SEASONAL FLIGHT AND VERTICAL DISTRIBUTION OF SCOLYTIDAE ATTRACTED TO ETHANOL IN AN OAK–HICKORY FOREST IN MISSOURI

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Abstract

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Window flight traps baited with ethanol attracted 15 genera representing 25 species of scolytids. *Monarthrum fasciatum* and *Xyleborus saxeseni* were the most frequently trapped scolytids. Evidence for seasonal flight periods and vertical flight distribution are presented for *Hypothenemus dissimilis*, *X. ferrugineus*, *X. saxeseni*, *X. sayi*, *X. xylographus*, *M. fasciatum*, *M. mali*, and *Corthylus columbianus*. Live *Q. velutina* injected with ethanol attracted five species of scolytids: *X. saxeseni*, *X. xylographus*, *M. fasciatum*, *M. mali*, and *C. columbianus*.

Introduction

Ethanol was recognized as a primary attractant for *Gnathotrichus sulcatus* LeConte (Cade *et al.* 1970) and *Trypodendron lineatum* (Olivier) (Moeck 1970). Circumstantial evidence was cited by Moeck (1970, 1971) that indicated ethanol is an attractant for numerous species of bark beetles.

In 1972, we tested window flight traps with water, water and detergent, Shell No Pest Strips®, and 50% ethanol. Only after the addition of ethanol were the traps efficient, and a large complex of bark beetles was found in the oak–hickory forest. In 1973, traps baited with ethanol were used to study the seasonal flight of bark beetles in the Clark National Forest in Dent Co., Missouri.

Materials and Methods

Window Flight Traps

The flight trap (Fig. 1) was constructed with a piece of single strength glass 26.7×45.7 cm. The glass was suspended vertically in a wooden frame that was bolted to the top of a 25.4 cm diameter 1.89 liter galvanized funnel. A screw top lid was soldered to the base of the funnel to support a 1 qt collection jar.

Thirty traps were operated in 1973. Three traps were suspended at each of the following heights: .3, .6, 1.2, 1.8, 2.4, 3.0, 3.7, 4.3, 4.9, and 5.5 m. The height of each trap was determined by measuring from the midpoint of the glass to ground level. The trap at the .3 m level had the collection jar and part of the funnel buried in the soil. The remaining traps were suspended from healthy *Quercus alba* L. and *Q. velutina* Lam. with nylon cord. All trap jars contained 250 ml of 50% ethanol. The jars and ethanol solutions were replaced weekly from 23 March to 26 October 1973.

Tree Injection

Two *Q. velutina* were injected with 95% ethanol on 6 April 1973 (Fig. 2). Six hollow aluminum tubes 7 cm long with .32 cm inside diameter were driven into each tree 1.4 m above the ground. The tubes were spaced 5 to 7.5 cm apart. Each tube penetrated the bark into the xylem. A Mauget Systemic Injector Unit® was attached to the open end of the tube. The injector consisted of two open ended cylinders which fit together to form a closed cylinder 4.4 cm long with 3.2 cm outside diameter. The aluminum tube entered the injector at its base. The injector was made of a polyethylene

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plastic and insured a good fit with the tube. The injector unit was modified by boring a 1.3 cm hole in the upper surface. This permitted the injector to be filled with ethanol while the feeder tube was inserted into the tree. After the injector unit was filled, the hole was stoppered with a "00" rubber stopper. The capacity of each injector was approximately 14 ml. The injectors were refilled each week. Each tree was wrapped with two strips of cheesecloth, each 23 cm wide, one strip above the injector points and one below. The cheesecloth was nailed to the bark and coated with Tanglefoot®. A control tree was wrapped as above but received no ethanol injection treatment. The cloths were examined weekly and the beetles removed.

FIG. 1. Window flight trap used to trap scolytids.

