Forest and Timber Insects in New Zealand No. 47

Insect Parasites of Sirex
(This leaflet should be read in conjunction with No. 20 Sirex and No. 48 Nematode parasite of Sirex)

Based on M.J. Nuttall (1980)

Insect: (Hymenoptera: Ichneumonidae, Ibaliidae, and Orussidae)

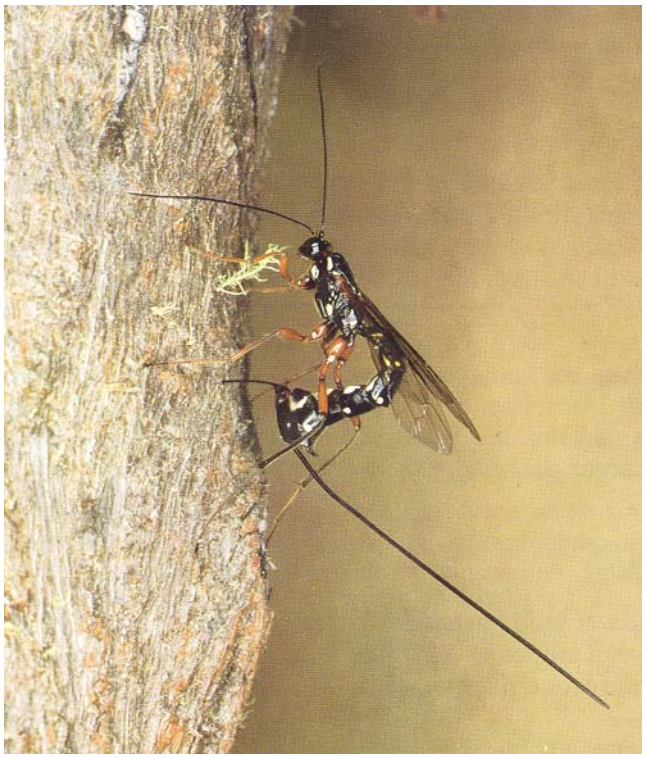

Fig. 1 - *Rhyssa persuasoria persuasoria* drilling into a radiata pine tree to sting, paralyse, and lay an egg on sirex larva. The ovipositor (entering the wood between the middle legs) is as long as the ovipositor sheaths which project to the rear.

Type of injury
As described in leaflet No. 20, the sirex woodwasp *Sirex noctilio* Fabricius, a European insect accidentally introduced into New Zealand before 1900, inserts eggs, mucus, and fungus into the wood of living pine trees and occasionally into larch and spruce. The combined effect of the mucus and fungus may kill susceptible trees. The sirex larvae tunnel for 1 or 2 years in the fungus-affected wood, pupate, and emerge during the summer as winged adults.
Larvae of certain parasitic insects destroy sirex larvae but cause no further damage to the tree; the holes made by adult parasites when emerging are also of no importance since the trees, or parts of trees, in which they occur are already dead as a result of successful sirex attack.

Hosts
In New Zealand sirex is the only host of the established introduced parasitic insects *Rhyssa persuasoria persuasoria* (Linnaeus), *R lineolata* (Kirby), and *Megarhyssa nortoni nortoni* (Cresson) (Hymenoptera : Ichneumonidae), and the two subspecies of *Ibalia leucospoides* (Hochenwarth) (Hymenoptera Ibaliidae).

Sirex larvae are sometimes also attacked by the native parasite *Guiglia schauinslandi* (Ashmead) (Hymenoptera : Orussidae), although the usual hosts of this parasite are larvae of pit weevils *(Psepholax)* and a longhorn beetle *Stenopotes pallidus* Pascoe.

Distribution

Rhyssa persuasoria persuasoria was deliberately introduced as a control measure from Europe in 1928-29 and in 1931, and is well established throughout our exotic pine forests.
Rhyssa lineolata from North America was first discovered in New Zealand in 1955 and probably entered the country accidentally in timber cut from woodwasp-infested trees. It is known to be naturally established in six forests in the southern half of the North Island, and has been recovered from Waitangi following release in the forest there.
Megarhyssa nortoni nortoni was deliberately introduced from North America in 1962 and 1964 and was first liberated in 1964. It is known to be established in 21 forests.
lbalia leucospoides leucospoides, deliberately brought from Europe in 1950 and 1951 and first liberated in 1954, is. well established almost everywhere sirex occurs in New Zealand.
lbalia leucospoides ensiger a subspecies from North America, was first released in 1966 and has been recovered from seven forests. It interbreeds with the already well-established *I. leucospoides leucospoides.*
Guiglia schauinslandi probably occurs throughout New Zealand wherever its hosts are present.

