DISTRIBUTION OF *COLEOPHORA LARICELLA* (LEPIDOPTERA: COLEOPHORIDAE) AND ITS MAJOR PARASITES IN THE CROWNS OF WESTERN LARCH IN BRITISH COLUMBIA[1]

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ABSTRACT

The distribution of *Coleophora laricella* (Hbn.) and its parasites *Dicladocerus* spp. *(D nearcticus* Yosh. and *D. pacificus* Yosh. (Yoshimoto 1976)) and *Spilochalcis albifrons* (Walsh) in the crowns of western larch were determined for five classes of trees. In open-grown trees more than 7.6 m high, *C. laricella* densities were greater at 1.5-3.1 m than at 6.1-7.6 m above the ground, on the sunny side of a tree than on the shaded side, and on the outer half than on the inner half of a branch. In open-grown trees 3.0-4.6 m high and in trees forming a closed canopy, only the outer branch halves had significantly greater densities. The only significant variation in parasitism by *Dicladocerus* spp. occurred between branch halves in open-grown, non-roadside trees more than 7.6 m high, with more parasitism on the inner halves than the outer. Parasitism by *S. albifrons* was significantly greater at the lower crown level than at the higher in open-grown, closed-canopy, non-roadside trees that were more than 7.6 m high, and on the outer branch half than on the inner half in the same category of tree.

INTRODUCTION

Little is known about the within-tree distribution of the larch casebearer, *Coleophora laricella* (Hbn.) (Lepidoptera: Coleophoridae), an introduced pest, and its major parasites in British Columbia, in trees growing in different situations. It is thus difficult to develop adequate sampling procedures. *Dicladocerus* spp. *(D. nearcticus* Yosh. and *D. pacificus* Yosh. (Yoshimoto 1976) (Hymenoptera: Eulophidae) and*Spilochalcis albifrons* (Walsh) (Hymenoptera: Chalcididae) were by far the most abundant species in a two-year survey of parasites of *C. laricella* (Miller and Finlayson 1974, 1977).

Webb (1953) examined the distribution of *C. laricella* on American larch, *Larix laricina* (Du Roi) K. Koch, but only on large, open-grown trees. There have been no published reports of within-tree distribution of *C. laricella* in western larch, *Larix occidentalis* Nutt. Distributions of *Dicladocerus* spp. and *S. albifrons* on western larch have been reported by Tunnock *et al.* (1972), but again only on large, open-grown trees.

The objective of this study was to determine the within-tree distributions of *C. laricella*, *Dicladocerus* spp. and *S. albifrons* in western larch trees growing in various situations, to provide data that could improve sampling techniques.

METHODS

Crowns of 40 western larch trees in five classes were sampled on 13 June 1974 at Shoreacres, British Columbia. The five classes of trees and the number in each class were:

Class	Description	Number of trees
1	Open-grown trees at least 91.4 m (100 yd.) from road and over 12.2 m (40 ft.) high	10
2	Same as Class 1 except 7.6-10.7 m (25-35 ft.) high	10
3	Same as Class 1 except 3.1-4.6 m (10-15 ft.) high	5
4	Same as Class 1 except trees were roadside	5
5	Same as Class 1 except trees formed closed canopy. Trees sampled were at least twice height of trees from the edge of stand	10

[1]Based on a thesis submitted by the senior author in partial fulfillment of an M.Sc. degree

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Samples from Class 1 trees were also taken on 15 May 1974 but were analyzed for distribution of *C. laricella* only.

Samples were taken at two crown levels: 1.5-3.1 m (5-10 ft.) and 6.1-7.6 m (20-25 ft.) above the ground. Two primary branches were taken from both the sunny and shaded sides of each tree from each crown level and cut in half. The branch halves were mass-reared in pairs according to tree, crown level, side of tree, and branch half. Rearing was done in 30.5x61.0x 30.5 cm (1x2x1 ft.) cages constructed from corrugated paper cartons, the tops of which were replaced with 0.2 mm mesh.

