EFFECT OF ANTI-AGGREGATIVE PHEROMONES 3,2-MCH AND *TRANS*-VERBENOL ON *DENDROCTONUS RUFIPENNIS* ATTACKS ON SPRUCE STUMPS

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ABSTRACT

Anti-aggregative pheromones 3,2-MCH and 3,2-MCH with *trans*-verbenol were released from open vials enclosed in perforated cans attached to both sides of 50 winter-cut spruce stumps which normally attract spruce beetles (*Dendroctonus rufipennis*). Although significantly fewer attacks occurred on treated than on untreated stumps, the attack density was not sufficiently reduced to be of practical value in controlling spruce beetle reproduction in this host material. There was no significant difference in reduction of beetle attacks between the 3,2-MCH and the 3,2-MCH with *trans*-verbenol treatments.

RESUME

On a libère à partir de fioles ouvertes placées à l'intérieur de canettes perforées, attachées aux "deux côtés" de 50 souches d'Epinette coupees en hiver, des phérormones anti-agglomérantes 3, 2-MCH et 3, 2-MCH avec *trans*-verbenol et qui normalement, attirent de Dendroctone de l'Epinette (*Dendroctonus rufipenns*). Malgré un nombre significativement rèduit d'attaques contres les souches traitees, comparativement aux autres souches, la densité de l'infestation ne fut pas suffisamment diminuèe pour constituter un moyen pratique d'enrayer la reproduction du Dendroctone de l'Epinette dans cet arbre hôte. Il n'y eut pas de différénce significative dans la baisse des attaques du Dendroctone entre les traitements 3, 2-MCH et 3, 2-MCH avec *trans*-verbenol.

INTRODUCTION

The spruce beetle, *Dendroctonus rufipennis* (Kirby), occurs throughout the range of spruce in Canada and the United States (Wood, 1963). At epidemic levels, it attacks and kills large volumes of mature standing spruce (*Picea engelmannii* Parry, *P. glauca* (Moench) Voss), and at endemic levels, it breeds principally in fresh spruce windfall, stumps and slash.

3,2-MCH ([3]-methyl-2-cyclohexen-1-one), an anti-aggregative pheromone produced by the Douglas-fir beetle, *Dendroctonus pseudotsugae* Hopk., has been shown to mask the effect of the aggregative pheromones of this beetle (Rudinsky *et al.*, 1972). Other experiments with this pheromone applied to spruce logs have shown a similar anti-aggregative effect to spruce beetles (Rudinsky *et al.*, 1974; Kline *et al.*, 1974). A second pheromone, *trans*-verbenol (trans- 4, 6, 6-trimethylbicyclo - (3-1-1) -3-hepten-2-ol), is the principal aggregative pheromone of the mountain pine beetle, *Dendroctonus ponderosae* Hopk. (Pitman and Vité, 1969), but is an anti-aggregative pheromone component of the western pine beetle, *Dendroctonus brevicomis* Lec. (Wood, 1972). Results of experiments on the effect of *trans*-verbenol on Douglas-fir beetle are unclear; comparable experiments have given both aggregative and anti-aggregative results (Rudinsky *et al.*, 1972). Furniss *et al.* (1976) stated that *trans*-verbenol repressed attraction of spruce bettle to logs with and without the synthetic attractants frontalin and seudenol, but that its effect was less than that of 3, 2-MCH.

An experiment to determine the anti-aggregative effect of 3,2-MCH and 3,2-MCH with *trans*-verbenol on spruce beetle was carried out during the spring and summer of 1975, using attractive spruce stumps in a winter clearcut area in central British Columbia.

METHODS

Twenty 5-stump groups, in 10 pairs with approximately 50 m between groups in each pair, were selected throughout a large clear-cut area and treated as follows: 10 groups, one of each pair, were designated as controls and left untreated; the other 10 groups were alternately treated with 3, 2-MCH alone or with 3, 2-MCH and *trans*-verbenol. Closed perforated film cans, each containing an open 0.5 dr vial with 0.1 ml 3, 2-MCH (Rudinsky *et al.*, 1972), were placed on the centers of the north and south sides of each treated stump. For each stump treated with both 3, 2-MCH and *trans*-verbenol, a second open 0.5 dr. vial containing 0.15 ml of *trans*-verbenol was put in each can with the 3, 2-MCH. Vials were checked for evaporation throughout the flight period to ensure the presence of the two chemicals.

