

## THE BIOLOGY OF *MONOCHAMUS NOTATUS MORGANI* (Coleoptera: Cerambycidae<sup>1</sup>)

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About 1940, localized infestations of bark and timber beetles appeared in the Lumby district of the interior of British Columbia. The character of the outbreaks indicated that these insects were on the increase, and in several instances officials of lumber mills expressed concern over the loss which might be incurred. Recognition of the situation led the writer to make a biological study of the timber sawyer, *Monochamus notatus morgani* Hopping at Trinity Valley, B.C., from 1940 to 1944. In 1945, *morgani* was described as a subspecies of *M. notatus* Drury by G. R. Hopping (Proc. Ent. Soc. B.C., 42:17-18).

So far as is known this timber sawyer infests only western white pine, *Pinus monticola* Dougl. In several trials where a choice of hosts was provided oviposition took place only on logs of this tree. It has been known for a long time that these beetles will attack only certain trees, especially those which have been weakened in some manner or other. Various statements have been made as to what time must elapse after trees are cut before the logs become susceptible to infestation by sawyer beetles. At the height of the flight period in 1942, *M. n. morgani* was found attacking trees two days after felling.

The life history of the beetle in western white pine logs requires two years for its completion.

*Adult:* The ashen-grey, square-shouldered beetle with its long antennae is a conspicuous forest insect during July, August and September. Examinations of a number of logs in 1942 revealed that emergence extended throughout a period of 30 days, from about July 9 to August 10. The first adults were formed in the pupal chambers between July 2 and July 9. On the latter date the first two emer-

gence holes were located. The last adults emerged from heavily shaded portions of logs on August 10. Apparently the beetle lives for a considerable period of time as the last adults were seen in a weakened condition attempting to oviposit in logs on October 1. In the latter half of September the beetles were scarce and appeared only during the warmest periods of sunny days, usually between one and three o'clock in the afternoon. The majority of these were females. Adults kept under artificial conditions and provided with food lived for at least one month; many survived for 50 days or more. One female kept in a wire cage and fed on white pine branches lived for 82 days.

So far as we know the only food normally taken by the adult during its life is the outer bark and phloem of living twigs and branches of western white pine, Douglas fir, Engelmann spruce, western hemlock and western red cedar. White pine is preferred; cedar is eaten only occasionally. The xylem of attacked twigs is not eaten but it may be severely scored by the mandibles. Feeding occurs only after sunset. At that time nearly all adults fly from oviposition sites to standing trees close at hand. The height to which they fly may be 40 feet or more. In the latter part of September a small amount of feeding by old and weak adults sometimes occurs on the logs. When confined on cut logs, adults feed voraciously on the bark.

During the peak of the flight period the male is usually found in attendance with the female. Copulation occurs quite frequently immediately before and after oviposition, but once the female begins to form an egg scar, the male seldom intervenes until oviposition is completed. Males of *M. Oregonensis* have been observed in copulation and in attendance with females of *M. n. morgani* while the latter were depositing eggs.

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*Monochamus*, a sun-loving insect, prefers to lay its eggs on areas of logs exposed to sunlight. The presence of bark on the log is a prerequisite to oviposition, and thick bark rather than thin is preferred. The egg scars are not necessarily made in crevices as is often the case with other species of this genus. The type of scar made prior to oviposition is characteristic of both *M. notatus* and *M. oregonensis*. It consists of two punctures and a narrow slit, and is made as follows: selecting a place in the log where the young are likely to develop, the female begins to dig out a slit, invariably starting with the left mandible, the right mandible serving as a fulcrum which produces one puncture. Then the mandibles are switched to the left so that the left mandible forms a fulcrum (and the second puncture) while the right mandible completes the slit into which the ovipositor will eventually be placed. The depth of the punctures varies with the softness of the bark and the effort expended in digging out the slit. The slit is about 2 mm. in length, and the thickness of the mandibles in width. The bark dug from the slit is cast aside. Having completed the egg scar, the adult turns around, usually clockwise, and with the aid of tactile hairs on the end of the abdomen finds the scar into which she forces her ovipositor. Sometimes, after much effort, the egg scar is not located and she wanders off in search of other grounds to begin all over again. In most cases, the egg scar is made nearly parallel with the grain of the wood. Only one egg is deposited in each scar. It is placed in the soft succulent secondary phloem close to the cambium layer. No matter at what angle to the grain the scar is constructed, the egg is always placed with its longitudinal axis parallel with the grain of the wood. The phloem around the slit in which the egg is deposited soon turns brown making it easy to find the position of eggs when the bark, including the phloem, is peeled from the log.

*Egg*: The egg is elongate oval, with a tendency to be somewhat sausage-shaped.

The micropyle end is slightly flattened and depressed. Close to this end, the egg has its greatest width, and then tapers slightly towards the opposite end which is more pointed. The outer surface is very lightly but profusely patterned probably as a result of the impressions of the follicular cells. The length and width of the eggs are fairly constant, averaging 4.46 m.m. and 1.22 mm. respectively. Of 26 eggs examined, the length ranged from 3.34 to 4.81 mm. and the width from 1.12 to 1.28 mm.

