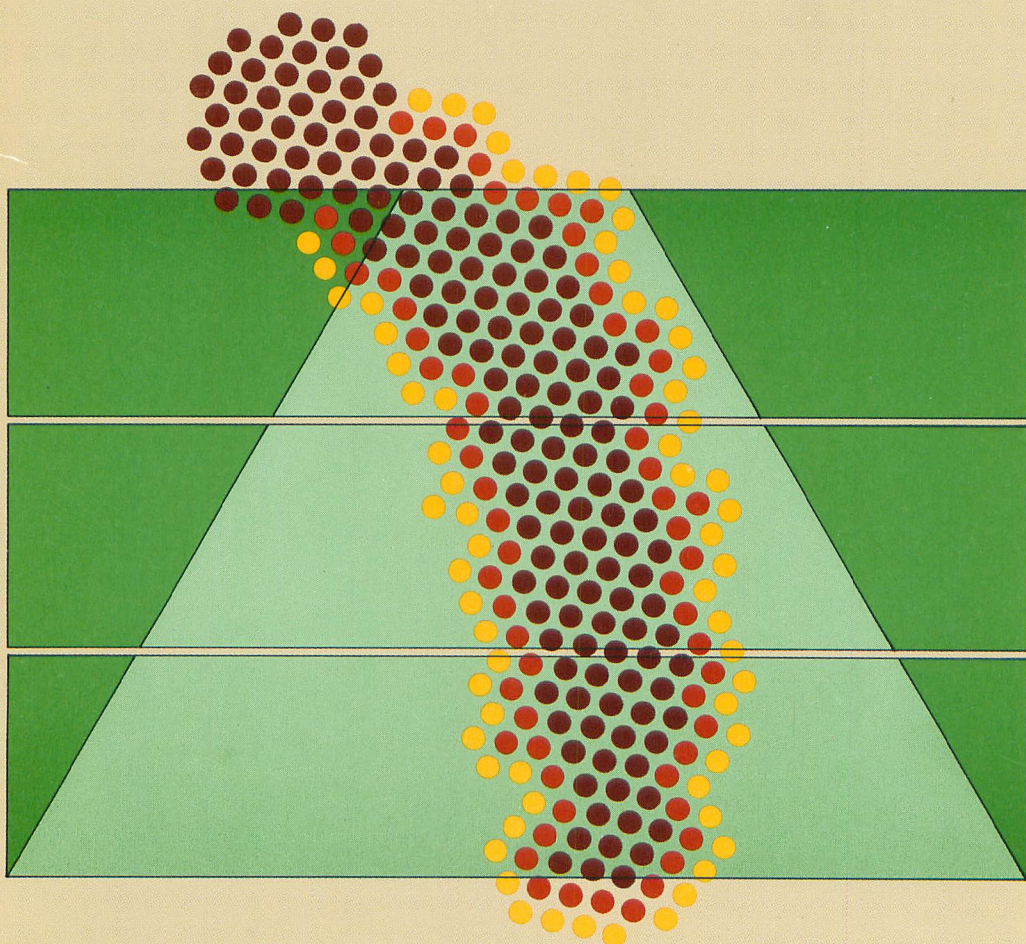




Canada
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Spruce Budworms
Program

KEYS TO LEPIDOPTEROUS LARVAE ASSOCIATED WITH THE SPRUCE BUDWORM IN NORTHEASTERN NORTH AMERICA



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**KEYS TO LEPIDOPTEROUS
LARVAE ASSOCIATED
WITH THE SPRUCE
BUDWORM
IN NORTHEASTERN
NORTH AMERICA**