Parasites were collected daily and placed directly into 70% ethanol. After parasite emergence was completed, host cases were removed manually and the number of fascicles counted.

For statistical analyses, $\log_{10}$ x transformations were done on *C. laricella* densities (number per 100 fascicles) and arcsine transformations were calculated for percentage parasitism data. In analyses of variance (Dixon 1973) of the intra-tree distributions of each class, trees were allowed to go random, resulting in conservative F values. The data are presented in the untransformed form.

RESULTS

There were no significant differences between the tree classes in mean density of *C. laricella* or mean percentage parasitism by *Dicladocerus* spp. or by *S. albifrons* in the crown levels (Table 1). *C. laricella* densities varied significantly between crown levels, between sides of the tree, and between branch halves in Classes 1, 2 and 4; and between branch halves only in Classes 3 and 5 (Figure 1). The densities were significantly higher on the outer branch halves than on the inner in all classes. Significantly higher densities occurred at the lower crown level than at the higher in Classes 1, 2 and 4 but no significant differences occurred between crown levels in Class 5. Densities were also significantly higher on the sunny sides of trees than on the shaded sides in Classes 1, 2 and 4 but no significant differences between sides of trees occurred in Classes 3 and 5. The distributions did not differ in Class 1 trees between the two collections.

The only significant variation in parasitism by *Dicladocerus* spp. occurred between branch halves, with more parasitism on the inner than on the outer halves, in Classes 1 and 2 (Fig. 2).

No significant variations occurred between crown levels or sides of trees in any of the classes, or between branch halves in Classes 3, 4 and 5.

Parasitism by *S. albifrons* was significantly greater at the lower crown level than at the higher in Classes 1, 2 and 5; and on the outer branch halves than on the inner in Classes 1 and 2 (Fig. 3). No significant differences occurred between branch halves in Classes 3, 4 and 5, or between crown levels in Class 4.

DISCUSSION

Webb (1953) found distributions of *C. laricella* similar to those in the crown levels and branch portion in open-grown tree classes 1 to 4 of this study, i.e., higher casebearer densities at the bottom of the crown than at the top and on the terminal part of the branch than at the base. The abundance of *C. laricella* larvae and pupae on the sunny side of the tree and the outer half of the branch may reflect the oviposition site preferences of the female moths

TABLE 1. Density of **Coleophora laricella** and percentage parasitism by **Dicladocerus** spp., and by **Spilochalcis albifrons** in five classes of trees on 13 June 1974 at Shoreacres, British Columbia. (X = mean, SD = standard deviation)

Class	Crown Level (ft.)	C. laricella density (no./100 fascicles)		% Parasitism			
				Dicladocerus spp.		S. albifrons	
		$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
1	5-10	19.1	5.7	6.5	2.6	9.1	4.1
	20-25	9.7	2.6	8.4	2.9	4.2	3.1
2	5-10	19.4	4.5	7.1	2.3	10.3	4.7
	20-25	8.7	1.9	7.7	2.1	5.8	3.8
3	5-10	13.2	2.8	9.7	1.6	7.3	2.6
	20-25	11.0	2.2	9.4	5.0	3.1	3.4
4	5-10	23.1	3.2	5.0	1.6	7.6	3.5
	20-25	10.8	2.3	6.9	3.4	2.8	2.8
5	5-10	17.2	2.8	6.6	4.3	11.2	5.8