Stumps were treated by May 29 and left throughout June, the beetle flight period. After flight, six 10.16-cm-diameter bark samples were cut randomly from the north lower side of each stump. The number of entrance holes was counted on each sample and totalled for all samples in all stumps of each group. A randomization test for matched pairs (Siegel, 1956) was used to compare the 3,2-MCH-treated stumps to their respective controls, and 3,2-MCH + *trans*-verbenol treated stumps to their respective controls. Differences between treated and control pairs were calculated for each of the 3,2-MCH and 3,2-MCH - *trans*-verbenol groups, and the two treatments were compared to each other, using a randomization test for two independent samples (Siegel, 1956).

RESULTS AND DISCUSSION

The emission of 3,2-MCH alone and that of 3,2-MCH and/*trans*-verbenol at attractive spruce stumps resulted in a reduction in the number of beetle attacks compared to attacks on untreated stumps, although only two of the 10 treated replicates were not attacked (Table 1). The addition of *trans*-verbenol to 3, 2-MCH made no significant difference to the degree of reduction in the number of attacks.

The emission of 3, 2-MCH at spruce stumps produced a 50% reduction in attack density, with a spacing of less than 1 m between 3, 2-MCH containers on individual stumps. Rudinsky *et al.* (1974) used a 1.8 m spacing between 3, 2-MCH containers on downed spruce trees and achieved complete protection from attacks. Since the north aspects of the spruce stump bases are the most productive areas for spruce beetle brood in logging slash (Dyer and Taylor, 1971), the reduced attack density on 3, 2-MCH-treated stumps is not low enough to ensure population reduction in the next generation. The lower density broods would reduce competition and thereby possibly increase survival to maturity under suitable environmental conditions. The difference between the reduction of attack on spruce stumps and that on downed trees may be due to the difference in environmental exposure around the treated material. Open logging slash, with greater air movement and higher temperatures, would tend to disperse the 3, 2-MCH faster than in a more sheltered stand environment, thereby producing a lower concentration of 3, 2-MCH at the source.

Therefore, 3,2-MCH apparently cannot be applied by this method as a practical means of reducing spruce beetle populations breeding in suitable logging slash.

TABLE 1. Spruce beetle attacks/m² from 600 samples on north sides of 100 stumps with two treatments and paired controls.

	3, 2-MCH		3,2-MCH + *trans* verbenol	
	TREATMENT	CONTROL	TREATMENT	CONTROL
Mean	12.3[1]	24.6	8.2[2]	16.5
Range	0 - 28.8	8.2 - 37.0	0 - 24.7	4.1 - 28.8

[1]differs from paired control @ 0.125 level of significance.
[2]differs from paired control @ 0.05 level of significance. No difference between MCH and MCH + *trans*-verbenol @ 0.05 level of significance.

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INSECTS COLLECTED FROM AN ALPINE-SUBALPINE REGION IN SE BRITISH COLUMBIA

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ABSTRACT

Insects were caught in a subalpine area of southeastern British Columbia. The list consists of 23 spp. and 37 genera, in families of five orders. The insects were collected during July and August, 1975 as part of a larger study of the ecology of mountain caribou in the Poplar Creek area, north of Nelson, B.C.

INTRODUCTION

There are few identified collections of insects in the alpine-subalpine environment of British Columbia. This is a report on insects collected in the central Selkirk Mountains of British Columbia during July and August 1975. The paper by Allan (1969) is most similar to the present report, although his collections were mainly from lower elevations and limited to the family Syrphidae. Other related studies, but not from British Columbia, include those of Chapman (1954), Dodge and Seago (1954) and Mani (1955).

The insects reported here were obtained during a survey for potential pests of mountain caribou (*Rangifer tarandus montanus*) inhabiting the alpine-subalpine environment at the same time of the year. The caribou is the subject of a study by Harling and Snyder (unpublished).

METHODS AND STUDY AREA

The insects were sampled between 10 July and 27 August, 1975 with pieces of wire screen (40x50 cm), smeared with grease and placed on supports about 0.9 m above ground level. Additional collections were made with hand nets and a Malaise trap. The insects were first identified in the laboratory and the identifications verified by the Biosystematics Research Institute, Canada Department of Agriculture, Ottawa, Ontario.

General meteorological data were obtained from maximum and minimum thermometers, a sling psychrometer, and a simple rain gauge; wind speed and direction were estimated at the time when samples were collected from the traps.

The collection was mainly from the extreme north fork at the west end of the headwaters of Poplar Creek (50° 21′ N, 117° 21′ W) in southeastern British Columbia. The area comprised alpine meadows, talus slopes, receding snow patches and the upper fringe of climax stands of englemann spruce (*Picea englemanni*) and subalpine fir (*Abies lasiocarpa*). The collections were made between 1500 and 1650 m elevation.