Economic importance

The complex of introduced parasitic insects may kill over 70% of sirex larvae in a particular forest area. *Guiglia schauinslandi* parasitises few sirex larvae and is of little significance. (Other factors controlling sirex are the presence of a nematode worm which can sterilise the sirex female, and most importantly, good forest management to encourage vigorous growth of trees and thereby increase their resistance to sirex attack.)

Description

All the insect parasites have two pairs of veined, transparent, membraneous wings. The females have a thin, flexible ovipositor (egg- laying drill), the walls of which consist of three parts. These parts fit together along their length to form a tube down which the egg passes. Two of the parts, which run in grooves in the third part, are serrated at the tip and act as vertical saws. The size of the adult parasite depends on how large the parasite larva was able to grow, and this in turn is determined by the size of the host sirex larva.
Rhyssa persuasoria persuasoria (Fig. 2) has a black body with spots of white on the head, thorax, and abdomen. These spots vary in size and number for some individuals appear almost wholly black. The legs are reddish brown, and the antennae completely black. Body length (measured from front of head to end of abdomen) can be from
9 mm in the smallest male up to 35 mm for the largest female. The ovipositor is slightly longer than the female's body and when not in use projects straight out behind her enclosed between two protective sheaths. The male has an elongated abdomen slightly swollen towards the rear.

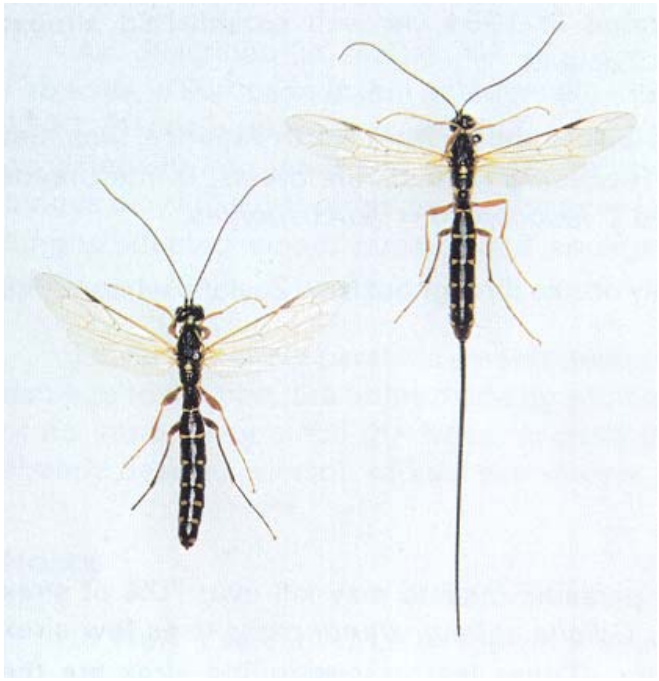

Fig 2 - *Rhyssa persuasoria persuasoria* adults: male on the left, female on the right.

Rhyssa lineolata (Fig. 3) is similar in size and shape to *R. persuasoria persuasoria* but the white markings are more numerous. A distinctive feature on all specimens except the very smallest males is the white band just past the middle of each antenna.

