# THE BIOLOGY OF THE EASTERN PINE SHOOT MOTH, *EUCOSMA GLORIOLA* HEINRICH (LEPIDOPTERA: TORTRICIDAE) ON JACK PINE REGENERATION IN THE SANDILANDS PROVINCIAL FOREST, MANITOBA

by

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TABLE OF CONTENTS

## INTRODUCTION

The eastern pine shoot moth (Eucosma gloriola Heinrich) was first recorded in 1930 in southwestern Connecticut by Heinrich (1931), and is now known to occur in other parts of the United States and Canada (DeBoo, 1966). Damage by this insect was first observed in Manitoba on jack pine (Pinus banksiana Lamb.) in the central portion of the Sandilands Provincial Forest in 1950 (Wong et al, 1950). It became abundant in this area seven years after a wildfire in 1955, that burnt over 24,000 acres and destroyed 12,000 acres of merchantable and young growth of jack pine in the northern portion of the Sandilands Provincial Forest (Cayford, 1963). In 1962, the leaders of jack pine regeneration in the five to six foot class were moderately infested, and those on trees in the three to four foot and seven to eight foot classes were lightly damaged on the burnt over area (Wong and Lawrence, 1963). Information on the biology of E. gloriola on jack pine regeneration in the Sandilands Provincial Forest was obtained from 1962 to 1966. A description of the study area (Fig. 1) has been made by Cayford (1963).

## METHODS

The biology of E. gloriola was determined by weekly collections of leaders and laterals of jack pine regeneration from early May to mid August, and by direct field observations. Larval activity within the shoots were examined under a dissecting miscroscope in the laboratory before the infested shoots were cut into 6 to 8 inch lengths and placed in a rearing jar containing soil. Adult insects for laboratory studies of oviposition were obtained by removing some of the overwintering pupae from the cold room held at 34F in January. Males and females were placed in three different rearing cages (Fig. 2, A,B,C) with new and old growth of jack pine. In addition, pupae from the cold room were placed in the soil litter beneath a small caged jack pine in early May (Fig. 2D).

Information on the intensity of attack and incidence of leader and lateral damage in relation to tree height and density were studied in two twentieth-acre strip plots selected at random each year on three different site classes in the Sandilands Provincial Forest. These site classes were described by Cayford (1963) as dry, moderately fresh and moist, and supported approximately 800, 4,000, and 12,000 stems per acre, respectively.

## LIFE HISTORY AND HABITS

E. gloriola has a univoltine life history in Manitoba and overwinters in the pupal stage. The seasonal occurrence of the life stages is shown in Fig. 3. Adults were observed in the field only on May 25, 1965. Collections of first-instar larvae indicate that the adults are present from early to late May. No eggs were observed in the field, even when pupae were planted beneath a caged tree. In the laboratory, females deposited whitish cream-colored eggs (average size 0.61 x 0.39 mm) mainly singly but also in groups of two to five on the old and new foliage of jack pine and on the walls and floor of the rearing cages. Head capsule width measurements of preserved larvae collected at weekly intervals suggest five distinct instars (Fig. 4). The first instar enters the pith of the new growth of the leader or laterals of jack pine regeneration usually from behind a needle fascicle, (Fig. 7) occasionally behind a cone, scale or small shoot, and sometimes from the side of a needle