RESULTS

Table I lists the insects collected during the study. Only those taxa verified by the Biosystematics Research Institute have been included. Dipterans alone made up about 78% of the catch. The families Bibionidae, Syrphidae, Tabanidae and Tipulidae comprised more than 50% of all the Dipterans caught. Hemip-

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Table 1. Insects collected from the Poplar Creek area of SE British Columbia, July and August, 1975.

COLEOPTERA		
	Buprestidae	**Agrilus** sp.
		Melanophila drummondi (Kby.)
	Cantharidae	**Podabrus scaber** (LeC.)
	Carabidae	**Phloeopterus** sp.
	Cerambycidae	**Anoplodera aspera** (LeC.)
		Xylotrechus longitarsis (Csy.)
	Chrysomelidae	**Chryomela** sp.
		Syneta subalpina (Edwards)
	Coccinellidae	
	Elateridae	**Ctenicera hoppingi** (Van Dyke)
		Ctenicera sylvatica (Van Dyke)
	Lycidae	**Dictyopterus** sp.
	Scarabeidae	**Aphodius** sp.
	Scolytidae	**Orthotomicus** sp.
		Trypodendron lineatum (Oliv.)
	Cryphalini	
	Scraptiidae	**Anaspis** sp.
	Staphylinidae	**Ptomaphagus** sp.
	Omaliinae	
DIPTERA		
	Anthomyiidae	**Hylemya** sp.
		Hylemya (Pegohylemia) fugax (Meigen)
		Hylemya (Botanophila) spinidens (Malloch)
	Bibionidae	**Bibio** sp.
	Calliphoridae	**Phormia regina** (Mg.)
	Drosophilidae	**Clastopteromyia inversa** (Walker)
	Empididae	**Drapteris** sp.
		Empis brachysoma (Coquillett)
	Tachydrominae	
	Muscidae	**Lasiops medius** (Stein) ♂
	Rhagionidae	**Symphoromyia atripes** (Bigot)
	Syrphidae	**Chrysotoxum** sp. ♂
		Melangyna sp. ♂
		Syrphus torvus (O.S.) ♂
	Tabanidae	**Hybomitra osburni** (Hine)
	Tachinidae	**Nowickia pilosa**
	Tipulidae	
	Limoniinae	
	Tipulinae	
HEMIPTERA		
	Miridae	**Irbisia nigripes** (Kgnt)
		Lygus varius (Kgnt)
HYMENOPTERA		
	Bombidae	**Pyrobombus (Pryrobambus) flavifrons flavifrons** (Cresson)
	Colletidae	**Hylaeus** sp.
	Siricidae	**Urocerus gigas flavicornis** (F.)
	Tenthredinidae	**Tenthredo** sp.
		Dolerus (Dolerus) sp.
	Pamphiliidae	**Pamphilius** sp.
LEPIDOPTERA		
	Nymphalidae	**Boloria epithore** (Edwards)

terans and Lepidopterans each comprised less than 2% of the total; Coleopterans and Hymenopterans represented the rest.

The temperature during the study ranged from 3.4°C to 23.9°C with humidity from 43-88%. The maximum precipitation recorded on a sampling day was 0.48 cm and on other days was often zero. Wind speed varied from force 0 to force 2 and was usually from the south.

Catches were largest during periods of high temperature, low precipitation, and low humidity. No clear trend was noted with reference to wind speed or direction. Other authors (Chapman, 1954; Mani, 1962) have confirmed that the meteorological factors recorded here do have a marked effect on insect activity at high elevations.

DISCUSSION

At least an additional 25 species were caught but were not identified by the Biosystematics Research Institute because they were damaged in transit.

The methods employed in this investigation were relatively simple, so that the analysis of relative abundance could not be sophisticated. However, the predominance of Dipterans in relation to other groups was significant and consistent with other surveys of alpine insect fauna (Chapman, 1954; Dodge and Seago, 1954; Mani, 1955, 1962). Among families, the Syrphidae and Tabanidae were abundant as also reported by Chapman (1954) but the Tachinidae which he found to be abundant were represented here by a single specimen.

A number of the Dipteran species listed in Table I may be associated with the caribou population of the area. In particular, the blowfly *(Phormia regina* (Mg.)) and the tabanid *(Hybomitra osburni* (Hine)) could be potential caribou pests because related genera have been confirmed as large mammal pests (Prior, 1968). Bot and warble flies parasitize caribou (Bergerud, 1961; Low, 1964; Layser, 1974) and although no such species were recorded in our samples, a close relative (the tachinid *Nowickia pilosa*) was caught. The mountain caribou continue to be studied in the area and it is hoped that some confirmation of their insect pests will be forthcoming.

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