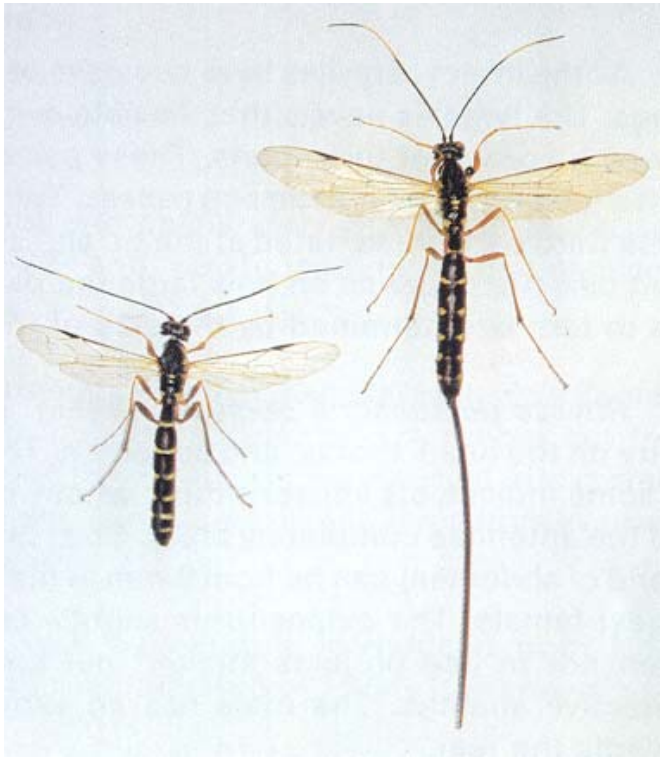

Fig. 3 - *Rhyssa lineolata* adults: male on the left, female on the right.

Megarhyssa nortoni nortoni (Fig. 4) is brown, black, and yellow, and has a row of oval yellow spots along each side of the abdomen. Legs are mostly yellow or light brown, and the antennae are all black. Body length can range from 15 mm to 45 mm. The ovipositor is similar to that of

Rhyssa but is about twice as long as the body. The abdomen of the male is usually long and narrow, but in very small specimens it becomes slightly swollen.

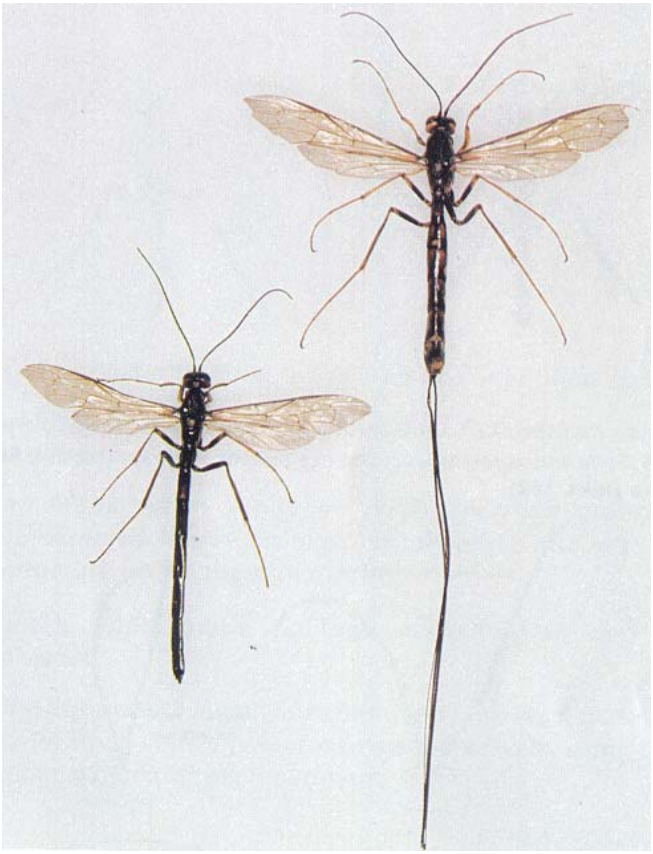

Fig. 4 - *Megarhyssa nortoni nortoni* adults. male on the left, female on the right. Actual size.

Ibalia leucospoides leucospoides (Fig. 5) has a dark brown abdomen and black head, thorax, legs, and antennae. The body can be from 5 mm to 16 mm long, and the wingspan 8 mm to 23 mm. When not in use the ovipositor is retracted inside the body. The most distinctive feature of both sexes is the abdomen which is so flattened at the sides that when viewed from above it looks like the sharp edge of a knife. The abdomen of the male when seen side on is, however, less angulate than that of the female (Fig. 6). The male also has a small notch on the outside edge of each antenna where it joins the head.