fascicle. The entrance holes are about 0.3 mm in diameter and are made 1 to 3 mm above the base of the needle fascicle, scale, etc., almost anywhere along the new growth (Fig. 5). The larva mines downward in the pith and gradually widens the gallery until it is as wide as the diameter of the pith. In the fifth instar, it mines downward for a short period (Fig. 10) before reversing its direction to mine upward for 5 to 100 mm to notch the vascular tissue (Fig. 11). Butcher and Hodson (1949) believe the girdling of the vascular tissue by the eastern pine shoot moth may be a precautionary measure to prevent the larva being trapped in the pitch. It is in the area of these notches that the break occurs to the leaders and laterals of jack pine regeneration (Figs. 12 and 13). The fifth-instar larva may extend the gallery 3 to 57 mm beyond the entrance hole, depending on the size of the shoot, before reversing its direction again to make an exit hole 2 to 73 mm below the top of the gallery (Fig. 8). The whitish granular frass produced mainly by the fifth instar and the reddish-brown frass produced by the early instars suggest that the larva of E. gloriola does not consume the same food material throughout its larval development in the new growth of jack pine. The length of the gallery mined by a larva of the eastern pine shoot moth may extend from 102 to 294 mm from base to apex. The last instar emerges from the shoot around mid-July and drops to the ground to pupate. Some larvae of E. gloriola apparently were unable to emerge from the leaders or laterals of jack pine in the field and pupated in the shoot. The activity of this insect in an infested shoot is depicted in Fig. 6. The pupa is formed within a cocoon in which particles of soil and debris are incorporated in the wall. In the spring the pupa wiggles itself partly free from the cocoon (Fig. 9) before emerging as an adult.

In areas of high populations of E. gloriola up to six larvae have been observed infesting a single leader of jack pine. These larvae entered the same shoot at different distances above the base of the new growth. When a larva encounters the frass or tunnel of another, it generally changes from positive geotropism to negative geotropism or will continue in the same direction only if the mines are separated by pith or frass. The number of exit holes present indicates that not more than three larvae were apparently able to complete their development in the larger shoots. Only one exit hole is present in the smaller shoots. Similarly, Butcher and Hodson (1949) have observed five advanced larval instars of the pine shoot moth in a single shoot at the same time in Minnesota, but only 2 or 3 larvae were able to complete their development in the larger shoots.

## PARASITES

The following parasites were recovered from rearings of E. gloriola from 1964 to 1966.

| | |
|---|---|
| Braconidae: | Bracon rhyacioniae (Mues.) |
| Ichneumonidae: | Glypta sp. n. |
| | Rhorus (Cyphanza) sp. |
| Pteromalidae: | Habrocytus sp. |

Glypta sp. n. was the most common parasite recovered and it was present in all site types studied.

## DAMAGE BY E. GLORIOLA ACCORDING TO DENSITY AND HEIGHT OF JACK PINE REGENERATION

The examination of all the trees in two twentieth-acre strip plots in the three different sites from 1962 to 1966 indicated that jack pine regeneration between 2 to 14 feet in height are the ones infested by the eastern pine shoot moth (Wong et al, 1966). There did not appear to be any relationship between intensity of attack and stand density (Table I). Similarly, the data in Table I do not show any consistent relationship between damage by E. gloriola and the size range of the trees attacked. There is some evidence that the insect attack the taller trees. Since all the trees studied in the three sites were all under 17 feet, future studies will be made to determine any relationship when the trees in these sites are taller.

TABLE I

Damage caused by Eucosma gloriola Heinr. in three forest sites in the Sandilands Provincial Forest

| Site | Year | Total No. of trees in two twentieth-acre plots | % of trees infested | Mean Height (ft.) | | Student t[a] |
|---|---|---|---|---|---|---|
| | | | | Healthy trees | Infested trees | |
| | 1964 | 134 | 6.71 | 2.61 | 3.80 | 3.30** |
| Dry-------- | 1965 | 44 | 20.45 | 6.08 | 5.22 | 1.85 |
| | 1966 | 44 | 11.36 | 5.82 | 6.80 | .91 |
| | 1962 | 373 | 10.99 | 5.37 | 5.80 | 1.75 |
| Moderately | 1964 | 412 | 7.03 | 6.07 | 5.65 | 1.40 |
| fresh---- | 1965 | 222 | 11.71 | 5.46 | 4.76 | 1.34 |
| | 1966 | 223 | 3.58 | 5.21 | 10.40 | 6.18** |
| | 1962 | 483 | 6.83 | 5.04 | 5.81 | 6.69** |
| Moist------ | 1964 | 1048 | 14.59 | 6.81 | 7.24 | 3.43** |
| | 1965 | 356 | 17.69 | 7.71 | 8.23 | 1.34 |
| | 1966 | 354 | 1.97 | 7.77 | 10.71 | 2.90** |

[a]Numbers marked with a double asterisk are significant at the .01 level.