by O.H. Lindquist

**Great Lakes Forest Research Centre
Sault Ste. Marie, Ontario**

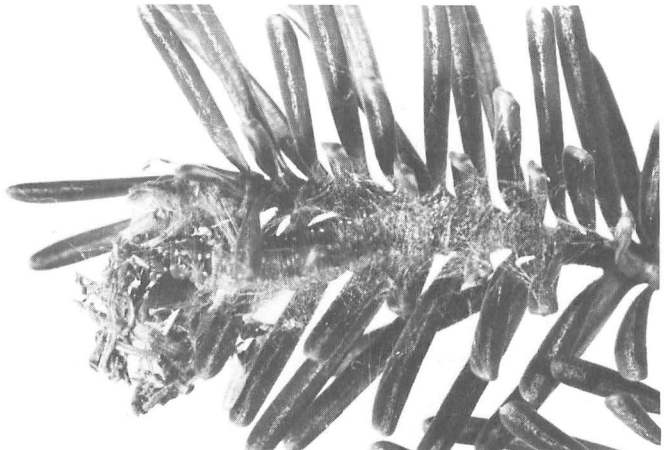
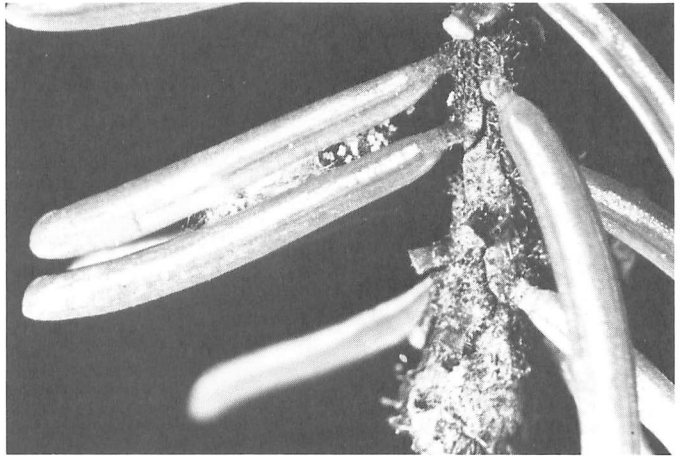
**Canadian Forestry Service
Department of the Environment
1982**

ABSTRACT

This report was prepared to facilitate the separation and identification of lepidopterous larvae associated with the spruce budworm (*Choristoneura fumiferana* [Clem.]) in its various feeding sites on spruce (*Picea* spp.) and fir (*Abies* spp.) in northeastern North America. Three dichotomous keys, with 12 illustrations, are presented; they deal with needleminers, defoliators, and cone feeders. Twenty-two references to the larval morphology and/or biology of species are cited.

RÉSUMÉ

L'objet de ce rapport est de faciliter la distinction et l'identification des larves de lépidoptères apparentées à la tordeuse des bourgeons de l'épinette (*Choristoneura fumiferana* [Clem.]) qui s'alimentent sur les épinettes (*Picea* spp.) et les sapins (*Abies* spp.) du nord-est de l'Amérique du Nord. On y présente 3 clefs dichotomiques ainsi que 12 illustrations de défoliateurs, de mineuses des aiguilles et de ravageurs des cônes. On y cite également 22 références sur la morphologie larvaire et (ou) la biologie des espèces.



Spruce budworm feeding sites.

ACKNOWLEDGMENTS

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Illustrations for the keys were prepared by Kathryn L. Smith.

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INTRODUCTION

Frequently, when studying the spruce budworm, *Choristoneura fumiferana* (Clem.), it is difficult to separate and identify other small associated larvae that feed on fir (*Abies* spp.) and spruce (*Picea* spp.). Earlier work dealing with this problem was done by Brown (1941) and Miller (1950). This report contains keys to needleminers, defoliators, and cone feeders associated with the above-mentioned tree species. Information on insect species included in this report was drawn from data amassed by the Forest Insect and Disease Survey at the Great Lakes Forest Research Centre, Sault Ste. Marie, Ontario, augmented by information from general entomological literature.

With the exception of two geometers, all species in the keys are microlepidopterans, the broad group of Lepidoptera that includes the spruce budworm.

A dissecting microscope is necessary to locate and identify many of the characters used in the keys, particularly when dealing with early or intermediate stages of larvae. Setae and pinacula (setal bases) of selected segments of a generalized tortricid larva are shown in Figure 1. The months specified in the keys refer to seasonal occurrence of larvae in Ontario.

