The Comparative Biologies of Certain New Zealand Cerambycidae

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SUMMARY

The life-histories of several cerambycid species are described and compared, the information recorded having been compiled from field observations and laboratory rearings. The duration of the life-cycle of any one species may show considerable variation, which appears to be influenced by the moisture content of the wood in which development takes place.

INTRODUCTION

The large family Cerambycidae, or longhorn beetles, includes species which attack living trees, species which feed in dying and dead trees and species which complete their development in wood varying from seasoned timber to that in different stages of decay. Those which attack living trees in New Zealand are fortunately few in number, though *Navomorpha lineatum* F. causes damage to Douglas fir by boring into, and eventually girdling, branches and sometimes the terminal portion of the main stem. *Oemona hirta* F. is a noted pest of unthrifty citrus and has become known as the "lemon tree borer", while *Ochrocydus huttoni* Pasc. damages the main stem of *Leptospermum* spp. Most species feed in the phloem and outer sapwood of dying and recently dead or felled trees. Some of these enter the wood at various stages of larval development, becoming true wood-borers, others enter the wood only to pupate, while some penetrate no further than the inner bark. *Sommatidia antarctica* White may exist entirely in bark scales while other species, immediately after eclosion, enter the wood in which they spend their entire immature stages. These latter species include *Ambeodontus tristis* F. the "two-toothed longhorn", one of the economic timber pests of New Zealand.

The purpose of this paper is to record observations made and experimental work done by the author on certain cerambycid species native to New Zealand. While admittedly incomplete, it is hoped that the information may have some value for workers interested in the Cerambycidae.

TECHNIQUES

In addition to regular field examinations, infested branches and small logs were kept in the laboratory. These were split along the line of larval activity and the pieces then placed together

and held in position by rubber bands or tape. They were kept in quart jars and larger rearing cages in which different moisture contents of the wood were maintained by varying the frequency and amount of water, added to each specimen. Monthly examinations were made and as larvae ceased feeding, several of each species were removed to glass tubes containing cotton wool so moistened with water as to provide a relative humidity within a satisfactory range. Development in the pupal stage was followed in detail.

General Development of Cerambycids

Individual life-cycles may vary both in the same and in different species. From a batch of eggs from one female of *Prionoplus reticularis* White, some larvae develop to adults in two years, most take three years, and some do not pupate in this time, though apparently under the same environmental influences. Of the environmental factors determining the duration of the life-cycle, water content of the wood was found to exercise an important influence. Laboratory work showed that where infested wood had a moisture content of 40 per cent. to 100 per cent., based on the oven-dry weight, larval development proceeded satisfactorily. In wood with a moisture content of less than 25 per cent., the larvae of *P. reticularis* died after one year, the first mortality recorded being just over three months from the date of eclosion. In branch sections where the moisture content of the wood was 29 per cent., *Tetrorea cilipes* White and *Hexatricha pulverulenta* Wwd., emerged in two years and four months, but were significantly smaller than the average size of those reared in less than two years from wood with a moisture content above 40 per cent. It would therefore appear that wood moisture contents of less than 30 per cent., both increase the length of the life-cycle and decrease the adult size of cerambycids which develop therein. Moisture contents below 25 per cent are eventually lethal to the larvae of *P. reticularis*. It was also found that increasing the moisture in tubes where pupae were developing resulted in deformities associated with the inability of the adult to shed the pupal exoskeleton properly. In most instances recorded, the elytra and wings were affected but occasionally a leg did not complete development. Pupal mortality increased under conditions of both high and low moisture. In the former, fungal moulds appeared to be the main factor involved, while in the latter it was desiccation.

The eggs of cerambycids are white to cream-coloured when laid, but those of a few species may darken later. They are usually two to three times as long as wide and elliptical in shape. Those species which lay eggs in batches, such as *P. reticularis,* have eggs that appear somewhat straight-sided and pointed on the ends. When laid singly they are elliptical and about 3 mm x 1.2 mm. The eggs of *T. cilipes* are white when laid and have conical ends.

Most of the species which lay their eggs under bark scales and along bark crevices have eggs in which the contents do not fully expand their chorions. These eggs take on the shape of the crevice in which they are deposited.

The incubation period of eggs varies between 14 and 30 days, depending on the species. In most cases, eggs laid by one female on the same day hatch within four days of one another. Hatchings of a single batch of eggs of *P. reticularis* are sometimes spread over two weeks.