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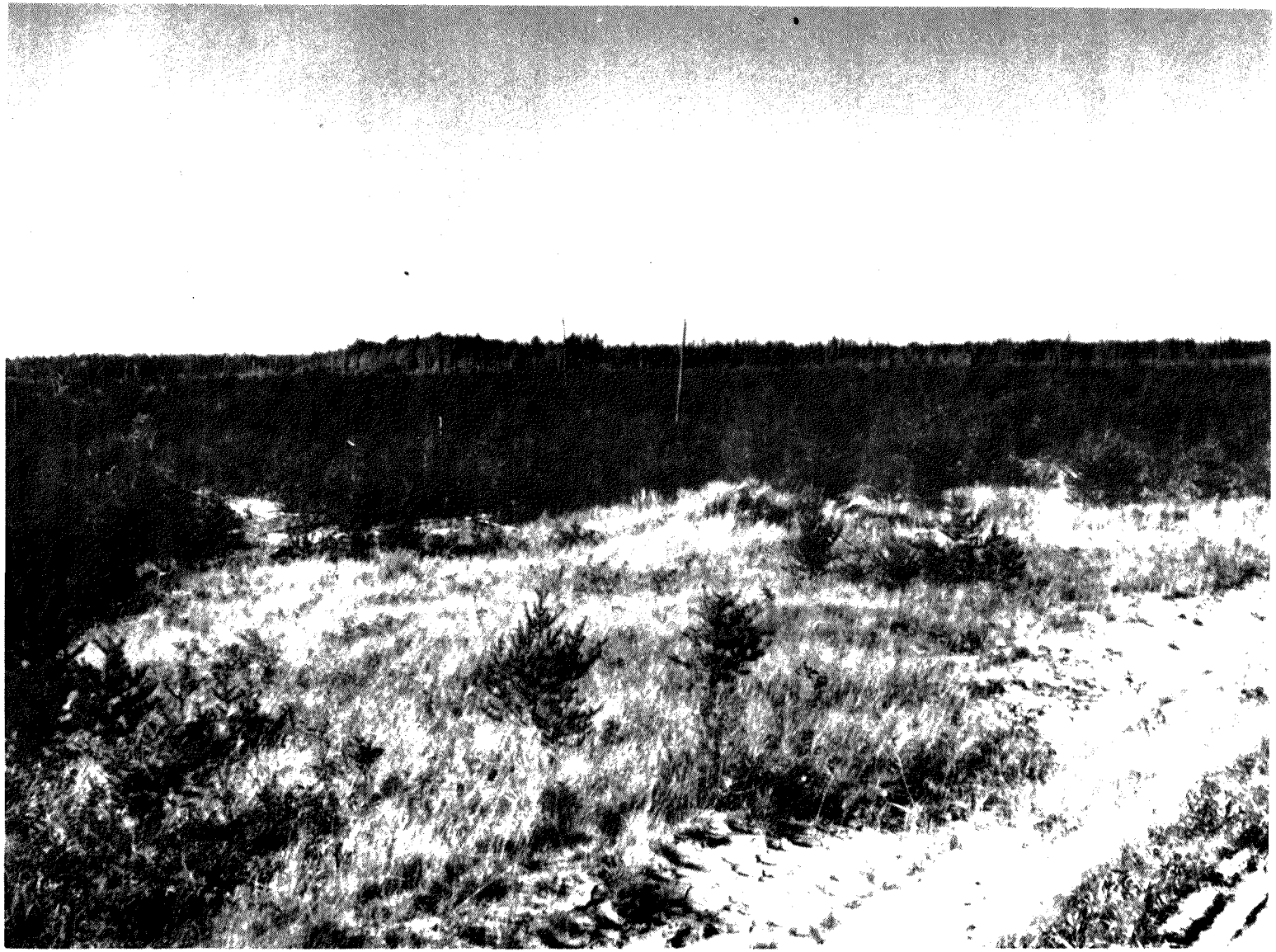
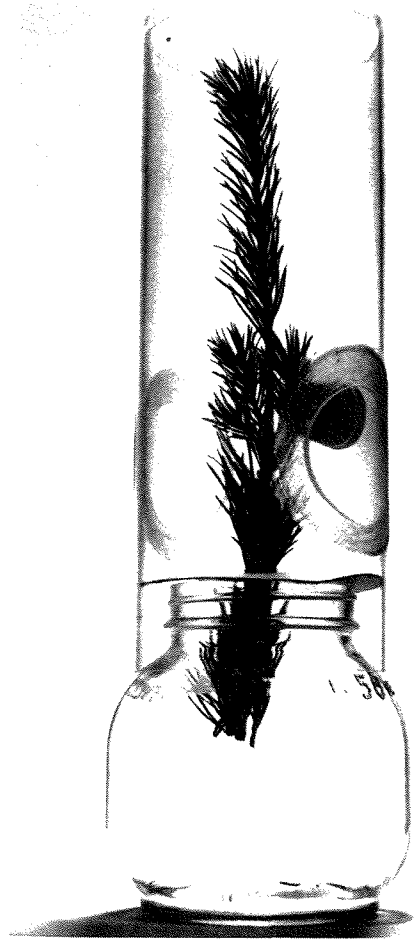


