

LIFE HISTORY STUDIES OF *GONOMETA PODOCARPI* AURIVILLIUS (LEPIDOPTERA: LASIOCAMPIDAE) IN EAST AFRICA¹

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ABSTRACT

There are two distinct larval generations of *Gonometa podocarpi* in a year; the first one is between early May to mid-October, and the second one is between the second week in November and the end of April. The last two instars cause the heaviest defoliation. The egg may be parasitized and rendered infertile by a Eupelmid of the genus *Anastus*. Both the larval and pupal stages of *G. podocarpi* are killed by Hymenopteran and Dipteran parasites which attack during the former stage. Under experimental conditions, adult moths will not mate unless the males have large enough space in which to fly after emerging from the cocoons. Adult longevity averages eight days for the males and ten days for the females.

INTRODUCTION

Gonometa podocarpi Aur. is a pest widely distributed in sub-Saharan Africa, where its larvae cause serious defoliation of conifers, in addition to attacking the leaves of many dicotyledons. *Acacia lahai*, *Acacia mearnsii*, *Cupressus benthamii*, *Cupressus lusitanica*, *Eucalyptus regnans*, *Juniperus procera*, *Pinus halepensis*, *Pinus leiophylla*, *Pinus montezumae*, *Pinus patula*, *Pinus radiata*, and *Podocarpus gracilior* are among the trees it attacks in East Africa (Kenya, Tanzania and Uganda). Twice within the last five years, following periods of unusually low rainfall, the insect has caused complete defoliation of large pine plantations in Uganda. Many of the trees it attacks have been imported into East Africa to replace the diminishing, indigenous natural forests. Therefore, effective control of this pest is considered imperative. A thorough understanding of its basic biology is a necessary step in attempting to work out reliable sampling methods by which potential outbreaks could be predicted and, possibly, effectively controlled. This study was set up as an attempt to elucidate some aspects of its basic biology.

No thorough study of the basic biology of *Gonometa podocarpi* has so far been undertaken, except for a very limited amount of laboratory observations by Gardner (1957) in Kenya. Such laboratory studies have certain drawbacks, which make them unsuitable for work on insects which have to be dealt with in the field. Generally such studies are carried out inside buildings, where such factors as humidity, light, and temperature are different from those in the field. Moreover, the larvae reared under laboratory conditions are usually fed on excised foliage, which must cease to be comparable with normal plant tissue within an hour or so following its removal from the growing plant (Bonner, 1950). The present work was, therefore, carried out in the field, where the insect occurs and breeds naturally.

MATERIALS AND METHODS

Eggs and young larvae of *Gonometa podocarpi* were collected in the forest and either placed on young *Pinus patula* in an open-air insectary or caged on *P. patula* in forest plantations. These were observed throughout the developmental stages to the adult stage. Eggs laid by moths in the insectary were those used in the life-history studies. Young larvae emerging from the eggs were either caged or released into the open-air insectary. The cages, made of metal frames and covered with white muslin, were cylindrical in shape, 30 cm in diameter and 90 cm high.

¹Manuscript received September 2, 1970.

The insectary was made of wood and fine wire-mesh, and measured 6 x 4 x 2 m. About 400 *G. podocarpi* laboratory-hatched larvae were released in the insectary. Different-colored oil paints were used to mark the larvae in order to facilitate investigation of stadia and the number of molts.

RESULTS—THE LIFE CYCLE

The Egg

The eggs are smooth and white in color at the time of oviposition. Each egg is round in shape and has a diameter of about 2.3 mm. Each egg is covered with a colorless, adhesive substance which enables it to stick to the other eggs in the batch and to the object on which it has been deposited. The eggs begin to turn beige after about three days and eventually, after about 10 to 14 days, become very dark grey. Occasionally some eggs remain white until they hatch, while others do change color but until at least two weeks after they have been laid. Unfertilized eggs turn dark and then collapse on one side. The period between oviposition and hatching of the eggs averages 22 days (range 14 to 35 days).