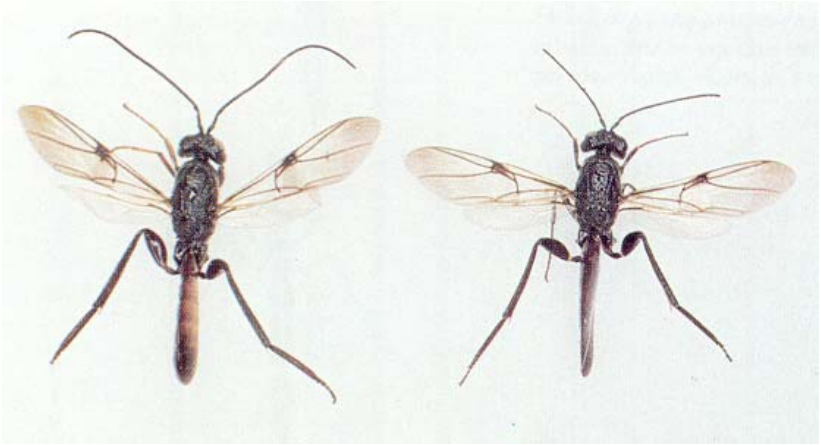

Fig. 5 - *Ibalia leucospoides leucospoides* adults: male on the left, female on the right.

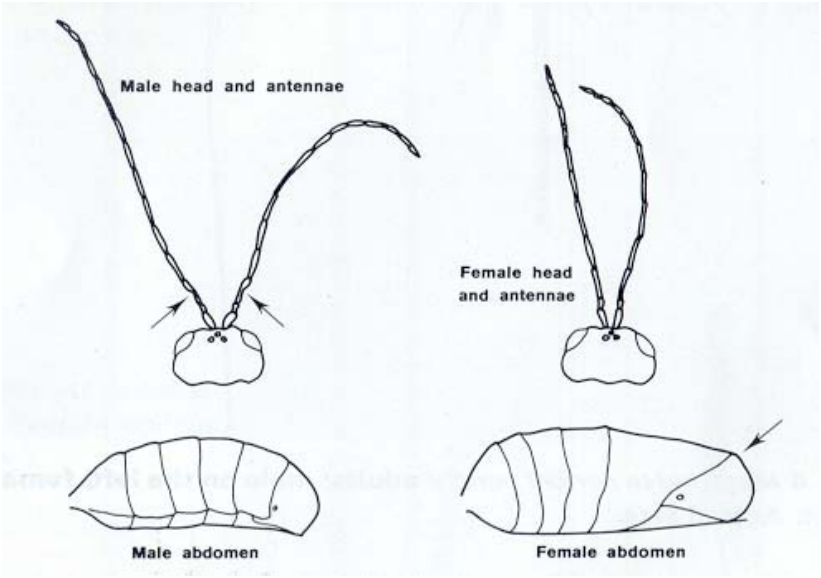

Fig. 6 - *lbalia.*- top view of heads and antennae, and side view of abdomens. Male has notch (arrowed) on outer side of third antennal segment. Abdomen of female is more sharply angled (arrowed) than that of male.

lbalia leucospoides ensiger is the same shape and size as *I leucospoides leucospoides,* but its abdomen is light brown. The females have a dark mark towards the top rear of the abdomen. Progeny arising from interbreeding with *1. leucospoides leucospoides* usually lack these colour differences.
Guiglia schauinslandi (Fig. 7) is stout bodied, black, and between 5 mm and 12 mm long. The end segments of the antennae of the female are more thickened than those of the male, and have a peg- like tip. The female can also be recognised by the groove for the retractile ovipositor on the underside of the last abdominal segment.

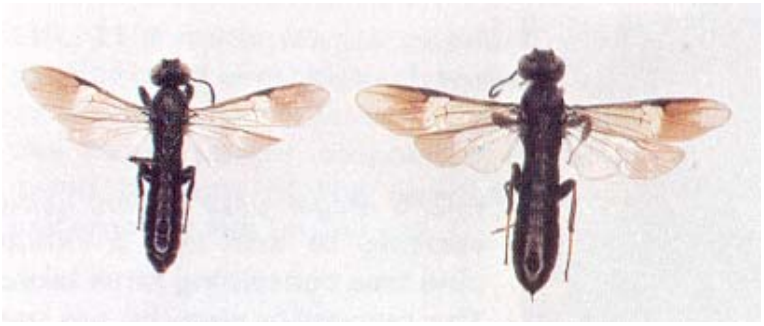

Fig. 7 - *Guiglia schauinslandi* adults: male on the left, female on the right.