Fig. 1. Study area of *E. gloriola* in jack-pine regeneration, Sandilands Provincial Forest.

A



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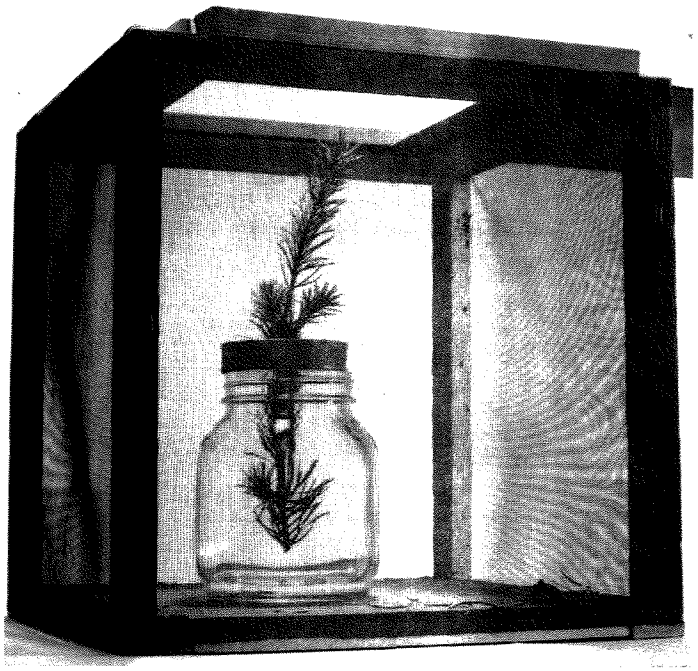

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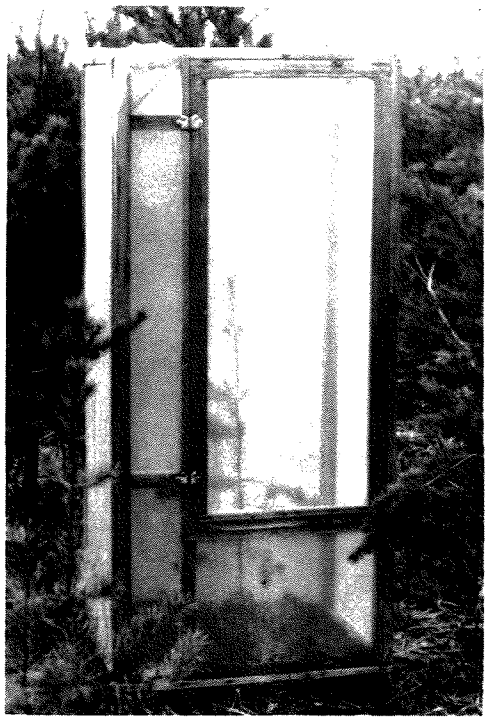

