

THE BIOLOGY AND DESCRIPTION OF IMMATURE STAGES
OF *EXOTELEIA NEPHEOS* (GELECHIIDAE)
ON PINE IN ONTARIO

O. H. LINDQUIST AND J. R. TRINNELL

Forest Research Laboratory, Sault Ste. Marie, Ontario, Canada

INTRODUCTION

Adults of an undescribed species of *Exoteleia*, were first obtained by the Forest Insect and Disease Survey in 1958 during rearing experiments with the European pine shoot moth, *Rhyacionia buoliana* (Schifferrmüller). Larvae and pupae of the *Exoteleia* were not found in the field until 1961, and in the following year a life history study was begun near Port Burwell in southern Ontario where relatively pure populations were detected on red and Scots pine. Most of the observations and stages described in this paper pertain to material collected on red pine because of the larger numbers of *Exoteleia* present on that host in the study area. Freeman (1966) described the adult as *Exoteleia nepheos*.

DISTRIBUTION, HOSTS, AND INJURY

E. nepheos is known in southwestern Ontario at Harrow, Port Burwell, Woodstock, Elmira, and Alliston. The insect has also been reported from Toronto, Ottawa, and Ohio (Freeman, 1966).

E. nepheos has been found on red pine, *Pinus resinosa* Aiton, less frequently on Scots pine, *P. sylvestris* Linnaeus, and rarely on Mugho pine, *P. mugho* Turra. The Port Burwell infestations have persisted at least since 1961 when they were discovered on trees 10 to 25 feet in height.

Larval feeding of *E. nepheos* stunts growth of the new shoots (Fig. 4) giving the branches of infected pines a tufted appearance. However, trees attacked for at least three successive years in the study area do not appear to have been damaged seriously and the insect is currently of little consequence in pine plantations of southern Ontario.

STAGE	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT
Adult				-----	--		
Egg				-----	--		
Larva in needle		-----			-----	-----	
Larva in flower or bud		-----	-----				
Pupa			-----	--			

Fig. 1. Seasonal distribution of the stages of *Exoteleia nepheos* Freeman.

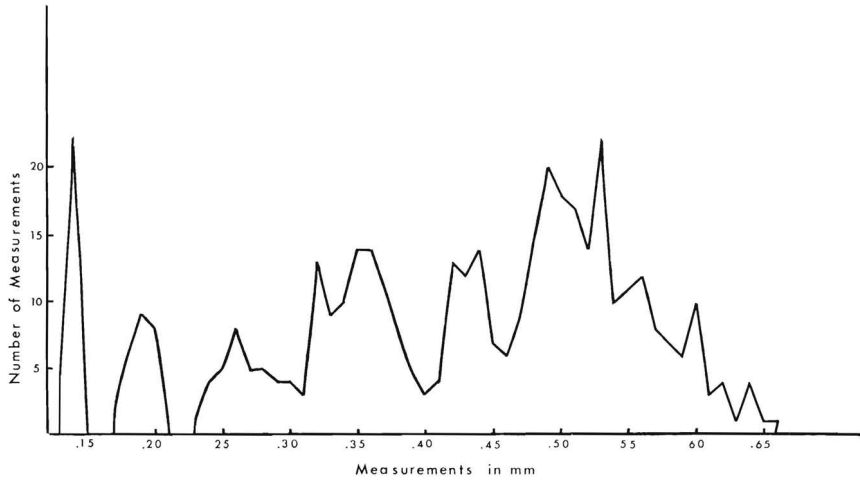


Fig. 2. Distribution of larval head capsule measurements for *Exoteleia nepheos* Freeman.

