EMERGENCE OF PREDATOR AND PARASITES OF THE WHITE PINE WEEVIL, *PISSODES STROBI* (COLEOPTERA: CURCULIONIDAE) FROM ENGELMANN SPRUCE[1]

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ABSTRACT

Adult insects of 13 species emerged from 153 leaders of Engelmann spruce attacked by *Pissodes strobi* at two British Columbia locations. The most abundant species was the dipteran, *Lonchaea corticis*, a scavenger and predator of immature *P. strobi*. The most important primary parasites that attack 4th-instar larvae and pupae were the hymenopterans, *Dolichomitus terebrans nubilipennis*, *Bracon pini*, *Eurytoma pissodis*, and *Rhopalicus pulchripennis*. Competition for suitable hosts appears greatest between the two last-named species, since females exhibited agonistic behaviour when searching for oviposition sites.

INTRODUCTION

Detailed studies have been carried out by Harman and Kulman (1967 and 1968) of the insect fauna associated with the successful attack and brood establishment of the white pine weevil, *Pissodes strobi* Peck, in leaders of eastern white pine, *Pinus strobus* L. Less extensive work has been done on infestations in Engelmann spruce, *Picea engelmannii* Parry (Stevenson, 1967). Little is known, however, of the mechanisms that the parasites might employ to minimize competition for suitable white pine weevil hosts and to synchronize their emergence with the host's life cycle. My observations on Engelmann spruce populations had indicated that most of the parasite species overwintered in the damaged leaders from which *P. strobi* had emerged the previous autumn. This paper reports the sequence of emergence of the parasite complex in the spring, and indicates the temporal partitioning of the parasite species in their utilization of the weevil hosts under field conditions.

METHODS AND MATERIALS

One hundred fifty-three dead terminals of young, open-grown Engelmann spruce attacked by *P. strobi* in 1976 were collected on May 6 and 7, 1977. Most of the leaders (132) were collected from Kootenay National Park, B.C., and the remainder from Glacier National Park, B.C., 640 km northwest of the initial collection site.

Each leader was put into a polyethylene bag and maintained in the laboratory at 20-24°C. The number and species of insects that emerged from each leader was recorded daily. Hymenopteran insects were held in small rearing cages to study inter- and intra-specific agonistic behaviour, whereas dipterans were identified and released after examination of the leaders. The number of emergence holes of weevils in the periderm of each leader were counted to assess the field emergence of adults from these leaders in autumn 1976.

RESULTS AND DISCUSSION

Table 1 shows the numbers and species of insects that emerged from the 153 leaders including species new to Engelmann spruce. The most abundant insect was a dipteran, *Lonchaea corticis* Taylor, a scavenger and predator of immature *P. strobi* (Harman and Kulman, 1967), particularly of pupae (R.I. Alfaro, pers. comm.). Construction of chip cocoons by 4th-instar weevil larvae in preparation for pupation may have adaptive significance not only to prevent desiccation, but also as a physical deterrent to predation by *L. corticis*. The principal parasite species were hymenopterans: *Dolichomitus terebrans nubilipennis* Viereck, *Eurytoma pissodis* Girault, *Bracon pini* Muesebeck, and *Rhopalicus pulchripennis* Crawford. Harman and Kulman (1967) and Stevenson (1967) verified that these four hymenopterans are primary parasites of white pine weevils infesting eastern white pine and Engelmann spruce, respectively. Stevenson (1967) recovered significant numbers of the braconid, *Eubadizon strigitergum* Cushman, and the ichneumonid, *Helcostizus rufiscutum* Cushman from Engelmann spruce leaders attacked by *P. strobi* in Kootenay National Park, B.C.; nevertheless, these two primary parasites were not recovered in the present study. Stevenson (1967) did not, however, specify their peak emergence periods.

