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OBSERVATIONS ON THE BIOLOGY OF ANISODERA GORYI BALY IN MALAYA (Coleoptera: Chrysomelidae)

By W. W. Macdonald

LIVERPOOL SCHOOL OF TROPICAL MEDICINE[1]

In Malaya, and probably elsewhere, the chrysomelid beetle *Anisodera goryi* Baly is very closely associated with bamboos. The species is one of the principal bamboo-borers in forest reserves and the passages bored through the bamboo culms allow mosquitoes to enter and breed in the hollow internodes. The dependence of many species of mosquitoes on the activities of the beetle has been discussed elsewhere (Macdonald, 1960), and this account is therefore concerned only with observations made on the beetles during the course of work on mosquitoes.

Little is recorded about the habits of the genus *Anisodera*, but Stebbing (1914: 254) has given an account of a related beetle, *Estigmena chinensis* Hope, which causes considerable damage to bamboo shoots in parts of India. The collection of *A. goryi* in the British Museum (Natural History) includes specimens from Thailand, Malaya and Java, but the distribution may well be wider than this suggests. In Malaya, collections were made only in the forest reserves of the state of Selangor, principally at Ulu Gombak, Ulu Langat and Templer Park, but the beetle probably also occurs in other areas in which forest bamboos are found. In the Selangor reserves one of the more common bamboos is *Gigantochloa scortechinii* Gamble and most of the following observations were made on this species. Another quite common bamboo, *Dendrocalamus pendulus* Ridley, is also readily attacked by *A. goryi*.

THE LIFE-CYCLE OF *A. goryi*

The eggs

Although several searches were made, eggs of *A. goryi* were not seen. It is very likely, however, that they are laid directly on the culm, or wall, of young bamboos and probable that only one or two eggs are laid on any one internode: this conclusion is suggested by the distribution of the larvae.

The larvae

Recently hatched larvae bore through the soft culm of a young bamboo, the oval entrance to the narrow passage measuring 1–2 mm along the greatest axis. Below the lower lip of the entrance there is left behind by the burrowing larva a little mound of fine bamboo

1. Formerly Institute for Medical Research, Kuala Lumpur, Malaya.

fragments, and the presence of these helps one detect newly attacked internodes: the soft, slightly sticky fragments adhere to the culm for several weeks before being weathered off. Usually there is only one beetle passage in any one internode; occasionally there may be two, but rarely more. The entrances are almost invariably situated in or above the 'V' formed by the overlapping culm sheath (Fig. 1); that is to say they are always found in the upper part of the internode. Having penetrated the culm, the larva moves downwards, perhaps feeding on the inner tissues of the bamboo at the same time. Then, within a few days of entering the internode, the larva begins another passage—this time towards the outside—and this second passage will be the exit for the adult beetle several months later. The exit is bored while the culm is still soft, and it is always situated much lower than the entrance, usually in the lower third of the internode and often on the other side from the entrance, where the culm sheath does not overlap. However, the exit passage is not completed at this stage, for the larva stops burrowing on passing through the outer layer of the culm and does not continue through the tough culm sheath (Fig. 1). The exit is therefore not readily detected by casual examination of the outside of the bamboo. Having prepared the exit passage, the larva retreats into the internode and soon afterwards begins to construct a pupation chamber. There are insufficient data, however, to say exactly how soon after completing the exit passage the larva begins its pupation chamber. The exit is larger than the entrance passage since it will later accommodate the adult beetle, but initially the outer opening may measure only 4–5 mm along the greatest axis. Later, this opening may measure 8–10 mm.

When there are two larvae in an internode each might have entered by a separate passage but may share a common exit passage; this is not uncommon. Occasionally there may even be instances where larvae have shared a single entrance passage.