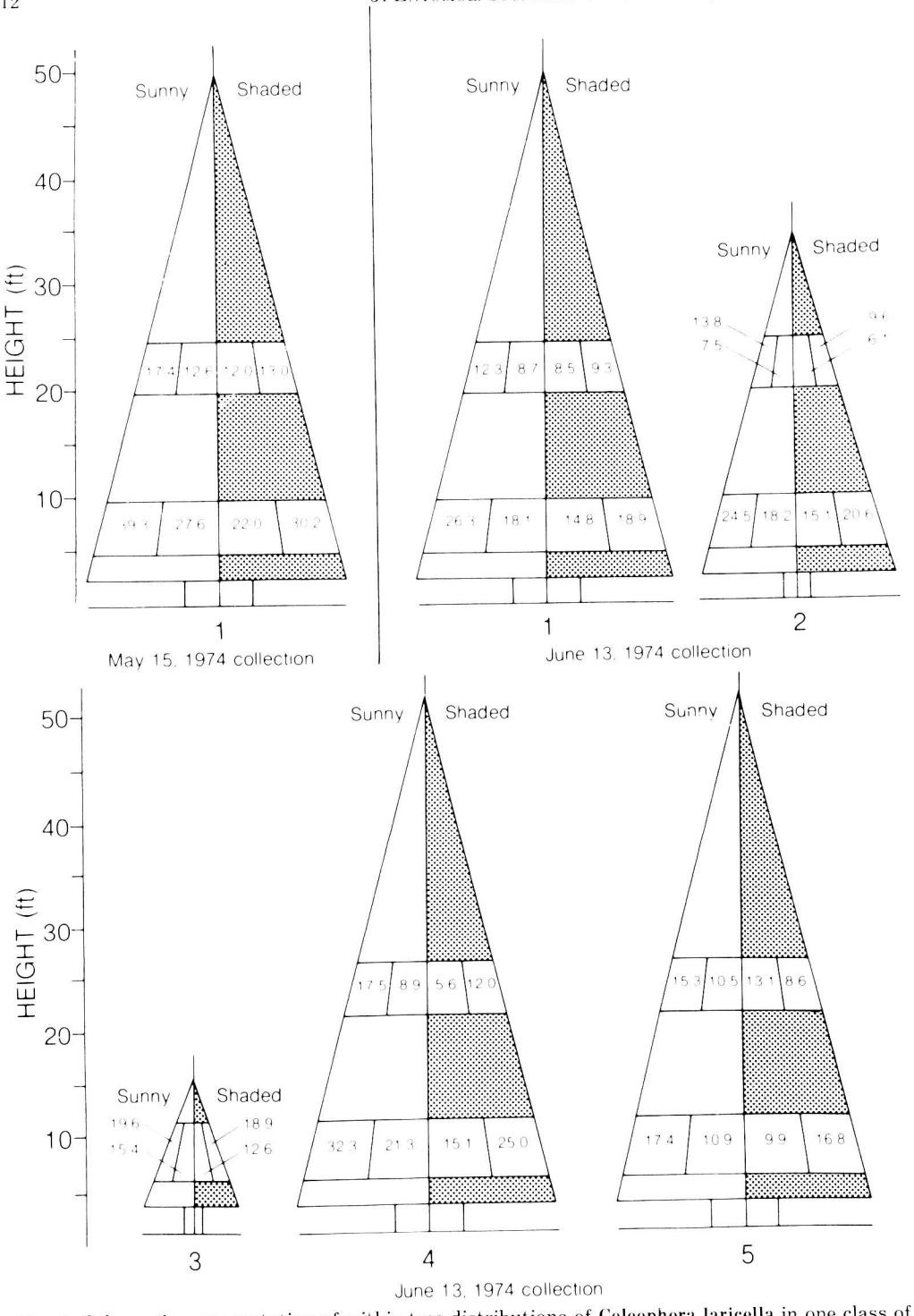

Fig. 1. Schematic representation of within-tree distributions of **Coleophora laricella** in one class of tree on 15 May 1974 and five classes of trees on 13 June 1974 at Shoreacres, British Columbia. (Numbers represent number of casebearers per 100 fascicles, the outer being those of the outer branch half and the inner those of the inner branch half)