Larval development in the species studied occupied one to three years and the pupal period was 15–25 days. In general the pupae undergo the same stages of development irrespective of the species. The pupal chambers were all found to be constructed along the longitudinal axis of the infested wood and the pupae were orientated with their heads towards the top of the tree and their dorsal surfaces toward the centre of the tree. If the infested wood was lying on the ground, the dorsal surfaces of the pupae were toward the ground. Pupae, held in tubes, usually rest on their backs, but regular movement on to their sides and back again was observed. Pigmentation commences in 5 to 9 days when the eyes become pink, gradually darkening to black in a further 5–12 days. The order of pigmentation of other parts are mandibles (commencing at the tips), leg and tarsal joints (commencing with the joint of the femur and tibia), pronotum, claws, other thoracic sclerites, ventral abdominal sclerites, pygidium, elytra and head. The final ecdysis occurs during pigmentation, usually a few days after the eyes become black. In 12-24 hours following the moult, the wings and wing cases are expanded to full size, and in 2–4 days reach full pigmentation.

Following the final moult, the adults continue development for 5–14 days, the enlarged abdomen being last to retract to its final size. The beetles then remain in their pupal chambers for two or more days before commencing emergence from the wood. In certain species which pupate in the autumn and early winter, the adults overwinter in the pupal chambers.

Habits of Some Adult Cerambycidae

The New Zealand Cerambycidae include species which attack a wide range of tree species as well as species which have a restricted host range. *Prionoplus reticularis* and *Stenopotes pallidus* Pasc. attack a number of conifers but have not been recorded from hardwoods. *Didymocantha* spp. are restricted to the southern beeches (*Nothofagus* spp.), *Coptomma variegatum* F. has a wide range of hardwood host species, while *Hexatricha pulverulenta* attacks both conifers and hardwoods. The latter, which was once common in mixed podocarp/beech forests, has moved into

man-made pine forests where it develops in the phloem/cambial tissues of dead pine trees and logs (Gourlay, 1951).

Activity patterns of most New Zealand longhorn beetles are related to decreasing light intensity. *Sommatidia, Tetrorea* and *Hexatricha* emerge in the warmest part of the day, but apart from crawling on tree trunks are mainly sedentary during daylight. Pairs of *P. reticularis* have been found mating under pine logs during the day and *T. cilipes* has been observed chewing the soft bark around buds of *Griselinia littoralis* Raoul at midday. If disturbed during daylight, cerambycids will stand and defend themselves or crawl away, but will seldom fly. In the evening they are most active and will fly off at the slightest disturbance. Most species apparently mate following evening emergence and the females deposit most of their eggs on subsequent nights. Adults could not be induced to mate in glass tubes. In most cases the sexes fought and damaged each other. Mating did occur in large tins and fertile eggs were laid. In general the number of eggs laid under laboratory conditions was fewer than that recorded in the field, and it would appear that there may be a conditioning flight period necessary before significant oviposition occurs. Each male and female may mate several times before females oviposit. Oviposition habits vary both in the sites selected and in the number of eggs deposited together.

P. reticularis commonly lays large batches of eggs under loose bark, between recently sawn boards and other timbers stacked together, and smaller batches in the exit holes and entrance tunnels of the larger wood-boring insects. Most of the species studied place only a few (usually 1–3) eggs together but sometimes a number are laid in a line along bark-fissures or wood-checks. A few species, including *A. tristis,* may re-enter their own pupal chambers to lay 1–5 eggs, while females of *Tetrorea* spp. sometimes chew small patches of soft bark and oviposit one or two eggs in such roughened bark on twigs and small branches. A female of *P. reticularis* may lay up to 120 eggs while single females of *T. cilipes* and *S. pallidus* usually lay between 40 and 60 eggs each.

Specific Life-cycles

Sommatidia antarctica White. Adults commence emerging in late December and continue to early February. The eggs are laid in roughened bark of rimu (*Dacrydium cupressinum* Soland.) and other softwoods and hatch in 14–20 days. The larvae feed within the bark scales and pupate at the end of their tunnels in prepared pupal chambers in late October and November. The pupal period to the moult averages about 16 days, and adult development continues for 5–8 days. Emergence of adults from the bark occurs variously up to 34 days following the commencement of pupation.

Adults of *S. antarctica* have been reared from *Pinus radiata* D. Don., *Podocarpus spicatus* R. Br. and *P. dacrydioides* A. Rich. in addition to rimu. As it is round in cross-section through the abdomen, this species constructs round exit holes in contrast to those of many other longhorns.