The status of the remaining insect species listed in Table 1 is less well known, although Harman and Kulman (1967) report that *Pseudoeucoila* sp. is itself a parasite of *L. corticis*. Little is known of the general biology of

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Table 1. Insect species that emerged during May 10 - June 13, 1977, from 153 Engelmann spruce leaders naturally attacked by the white pine weevil, *Pissodes strobi*, in 1976 at two British Columbia locations, 640 km apart.

Species	Status	Glacier National Park		Kootenay National Park	
		Total No. of insects	% leaders infested (N=21)	Total No. of insects	% leaders infested (N=132)
DIPTERA					
Lonchaea corticis ǂ	scavenger/predator	102	57.1	1,869	81.8
*Rhexoza sp.**	undetermined			28	1.5
*Oscinella sp.** ǂ	"			11	5.3
HYMENOPTERA					
Dolichomitus terebrans nubilipennis ǂ	primary parasite			65♂, 34♀	25.0
Eurytoma pissodis ǂ	"			75	20.5
Bracon pini ǂ	"			12♂, 11♀	5.3
Rhopalicus pulchripennis ǂ	"	1	4.8	18	8.3
*Pilinothrix sp.**	undetermined	28	42.9	105	10.6
*Pediobius sp.** ǂ	"			4	0.8
*Pseudoeucoila sp.** ǂ	parasite of *L. corticis*			2	1.5
*Diadegma sp.**	undetermined			1	0.8
*Platygaster sp.**	"			1	0.8
*Cyrtogaster sp.**	"			1	0.8

ǂ Species previously reported from leaders of eastern white pine attacked by *P. strobi* (Harman and Kulman, 1967).

* Species not previously reported from leaders of Engelmann spruce attacked by *P. strobi*.

Pilinothrix sp. which has not previously been reported from conifer terminals attacked by *P. strobi*.

Associated insects emerged from 90% of the spruce leaders collected in Kootenay National Park, but only 35% of these leaders bore evidence of successful emergence by weevils in the previous autumn. Comparable data from Glacier National Park indicated that weevils had emerged from 38% of the spruce leaders, whereas associated insects emerged from 67%. In both locations, the emergence of white pine weevils from attacked and killed spruce leaders was low, with a mean of only one adult per leader based on the count of emergence holes. These data suggest that entomophagous insects play a pivotal role in regulating the population of the weevils. Particularly important is *L. corticis* because each predator larva commonly attacks more than one immature weevil to complete its development (R.I. Alfaro, pers. comm.). The four species of primary parasites are probably of relatively minor importance in the regulation of weevil populations.

Figures 1-5 show the emergence over 28 days of *L. corticis* and four primary parasites from the spruce leaders. The median emergence date for *L. corticis* was May 16, but the primary parasite species combined had a bimodal emergence pattern. The median emergence dates for *D. terebrans nubilipennis* and *B. pini* were May 11 and 12, respectively. Stevenson (1967) reported that *D. t. nubilipennis* emerged in the field during a 4-week period from late May to June. Although early instar weevil larvae are present in attacked host leaders in June, oviposition by *D. t. nubilipennis* is delayed until July when 4th-instar larvae are available. Among the four primary parasites, only *D. t. nubilipennis* is morphologically adapted to oviposit alongside deep-lying *P. strobi* larvae that have constructed pupation chambers within the pith of the leader (Stevenson, 1967).

The median emergence dates for *R. pulchripennis* and *E. pissodis* were May 30 and June 1, respectively. Of particular interest was the agonistic behaviour, both inter- and intraspecific, which I observed between these two similar-sized parasites. In a rearing cage, mated females of both species were observed attempting to oviposit into the wooden surfaces although no spruce leaders or white pine weevils were present. When two females of the same or different species met on this substrate, one or both adopted a characteristic threat posture in which both the abdomen and prothoracic legs were raised and the wings held over the