The Larva

A small, almost cylindrical larva hatches from each egg. The larva at this time is about 10 mm long and is charcoal-grey in color, with the anterior margin of the first thoracic segment bearing long, light-yellow hairs, or setae. The larva has been observed to molt either six times (males) or eight times (females) before forming a cocoon. After the first molt, which takes place about three weeks after hatching, the lateral surfaces of the body become covered with light-grey hairs, while the hairs on the dorsal surface remain dark-grey. About that time, four tufts of dark-red, needle-like hairs become clearly noticeable on the dorsum of the thoracic region. Specimens with only three such tufts were also observed during this study. The mechanism of the tuft formation and the factors which may be responsible for the observed variation have not been investigated. With the second molt, deep-yellow hairs appear on the body; at first only two rows of these are visible along the mid-dorsal surface, but as the larva gets larger and larger, they are seen to cover not only the dorsal but also the lateral surfaces. A few black, stiff hairs, which contain an irritant to both humans and potential predators, are interspersed among the yellow, but are more numerous among the red tufts on the thoracic area. Most of the specimens from southern Tanzania have no yellow hairs, and are almost entirely black in color, except for the reddish dorso-thoracic hairs.

The larval stage lasts an average of 15 weeks (range 13 to 18 weeks). A fully-grown larva attains a length of about 11 cm. This differs with the observations of Gardner (1957), who reported that a fully grown larvae in Kenya attains a length of only 9 cm. Observations made during the present study indicate that the last two instars are the most voracious feeders and do a considerable amount of defoliation in just a few days.

There are two distinct larval generations in a year, the first between early May and mid-October, the second between mid-November and the end of April. In addition, a few larvae may be observed in off-peak periods.

The Pupa

A fully grown larva stops feeding, moves up the side of the cage or insectary wall, or up the tree on which it has been feeding, and commences to spin a cocoon. It curves its posterior abdominal tip ventrally and, with its prolegs holding on to the wall or the tree, it moves its head from side to side, working incessantly to construct the cocoon. Numerous larvae body hairs are embedded in the external surface of the cocoon wall, while the inner surface is hair-free. The exuviae are pushed beneath the posterior end of the pupa and remain there, within the cocoon. The cocoons containing males are smaller than those containing females.

The duration of the pupal stage averages 72 days, the range varying from 55 to 97 days. Gardner (1957), working under laboratory conditions in Kenya, has reported that the length of the pupal stage is 38 days. This is obviously not in agreement with the findings during the present study. Although Gardner's report contains no description of the conditions under which his work was conducted, the differences between his findings and those reported in this paper are probably due to the fact that his studies were carried out in the laboratory.

The Adult

The adult moths are rust-red in color, with the males being darker and smaller than the females. The male hind-wings have a small sub-hyaline-to-hyaline area in the mid-posterior regions. The body of the female is about 5.2 cm long; that of the male is about 3.2 cm long. The wing-span is about 10 cm in the female and 5.4 cm in the male. Unlike the female, the male has a tuft of yellow hairs at the posterior tip of the abdomen.

The adult moths will not mate unless they have large enough space for the male to fly after emerging. Laboratory-cage experiments carried out over a period of years produced no instances of mating. However, mating took place readily in the open-air insectary. Free males generally came flying to the female-containing cages in the field and, when caught and placed in the cages, mated readily with the females. The effects of flight on the physiological processes in the male, which lead to mating in *Gonometa podocarpi*, have not been investigated.

The preoviposition period varies from 2 to 4 days, after which each female lays 30 to 50 eggs daily, for most of her adult life. Most females lay between 300 to 350 eggs, in a number of separate batches. Some of the females have been found not to lay all their eggs; as many as 35 eggs were counted in a dead female which died after it had stopped laying eggs two days previously. Adult longevity averages 8 days (range 3 to 15) for males (based on 120 specimens) and 10 days (range 5 to 18) for females (based on 100 specimens).

Parasites

Eggs of *Gonometa podocarpi* are parasitized by a Hymenopteron of the family Eupelmidae, belonging to the genus *Anastus*, the only known parasite of *G. podocarpi* eggs. Adult *Anastus* parasites usually emerge from the attacked eggs. Such eggs do not hatch.

The larvae of *Gonometa podocarpi* are fatally parasitized by a number of insects, the most common of which are the Hymenopterans *Meteorus trilineatus* Cam (Braconidae) and *Pimpla mahalensis* Grib (Ichneumonidae), and the Dipteran *Sturmia gilvodes* Curran (Tachinidae). Most of the parasitized larvae die; a few may go into pupal stage, but these too die and do not emerge as moths. So far, no parasites of adult moths have been found.

In addition to the parasites, a noninclusion-type virus is becoming increasingly important as a killer of *Gonometa podocarpi* larvae in the fourth and fifth instars. These factors, of parasites and virus disease, offer hope for some natural biological control of the pest.

ACKNOWLEDGMENTS

The work done by the author's assistants, W. M. Demba-Olith and Obuya Onditi, is gratefully acknowledged. This study was supported by funds from the East African Community.

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