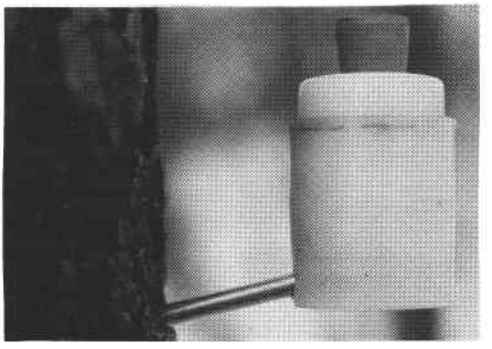

FIG. 2. Modified Mauget Systemic Injector Unit® used to inject 95% ethanol into *Q. velutina*.

Results and Discussion

Window Flight Traps

Fifteen genera represented by 25 species of scolytids were trapped (Table I). A total of 10,458 scolytids were trapped. Three species accounted for 90% of all scolytids recorded: *M. fasciatum* 46%, *X. saxeseni* 41%, and *X. sayi* 3%. Several species were represented by single specimens: *O. caelatus* and *P. juglandis*. Figure 3 shows the distribution of the flight pattern throughout 1973 of those beetles caught in sufficient numbers to graph. While these flight periods give a time when a species may be flying, they do not necessarily represent all the flight periods for that species. Three species *X. saxeseni*, *M. fasciatum*, and *M. mali* have been observed to exhibit a distinct flight period at the latter part of June and into the first 3 weeks of July. The determination of this flight period for these three species was made by collection of these beetles from sticky traps placed on attractive host material in the same location as the window flight traps. A possible explanation for the absence of this flight period being recorded by the window flight traps is that in the area that the traps were placed, a large amount of attractive host material was present at that time. This material may have been more attractive than the baited traps.

The traps were selective in trapping male beetles of *M. fasciatum*, *M. mali*, and *C. columbianus*. Over 99% of *M. fasciatum* and *M. mali* were males. Ninety-three per cent of the *C. columbianus* were males. Our field observations show that male

Table I. Scolytids collected in window flight traps in the Clark National Forest in Dent Co., Missouri, in 1973

Scolytus multistriatus (Marsham)	*Xyleborus celsus* Eichhoff
S. quadrispinosus (Say)	*X. ferrugineus* (Fabricius)
Hylastes tenuis Eichhoff	*X. saxeseni* (Ratzeburg)
Phloeotribus liminarus Harris	*X. sayi* (Hopkins)
Chramesus hicoriae LeConte	*X. xylographus* (Say)
Hylocurus torosus Wood	*Pseudopityophthorus asperulus* (LeConte)
Micracisella nanula (LeConte)	*P. minutissimus* (Zimmermann)
Hypothenemus dissimilis (Zimmermann)	*P. pruinosus* (Eichhoff)
H. interstitialis (Hopkins)	*Pityophthorus juglandis* Blackman
H. rotundicollis (Eichhoff)	*Monarthrum fasciatum* (Say)
Dryocoetes granicollis LeConte	*M. mali* (Fitch)
Orthotomicus caelatus (Eichhoff)	*Corthylus columbianus* Hopkins
Ips grandicollis (Eichhoff)	

M. fasciatum (Roling and Kearby 1974) and male *C. columbianus* (Nord 1972) act as the initiator of the gallery system. The attraction to ethanol indicates that this substance or some substance similar to it may be one factor attracting the male beetle to the host and that the male beetle then attracts the female to the host tree.

Even though the traps captured a large number of scolytids, it is doubtful that all scolytids in the area were caught equally as well. For example, observable populations of *S. quadrispinosus*, *P. minutissimus*, and *P. pruinosus* were in the area that the traps were located, yet the number of these species trapped was low.