The eggs hatch within 9 to 15 days depending upon weather conditions and position of the egg with respect to the amount of direct sunlight. Emergence of the larva takes place at the micropyle end, but somewhat on the side. The first signs of hatching are minute swellings on the surface of the egg, these being the outer manifestation of pressure applied by the mandibles of the young larva. The chorion is soon broken and the larva emerges from a very ragged hole. As many as five hours may elapse from the first signs of hatching until the larva is completely free from the egg.

*Larva*: The larva is an elongate, footless, white grub. Motion is achieved through the use of dorsal and ventral ampullae which, when contracted to the anterior end of the body, serve to move the larva along its tunnel.

The size of the larvae varies considerably according to age, individual, and sex. A larva just emerged from the egg measures 4.24 mm. long, 1.28 mm. wide at the prothorax, and 1.20 mm. thick. Larvae taken from galleries on Dec. 15, 1942, approximately four months after hatching, varied from 11.5 mm. to 22 mm. in length and from 4.03 mm. to 5.72 mm. in width. At maturity some measure as much as 60 mm. or more.

Immediately upon hatching, the larva begins to feed. It soon makes its way to the cambium region, mining between the bark and sapwood, considerably scoring the latter. The chips and excrement are packed between the bark and the wood so that

eventually the bark becomes separated from the wood. About two months after the first eggs are laid, the first extrusion holes are formed from which the chips are emitted. These oblong holes are approximately 4 mm. long and 2 mm. wide and occur in the majority of cases on the lower surfaces of a log. At about the time the extrusion holes are formed, the larvae begin to excavate holes in the wood. Of 23 living larvae, the progeny of two females, only eight had begun to make galleries into the sapwood on Sept. 15, 1942. During the first fall, the holes are extended into the wood to a maximum depth of about two inches. As in the case of the extrusion holes, the mouths of the wood galleries are found generally on the sides and lower surfaces of logs. Feeding continues throughout the following year and by the spring of the second year a U-shaped tunnel is formed. By this time the larvae are practically full grown.

*Pupa:* The pupa is formed in a chamber at the end of the larval gallery. This chamber is oblong in cross section and varies from 6.3 to 12.7 mm. in thickness and from 11.0 to 25.4 mm. in width. It may be 50.8 mm. or more in length. The pupal chamber usually extends to within about 6.3 mm. from the surface of wood; some, however, extend to within only 25.4 mm. while others have been found as close as 1.6 mm. or less. Generally the chamber is constructed on a slope so that the pupa rests on one side.

The prepupal stage must be exceedingly short, since from all galleries examined in June and July of 1942, only one specimen was taken. Minor changes occurred in this specimen during the 20 minutes

between its removal from the gallery and its preservation. The first signs of pupal transformation were observed on June 5 when only one pupa could be found in many galleries examined. The duration of the pupal stage is approximately one month.

As the pupa matures, the first signs of true adult characters become evident in the eyes. These organs change colour from a yellowish-white to a bright pink and soon after assume the black pigment of the adult. Subsequently, blackening of the cuticular surfaces becomes evident, first at the extremities of the appendages such as the claws, the distal ends of the mandibles, the edges of the wings, and also around the joints of the legs. Blackening continues progressively backwards, especially on the mandibles.

*Parasites:* Only one parasite of *M. n. morgani* is definitely known. It has been tentatively placed in the genus *Ichneumon*. Another ichneumonid belonging to the genus *Doryctes* has been found in the larval galleries of *Monochamus*, but its relationship with the host is not definite.

In 1941 a dipterous maggot was taken from a gallery in which the sawyer larva was partially destroyed. An attempt to rear this specimen was unsuccessful. Parasitism by Diptera has not been observed since that time.

*Disease:* Apparently *Monochamus* is relatively free from disease. Over a two-year period, only two specimens showing definite symptoms of disease were found. Both were dead adults in their pupal cells and at the time of examination (July 29, 1942) were entirely black and reeked with a strong sickly odour.

A COLONY OF *TROPIDISCHIA XANTHOSTOMA* NEAR WELLINGTON, B.C. (Orthoptera: Stenopelmatidae).—On September 28, 1946, while examining a shallow well near Hammond Bay, B.C., I found it occupied by a colony of the strange spidery cave crickets, *Tropidischia xanthostoma* (Scudder). I counted six adults, and noted that there were several times as many nymphs, although I could not make an exact check of these. One pair of adults I noticed in coitu.

When alarmed the insects leaped or fell into the water, where they were evidently quite at home. They swam powerfully to the sides of the well, and re-

mained quietly clinging to the concrete below the water level without showing any signs of anxiety to regain the surface.

Normal water level is not over six feet down. The well is completely lined with concrete, the masonry extending a foot or so above ground level, where it is covered with rough planks. Many of the immature crickets were clinging upside down to these planks when I first disturbed them.

I had descended the same well on a previous occasion, during May of 1945, but at that time no crickets were seen.—Richard Guppy, Wellington, B.C.