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KEY TO ADULT MALES OF CONIFER-FEEDING SPECIES OF *CHORISTONEURA* LEDERER (LEPIDOPTERA: TORTRICIDAE) IN CANADA AND ALASKA

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Abstract

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A key, based on morphological characters of adult males, separating six traditionally recognized conifer-feeding *Choristoneura* species, *C. pinus* Freeman, *C. lambertiana* (Busck), *C. fumiferana* (Clemens), *C. occidentalis* Freeman, *C. biennis* Freeman, and *C. orae* Freeman occurring in Canada and Alaska is provided and illustrated. The newly discovered morphological features, the aedeagus of *C. fumiferana* and *C. pinus* with a short apical spine and with many microscopic spicules on the distal half, are used to separate these two species from their western allies *C. occidentalis*, *C. biennis* and *C. orae*.

Résumé

L'auteur fournit une clef de détermination illustrée basée sur les caractères morphologiques des adultes mâles pour séparer les six espèces du genre *Choristoneura* traditionnellement reconnues comme des ravageurs des conifères du Canada et de l'Alaska, *C. pinus* Freeman, *C. lambertiana* (Busck), *C. fumiferana* (Clemens), *C. occidentalis* Freeman, *C. biennis* Freeman et *C. orae* Freeman. Les nouveaux caractères morphologiques, soit l'édéage du *C. fumiferana* et du *C. pinus* avec une épine apicale courte et la présence de spicules microscopiques sur la moitié distale de l'édéage, permettent de séparer ces deux espèces des *C. occidentalis*, *C. biennis* et *C. orae*.

Introduction

Six conifer-feeding species of *Choristoneura* Lederer occur in Canada and Alaska: *C. pinus* Freeman, *C. lambertiana* (Busck), *C. fumiferana* (Clemens), *C. occidentalis* Freeman, *C. biennis* Freeman, and *C. orae* Freeman. The first two species feed on *Pinus* spp., the rest feed on various species of *Abies, Picea*, *Tsuga*, and *Pseudotsuga*. Freeman (1953, 1967) distinguished these species on the basis of geographic distributions, natural larval hosts, and life histories; the shape of the uncus was the only morphological character used by Freeman to separate the adults of two sympatric species, *C. pinus* and *C. fumiferana*.

The extensive color and pattern variation of the forewing and morphological resemblance among conifer-feeding *Choristoneura* species in Canada and Alaska have created difficulties and confusion in the identification of species. In the present paper, newly discovered morphological characters are used to distinguish *C. fumiferana* and *C. pinus* from their western allies, *C. occidentalis*, *C. biennis*, and *C. orae*. The short apical spine and the presence of microscopic spicules on the distal half of the aedeagus (Figs. 1–4) are unique characters of *C. pinus* and *C. fumiferana* suggesting these two species are more closely related to each other than to species occurring in the western regions. Other morphological features such as variations of colors and patterns, and wing sizes, which cannot be properly incorporated in the key, will be discussed in detail in a more comprehensive paper at a later date. Also, the taxonomic status of the taxa mentioned are not discussed at the present time; the species names used in this paper were based on the classification given by Powell (1980, 1983). Even though *C. occidentalis* and *C. biennis* are recognized

as two distinct species as proposed by Freeman (1967), they remain morphologically indistinguishable.

The adult females of this closely related species group, as in many cases in Tortricidae, contain little morphological information for species separations. Females of species with fairly consistent forewing colors, such as those of two sympatric species *C. fumiferana* and *C. pinus*, can be separated on the basis of color: all females of *C. pinus* are reddish brown, whereas most females of *C. fumiferana* are dark blackish brown except for a few yellowish-brown individuals. However, this separation can be made only with specimens collected in areas east of the Rocky Mountains to the east coast of Canada and the United States, where *C. fumiferana* and *C. pinus* occur naturally. Females of *C. pinus* and *C. fumiferana* cannot be separated, on the basis of color, from those of the western species, *C. occidentalis*, *C. biennis* and *C. orae*, because forewing colors of the latter are greatly variable and overlap widely with those of *C. pinus* and *C. fumiferana*. Therefore, the use of the forewing colors is limited and has little value in the identification of females of the spruce-budworm species complex in Canada and Alaska.