LIFE HISTORY AND HABITS

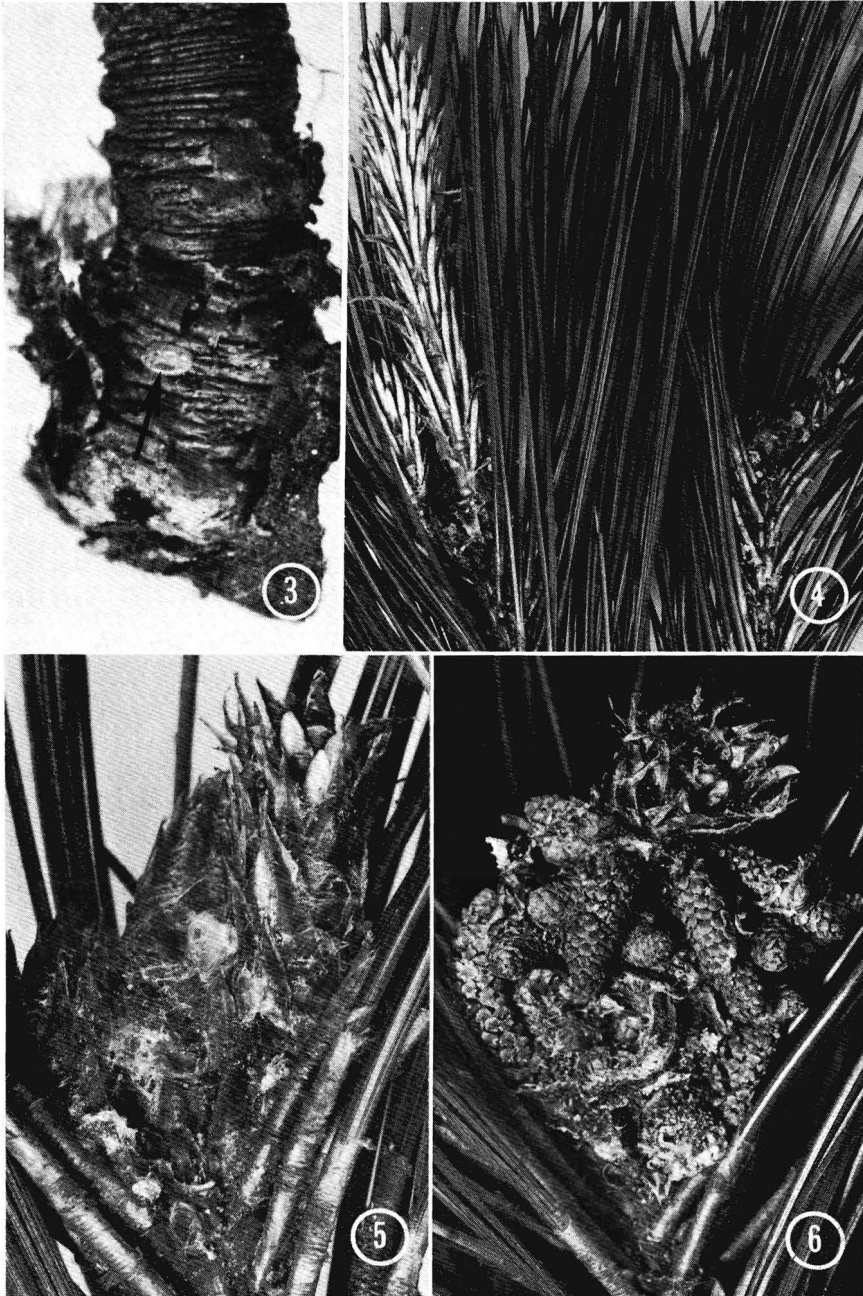
E. nepheos has one generation a year in Ontario. The course of seasonal development is shown in Fig. 1.