Perhaps the most difficult task is separating the spruce budworm from its associates during its needle-mining stage — particularly on spruce, where several other species are also found. In native stands of spruce in Ontario, the major associates appear to be the orange spruce needle-miner, *Pulicalvaria piceaella* Kft., and the spruce coneworm, *Dioryctria reniculelloides* Mut. & Mun. These three species can be separated in the field roughly on the basis of seasonal occurrence and damage. The needleminer starts mining in late summer and its presence is indicated in the spring by bundles of four or five dead mined needles tied loosely with silk. The budworm mines one to four needles, often partially, only in the spring; mined needles, with a small amount of webbing attached, are usually scattered and erect on the twig. The coneworm mines one or two needles in the spring, usually near a bud; each needle has a tube of web-

bing, covered with fine brown excreta, extending to the stem or bud. Positive identification of miners, however, usually requires a microscopic examination of the larvae. Larval lengths are not indicated in this key but all are less than 10 mm.

The defoliators most often found in association with the spruce budworm are the spruce coneworm, spruce shootworms, *Zeiraphera* spp., the eastern blackheaded budworm, *Acleris variana* (Fern.), and larvae of spruce needle moths, *Archippus* spp. These and many lesser species are included in the following keys.

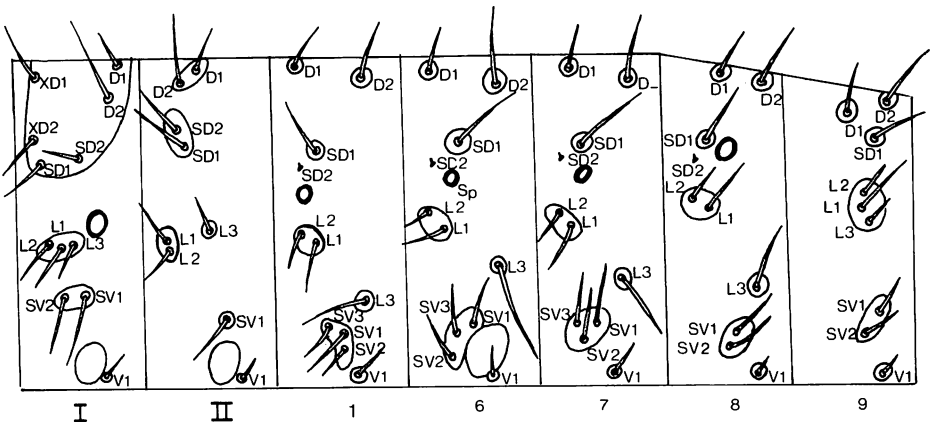
The most injurious species among the external insect feeders on conelets and cones of spruce and fir, other than the spruce budworm, are the spruce coneworm and the fir coneworm, *Dioryctria abietivorella* (Grt.). A common internal feeder is the larva of the spruce seed moth, *Laspeyresia youngana* (Kft.).

For additional information on many of the species dealt with in the following keys a number of publications are specifically recommended. "Insects of Eastern Spruces, Fir and Hemlock" (Rose and Lindquist 1977), which includes color illustrations and biological sketches for some 75 species. "Annotated Keys to some Nearctic Leaf-mining Lepidoptera on Conifers" (Freeman 1967) is based mainly on the completed larval behavior and is useful in identifying injury by the various needle-mining species. Cone and Seed Insects of North American Conifers (Hedlin 1980) is the best current reference to cone insects.

KEY TO NEEDLEMINERS

- 1.** Anal fork present ventrally on last segment of larva (Fig. 2, 3). _____ **2**
 Anal fork absent. _____ **8**
-
- 2.** Anal fork of tortricid type (Fig. 2); larva a miner in early instars only. _____ **3**
 Anal fork with median pair of prongs enlarged and sickle-shaped (Fig. 3). _____ **4**
-
- 3.** Body orange to cream colored; head, thoracic shield, and legs slightly dark to brown. One to four needles mined, often only partially, in the spring; mined needles usually scattered and upright on twig. A small amount of webbing is spun from the entrance hole to an adjacent needle or to the stem. (McGugan 1954, Freedman 1967). _____
 _____ *Choristoneura fumiferana* (Clem.)
- Body greenish; head, thoracic shield, and legs dark. Four to six needles partially mined from late autumn to early spring; mined and adjacent needles are webbed together lightly with silk. (Freeman 1967). _____
 _____ *Archippus packardianus* Fern.
- (Other less common species of *Archippus* would probably be keyed here as well.)