Stenopotes pallidus Pascoe. Earliest recorded emergences were in late September, though most adults emerge between early December and late January. Mating has been observed on tree trunks during the evening and eggs are deposited in bark crevices under the raised edges of the bark. The incubation period ranges between 15 and 26 days, most hatching occurring in 18–21 days. The larvae feed for some time in the phloem/cambial tissues of dying, dead and recently felled trees. They enter the wood about half-way through larval development, becoming wood-borers. Their tunnels are packed tightly with frass. Pupal chambers are constructed in the wood and open to the inner bark. The pupal and teneral adult period ranges between 27 and 32 days. This species has been reared from *Podocarpus totara* D. Don., *P. ferrugineus* D. Don., rimu and larch (*Larix* spp.).

Development from egg to adult takes about 14 months, so that overlapping broods may occur in this species. The spring-laid eggs apparently produce adults in late summer about 14 months after oviposition, and late summer and autumn eggs give rise to adults in the spring 18–20 months later.

Hexatricha pulverulenta Wwd. The adults of this lamiid emerge from late September to December. They are sedentary during daylight, often on the trunks of trees, but become active towards early evening. Mating and oviposition have not been observed, but by tracing back along larval tunnels in the bark, oviposition sites have been found. The females of this species appear to chew a groove along existent bark fissures or around the edge of bark scales and then to deposit one or two eggs in this groove. Jeffreys (1939) has described the morphology and certain of the habits of this species in greater detail than given here. The larvae feed in the phloem, eventually penetrating the outer sapwood as they grow. They pack their tunnels tightly with frass and prepare large, broadly-oval pupal chambers which are almost opened to the outside so that the adults chew away very little bark when ready to emerge. The exits are round, with ragged edges. The pupal period varies from 18 to 25 days, followed by 5–12 days of adult development, and emergence from the bark takes place 2–8 days following complete metamorphosis.

While the incubation period has not been established, the period from adult emergence to early larval activity of the new brood indicates that this is between 14 and 26 days, depending on the

temperature, as it is in *S. pallidus*. This species has either a one- or a two-year life-cycle from a single oviposition. The period from oviposition to adult emergence being apparently similar to that for *S. pallidus*. It attacks dead and dying trees of silver beech (*Nothofagus menziesii* Oerst.) and hard beech (*N. truncata* Cock.) as well as *Pinus radiata*.

Tetrorea cilipes White. Though this species has been reared from the trunks of lower canopy or secondary hardwoods such as *Nothopanax arboreum* Seem. and *Griselinia littoralis*, it is apparently more common as a twig and small branch borer. The larvae often feed along the line of the pith, the tunnel, in contrast to those previously described, being kept relatively clear of frass for some distance behind the larva. Pupation takes place in a section of the tunnel almost opened to the outside and lightly blocked off at both ends by coarse wood frass. The adults emerge from November to late January and eggs are laid singly or in twos and threes in small patches of chewed bark on twigs. The incubation period varies between 16 and 25 days, averaging about 19, and, as in *H. pulverulenta*, some adults emerge in one year and others in two years. The pupal and adult development periods together average about 28 days, with a range of 24 to 36 days.

T. maculata Broun is a twig and small branch borer in silver beech, but the larvae construct a meandering tunnel in the wood and pupate in the wood just below the bark.

Didymocantha picta Bates and *D. quadriguttata* Sharp have been reared from all the species of *Nothofagus*. They usually have two-year life-cycles, but some take longer where moisture is critical. Late-stage larvae have been kept for three years in wood with a moisture content of 22 per cent (based on the oven-dry weight) without completing development. Adults emerge from late August in warm sites to January in cooler sites. The eggs are laid in bark crevices in a similar manner to that described for *S. pallidus* and the incubation period is also comparable. The early larvae may spend some time in the phloem, while others enter the wood at a relatively early stage of development. Feeding ceases and pupal chambers are constructed in the summer of the second year. Pupation occurs from April onward, and fully developed adults can be found in the wood in June. The pupal chambers are often relatively deep in the wood with exits into the bark. The pupal and teneral adult periods together average about 34 days, but adults may not emerge for several months.

Prionoplus reticularis White, the Huhu, usually has a three-year life-cycle, but a few adults may emerge in two years while other larvae of the same brood may not pupate for more than three years. The adults emerge from the dead and decaying wood of a variety of softwood species, peak emergence occurring in November and

December. The eggs are usually laid in large batches under loose bark, between pieces of stacked freshly-sawn timber, and in exit holes of wood-boring insects. They take 16–25 days to hatch. Larval activity in pine is such that layers of summer wood may be removed in curved sheets due to destruction of the soft spring wood. Pupal chambers are constructed from August onward, and most pupation takes place in October and November, the pupal period being about 20–24 days, followed by 10–14 days of adult development. Adults emerge two or more days later. Late stage larvae prepare emergence tunnels into the bark.

