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THE BEHAVIOUR AND WEB STRUCTURE OF THE KATIPO *LATRODECTUS KATIPO*

by D.J. Court*

SUMMARY

The web structure of the female *Latrodectus katipo* Powell 1871 is described and related to habitat. The capture of prey by the spider is investigated and described. An illustration of the web is given for comparison with the webs of other members of the family Theridiidae.

INTRODUCTION

The katipo belongs to a genus of spiders which is very widely distributed throughout the world. Species are often hard to distinguish when morphological characters alone are studied. It is believed that there may be some speciation in the New Zealand forms (Forster pers. comm.) and the study of their behaviour as well as anatomy is desirable.

The katipo spider, at present regarded as one species *Latrodectus katipo,* is the only member of the genus that occurs in New Zealand. Katipos are to be found around most of the New Zealand coast, especially in the dunes behind ocean beaches. Parrott (1948) suggest that they do not extend further than three miles inland. On the east coast of the South Island the spiders are not found further south than Dunedin and no further south than Greymouth on the west coast.

The web of the male has not been studied by me, since I have found only adult males that had abandoned their webs. These had moved into the vicinity of the webs of female katipos.

MATERIALS AND METHODS.

The method of Szlep (1965) is generally followed. The webs in the field are usually fragmented or complicated by debris and it is easier to study the true form of the webs if the spiders are placed in observation boxes. It is assumed that little change in basic web structure occurs. The boxes used measured 60 x 20 x 25 cm., the longest measurement being taken horizontally. The floor of the boxes was covered with fine sand to simulate the habitat. One side of the box was of fine plastic sheeting so that activity of the spiders at night could be observed. Spiders were observed at night using an ordinary 1½V torch. Constant illumination of the spiders was possible for three minutes without any apparent effect on their behaviour. Longer periods however reduced the activity of the katipos, especially during web spinning. A small door was constructed in the plastic sheeting at one end for the introduction of live food.

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* Botany Department, University of Auckland.

The remaining three walls of each box were painted with matt black paint so that the individual threads would stand out more clearly for photographic purposes. The web was then sprayed with HC1 and NH_4OH vapours (Peters, 1937). The HC1 and NH_4OH vapours react to give a white condensate of NH_4C1 on the silk threads and makes the web more visible.

Katipos were collected from Muriwai Beach, Ocean Beach (Whangarei North Head) and Pakiri Beach. All specimens used belonged to the variety of katipo which at maturity has no red stripe on the posterior of the abdomen. Urquhart in 1889 described this variety as sub species *atritus*. A dull red hourglass shaped marking is ventrally situated on these specimens. The spiders that do possess the posterior red stripe also have the ventral marking.

HABITAT

Katipos are found in dune areas behind ocean beaches and live amongst the tussock grasses and sedges such as *Desmoschoenus spiralis* (pingao), *Spinifex hirsutus* (spinifex), *Ammophila arenaria* (marram) or in any debris offering shelter. During the day the spider is in retreat amongst the bases of the tussock or in vegetable debris which afford the only wind-still habitat above the surface of the sand; this position is essential for the avoidance of excess dehydration caused by wind and the high daily temperatures occurring on sand dunes.

Prey in these areas is very abundant and includes *Anisolabis littorea* (common beach earwig) and *Talorchestia tumida* (sand-dune hopper). The exoskeletons of *Anisolabis* may be found coating the outside of the retreat, together with a very densely spun layer of silk the retreat is rendered impervious to water. The waterproofing of the retreat is important, as during rainfall, most of the runoff from tussocks is directed to the centre and base of the tussock.

WEB STRUCTURE

The web consists of a retreat and a catching web. The retreat lies deep in the leaf bases of tussock grasses or in vegetable debris. It is elaborated to form a blunt-ended tube. The walls are of closely interwoven silk and form an opaque and waterproof enclosure. Exoskeletons of the prey are sometimes fixed to the retreat walls. Captive spiders build their retreat near the ceiling of the cage and do not spin a closely woven retreat.

The catching web of the katipo is an extension of the retreat and consists of three layers. The two upper layers are in a horizontal plane. The lower layer is spun in a vertical plane. The retreat enlarges gradually to form the main lattice platform on which the spider rests in wait of prey during darkness.

The upper layer consists of a network of large meshes and is attached to the ceiling and walls. It supports the lattice platform and middle layer. The platform extends in all directions to form the middle layer which is a network of small meshes.