Figure 1.
 A tortricid larva: setal map of thoracic segments I and II and abdominal segments 1 and 6 to 9. Abbreviations: D, dorsal; SD, subdorsal; L, lateral; SV, subventral; and V, ventral; Sp, spiracle.



-
4. Body pale with a distinct pattern of reddish longitudinal stripes or transverse bands. Larvae usually on spruce. _____ 5
 Body uniformly brownish, dull orange-yellow or brick red; head black in early stages, later same as body color. Larval behavior is variable, but on spruce four to five adjacent needles are often mined in the fall and may be found tied in a loose bundle on twigs in the spring. Additional nearby needles are usually mined in the spring. (McLeod 1966, Rose and Lindquist 1977). _____
 _____ *Pulicalvaria piceaella* (Kft.)
-
5. Body pale; each segment with a broad, dorsal, transverse band of dark pink or red. _____ 6
 Body ivory-yellow with pink or red longitudinal stripes. Larvae only occasionally mine needles of spruce. _____ 7
-
6. Head chestnut-brown; thoracic shield, anal plate, crochets, and anal fork brown; abdominal and anal crochets with a median gap. Larvae mine the new needles of mainly red spruce and black spruce in July and August. (McLeod 1962). _____
 _____ *Eucordylea ducharme* Free.
 Head and thoracic shield light amber; no median gap in series of abdominal and anal crochets. Each larvae mines about six needles in autumn and the following spring. A characteristic dense silk tube, later frass covered, is spun along the twig between mined needles. (Freeman 1967). _____
 _____ *Pulicalvaria martini* Free.
-
7. Thoracic shield and anal plate deep brown, bordered laterally and posteriorly with dark gray; anal fork dark brown or black. Larva in June, occasionally mining needles. (McLeod 1962). _____
 _____ *Eucordylea atrupictella* Dietz

Thoracic shield, anal plate, and fork pale brown; thoracic shield and anal plate lacking gray border. Larva in June, occasionally mining needles. (McLeod 1962).

_____ *Eucordylea blastovora* McLeod

8. Larvae on spruce. _____ **9**

Larvae on balsam fir. Four or more needles, usually in pairs, are mined almost entirely, in autumn and early spring. The pupa is formed in a mined needle in May. (Freeman 1967). The full-grown larva of this little-known species is believed to be similar in color to a third instar budworm, but larger, and presumably lacks an anal fork.

_____ *Epinotia balsameae* Free.

9. Larva not striped. Conspicuous clusters or nests of dead needles, mainly on planted spruce. _____ **10**

Larva cinnamon-brown with a series of nine, dark brown, broken longitudinal stripes; head and thoracic shield near black. One or two needles, usually near a bud, mined in early spring; silken webbing with fine brown excreta between entrance hole and stem. (McLeod and Daviault 1963).

_____ *Dioryctria reniculelloides* Mut. & Mun.

10. Body brownish except cream-gray in last instar; head, thoracic shield, and legs dark brown. A group of adjacent needles is mined and secured to the twig with silk from late summer to the following spring. Pupa brownish. (Lindquist and Harnden 1966, Rose and Lindquist 1977).

_____ *Epinotia nanana* Treit.

Body greenish; thoracic legs pale; head and thoracic shield yellow-brown. The nearly full-grown larvae overwinter in nests of dead, mined needles and excreta tied together loosely with silk. Mining is completed in the spring. Pupa green. (Cumming 1954, Rose and Lindquist 1977).