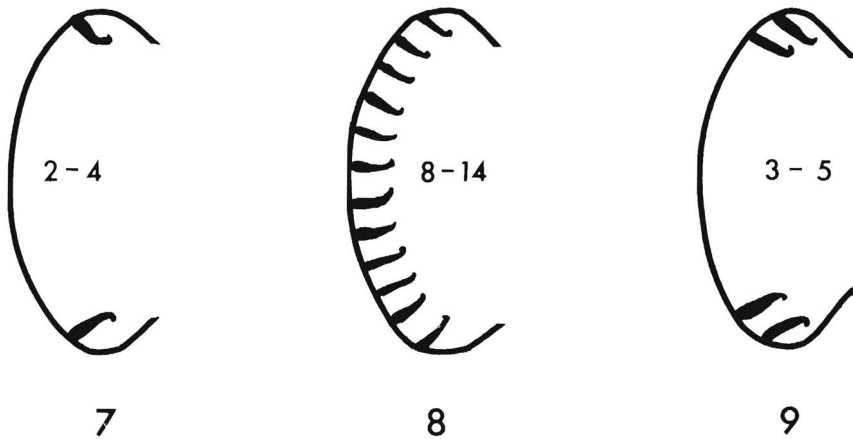
There are probably five larval instars, although the distribution of 428 head capsule measurements as shown in Fig. 2 indicates a possible anomaly among head capsules measuring 0.40 to 0.46 mm. The theory of geometric progression of head capsule widths proposed by Dyar (1890) supports five larval instars. Mean widths for instars I and II, 0.136 and 0.190 mm respectively, were used to calculate the following theoretical widths of successive instars: Instar III, 0.26 mm, Instar IV, 0.355 mm, and Instar V, 0.485 mm. As may be seen in Fig. 2, these values closely approximate the midpoints of the distributional curves for the last three of five instars. Martin (1959) mentions that the related species, *Exoteleia dodecella* (Linnaeus) has five larval instars.

Adult flight occurs from early July to early August, with moth activity around host trees restricted to late evening from about 2200 hours to midnight E.D.S.T. Mating was not observed. The greatest number of adults appeared on warm nights when a light breeze was blowing; few

→

Figs. 3-6. *Pinus resinosa* affected by early stages of *Exoteleia nepheos* Freeman; 3, needle sheath with egg; 4, shoots affected by larvae (right) and unaffected (left); 5, shoot stunted by larval feeding; 6, infested staminate flowers tied with silk. Photos by D. C. Anderson.





Figs. 7-9. Diagrammatic representation of crotchets of *Exoteleia* species; 7, *E. nepheos* Freeman; 8, *E. dodecella* (Linnaeus); 9, *E. pinifoliella* (Chambers).

were present on cool, calm nights, or if dew was forming on the foliage. When seen with the aid of a flashlight, moths were extremely active, walking rapidly along needles and twigs, with antennae vibrating. During oviposition, which lasts from 20 to 60 seconds, the abdomen is arched and the antennae are motionless.

Eggs (Fig. 3) are usually laid singly, rarely in clusters of two to four, on needle sheaths of the previous year's foliage or occasionally under loose bark scales of twigs. When laid on the needle sheath, eggs are usually concealed under the membranous scales near the base, but occasionally they are found between transverse folds or fully exposed on the sheath surface.

First instar larvae are found in early August, mining along the edges of the apical portion of needles. The entrance hole to the mine is covered with silk and usually occurs on the flat side of the needle. By early September most of the larvae are in the second instar. Third instar larvae are present in early October, and by mid-November most larvae are in the fourth instar, overwintering in the needle mine. In spring, they vacate this mine and enter the same needle at a lower point or an adjacent needle. Mining appears to be restricted to the apical two-thirds of each needle with emergence and exit holes varying considerably both in number and location on the needle. Mining terminates in mid- to late May, when the larvae migrate and feed in staminate flowers or elongating buds (Figs. 5, 6).

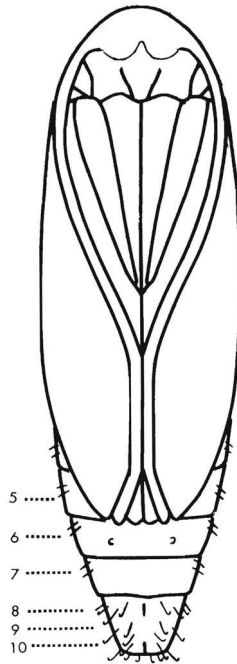


Fig. 10. Female pupa of *Exoteleia nepheos* Freeman, ventral aspect; abdominal segments 5–10 indicated.