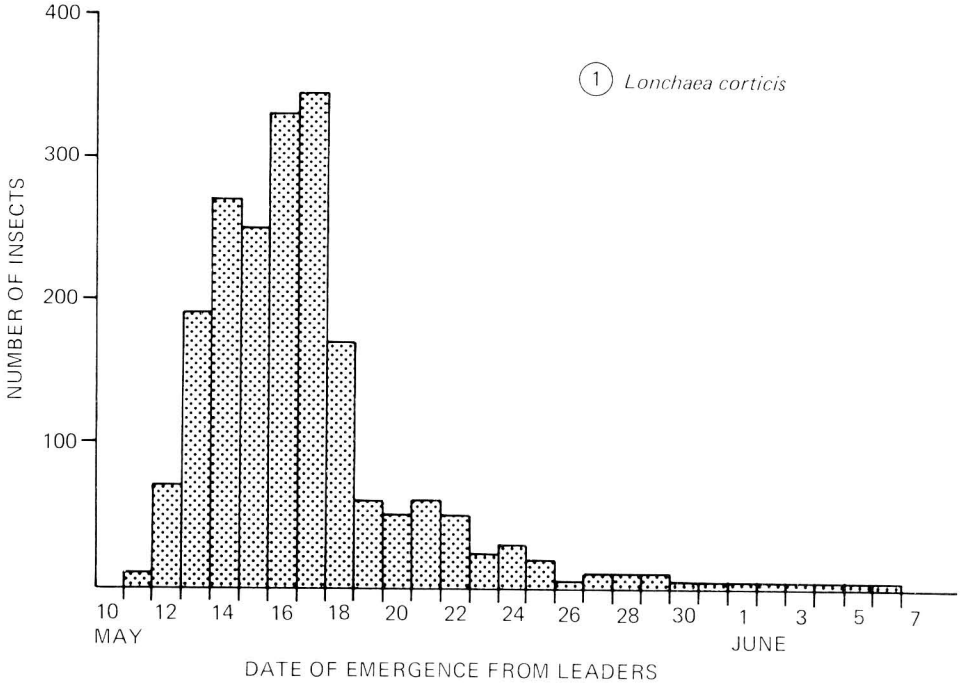
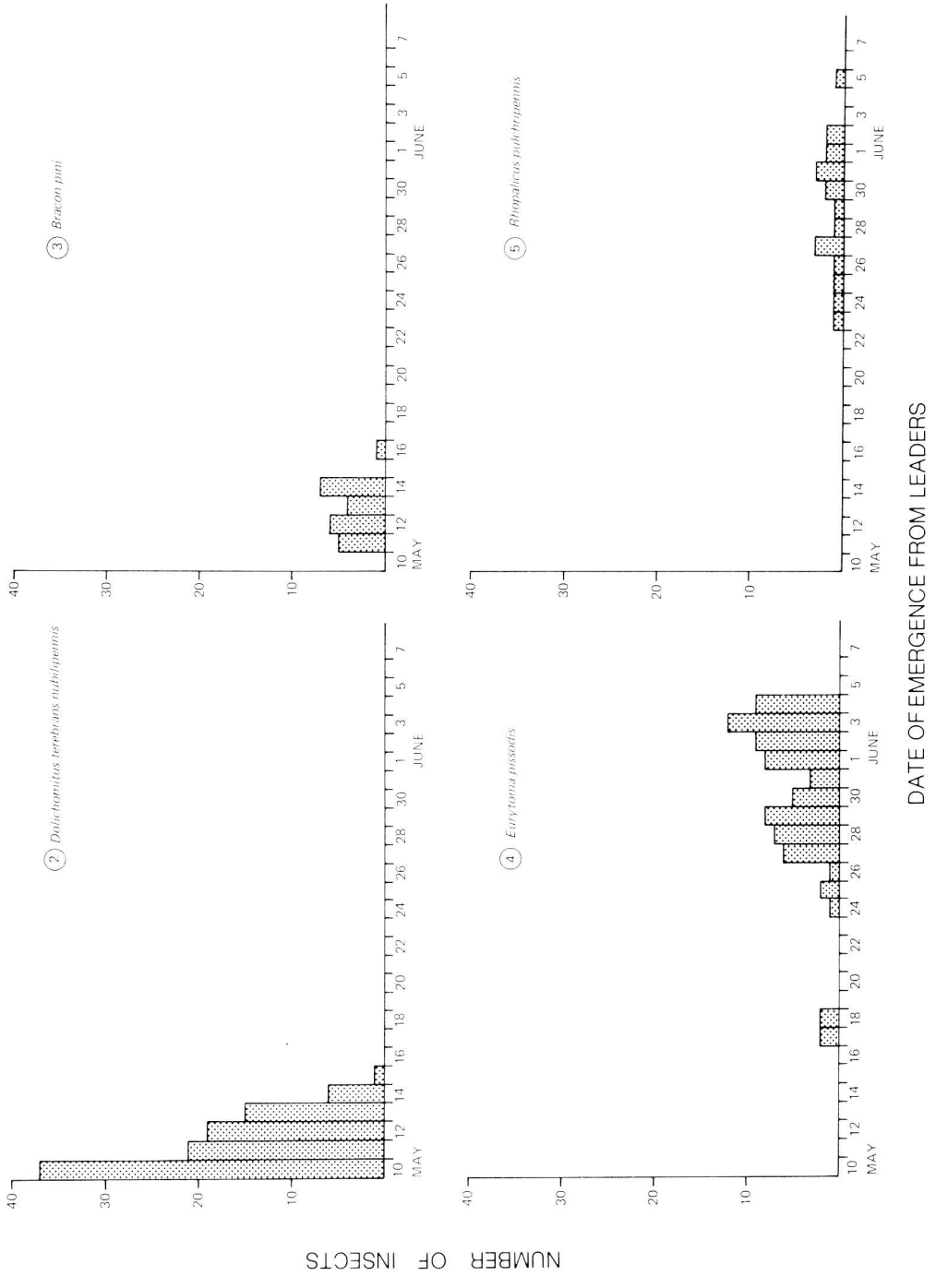