_____ *Endothenia* (= *Taniva*) *albolineana* (Kft.)

KEY TO DEFOLIATORS

- 1.** Proleg crochets forming or tending to form a circle (Microlepidoptera in part, Fig. 4). _____ **2**
Proleg crochets in longitudinal series (Fig. 5). _____
_____ Macrolepidoptera
-
- 2.** Two prespiracular setae (L1 and 2) on prothorax (Pyralidae, Fig. 6.) _____ **3**
Three prespiracular setae (L1, 2, and 3) on prothorax (Fig. 1). _____ **5**
-
- 3.** A dark ring around subdorsal (SD) setae on mesothorax and abdominal segment 8 (Fig. 7). _____ **4**
_____ **4**
Subdorsal (SD) setae not ringed; head reddish; thoracic shield yellowish; body pale with indefinite dark mid-dorsal line; brown subdorsal and supraspiracular lines tend to fuse; integument with short rows of minute pits on body segments. Full-grown larva about 17 mm long. Collected mainly in club-top black spruce from June to September. (Brown and McGuffin 1942, Wong 1960). _____
_____ *Herculia devialis* Grt. (= *thymetusalis* Wlk.)
-
- 4.** Anal shield pale with dark lateral areas; head pale brown to dark brown; body pale red to dark purple-brown above spiracles, paler below; thoracic legs pale. Full-grown larva about 20 mm long. Spring to fall. (Lyons 1957a, Rose and Lindquist 1977). _____
_____ *Dioryctria abietivorella* (Grt.)

Figure 2.
Tortricid-type anal fork

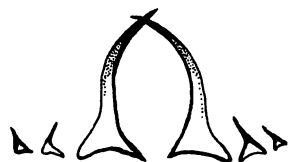
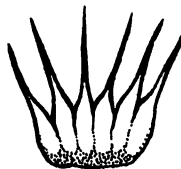


Figure 3.
Sickle-pronged anal fork:
example *Pulicalvaria piceaella*
(Kft.)

Anal shield pale; head dark brown, transversely wrinkled; body pale with cinnamon and brown lines; thoracic legs near black. Full-grown larva about 17 mm long. May to late July. (McLeod and Daviault 1963, Rose and Lindquist 1977). _____
_____ *Dioryctria reniculelloides* Mut. & Mun.

- 5.** Anal fork with median pair of prongs enlarged and sickle-shaped (Fig. 3) _____ **6**
Anal fork of tortricid type (Fig. 2) or absent. _____
_____ **8**
-

- 6.** Body ivory-yellow with a series of irregular pink stripes. _____ **7**
Body orange-yellow to brick red without stripes; head blackish in early stages, later shiny brown. Full-grown larva about 8 mm long. August to following July. (McLeod 1962, 1966, Rose and Lindquist 1977). _____
_____ *Pulicalvaria piceaella* (Kft.)
-

- 7.** Anal fork dark brown or black, well developed, including bases of prongs; head brown; thoracic and anal shields brown, bordered laterally and posteriorly with dark gray. Full-grown larva about 9 mm long. Mainly June, July. (McLeod 1962). _____
_____ *Eucordylea atrupictella* Dietz.
Anal fork pale brown with lateral prongs not prominent, their bases only slightly enlarged; shields pale brown lacking gray border. Full-grown larva about 8 mm long. Mainly June, July. (McLeod 1962). _____
_____ *Eucordylea blastovora* McLeod
-

- 8.** Two subventral (SV) setae on abdominal segment 7. _____ **9**
Three subventral (SV) setae on abdominal segment 7 (Fig. 1). _____ **13**
-

-
- 9.** Anal fork present. _____ **10**
 Anal fork absent; body cream colored with dark setal bases; shields and legs dark brown in early stages, later yellowish. Full-grown larva about 10 mm long. Late May to early July. (MacKay 1959, Pilon 1965, Rose and Lindquist 1977). _____
 _____ *Zeiraphera canadensis* Mut. and Free.
-

- 10.** Dorsal (D1) and subdorsal (SD1) setae on abdominal segment 9 on same pinaculum. _____ **11**

