickly becomes consumption. *H. crassicrurus* does this but also wraps its legs around the prey quickly to ensure escape is not possible. The front and middle legs are involved and the spines on the tibiae assist by giving a firm hold. The weta will then bite quickly and deeply, before starting to eat.

As with other wetas the females consume more insects and animal material than the males. An increase in the amount of this type of food eaten occurs approximately 3 weeks before oviposition.

Stridulation

H. crassicruris was quite vocal, with the stridulation being similar to that of *H. crassidens.* It will even on occasion respond to stridulation of the Wellington weta. The nymphs of this species are particularly fond of using their sound apparatus. The rubbing noises heard when the weta 'telescopes' its abdomen seem to be only used when the weta is under threat, although I have heard the sound occasionally when wetas are jostling about in their gallery.

Mating

H. crassicruris displays the same shuddering motion as does *H. crassidens* during courtship. Copulation takes a little longer than with *H. crassidens* - just over 2 minutes on some occasions - and the male is less assertive towards the female after mating. The females are receptive from September onwards through summer and autumn.

Eggs and Egg Laying

In April the females in my programme laid in the soil of the enclosures. The eggs are 6.5 to 7 mm long, greyish- black in colour and cigar-shaped. The female is cautious on the floor and very thorough in her search for a place to lay. She moves slowly, turning her head from side to side and palpating with her palps. Like other wetas, *H. crassicrurus* tends to lay where previous oviposition has taken place.

Emergence

Hatching in this species commences during October and continues until the end of November. The females are very productive - 962 eggs hatched. When hatching stopped I checked the soil. I found hundreds of empty egg shells. Like those of *H. crassidens,* the shell or chorion was neatly split at the top, broad end, and a fine split extended down one side. I only found 10 unhatched eggs. I raised the nymphs successfully as described in article No. 5 page 30.

ARTICLE 3. Keeping the Auckland weta, *Hemideina thoracica* (White, 1846)

This weta is similar in many ways to *Hemideina crassidens* in much of its behaviour and its captive management, but there are some significant differences which separate it from other *Hemideina* wetas.

Hemideina thoracica is a small to average sized tree weta. It ranges from 37 to 65 mm long. Adults weigh between 2 and 4 g. Males are often on the small side. Fig. 7 shows some of this weta's special features. It has longer, thinner legs than *H. crassidens* and its head is almost black in colour. This is the same in both sexes. The antennae are extremely long and its pronotum is light coloured unlike the usually black pronotum of *H. crassidens.* It has a uniformly greyish brown coloured abdomen lacking the transverse stripes.

The distribution of this weta overlaps that of *H. crassidens* at Manakau, just south of Levin. The wetas I have bred came from near Levin. They are usually found in holes situated in suspended dead branches, and dead or dying vines. This weta is arboreal and omnivorous.

Housing and Habitat

I housed this species in the usual glass tank with metal lid enclosure such as was used for *H. crassidens.* It was less inclined to use the special harem gallery, preferring to hide individually in the flax shelters. This species made good use of the *Coprosma* twigs and foliage and spent much of its time in it.

Friable soil was laid at a depth of 50 mm and this was covered with a light sprinkling of leaf litter, the same conditions as were used for *H. crassidens.* (See article No. 1, p.10).

Environmental Conditions

The temperature tolerance of this species is the same as *H. crassidens, 10* to 25°C being the optimum. This weta did not become quiescent like the *Deinacrida* species did. It became very restless above 25°C and would often try to hide under leaf litter on the soil surface if the temperature rose to 30°C.