Vertical threads make up the lower layer and these may be attached to the substratum from either of the above layers. Up to fifty vertical threads have been observed. In the cages, these catching threads were also attached to the walls. Both these threads and the outermost catching threads may be inclined at an angle of up to 45^{0} from the vertical. The ends of the catching threads are coated with viscid droplets. The droplets begin where the thread is attached to the substratum and continue one to two centimetres up the thread. Crawling insects that touch the threads adhere to these viscid droplets. (Fig. 1).

The webs are not renewed every day but are enlarged as the spider grows. Normal activity of the spider causes the meshes of the lattice platform to become smaller and the silk more densely woven.

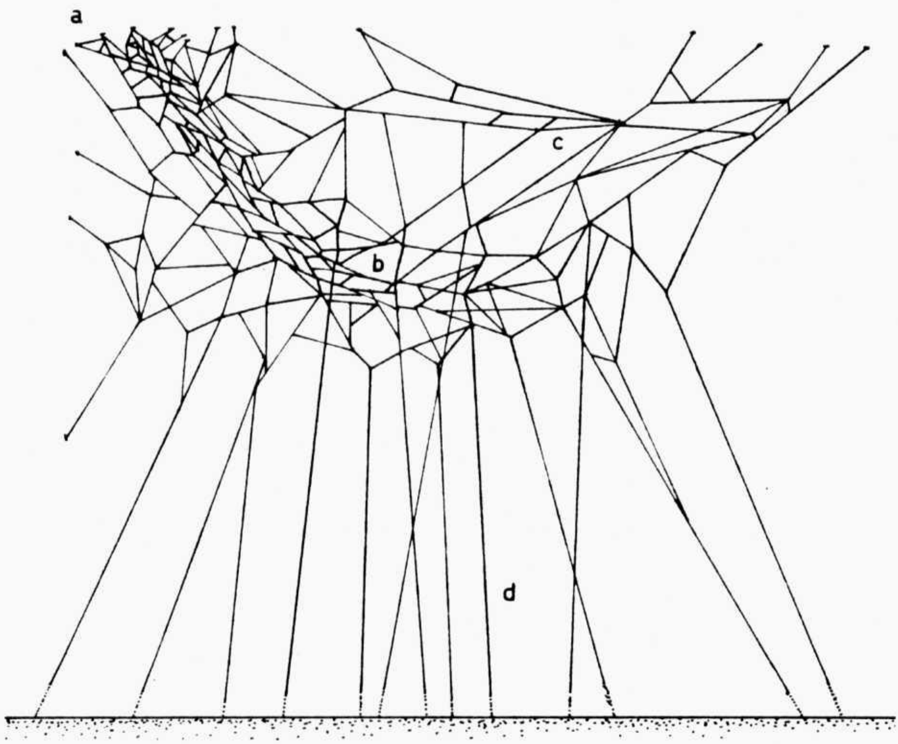

FIG.1 **Schematic diagram of web constructed in cage.**

a) Un-elaborated retreat.

b) Lattice platform with middle layer radiating from platform.

c) Upper layer with large-meshed network of threads.

d) Lower layer of vertical viscid threads.

THE WEB-SPINNING PROCESS

The katipo constructs its web at night and in early morning. When the web of the captive spiders is destroyed, the whole web may be renewed overnight.

During web-spinning, the spider is far more sensitive to torchlight than when capturing prey and observation of the spider was difficult. When the spider was disturbed by the light, the spinning would sometimes cease for an hour.

When first introduced to the cage, the katipos explored the cage and took up a position on the ceiling. This position marked the location of the future retreat.

Small bead-like dots of silk are attached to the ceiling; these form a firm anchorage for the following web construction. The upper layer of the web is then spun. Threads are attached to the ceiling and cage walls. Some vertical threads are spun and attached to the substratum during the construction of the upper layer. Further web-spinning activities have not been observed.

Szlep (1965) states that "the webs of the genus *Latrodectus* consist of three web layers, with vertical viscid threads, and possess more or less regular structures in the middle layer of the catching web. The regular structures are built at a late spinning stage and they result from spinning activities that are stereotyped to a certain extent".