 D1 and SD1 setae on separate pinacula on abdominal segment 9 (Fig. 1); body light green; head variable, yellowish with dark overlay to red-brown or black; thoracic shield dark in early stages, later pale bordered laterally and posteriorly with brown. Full-grown larva about 15 mm long. May to July. (MacKay 1962a, Miller 1966, Rose and Lindquist 1977). _____
 _____ *Acleris variana* (Fern.)
-

- 11.** Thoracic legs pale; prothoracic shield yellowish. _____ **12**
 Thoracic legs blackish; prothoracic shield dark posteriorly; body pale with wide purple-brown dorsal and lateral stripes. Full-grown larva about 10 mm long. May, June. (Rose and Lindquist 1977). _____
 _____ *Zeiraphera destitutana* (Walker)
-

Figure 4.
 Proleg crochets of
 microlepidoptera (in part)

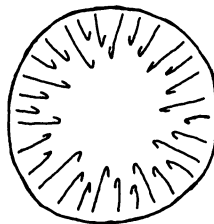
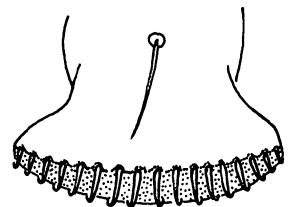


Figure 5.
 Proleg crochets of
 macrolepidoptera (in part)



12. Body cream without stripes; D1 seta on anal shield about half the length of SD1 (Fig. 8); head yellow with darker areas. Full-grown larva about 10 mm long. May to July. (MacKay 1962b, Rose and Lindquist 1977).

_____ *Zeiraphera fortunana* Kft.

Body cream with three, indefinite, wide orange-brown stripes in older larvae. D1 and SD1 setae on anal shield about equal in length; head yellowish. Full-grown larva about 10 mm long. May to July. (Blais 1961, MacKay 1962b, Rose and Lindquist 1977).

_____ *Griselda radicana* (Wlshm.)

13. Body brown; head yellow-brown, red-brown or black. _____ **14**

Body green, dorsum may be dark; head color various. _____ **15**

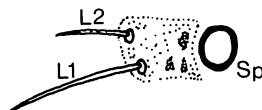
14. May to July; late instars with a pale lateral line; pinacula pale; thoracic legs dark. Full-grown larva about 22 mm long. (MacKay 1962a, Rose and Lindquist 1977).

_____ *Choristoneura fumiferana* (Clem.)

July to September; larva with large pale pinacula; setae dark, fine spinules on integument; thoracic legs and shield yellowish. Full-grown larva probably about 22 mm long. (MacKay 1962b). Not a common species.

_____ *Amorbis* sp. nr. *humerosana* Clem.

Figure 6.
Prespiracular setae on prothorax
of a pyralid

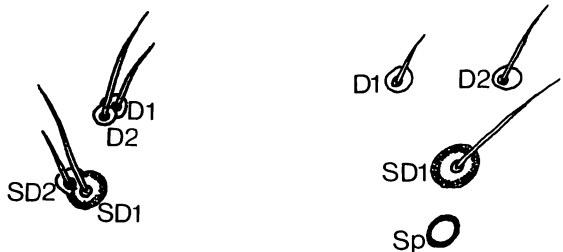


-
- 15.** Anal shield usually rounded (Fig. 9), rarely slightly tapered. _____ **16**
 Anal shield tapered (Fig. 10). _____ **18**
-

- 16.** Head greenish with lateral dark bar and often patterned overlay; thoracic shield greenish, dark posteriorly. _____ **17**
 Head blackish, sometimes yellow or red-brown; thoracic shield blackish, or greenish with dark lateral or posterior areas. Full-grown larva about 25 mm long. (MacKay 1962a, Chapman and Lienk 1971). May to July. _____
 _____ *Choristoneura rosaceana* Harr.
-

- 17.** Thoracic legs pale, light brown distally; SD1 pinacula more or less anterior to spiracle on abdominal segment 8 (Fig. 1); minute dense spinules on integument of body pale. Full-grown larva about 20 mm long. (MacKay 1962a, Rose and Lindquist 1977). June, July. _____
 _____ *Archippus packardianus* Fern.
- Thoracic legs brown; SD1 pinacula anterodorsal to spiracle on abdominal segment 8; minute dense spinules on integument of body dark. Full-grown larva about 20 mm long. (MacKay 1962a). June, July. _____ *Archippus strianus* Fern.