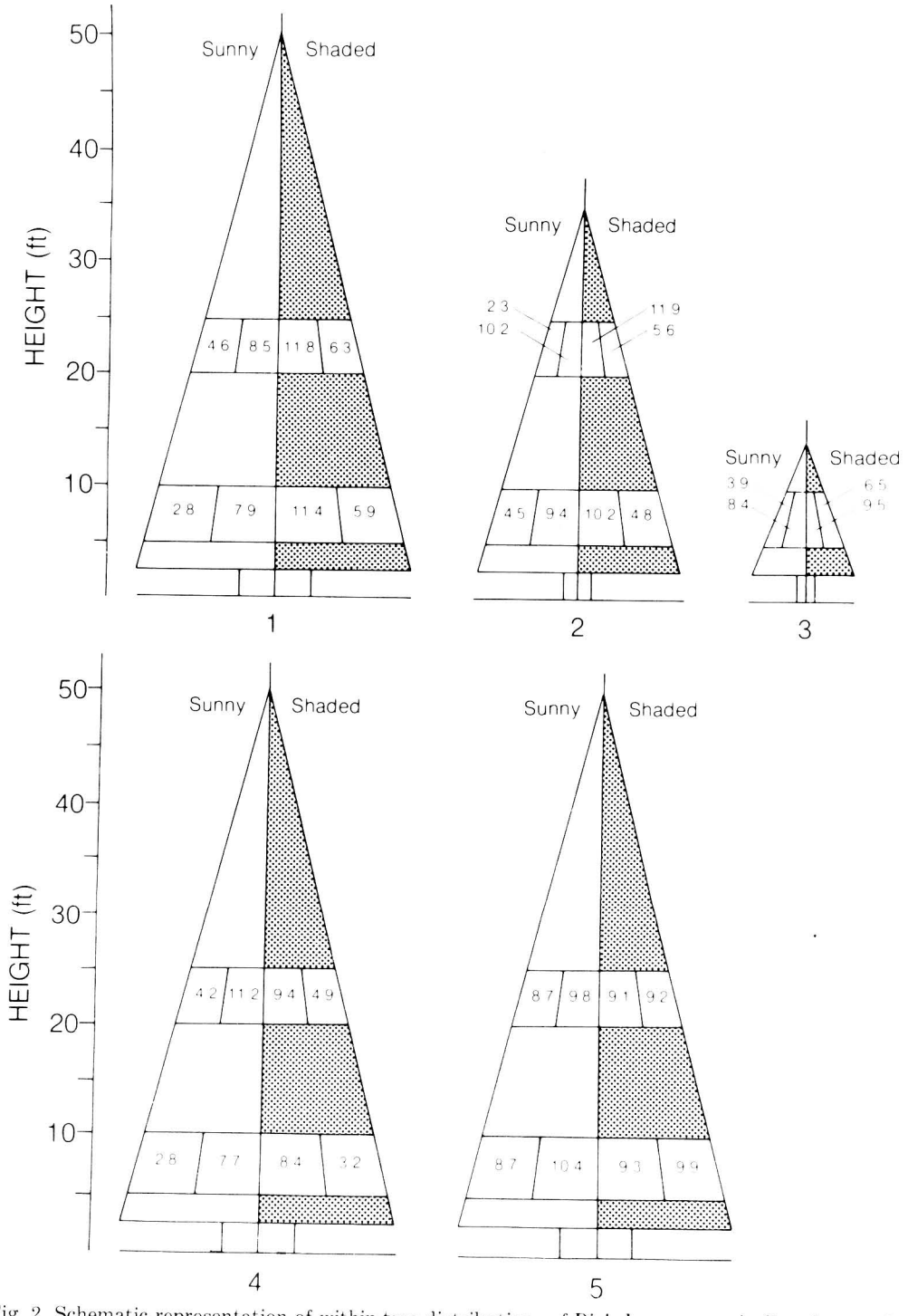

Fig. 2. Schematic representation of within-tree distributions of **Dicladocerus** spp. in five classes of trees on 13 June 1974 at Shoreacres, British Columbia. (Numbers represent percentage parasitism, the outer being those of the outer branch half and the inner those of inner branch half)