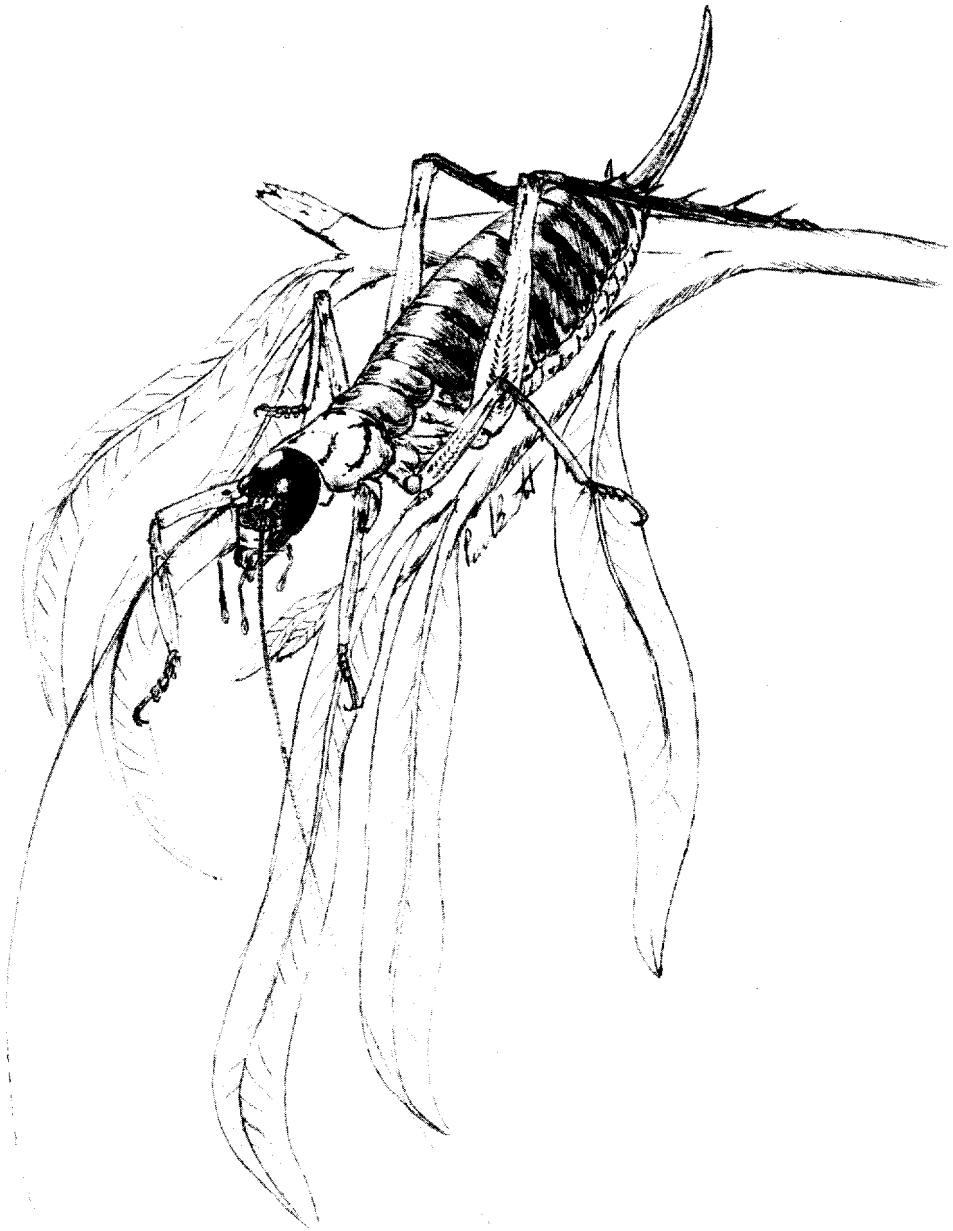


Fig. 3 Auckland weta *Hemideina thoracica* (White, 1846) (Levin specimen)

Humidity requirements are also like those of *H. crassidens* but this species has a distinct tolerance of higher humidity: 80 down to 60 % is ideal but this species was quite content with a range of 65 % to 85 %. The enclosure was misted every 2 days in dry weather and every 4 to 5 during damp times. This weta frequented damp shelters also.

Food

This weta feeds on a wide range of different plants and insects. Food preferences were similar to those of *H. crassidens* (see article No. 1) but as a guide, taupata, karamu, ngaio and mahoe are excellent. Pepper tree *Pseudowintera colorata,* is also a good source of food for this species and is normally not liked by other species of weta.

Insect food consisted of a variety of moths, caterpillars, mealworms etc. The weta also ate oxheart, new-born mice, dog sausage, dead foliage, bark, flower petals and fruit, with apple being a favourite. This weta fed nearly every night instead of every 2 to 3 nights so I provided fresh food each day.

Water was provided by using soaked cotton wool wads and by spraying foliage before adding it to the enclosure. Both methods were acceptable to the wetas which drank readily.

Behaviour

Activity

Energetic is the best way to describe this weta. It hardly goes anywhere without running and is interesting to watch at night. The species leaves its shelter quite early i.e. usually within an hour after dark and explores the enclosure often in a feverish manner. Although easily disturbed, *H. thoracica* quickly settles down again.