Larvae (Fig. 8) present in sirex tunnels can be identified as follows:

- *Sirex:* Cylindrical, yellowish-white grubs with rudimentary legs and hard, black tail spine.
- *Rhyssa* and *Megarhyssa:* White or yellowish-white grubs, somewhat tapered towards each end, no legs, no tail spine, and with a brown V- shaped structure under the mouth.
- *lbalia:* Smooth, white grubs, no legs, no tail spine, and with small horizontal jaws.
- *Guiglia:* White grubs with small horizontal jaws, no legs, no tail spine, and with a row of small spines (which can just be seen by using a hand lens) on the upper surface of each segment.

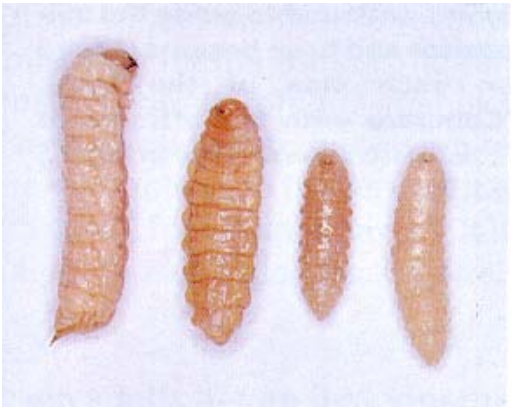

Fig. 8 - Larvae which may be present in sirex tunnels. From left to right *Sirex Rhyssa* (or *Megarhyssa*); *Ibalia;. Guiglia.*

Life history and habits

***Rhyssa* and *Megarhyssa*:** The rhyssine parasites are attracted by smell to trees which contain sirex fungus. The female drills randomly into the wood with her ovipositor until she reaches a sirex larva which she stings and paralyses (Fig. 1, 9, and 10). An egg then passes down her ovipositor on to the sirex larva. The egg can hatch in 2 days, and the parasite larva then eats the sirex larva; this generally takes about 5 weeks, but can take as little as 14 days.

Fig. 9 - *Megarhyssa nortoni nortoni* starting to drill into a radiata pine tree containing sirex larvae. The ovipositor sheaths are used to guide the ovipositor into the wood.

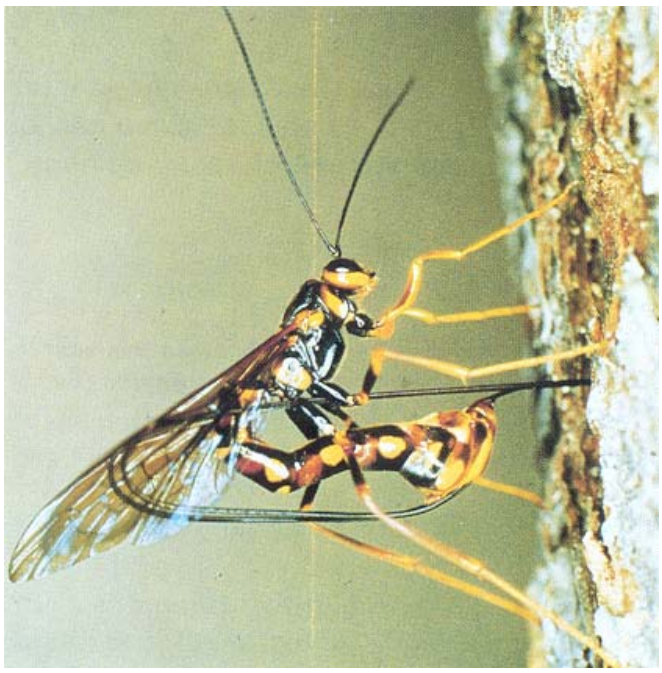

Fig. 10 - *Megarhyssa nortoni nortoni* with ovipositor almost fully in the wood. Note how the sheaths have continued t guide the ovipositor and have become looped on each side of the body. (Compare with the attitude of *R. persuasoria persuasoria* in Fig. 1).