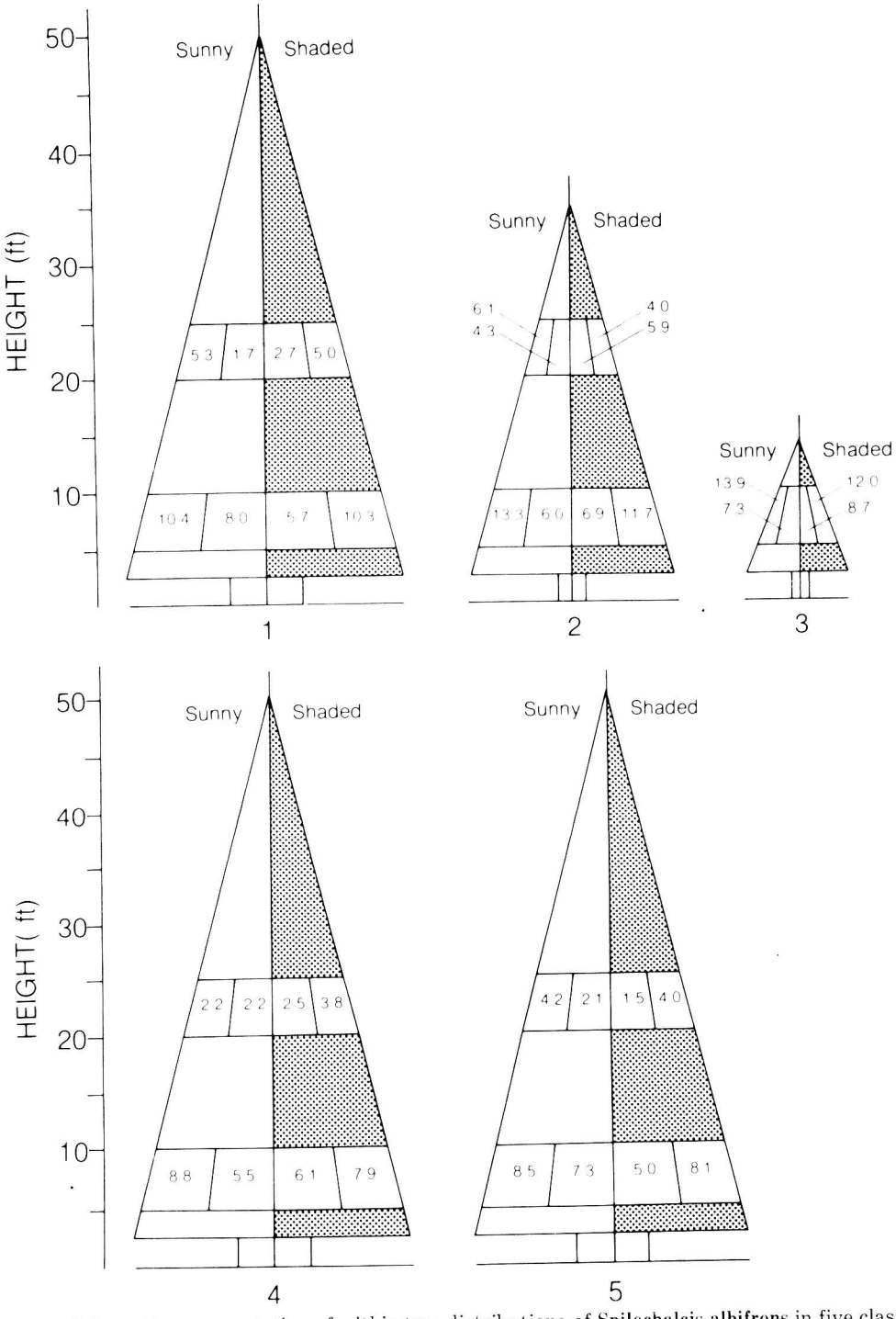

Fig. 3. Schematic representation of within-tree distributions of **Spilochalcis albifrons** in five classes of trees on 13 June 1974 at Shoreacres, British Columbia. (Numbers represent percentage parasitism, the outer being those of the outer branch half and the inner those of the inner branch half)

(Sloan and Coppel 1965; Webb 1953).