Movement

H. thoracica is a confident jumper and will accurately leap to where it wants to go with ease. It will jump up to, over to and down to the places it wishes to go to without hesitation. It will touch the new site repeatedly with its long antennae before leaping. This occurs in other weta species. This species readily jumps as a way of escape.

Feeding

When feeding, this weta, like *H. crassidens,* will pull foliage down to its mouth. Holding on to the leaf (particularly supple foliage e.g.

willow) it will pull down with the front legs. It eats quite large amounts but is easily disturbed by other wetas when feeding. It also holds down insects while eating them.

Stridulation

This weta is very vocal. It stridulates in the same way as *H. crassidens* but the sound is higher and often clearer than that of the larger Wellington weta. *H. thoracica* is quite aggressive towards its own kind and has a distinct dislike of *H. crassidens.* Skirmishes can readily occur but usually without severe conflict or injury. Stridulation, especially when involving eviction from shelters, is very effective in this species as a way of communicating.

Defence

This species defends itself vigorously and will bite if mishandled. It is otherwise a safe species to hold when at ease but is often a little hurried in its movements. It is a sprightly active weta well worth keeping.

Mating

Mating occurs throughout summer and autumn and the females begin to oviposit in April and May. The male has the same mating behaviour as *Hemideina crassidens* and *H. crassicruris* but the females are often not as receptive. The male was often seen chasing after a female until she stopped. Often the female would commence running again before copulation could take place. After locating a receptive female, usually amongst branches, copulation is initiated and, as in the other *Hemideina* species, usually lasts only one to one and a half minutes with the male hanging from the female. Usually the female departs first but sometimes it is the male. The male is sometimes assertive toward the female as in the other *Hemideina* species, but often the two simply part company without any agression.

Eggs and Egg Laying

Females laid their eggs throughout the enclosure. They were 5 to 6 mm long, black, and cigar-shaped. They are positioned vertically and the female only spends brief periods on the floor laying. The nymphs hatch in October. For information on rearing see article No. 5, page 30.

ARTICLE 4. Keeping the ground hemideina *Hemideina maori* (Pictet and Saussure, 1891)

I was pleased to receive specimens of *Hemideina maori* from Dr Mary McIntyre of Victoria University in 1989. This article describes the methods used to maintain this group of wetas in captivity. These methods showed that this species can be kept for an indefinite period quite satisfactorily.

H. maori is an interesting species of tree weta that has become adapted for living on the ground, and is found on the river flats of the foothills and mountainous regions of central Canterbury. It is illustrated in Fig. 4. The adult female of this species attained a weight of 4.6 g which is heavy for its size and measured 49-56 mm in length.

The species has shorter legs than most *Hemideina* wetas and a thickset round body. It has bold transverse black stripes along the length of the body, a dark brown head which is well developed even in females and an almost greenish colour on its legs and under parts. The antennae are shorter than the usual *Hemideina* antennae.

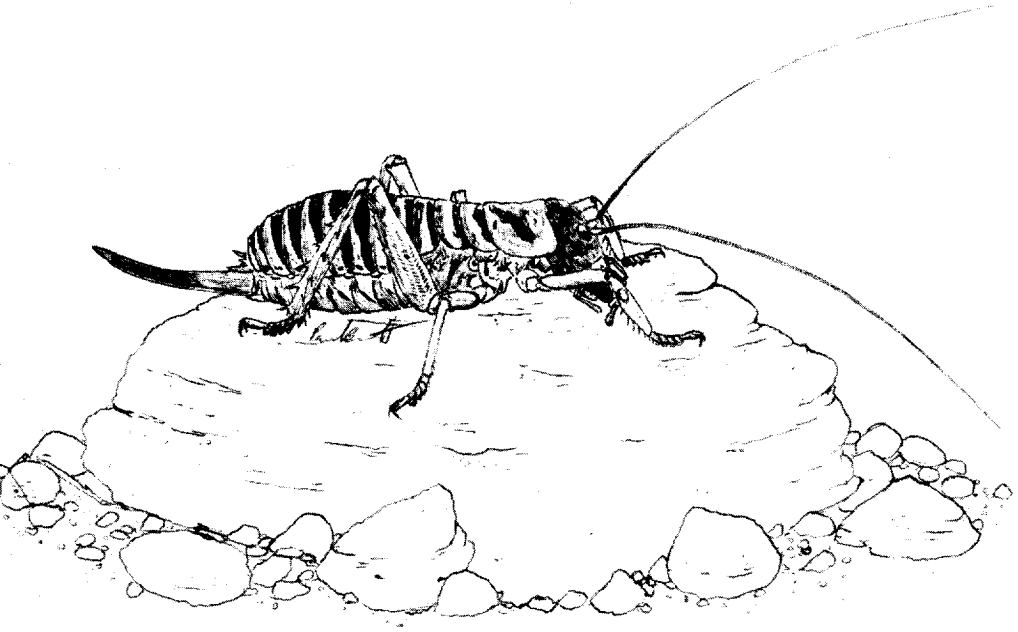
Hemideina maori is a ground-dwelling species hiding under stones, wood and debris beneath low shrubs. It does not raise its hind legs above its head in the same way as do other *Hemideina* and *Deinacrida* wetas.