Materials and Methods

Material used in this study was from the following localities:

***Choristoneura fumiferana*. Newfoundland**: Pasadena, 30.VII.1982, K. P. Lim, 240 ♂♂ (50 male genitalia). **Nova Scotia**: Inverness, 16.VII.1980, Forest Insect and Disease Survey (FIDS), 18 ♂♂ (18 male genitalia). **New Brunswick**: Filton, 18.VI.1981, FIDS, 60 ♂♂ (50 male genitalia). **Quebec**: Lac Philippe, 23.VII.1982, pheromone traps, K. Bolte & R. Smith, 120 ♂♂ (120 male genitalia). **Ontario**: Moosonee, VII.1982, FIDS, 70 ♂♂ (50 male genitalia). **Alberta**: Edmonton, 23.VI.1982, J. Petty, 118 ♂♂ (50 male genitalia). **N.W.T.**: Fort Simpson, 1960, 13 ♂♂ (13 male genitalia); Fort Smith, 18.VII.1950, J.B. Wallis, 1 ♂ (1 male genitalia); Yellowknife, 26.VII.1949, E.F. Cashman, 1 ♂ (1 male genitalia); Blackwater River, 26.VI.1960, C.E. Brown and E.F. Machuk, 17 ♂♂ (17 male genitalia). **Yukon**: Watson Lake, Alaska Hwy., m. 514, 21.VI.1977, L. Unger, 2 ♂♂ (2 male genitalia). **Alaska**: Fairbanks, Bonanza Creek, 14–26.VII.1980, R. Werner, and from pheromone traps at the same locality, nos. DA-1-2 and D-BCE-2, 25.VII.1980, by R. Werner, 17 ♂♂ (17 male genitalia). **British Columbia**: Liard Hot Spring, 30.VI., 2 & 5.VII.1971, FIDS, 3 ♂♂ (3 male genitalia); Liard, 6 & 9.VII.1973, 2 ♂♂ (2 male genitalia); Ft. Nelson, 5.VII.1968, 2.VII.1971, FIDS, 2 ♂♂ (2 male genitalia); Fireside, 5.VII.1974, FIDS, 1 ♂ (1 male genitalia).

***Choristoneura pinus*. Nova Scotia**: Lake Rossignol, 23.VIII.1951, D.C. Ferguson, 1 ♂ (1 male genitalia); Armdale, 10.VIII.1945, 8.VIII.1950, 8.VIII.1951, D.C. Ferguson, 4 ♂♂ (4 male genitalia); William Lake, Halifax, 17.VIII.1957, D.C. Ferguson, 2 ♂♂ (2 male genitalia); Halifax, Boulderwood, 9–17.VIII.1959, 12–18.VIII.1960, D.C. Ferguson, 9 ♂♂ (9 male genitalia); Cape Breton Highland National Park, Jack Pine Trail, 27.VI.1983, P.T. Dang, 1 ♂ (1 male genitalia). **New Brunswick**: Dunphy, North Co., 12.VII.1971, 8.VII.1983, FIDS, 4 ♂♂ (4 male genitalia); Arbeau, North Co., 8.VII.1983, FIDS, 3 ♂♂ (3 male genitalia). **Ontario**: Constance Bay, 5–9.VII.1934, W.J.B., 5 ♂♂ (5 male genitalia); Nepean, 5.VI.1983, P.T. Dang & P. Macdonald, 3 ♂♂ (3 male genitalia). **Manitoba**: Paratypes, Beausejour, 14–25.VII.1951, V. Hildahl, 140 ♂♂ (50 male genitalia).

***Choristoneura lambertiana*. Alberta**: Crowsnest, 3.4 mi E. of Burmis, 29.VI.1964, J. Petty & J. Smith, 6 ♂♂ (3 male genitalia); Burmis, 14–16.VII.1952, 22.VII.1963, Forest Insect Survey (FIS), 4 ♂♂ (4 male genitalia); Blairmore, 9.VIII.1949, FIS, 1 ♂ (1 male genitalia); near Maycroft, 18.VII.1940, FIS, 1 ♂; Coleman, 15.VII.1957, FIS, 1 ♂ 4 ♀♀.

***Choristoneura occidentalis*. Washington**: Holotype, ♂, CNC No. 8076, Yakima Ind.

Res., Monument Rd., Klickitat Co., genitalia slide No. 4498; paratypes, same locality as holotype, 12♂♂ 10♀♀. **British Columbia**: Lillooet, 6–27.VII.1943, 10.VI.–20.VII.1949, 10.VII.1953, FIS, 34♀♀; Clinton, 26.VII.1981, pheromone traps, P.T. Dang & K. Bolte, 100 male genitalia; Ashcroft, 24.VI.1982, P.T. Dang, 20 ♂♂ (20 male genitalia) and 28 ♀♀.