In mid-June, pupation occurs in the flowers and shoots honeycombed by the feeding larvae, and moths emerge in about two weeks. Because of silk spun by the larvae, flower clusters are not shed but often remain on the tree throughout the summer.

DESCRIPTION OF IMMATURE STAGES

Egg (Fig. 3).—About 0.5 mm long, 0.3 mm wide, more or less cylindrical with rounded ends; patterned with fine granulations, silvery-white, and becomes yellowish as the embryo develops.

Larva.—Pale yellow brown, at first, later in initial instar, body reddish, anal shield grey. Sclerotized areas gradually darken in succeeding instars. Overwintering larva, with head and sclerites on thoracic legs dark brown, prothoracic and anal shield slightly lighter; body reddish-brown. Mature larva about 6.5 mm in length, body pale yellow with a reddish hue. Spinules greyish, readily discernible, particularly on posterior segments at 25 \times magnification. Pinacula on posterior segments relatively large, darker than integument. Head, prothoracic shield, and sclerites on prothoracic legs brown-black. Anal shield and lateral sclerites on anal prolegs yellow to dark brown. Anal comb absent. Abdominal prolegs each bearing 5 to 10 crotchets which tend to form a circle. Each anal proleg usually bears a single crochet, occasionally two, near each lateral margin (Fig. 7). Subventral (SV) setae on abdominal segments 1, 2, 7, and 8 usually number 2 : 3 : 2 : 1. Setal map of some body segments in Fig. 11.

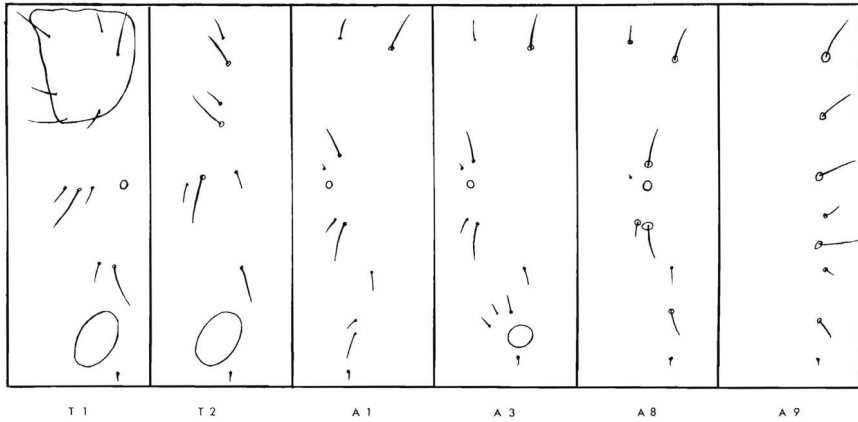


Fig. 11. Diagrammatic setal map for larva of *Exoteleia nepheos* Freeman; thoracic segments 1 and 2, abdominal segments 1, 3, 8, and 9.

Pupa (Fig. 10).—Yellowish brown, flattened dorsoventrally, averaging 3.9 mm in length and 1.2 mm in width. Antennae and wings extend to anterior edge of abdominal segment 6. Proleg scars present ventrally on abdominal segment 6. Spiracles relatively conspicuous, laterally on abdominal segments, setae short and fine. Abdominal segments 8 to 10 fused with fine hooks arranged around the combined segments.

PARASITES

Three chalcid parasites, identified at the Entomology Research Institute, Ottawa, were reared from material collected at Port Burwell. *Achrysocharis* sp. (Eulophidae) and *Copidosoma geniculatum* (Dalman) (Encyrtidae) issued from host larvae, and *Eurytoma* sp. (Eurytomidae) from host pupae.