CAPTURE OF PREY

Prey may be caught in any part of the web, but the snare is designed to catch a small invertebrate moving on the sandy substratum. These small animals brush against the vertical threads and adhere to the viscid droplets on their lower ends. The threads have been drawn tight when spun and so are under tension. The moment the thread is dislodged from the substratum the tension is transferred to the prey. Small insects that cannot resist this tension are pulled up into mid-air by the contraction of the thread and are then dealt with easily by the spider.

Larger insects such as *Anisolabis* are powerful and can tear free if the spider does not descend and attach further threads to the prey.

The swathing process later mentioned is associated with the prescence of a comb on the ventral surface of the fourth tarsus on each of the rear pair of legs. This comb is made up of a row of serrated spines that are used in teasing silk from the spinnerets.

To illustrate better the ensnaring process, several observed captures are described.

Capture of a small *Porcellio scaber* (slater). (Fig. 2.)

A small slater is introduced to the cage. When moving along the bottom of the cage the slater strikes a vertical viscid thread and a leg becomes attached. The stimulus imparted by the tensioned thread causes the slater to attempt to move away. The resulting movement of the web alerts the spider which then

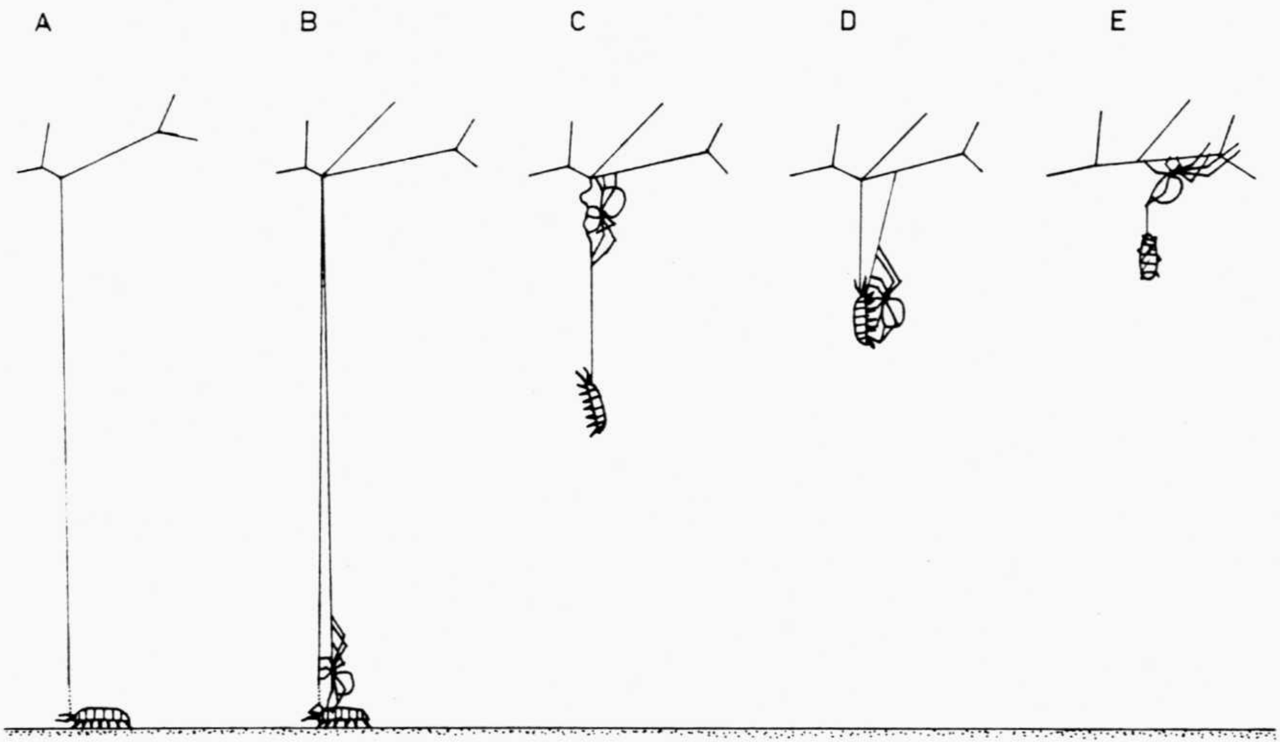

FIG. 2 **Capture of a small slater.**

a) Slater contacts vertical thread.
b) Thread is attached to slater.
c) Katipo pulls slater up to lattice platform.
d) Slater is secured to lattice, wrapped and bitten.
e) Prey attached to spinnerets and is carried into the retreat to be comsumed.