D

Fig. 2. Types of cages used for oviposition studies of E. gloriola

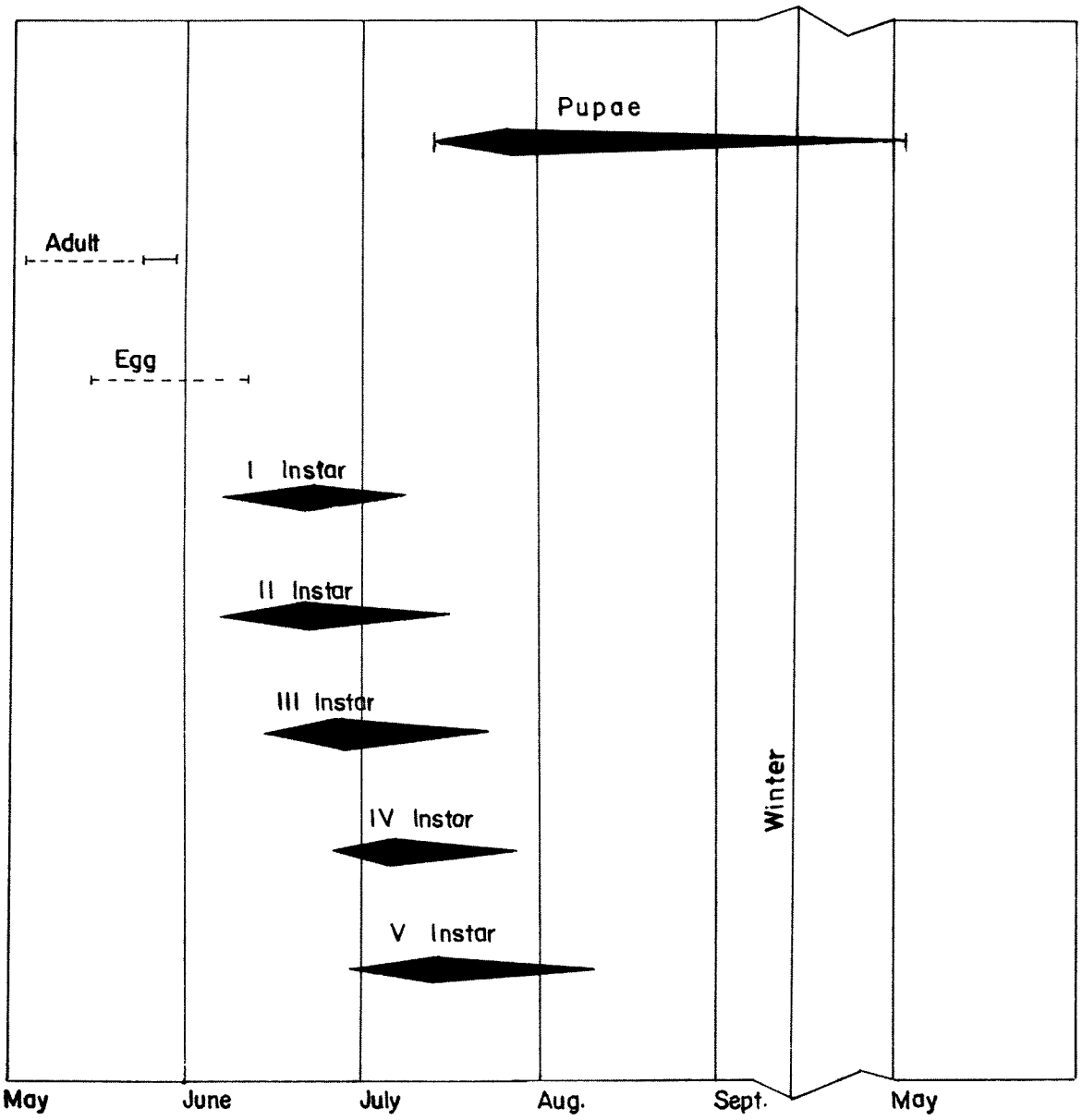


Fig. 3 Life cycle of E. gloriola in the Sandilands Provincial Forest, Man.