COMPARISON WITH OTHER SPECIES OF *EXOTELEIA* ON PINE

Three species of *Exoteleia* are known to occur in Ontario, *nepheos* Freeman, *dodecella* (L.), and *pinifoliella* (Chambers). They may be separated by differences noted in Table I and keys to larvae and pupae.

TABLE I—COMPARISON OF BIOLOGICAL FEATURES OF THREE SPECIES OF *EXOTELEIA* IN ONTARIO

	<i>nepheos</i>	<i>dodecella</i>	<i>pinifoliella</i>
Host Preference	red pine, Scots pine	Scots pine, Mugho pine	jack pine
Pupation Site	flowers, buds	buds	needle mine
Adult Flight	July	mid-June to early July	late June to mid-July

KEY TO LARVAE OF *EXOTELEIA* SPECIES IN ONTARIO

1. Crotchets on anal proleg in a single uninterrupted series of 8-14 (Fig. 8) *dodecella*
 Crotchets on anal proleg in two series of 1-3 situated near each lateral edge
 of proleg (Figs. 7, 9) 2
2. SV setae on abdominal segments 1, 2, 7, and 8 usually numbering 2 : 3 : 2 : 1
 (Fig. 11); anal proleg usually with a single crotchet near each lateral margin
 (Fig. 7). *nepheos*
 SV setae on abdominal segments 1, 2, 7, and 8 usually numbering 1 : 2 : 1 : 1
 (Lindquist, 1963); anal proleg with usually a pair of crotchets near each
 lateral margin (Fig. 9). *pinifoliella*

KEY TO PUPAE OF *EXOTELEIA* SPECIES IN ONTARIO

The pupae of *nepheos* and *dodecella* are not readily separable, except by colour, although they are distinct from *pinifoliella*. The following key attempts to separate the three species:

1. Pupa near black, in the needle mine; cutting plate present on frontal area of
 head (Bennett, 1954) *pinifoliella*
 Pupa yellow-brown or red-brown, in buds or flowers; cutting plate absent 2
2. Dark red-brown pupa; anal end tending to be notched (Martin, 1959) .. *dodecella*
 Yellow-brown pupa; anal end not notched (Fig. 10) *nepheos*

ACKNOWLEDGMENTS

We wish to thank Mrs. Zena Faux for her assistance in the preparation of the figures, and Mr. George Cruikshank of the Ontario Department of Lands and Forests, St. Williams, Ontario for providing a winter collection of study material.

LITERATURE CITED

- BENNETT, W. H. 1954. The pupal morphology of the pine needle miner. Proc. Ent. Soc. Wash., 56: 41-42.
 DYAR, H. G. 1890. The number of molts of lepidopterous larvae. Psyche, 5: 420-422.
 FREEMAN, T. N. 1966. A new species of *Exoteleia* Wallengren (Gelechiidae) on pine. Jour. Lepid. Soc., in press.
 LINDQUIST, O. H. 1963. Larvae of pine needle miners in Ontario. Canad. Ent., 95(5): 517-521.
 MARTIN, J. L. 1959. The bionomics of the pine bud moth, *Exoteleia dodecella* L. (Lepidoptera : Gelechiidae), in Ontario. Canad. Ent., 91(1): 5-14.

BOOK NOTICE

LEPIDOPTERA OF AMERICAN SAMOA, with particular reference to biology and ecology, by John Adams Comstock. To be published by the Bernice P. Bishop Museum, Honolulu, Hawaii, December, 1966; about 75 pp. Price \$3.50 bound, \$2.50 paper covers.

An annotated list of 118 species of Lepidoptera from American Samoa. Descriptions are given of immature stages of many of the species. There are 13 plates, with colored paintings of immature stages, and black and white photographs of adults.—J. LINSLEY CRESSITT, *Bishop Museum, Honolulu, 17, Hawaii.*