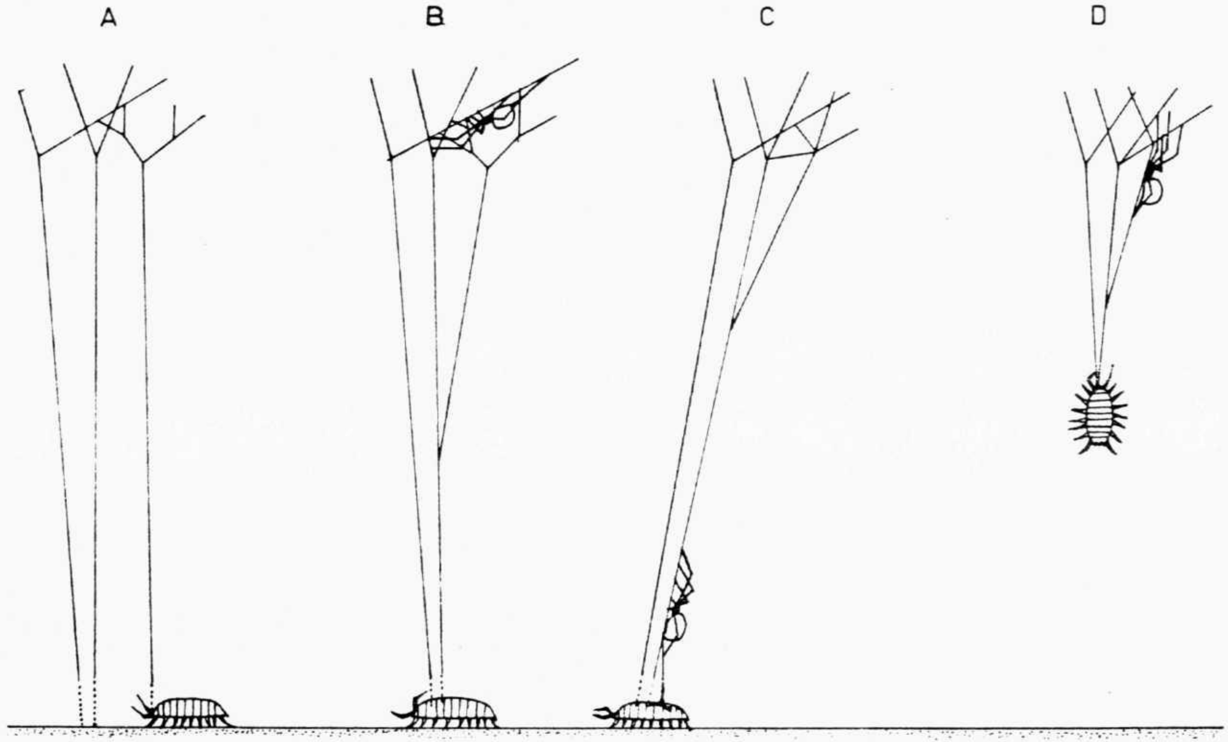

FIG. 3 **Capture of a large Slater**

a) Slater contacts vertical thread.

b) Struggling slater touches further vertical threads.

c) A thread is lead from a viscid smear of silk stuck to the slater, and pulled tight and fixed to the lattice.

d) Prey is lifted off substratum by the tension combined in the vertical threads. The slater is then lifted up to the lattice.

emerges from the retreat and takes up station on the horizontal lattice from which the vertical threads are suspended. The spider then rapidly determines the position of the appropriate vertical thread and then moves to this thread and drops down towards the prey. The two front pairs of legs are used as tactile organs to assess the size of the prey. A thread is then attached to the slater and the spider climbs back up to the lattice. One hind leg applies a tension on the newly spun thread as the spider ascends and the thread is fixed to the lattice. The slater is now pulled off the substratum and the slater pulled up to the lattice by a hand over hand action of the front pair of legs. Once secured to the lattice, the slater is wrapped in silk teased out from the spinnerets. When the slater is securely entrussed the spider bites into a soft part with its fangs, the bite being very prolonged. Digestive juices are then extruded from the mouth and resorbed as external digestion converts the tissues of the slater to a fluid.