The distribution of *Dicladocerus* spp. could be affected by movements of *C. laricella* after parasitization. The amount of spring movement by casebearer larvae is influenced by casebearer density, greater movements occurring at higher densities (Webb 1953). At the densities observed in this study, casebearer movement was not great enough to cause a difference in the distribution of the host between the two collections, the apparent period of parasitization (Miller and Finlayson 1977) in Class 1 trees. Host movement probably is not a factor in the distribution of *S. albifrons* as this species apparently attacks the sessile pupae of the host (Bousfield and Lood 1971).

The within-tree distributions of *Dicladocerus* spp. and *S. albifrons* in Classes 1 and 2 are similar to those in 9.1-12.2 m (30-40 ft.) trees in the western United States (Tunnock *et al.* 1972). The distributions of *Dicladocerus* spp. and *S. albifrons* within trees probably reduces competition for casebearers between these species on open-grown trees (Tunnock *et al.* 1972).

When measuring the degree of parasitism of *C. laricella*, Bousfield and Lood (1971) took their samples from the terminal 45.7 cm (18") of branches rather than whole branches. In open-grown trees more than 7.6 m (25 ft.) high, such a sampling technique would overestimate parasitism by *S. albifrons* and underestimate parasitism by *Dicladocerus* spp.

The differences in distributions of both *C. laricella* and its parasites between classes must be considered when measuring casebearer populations or parasitism, especially if less than whole-branch samples are taken, and when sampling trees of differing types.

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References

Bousfield, W. E. and R. C. Lood. 1971. Impact of parasites on the larch casebearer in the Northern Region 1970. U.S.D.A. For. Serv. Rept. 71-4, Northern Region, Missoula, Mont.

Dixon, W. J. 1973. **BMD Biomedical Computer Programs**. Univ. of Calif. Press, Los Angeles.

Miller, G. E. and T. Finlayson. 1974. Native parasites of the larch casebearer, **Coleophora laricella** (Lepidoptera: Coleophoridae), in the west Kootenay area of British Columbia. J. entomol. Soc. Brit. Colomb. 71: 14-21.

Miller, G. E. and T. Finlayson. 1977. Parasites of the larch casebearer, **Coleophora laricella** (Lepidoptera: Coleophoridae), in the West Kootenay area, British Columbia. J. entomol. Soc. Brit. Columb. (in press).

Sloan, N. F. and H. C. Coppel. 1965. Oviposition patterns and egg predation of the larch casebearer, **Coleophora laricella** Hbn. in Wisconsin. Univ. of Wisconsin For. Res. Note. No. 124.

Tunnock, S., M. McGregor and W. E. Bousfield. 1972. Distribution of larch casebearer parasites in the crowns of western larch trees in the Northern Region. U.S.D.A. For. Serv. Rept. 72-4, Northern Region, Missoula, Mont.

Webb, F. E. 1953. An ecological study of the larch casebearer, **Coleophora laricella** Hbn. (Lepidoptera: Coleophoridae). Ph.D. Thesis, Univ. of Michigan, Ann Arbor, Mich.

Yoshimoto, C. M. 1976. Revision of the genus **Dicladocerus** (Eulophidae: Chalcidoidea) of America north of Mexico, with particular reference to species attacking larch casebearer (Lepidoptera: Coleophoridae). Can. Ent. 108: 1173-1206.