The rhyssine larva does not bore in the wood, but remains in the sirex tunnel, usually for nearly a year, before pupating (Fig. 11). Adults bite their way out of the wood and most emerge in spring. Males start emerging slightly earlier than females and may sometimes be attracted to places on the bark where they expect a female to come out (Fig. 12). Some of the adults which appear in summer can be progeny from the same season's oviposition and may have spent as little as 8 weeks as larvae and pupae in the wood.

Fig. 11 - Female *Rhyssa* pupae. The ovipositor curls over the back to reach as far as the head. (in *Megarhyssa* female pupae the much longer ovipositor continues down in front of the head and bends underneath the body.).

Fig. 12 - Precopulatory activity by male *Megarhyssa* on bark of ponderosa pine at a spot where a *Megarhyssa* female later emerged.

The adult can obtain essential carbohydrate by eating the honeydew excreted by scale insects and aphids. In our pine forests the most common source of such food is produced by scale insects on "blighted" manuka *(Leptospermum scoparium).* Rhyssines may also feed on nectar, but owing to their chewing-lapping type of mouth they can take it only from flowers which have an open, flat shape. Without food adults may live for about 9 days, but if food is available not only is their life span increased to 1 o r2 months, but their egg-laying activity is also greater.
Not only sirex larvae but also pupae, and even adults before they emerge from the wood, can be parasitised by rhyssines.

***Ibalia*:** The female *lbalia* detects by smell a recent drill hole made by sirex when egg laying. She then lowers her ovipositor into the hole (Fig. 13), drills into the sirex egg, and deposits an egg into the body of the developing sirex larva. By the time the sirex larva hatches and bores into the wood, it has an *lbalia* parasite larva inside it. If the sirex larva has already hatched before discovery by *lbalia* it can still be parasitised provided it has not yet moved away from the egg laying site.

Fig. 13 - *Ibalia* female egg-laying down a drill hole made by a sirex female in living radiata pine. The triangular process pointing into the wood is part of the underside of the parasite which she lowers as a guide for her fine, hair-like ovipositor.

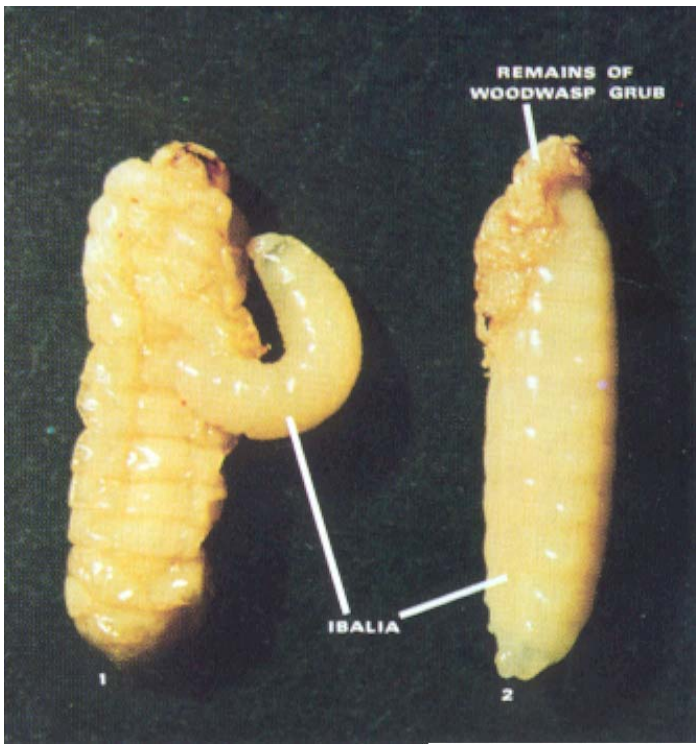

Fig. 14 - The first two and part of the third stages of growth of an *Ibalia* larva are spent inside the sirex larva. The third stage bites its way out (1), and eats the sirex larvae from the outside.

The *Ibalia* larva then sheds its skin to become a fourth stage larva (2) which remains in the sirex tunnel and pupates.