Capture of a large *Porcellio scaber* (slater). (Fig. 3)

A large slater is introduced. It strikes a vertical thread and moves away. The spider is alerted and takes up station on the lattice. With the tension of the vertical thread imparted to the carapace, the slater struggles vigorously and contacts several more verticals. The spider now descends to the substratum and casts a thick smear of viscid silk over the slater. A thread is lead from the viscid silk, pulled tight and secured to the lattice. This last process is repeated for so long as the slater is still mobile. With one large slater this fixing procedure took place eight times but, for the second and following fixings, the threads are teased out on to the slater rather than the production of further viscid smears. The threads are teased out on to the slater by the rear pair of legs whilst the spider is supported by the most anterior pair.

Capture of a large, fast moving earwig. (Fig. 4)

A large *Anisolabis* (earwig) is introduced. The earwig strikes a vertical thread and keeps moving after hitting further threads. Although these threads adhere, the earwig is still able to continue a straight course. The katipo picks up movements in the lattice corresponding to the contacted vertical threads. The spider then drops down to the substratum. The earwig in the meantime is pulling the threads to one side so that the katipo is not able to touch the prey. A new tactic is then employed by the spider. While still suspended by its newly spun vertical thread the spider moves round on the substratum in a circular course. This operation gives the spider a better chance to encounter the prey. When there is no result, the spider climbs back up to the lattice to take up station again.

A more accurate estimation of the position of the prey is made and the spider drops down and along a thread actually adhering to the earwig. A viscid smear of silk is attached to the earwig and capture proceeds as described for the large slater in the second example.

When the earwig is trussed securely but still struggling, bites may be administered by the spider while the prey is quiescent. With the effects of the venom the earwig presently becomes helpless.

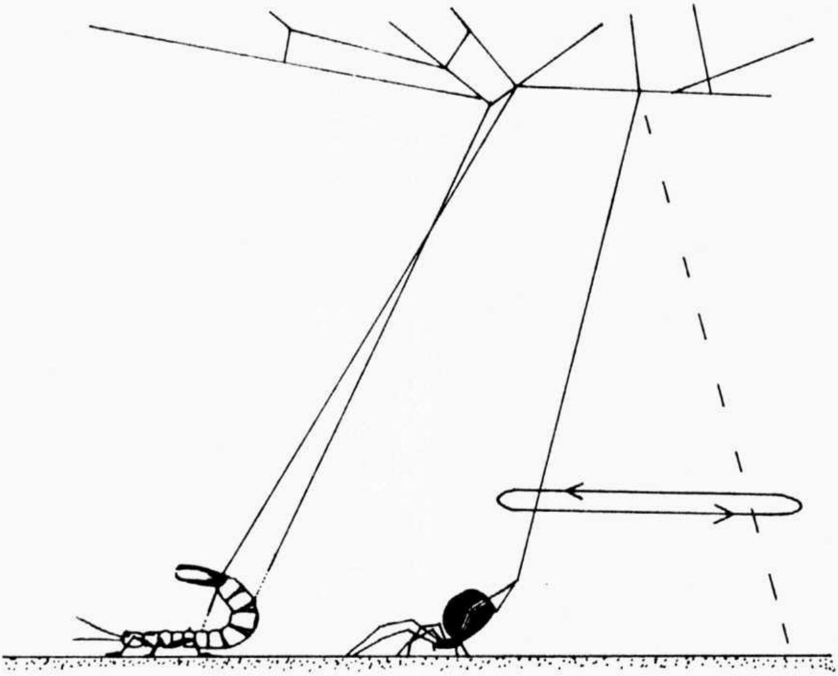

FIG. 4 **Katipo searching for ensnared prey.**

DISCUSSION OF CATCHING BEHAVIOUR

The capture of prey is according to a stereotyped pattern. With small insects, a whole catching cycle may be completed by one phase of activity following another upon the reception of suitable stimuli received in order. For example the vibrating vertical thread stimulates the spider to come out from the retreat, on to the lattice and down to affix a thread to the prey. When the spider finds the prey to be immobilised or secured, wrapping and lifting takes place.

Larger invertebrates, because of their repeated struggles, cause the spider to go through repetitions of the stereotyped patterns. This is shown by the repeated fixings of vertical threads stretching between prey and the web lattice.

When threads are pulled tight, during both the construction of the web and capture of prey, the silk is tensioned by the spider using one of the hind legs as a drag. Silk cannot be pulled tight directly from the spinnerets as the protein constituting the thread is still liquid over a short zone after being drawn from the spinnerets.

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