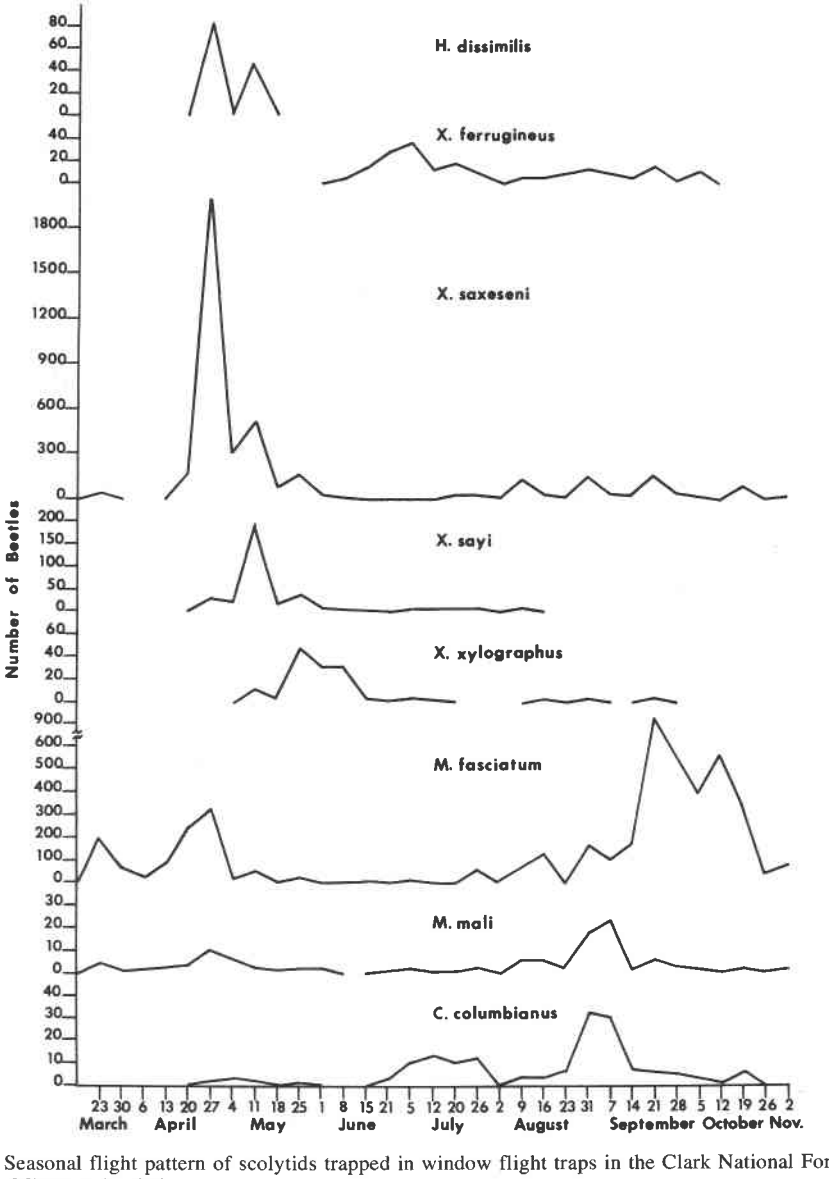

FIG. 3. Seasonal flight pattern of scolytids trapped in window flight traps in the Clark National Forest in Dent Co., Missouri, in 1973.

The vertical flight distribution of beetles is shown in Fig. 4. Most of the *X. ferrugineus* and *X. xylographus* were trapped at 1.8 m and lower. While *H. dissimilis*, *X. saxeseni*, *X. sayi*, and *C. columbianus* did not show distinctive flight levels, their flight ranged from .3 to 3.6 m. Distinctive levels of vertical flight distribution for *M. fasciatum* and *M. mali* were not apparent. This is not surprising since these beetles had been observed to attack black oak trees up to 13.4 m on the bole at this site (Roling and Kearby 1974). Chapman and Kinghorn (1958) noted that scolytids fly close to the ground. Our results were similar because most of the scolytids trapped were close to the ground.