The *Ibalia* larva grows inside the sirex larva for several months, then bites its way out and eats the remains of the sirex larva (Fig. 14). It pupates in early summer, turns into an adult and chews its way out of the wood leaving a small round hole. As with the rhyssines, the males start emerging slightly earlier than the females (Fig. 15). Adult *Ibalia* live for several weeks, and although they can feed on honeydew they seem to manage quite well without doing so.

Fig. 15 - Male *Ibalia* around a recently cut hole through which a female later emerged. (xl.25)

The female *Guiglia* drills her ovipositor into the wood to find and lay an egg on a sirex larva (Fig. 16). The parasite larva starts eating the sirex larva from the outside (Fig. 17), but may enter its body and finish it off from the inside once decomposition has started. Adults emerge in spring and early summer and live for several weeks.

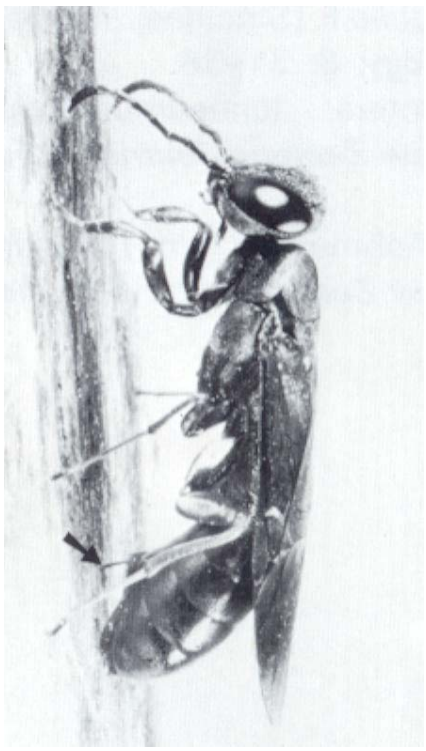

Fig. 16 - *Guiglia schauinslandi* drilling into a radiata pine tree containing sirex larvae. Ovipositor arrowed.

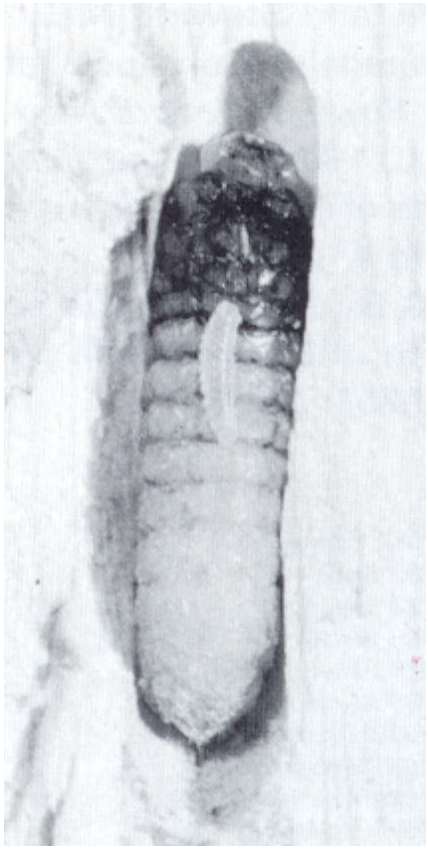

Fig. 17 - *Guiglia schauinslandi* larva eating sirex larva.

The sex of the progeny of the rhyssines, *lbalia,* and presumably *Guiglia*, is determined by fertilisation of the eggs: those laid by virgin females produce only males whereas both male and female offspring can be produced by mated females.
Multiple parasitism (when an individual host is attacked more than once by one or more species of parasite), or hyperparasitism (when one parasite attacks another parasite) can occur. Thus more than one *lbalia* egg can be laid inside a developing sirex larva, and a sirex larva, (which may also have been parasitised by *lbalia)* can have eggs laid on it by one or more rhyssine parasites or *Guiglia.* It is known that *Guiglia* can parasitise rhyssines, and that rhyssines can parasitise *lbalia.* However only one parasite adult emerges after multiple parasitism or hyperparasitism in sirex, the others being eaten or dying of starvation at some earlier stage in their development.

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