Blosyropus spinosus Redt. From limited observations and collections it would appear that this species has a similar life-history to that of *P. reticularis,* differing mainly in the time of pupation and main emergence, and in the construction of pupal chambers. Adults have been taken from dead "grass trees" (*Dracophyllum traversii* Hook. f.) in June. Examination of the workings of the larvae show that the eggs are laid in the tops of the dead grass trees. Tunnelling proceeds downward until the large pupal chamber is constructed in the base of the stem at, or slightly below, ground level. These chambers open to the outside but are blocked by a loose plug of coarsely chewed wood that has not passed through the alimentary tract. Emergence begins in late August, though emergence from red beech (*N. fusca* Oerst.) at Reefton, has been observed as late as February.

Discussion

While some of the information given here has not been replicated, in most instances numbers of larvae and adults have been reared. Most species were also observed in the field, and the two sets of records have been combined for the timing of events in the life-cycles, to try to eliminate any effects peculiar to laboratory rearing. This has resulted in wider ranges for the incubation and pupal periods than laboratory rearings indicate. In the incubation of eggs of the several species reported, most hatching occurred in 16–20 days. In some instances where two eggs, laid on the same day, hatched a week apart, no environmental effect could be found to explain the difference. Thus it would appear that there is a natural variability in the incubation period of the eggs of some cerambycids, in addition to the effects of varying environment. Apart from initial hiding of the eggs by females, there is no care of eggs by adults. On eclosion the larvae chew through the chorion and directly into the bark or wood to which the eggs are attached. The length of the larval period varies considerably, resulting in a wide range in the time of pupation, particularly in the true wood borers. The average pupal period of about three weeks is followed by a varying period of adult development and an even more

variable period of resting within the pupal chambers. Some species such as *Didymocantha* spp. and *Blosyropus spinosus* appear to hibernate or overwinter in their pupal chambers, after completing metamorphosis. The adult life-span varies considerably with the species as well as with the sex. Some females of *P. reticularis* and *H. pulverulenta* have lived a month without feeding, others died within 15 days. In general males live between 5 and 12 days, though a few die in 2 days, while others live almost as long as the females. Adult activity is closely related to light intensity, decreasing with higher and increasing with lower intensities. Feeding by adults has rarely been observed. *Tetrorea* spp. chew soft bark around buds, and several species held in cages frequently visited water droplets on bark. It is, however, possible that daily feeding by New Zealand longhorn beetles is more common than these limited observations indicate. The adults are seldom sufficiently stimulated during the day to take flight, most prefer to stand and defend themselves or to walk or run away. Some, like *H. pulverulenta,* stridulate strongly on being picked up, and most can nip sharply with their mandibles. In the evening they are easily disturbed, take flight readily, and some, such as *P. reticularis,* make a loud buzzing noise during flight.

In the life-histories of the members of the three Cerambycid sub-families studied here, the incubation of the eggs and the pupal periods are comparable, having similar ranges. The main differences are in larval habits. Of note are the tissues eaten by the larvae, the length of the feeding period, and the mode of construction of pupal chambers and exit tunnels. On being disturbed all pupae exhibit strong activity by sharply flexing the abdomen. They also appear to move position frequently during development which may be related to easy removal of the pupal exoskeleton at ecdysis. The period of post-pupal maturation differs markedly, being longer in *P. reticularis* than in the others. The time a fully developed adult spends in the pupal chamber also varies, depending on the time of the year in which pupation takes place. It reaches a maximum in *Didymocantha* and *Blosyropus,* both of which appear to hibernate.

Acknowledgments

The identification of species were made by Mr. E. S. Gourlay, D.S.I.R., Nelson, and his wide experience of New Zealand Coleoptera was generously imparted and freely drawn upon. Messrs. J. Hardcastle and L. Newman assisted with collections and rearings, and H. F. Lower assisted by constructively criticising the manuscript.

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News Item

The following is an interesting observation recorded in a letter to the Editor by Mr. Norman Elder, 43 McHardy Street, Havelock North:—

"March 2, 1956, Ruahine Range, Otumore Ridge, at the head of the Tukituki River, at an altitude a little below 5,000ft. Clear weather with a light westerly breeze. White butterflies (*Pieris rapae* Linn) in considerable density, and some thousands in number, were concentrated along the lee side of the ridge on a front of perhaps half a mile, attempting to cross it in the face of the wind, but being blown back. The time was approximately 3–3.30 p.m."