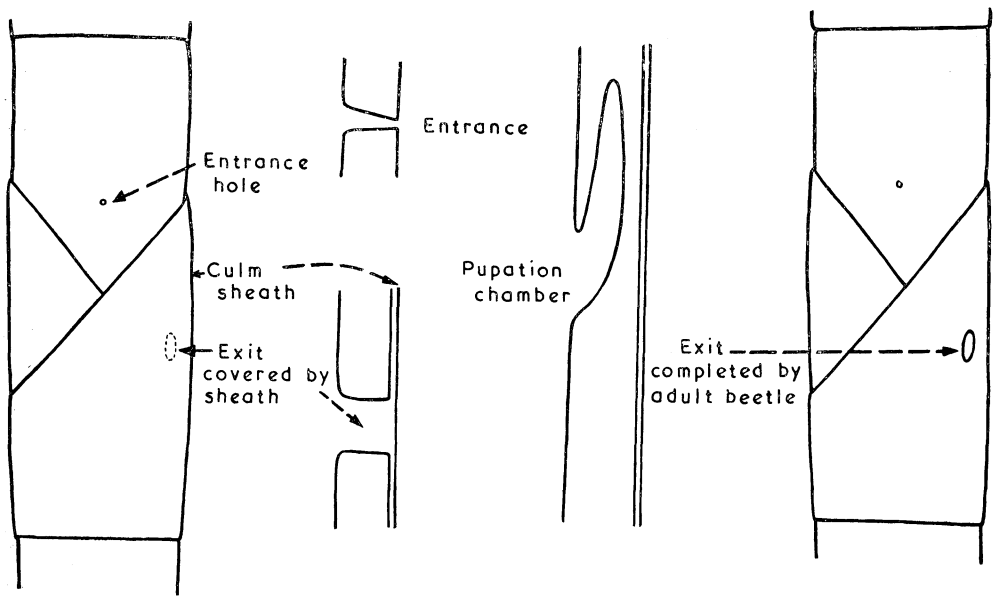

Fig. 1. Illustrating the burrowing activities of the chrysomelid beetle *Anisodera goryi* Baly in bamboo.

The pupa

The pupation chamber is a vertical burrow in the culm of the bamboo with a single, inner opening at the bottom end (Fig. 1). The chamber is always situated at a higher level than the exit passage, but lower than the entrance. Not uncommonly the opening into the chamber lies just above the exit. The larva pupates in the chamber lying head uppermost, and when metamorphosis is completed the pupa wriggles down to the mouth of the chamber where the adult emerges.

As a rule each larva constructs only one chamber, but there is some indirect evidence to suggest that occasionally more than one may be completed by a single individual. In addition to a completed chamber, a few internodes may contain one or two semi-completed chambers which have been abandoned.

The adult

On emergence from the pupal skin the adult often remains inside the internode for some weeks, not uncommonly resting inside the pupation chamber. When ready to leave the bamboo, the adult passes along the exit passage and neatly cuts through the culm sheath, which had been left intact by the larva. With the completion of the exit passage the way is now open for a variety of other arthropods to penetrate and colonize the bamboo internode.

The duration of the life-cycle

It is not possible to give precise data on the duration of each stage of the life-cycle of *A. goryi*, but from a long series of observations one can deduce that the larval stage lasts about six weeks to two months and the pupal stage nearly as long. From the time the young larva enters an internode until the adult beetle emerges from the pupal skin is, therefore, usually not more than four months.

A critical factor influencing the life-cycle is the developmental cycle of the bamboo. In the first place only young growing bamboos are suitable for the beetle, for only at this stage is the culm soft enough for the larvae to bore into the internodes; and secondly the period during which the culm is soft is limited to a few weeks at most, for as the bamboo approaches its full height, the culm hardens owing to the deposition of silica. In Selangor forest reserves there are only about three months in the year when bamboos at the right stage for the maintenance of the beetle larvae are present. There is an annual crop of bamboos, and the first shoots appear during July/August. For several weeks young shoots are common, but then the numbers decrease so that by October new shoots are rare. In general, *A. goryi* larvae attack *G. scortechinii* bamboos from August to October; pupae may be found from October until the end of the year; and the adults emerge in the new year until March or April.

No data are available on the habits of the beetle from the time the adults leave the internodes until the young larvae of the following generation appear at the beginning of the next bamboo crop. There may possibly be a second generation during the year since very occasional bamboo shoots appear 'out of season', otherwise one presumes that some of the adults survive until the main crop appears.

THE INCIDENCE OF BEETLE ATTACK IN BAMBOOS

In Ulu Gombak Forest Reserve regular observations were made on 100 bamboos from the time the young shoots appeared. Some of these died as shoots; others suffered damage to the growing tip during their early development and died soon afterwards; the majority grew to maturity. The bamboos were numbered, and then measured and inspected for beetle attack at intervals of 3–4 days. Accurate measurement was not practicable after a bamboo had grown beyond a height of about 6 m, and only the internodes below 3 m could be efficiently inspected. Observations were begun in September, 1959, and all the bamboos were cut down, measured, and examined internode by internode during April and May of the following year. Most of the bamboos measured between 18 and 21 m when cut; a few were cut down early before they reached maturity.

Table showing the incidence of attack by *Anisodera goryi* beetles on *Gigantochloa scortechinii* bamboos at Ulu Gombak Forest Reserve, Malaya.

Condition of bamboo	Number examined	Number attacked by *A. goryi*	Average number of internodes attacked
Died as shoots	6	—	—
Died before attaining a height of 4½ meters	23	12	2.1
Cut down before fully-grown	6	1	2.0
Cut down when fully-grown	65	47	2.9

The table shows that attack by *A. goryi* can be quite common, but at the same time only two or three internodes are usually attacked in a single bamboo. The damage caused is therefore very slight, and in no case did a bamboo die as a result of *A. goryi* attack. Those individuals shown in the table as having died before reaching a height of 4½ m died from other causes (*see* also Macdonald, 1960: 139). More than 70 % of the beetle attack was concentrated below the 3 m level, but damaged internodes were found as high as 10 m.

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