– – – – – deduced dates

——— observed dates

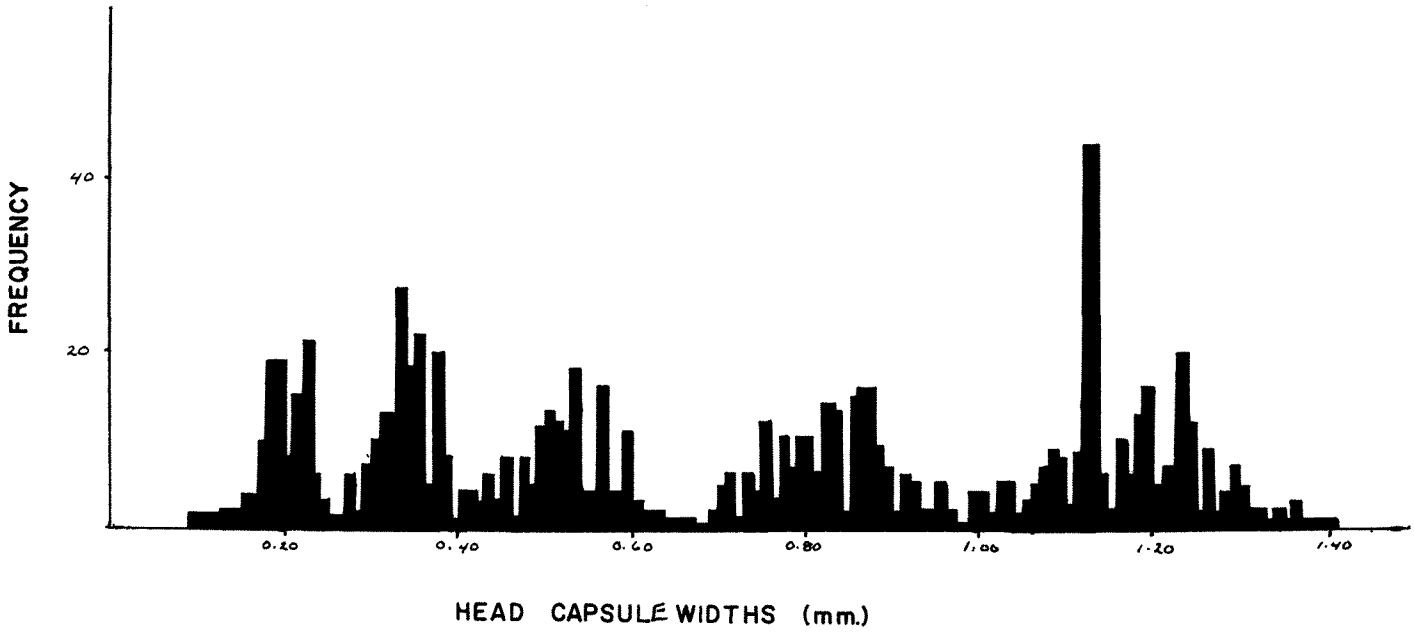


Fig. 4 Frequency distributions of head capsulewidths of E. gloriola larvae collected in the Sandilands Provincial Forest