Figure 7.
 Subdorsal setae on a) mesothorax
 and b) abdominal segment 8 of
Dioryctria spp.



18. Larva with brown markings on head or shields. _____ **19**

Larva generally pale, microscopic dorsal spinules dark, tending to give a striped appearance. Full-grown larva about 16 mm long. (MacKay 1962a).
May, June. _____ *Clepsis persicana* Fitch

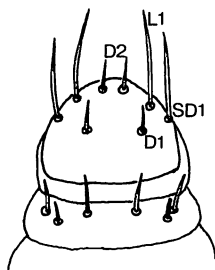
19. Larva mainly green; head with a pair of dark bars, later eight dark bars. Full-grown larva about 15 mm long. (Brown and McGuffin 1942, MacKay 1962a).
May to October but mainly August to September. _____ *Argyrotaenia occultana* Free.

Larva with dark markings on head, thoracic or anal shields. _____ **20**

20. Scattered dark markings on thoracic shield and often on anal shield; spinules very dark dorsally, pinacula pale and conspicuous; venter pale. Full-grown larva about 20 mm long. (MacKay 1962a).
June. _____ *Aphelia alleniana* Fern.

Thoracic shield with a dark lateral border or with a dark spot anteroventrad of SD1 seta; spinules pale; dorsal pinacula on mesothorax elongated posteriorly. Full-grown larva about 16 mm long. (MacKay 1962a). May to July. _____ *Sparganothis tristriata* Kft.

Figure 8.
Setae on anal shield of
Zeiraphera fortunana Kft.



KEY TO LARVAE IN CONES

- 1.** Prolegs present only on abdominal segments 6 and 10. (Geometridae) Full-grown larvae about 10 mm long. Larva boring into spruce cones in July and August. _____ **2**
Prolegs present on abdominal segments 3 to 6 and 10. _____ **3**
-
- 2.** Body pale pink with small brown pinacula on thorax and abdomen (McGuffin 1958, Rose and Lindquist 1977). _____
_____ *Eupithecia mutata* Pears.
Body flesh-colored with reddish stripes; narrow brown rings at base of dorsal setae (McGuffin 1958). _____
_____ *Eupithecia albicapitana* Pack.
-
- 3.** Two prespiracular setae (L1 and 2) on prothorax (Fig. 6); a dark ring around SD setae on mesothorax and abdominal segment 8 (Fig. 7). _____ **4**
_____ **4**
Three prespiracular setae (L1, 2, and 3) on prothorax (Fig. 1); no dark ring around SD setae on mesothorax and abdominal segment 8. _____ **5**
_____ **5**
-
- 4.** Anal shield pale; head dark brown, transversely wrinkled; body pale with cinnamon and brown lines; thoracic legs near black. Full-grown larva about 17 mm long. May to late July. (McLeod and Daviault 1963, Rose and Lindquist 1977). _____
_____ *Dioryctria reniculelloides* Mut. & Mun.
Anal shield pale with dark lateral areas; head pale brown to dark brown; body pale red to dark purple-brown above spiracles, paler below; thoracic legs pale. Full-grown larva about 20 mm long. May to October. (Lyons 1957a, Rose and Lindquist 1977). _____
_____ *Dioryctria abietivorella* (Grt.)