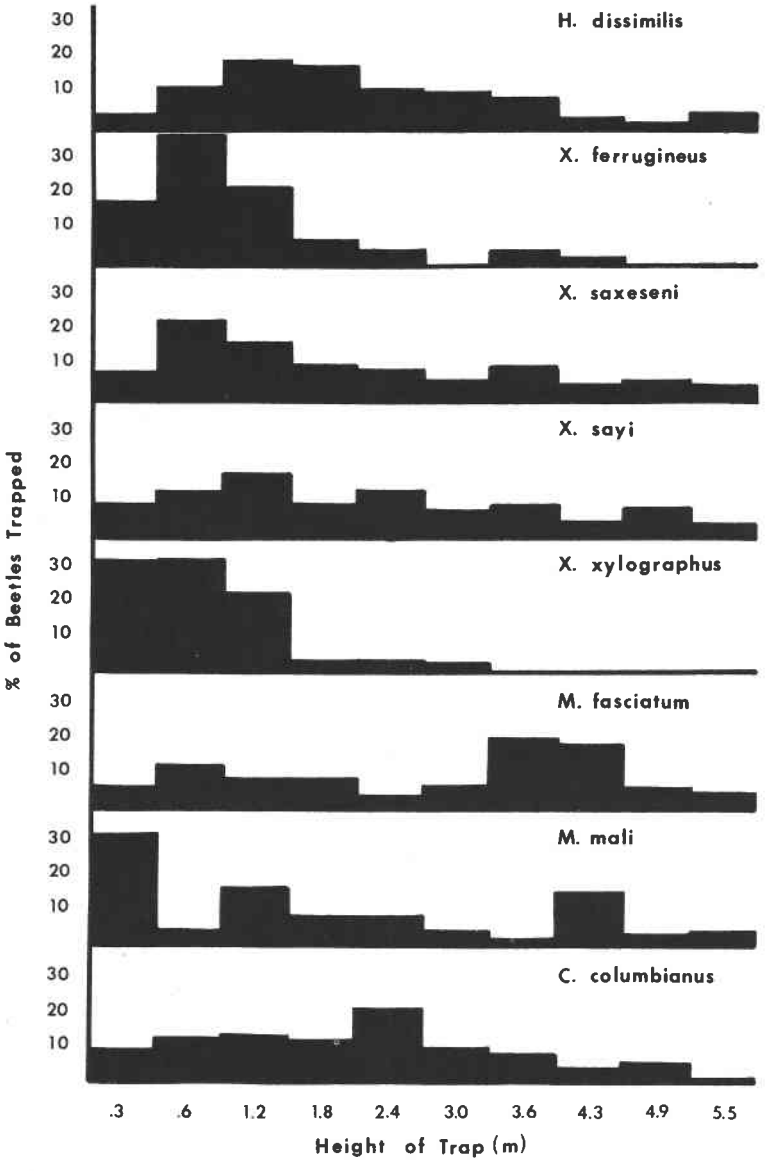

FIG. 4. Vertical flight distribution of scolytids trapped in window flight traps in the Clark National Forest in Dent Co., Missouri, in 1973.

The traps are convenient to the extent that they are not overly large and can be readily hoisted into the canopy. Minor difficulties were encountered with the traps. Debris falling into the funnels, dilution of the ethanol, and traps being damaged were the primary problems. Collection periods shorter than a week and the placement of a protective cover on the wooden frame might alleviate these problems.

Tree Injection

The two *Q. velutina* trees injected with ethanol remained alive. Beetles were attracted to the trees from 13 April to 5 July 1973. During this period, fresh attacks and borings were observed on the trees in strips approximately 3 cm in width and 30 cm above and 15 cm below the injection tubes. At termination, the feeder tubes no longer formed a tight seal within the tree so observations were ended. Five species of scolytids were trapped on the cloths: *X. saxeseni*, *X. xylographus*, *M. fasciatum*, *M. mali*, and *C. columbianus*. A total of 1257 beetles were recorded: *C. columbianus* and *X. xylographus*, 1%; *X. saxeseni*, 23%; *M. fasciatum*, 72%; *M. mali*, 4%. The control tree did not attract any beetles during the same period.

While the injected trees did not record as many different species as the flight traps, the results indicate that ethanol can induce a live black oak to develop properties of attractiveness for *X. saxeseni* and *M. fasciatum* normally found only in severely weakened or dead trees.

Acknowledgments

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