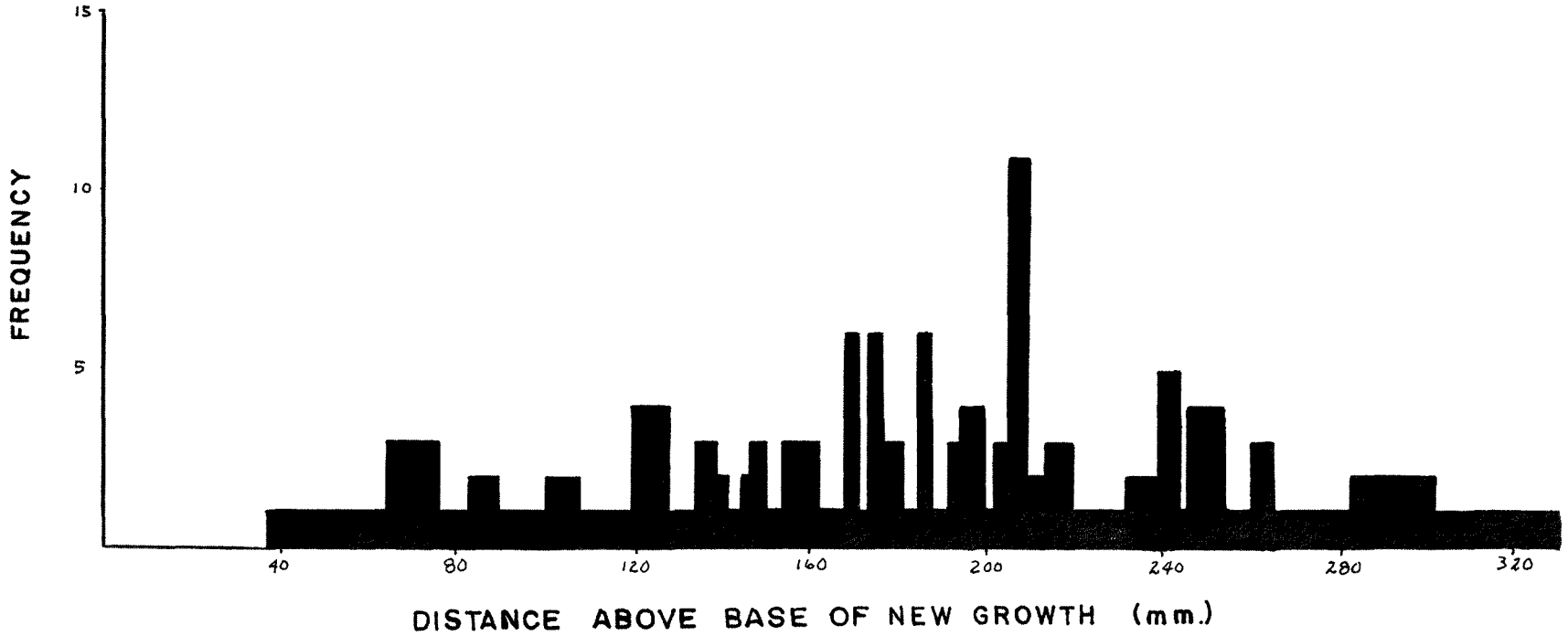


Fig. 5 **Position of entrance holes based on 133 observations in the Sandilands Provincial Forest — 1964–1965**