Figure 1. Daily emergence of *Lonchaea corticis* during May 10 - June 6, 1977, from Engelmann spruce leaders naturally attacked by **Pissodes strobi** in 1976 at two locations in British Columbia, 640 km apart.



Figures 2-5. Daily emergence of 4 species of primary, entomophagous hymenoptera during May 10 - June 6, 1977, from Engelmann spruce leaders naturally attacked by **Pissodes strobi** in 1976 at two locations in British Columbia, 640 km apart.

abdomen in a V-shape. Rapid butting contests would sometimes ensue until one or the other female retreated. More frequently, the threat posture deterred the advance of an approaching female, but several intances of butting were followed by grappling. Beaver (1967) reported similar agonistic behaviour in pteromalids competing for food resources or oviposition sites. *R. pulchripennis* and *E. pissodis* also compete for scolytid hosts such as *Dendroctonus monticolae* Hopkins (Bushing, 1965). Agonistic behaviour between these competing parasite species is likely to promote dispersal of the gravid females in the field.

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THE DISTRIBUTION OF *TANYPTERYX HAGENI* (ODONATA:PETALURIDAE) IN BRITISH COLUMBIA

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ABSTRACT

In British Columbia the petalurid dragonfly *Tanypteryx hageni* (Selys) is considered to be rare. A record in 1977 extends its known range almost to 51°N latitude. The record also disputes the belief that *T. hageni* normally is restricted to subalpine habitats. In the northern parts of its range it appears to occur naturally at sea level.

INTRODUCTION

Tanypteryx hageni (Selys) is the only western North American representative of the primitive dragonfly family Petaluridae. The family has a distribution so limited and disjunct that the nearest relatives of *T. hageni* are *T. pryeri* Selys in Japan and *Tachopteryx thoreyi* (Hagen) in eastern North America.

Tanypteryx hageni ranges from southwestern British Columbia south through the mountains to California and Nevada (Cannings and Stuart, 1977). American localities are discussed in Kennedy (1917), Whitney (1947), Smith and Pritchard (1956), Svihla (1959) and Paulson and Garrison (1977). In Washington and Oregon the larvae are known to inhabit