Housing

I received four specimens - one adult female and 3 nymphs of differing ages. Each weta was housed individually in a 2 litre plastic ice cream container. If more adults had been available I would have used the usual glass tank with steel lid housing that I use for most of the wetas I keep. The plastic containers proved quite satisfactory and the wetas settled down quickly.

Soft friable soil was spread to a depth of 25 mm for the nymphs, and 50 mm for the adult female. Leaf litter was sprinkled on top and pieces of bark and some stones were added. Climbing material such as *Coprosma* sprigs was added and freely used by the wetas. The sprigs were also useful in providing a substrate for the nymphs to cling to during ecdysis.

Fig. 4 The ground hemideina
Hemideina maori (Pictet and Saussure, 1891)



Environmental Conditions

The temperature requirements were the same as those of other *Hemideina* wetas. A temperature range of 9 to 25°C was quite satisfactory and humidity was kept at between 60% and 80%. 1 feel this species may be able to tolerate dryer conditions. The plastic containers were sprayed briefly every 2 days in summer and every 5 to 6 days in winter. The above conditions and fittings could have been duplicated easily in a 60 cm by 30 cm by 30 cm glass tank.

Food

Hemideina maori eats the same food as other *Hemideina* wetas. It is omnivorous and eats a reasonable amount of insect food. I found the following food items were willingly consumed by *Hemideina maori* - taupata, ngaio, mahoe, plantain, *Hebe,* willow and karamu. Dead leaves and bark were also eaten as were some flower petals *(Ranunculus* sp.*)* and fruit (apple). This weta also ate cabbage.

Insects consumed included mealworm larvae, caterpillars, moths, and crickets. Water was provided by spraying the foliage fed to the wetas. Cotton wool wads were not necessary in the small 2 litre plastic containers.

Behaviour

Although its defensive behaviour suggests that *Hemideina maori* is an aggressive weta, this is not so. Normally it is very placid and will tolerate handling very well. I found it quite endearing. The male nymph behaved in a similar way to the females and he was no more assertive than they were. He may become more so when mature because this species has an enlarged head with formidable mandibles, but not to the extent of other *Hemideina* wetas.

Activity

With colder temperatures *Hemideina maori* showed the same slowing down process as did other *Hemideina* wetas. Although it was slow it did not become quiescent like the Mahoenui weta did. Although it is likely this species spends a considerable amount of time in this slow condition in its natural habitat, it does not seem to have any particular adaptation to cold conditions at least below 10°C. However at 10°C it was more active than other weta species. The species may be able to store fat longer in order to survive the long cold periods.

Movement

Hemideina maori is not a great climber and the adult female was not as confident in this as were the nymphs. The nymphs jumped a little but the adult was quite reluctant to use this form of behaviour. In fact it jumped even less than the Mahoenui Giant weta!

Feeding

This weta was a rather sporadic feeder. It would often not eat for two to three nights, then eat a small amount and then a large amount. There appeared to be no pattern regarding its eating habits. It would however sometimes eat insects freely when fed by hand.

Defence

The defensive behaviour of this species is very interesting. It does not raise its hind legs above its head in the same way that other *Hemideina* and *Deinacrida* wetas do, and has lost to some degree, the ability to do so. When provoked the hind legs will rise a short way up but otherwise the weta adopts different defensive procedures. It will usually raise the front and middle leg facing its attacker, and, with exposed mandibles, will then roll upside down if the provocation persists. In this inverted position the weta will then strike its hind legs towards its head producing a distinct

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