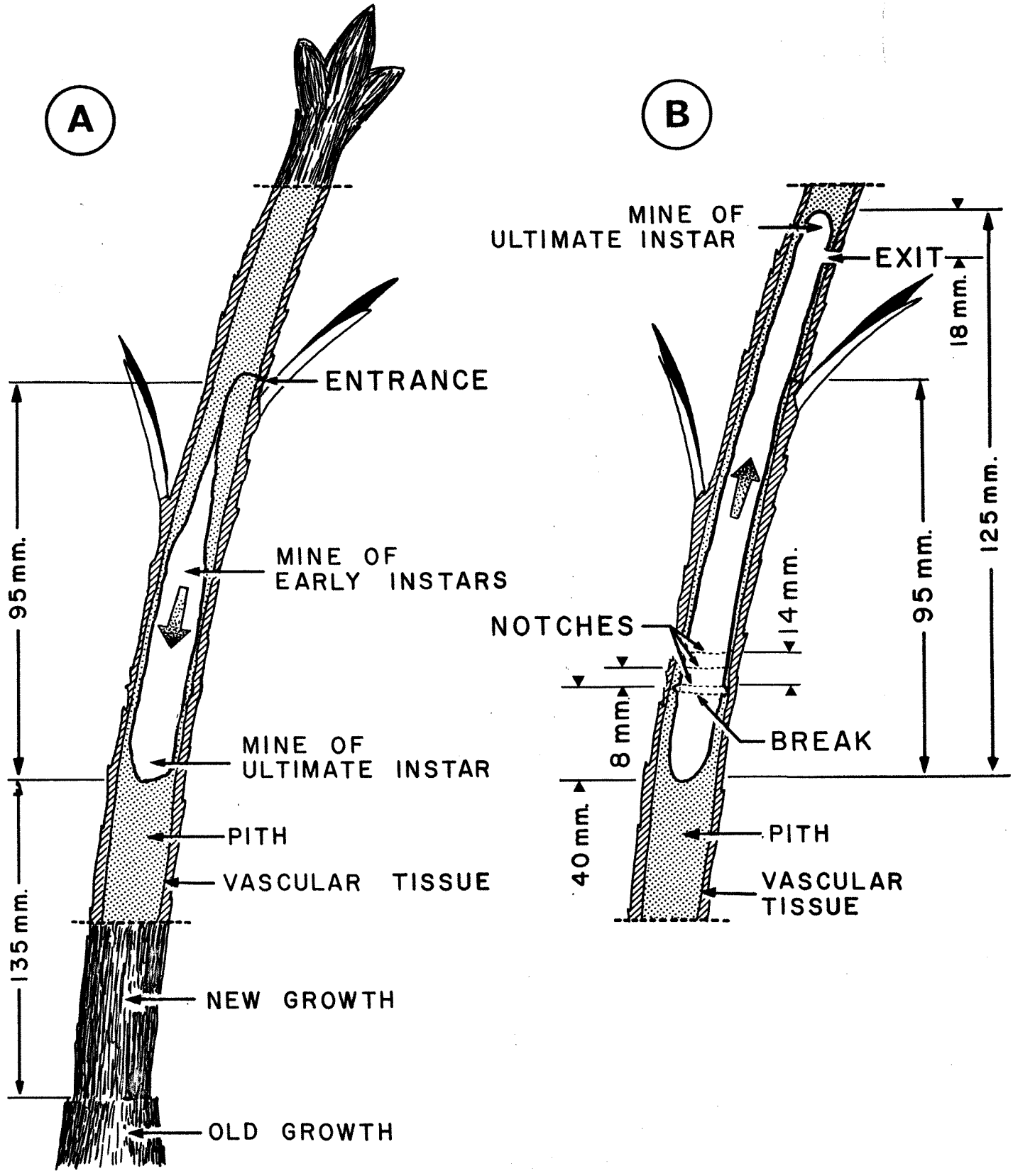
A
ENTRANCE
MINE OF
EARLY INSTARS
MINE OF
ULTIMATE INSTAR
PITH
VASCULAR TISSUE
NEW GROWTH
OLD GROWTH
95 mm.
135 mm.
B
MINE OF
ULTIMATE INSTAR
EXIT
18 mm.
125 mm.
95 mm.
14 mm.
NOTCHES
8 mm.
BREAK
40 mm.
PITH
VASCULAR
TISSUE

Fig. 6

Fig. 10. E. gloriola larva working down in leader of jack-pine regeneration.

Fig. 11. E. gloriola larva working up in leader of jack-pine regeneration.

Fig. 12. Broken leader of jack-pine regeneration caused by E. gloriola

Fig. 13. Broken lateral of jack pine regeneration caused by E. gloriola.