-
5. Anal fork present, tortricid type (Fig. 2). _____ 6
 Anal fork absent. _____ 8
-

6. Body pale to greenish, dorsum may be dark; head yellow-brown or red-brown. _____ 7
 Body brown, late instar larvae with a pale lateral line, pinacula pale; thoracic legs dark; head yellow-brown, red-brown or black. Full-grown larva about 22 mm long. May to July. (MacKay 1962a, Rose and Lindquist 1977). _____
 _____ *Choristoneura fumiferana* (Clem.)
-

7. Head red-brown with broad black lateral bar; pinacula D1 and SD1 on abdominal segment 9 (Fig. 1) widely separated; thoracic shield and legs dark brown. Full-grown larva about 16 mm long. On spruce from May to October. (MacKay 1962a). _____
 _____ *Archippus alberta* McD.
 Head yellowish, usually with black lateral bar; pinacula D1 and SD1 on abdominal segment 9 adjacent or merged; thoracic shield and legs usually dark brown. Full-grown larva about 12 mm long. May to September. (MacKay 1959). _____
 _____ *Paralobesia piceana* Free.
-

8. Body setae and pinacula minute; body creamy white, pale pink or yellowish; head and thoracic shield yellow-brown to brown. _____ 9
-

Figure 9.
 Rounded anal shield of
Archippus packardianus Fern.

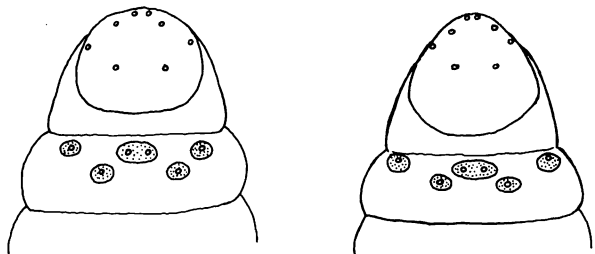


Figure 10.
 Tapered anal shield of *Clepsis persicana* Fitch

Body setae not minute, SD1 on abdominal segments 1 to 7 set in a brown crescentic sclerite (Fig. 11) or its pinacula joined with a sclerotized ring around spiracle (Fig. 12); body pale greenish tan or brown; head and thoracic shield yellow-brown or red-brown. _____ 10

9.

Body creamy white; anal proleg bearing three to six crochets; larvae tunnel in the cone, eating seeds, and overwinter in a tunnel in the cone axis of white, red, or blue spruce cones. Full-grown larva about 10 mm long. May to following spring. (Tripp 1954, MacKay 1959, Rose and Lindquist 1977). _____

_____ *Lasperyresia youngana* (Kft.)

Body probably pale pink or yellowish; anal proleg bearing 10 or more crochets. (The larva of this species is not known but is assumed to be similar to that of the western species *Barbara colfaxiana* [Kft.]). Full-grown larva probably about 12 mm long. Rarely in cones of white spruce and balsam fir from June to September. (Hedlin 1980). _____

_____ *Barbara mappana* Free.

10.

Body pale brown, later brown lined with gray; SD1 setae on abdominal segments 1 to 7 set in brown crescentic sclerites open dorso-posteriorly (Fig. 11), SD1 setae on abdominal segments 8 and 9 filamentous. Full-grown larva about 11 mm long. June to September. (Lyons 1957b). _____

_____ *Holcocera immaculella* McD.

Fig. 11.
Subdorsal seta on abdominal segment 6 of *Holcocera immaculella* McD.

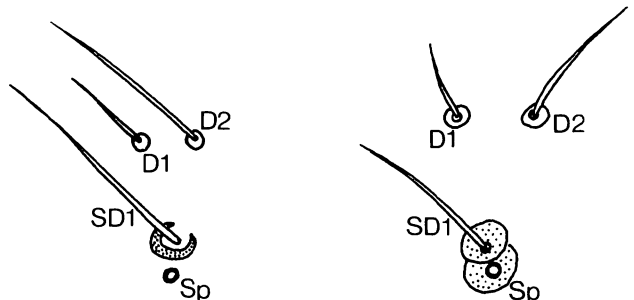


Fig. 12.
Subdorsal seta on abdominal segment 6 of *Eucosma tocullionana* Heinr.

Body pale greenish tan; head yellow-brown; pinacula bearing setae SD1 and 2 joined with sclerotized ring around spiracle (Fig. 12) on abdominal segments 1 to 8. Full-grown larva about 15 mm long. June to September. (MacKay 1959), Hedlin 1980). _____ *Eucosma tocullionana* Heinr.

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