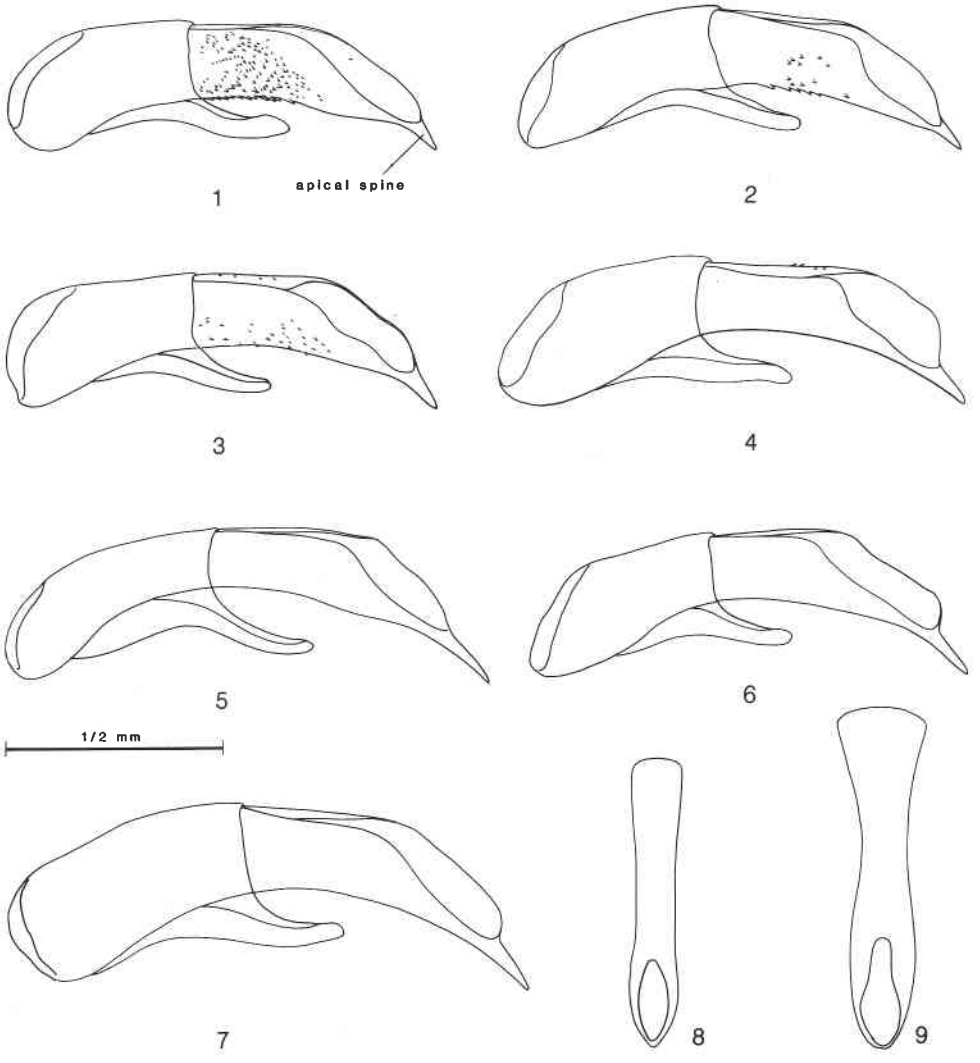
***Choristoneura biennis*. Alberta**: Lake Louise, 23.VIII.1968, C.S. Walley, 3♂♂ (3 male genitalia). **British Columbia**: Holotype, ♂, CNC No. 8075, Monashee Summit, 18.VII.1950, FIS, genitalia slide No. 1037; paratypes, same locality as holotype, 12–26.VII.1950, FIS, 7 ♂♂ 14 ♀♀; Silver Hills, 4.VIII.1949, 17–28.VII.1950, 4.VII.1950, FIS, 8 ♂♂ (8 male genitalia) and 19 ♀♀; Davie Lake, 1–24.VII.1950, FIS, 15 ♂♂ (15 male genitalia) and 60 ♀♀; Johnson Lake, 6–17.VII.1950, FIS, 6 ♂♂ (6 male genitalia); Bolean Lake, 18–26.VII.1950, FIS, 8 ♂♂ (8 male genitalia).

***Choristoneura orae*. British Columbia**: Holotype, ♂, CNC No. 8426, Kitimat, 16.VII.1962, genitalia slide No. 4499; paratypes, same locality as holotype, 28.VI–18.VII.1962, 2 ♂♂ 4 ♀♀; Kispiox, 29.VI.1982, P.T. Dang & L. Unger, 45 ♂♂ (45 male genitalia) and 95 ♀♀; Hazelton, 23.VI.1981, L. Unger, 10 ♂♂ (10 male genitalia) and 14 ♀♀. **Alaska**: Anchorage, VI.1980, E. Holsten, 12 ♂♂ (12 male genitalia) and 26 ♀♀; Fairbanks, Bonanza Creek, pheromone traps nos. DA-1-2 and D-BCE-2, 25.VII.1980, by R. Werner, 19 ♂♂ (19 male genitalia).

Morphological features of the male genitalia were studied and observed in glycerin after maceration in boiling 20% KOH solution for 3–5 min. Microscopic spicules can be observed at magnifications of 100 and 200× on a compound microscope; other observations including wing measurements were made with a stereoscopic microscope with magnifications of 20, 40, and 80×.

Key to Species (Males)

1. Aedeagus usually with at least a few (often 10–150) microscopic spicules. Apical spine short, conical, much shorter than width at midpoint of aedeagus (Figs. 1–4) 2
– Aedeagus smooth, without spicules. Apical spine slender, as long as, or longer than width at midpoint of aedeagus (Figs. 5–7) 4
2. Uncus broadened apically (Fig. 9). Aedeagus usually with many spicules except in a few individuals with fewer than 10, rarely none (Figs. 3–4). Forewing dark blackish brown. Larvae found mainly on *Abies*, *Picea*, and occasionally *Tsuga* species ..... *Choristoneura fumiferana* (Clemens)
– Uncus slender, almost parallel sided (Fig. 8). Aedeagus with many spicules (Figs. 1–2). Forewing reddish brown. Larvae found mainly on *Pinus banksiana* Lamb. and *P. resinosa* Ait. (*Choristoneura pinus* Freeman) 3
3. Wing bands well defined. Distribution: New Brunswick, Ontario, Michigan, Wisconsin, Minnesota, and Manitoba ..... *Choristoneura pinus pinus* Freeman
– Wing bands not well defined, consisting of numerous transverse reddish-brown striae. Distribution: east coasts of Canada and the United States ..... *Choristoneura pinus maritima* Freeman
4. Hindwing pale grayish yellow. Forewing yellowish, or orangish brown, wing bands dull, not distinctly contrasting with pale areas. Larvae found mainly on *Pinus contorta* Doug ..... *Choristoneura lambertiana* (Busck)
– Hindwing dark smoky brown. Forewing orangish, reddish, or blackish brown, wing bands well defined and distinctly contrasting with pale areas. Larvae found mainly on *Picea*, *Abies*, *Tsuga*, and *Pseudotsuga* species 5
5. Length of forewing 7.50–11 mm, most frequently 9–10 mm. Aedeagus usually narrow on basal half and gradually broadened toward apical opening (Figs. 5–6) ..... *Choristoneura orae* Freeman



FIGS. 1–9. 1–7, lateral aspect of aedeagus of *Choristoneura* spp. (corunti and vesica omitted): 1–2, *C. pinus*, paratypes, Beausejour, MB, slide nos. 840313-30♂ and 840313-26♂ respectively; 3–4, *C. fumiferana*, Edmonton, AB, slide No. 840312-26♂, Lac Philippe, PQ, slide No. 83427-19♂ respectively; 5, *C. orae*, Kitimat, BC, slide No. 82117-12♂; 6, *C. orae*, Kispiox, BC, slide No. 82117-12♂; 7, *C. biennis*, Davie Lake, BC, slide No. 840327-6♂. 8–9, dorsal aspect of uncus of *Choristoneura* spp.: 8, *C. pinus*; 9, *C. fumiferana*.

– Length of forewing 9–14 mm, most frequently 11–13 mm. Aedeagus usually uniform in width from basal half to apical opening (Fig. 7) .....
..... *Choristoneura occidentalis* Freeman
.....*Choristoneura biennis* Freeman

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