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Studies on the Flight Capabilities of *Dendroctonus frontalis* and *IPS calligraphus:* Preliminary Findings Using Tethered Beetles

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SUMMARY

Studies provide preliminary results of the flight capabilities of the southern pine beetle and the eastern six-spined engraver.

INTRODUCTION

The current widespread outbreak of the southern pine beetle, *Dendroctonus frontalis* Zimmermann, and the cut-and-leave technique employed to stop individual spot growth have raised many questions about the flight capabilities of bark beetles and the effectiveness of this control method. Few studies have dealt with the flight capabilities of the southern pine bark beetles. Radioactive tagging and marking beetles with fluorescent powders have been used to study dispersal of the southern pine beetle (Gara 1967, Moore et al. 1979). Flight mills have been used to study the flight capabilities of other bark beetles (Atkins 1961, Kinn 1971).

The studies reported here are preliminary results of the flight capabilities of the southern pine beetle and the eastern six-spined engraver. *Ips calligraphus* (Germ.). These findings are intended to provide preliminary knowledge regarding the flight capacity of southern bark beetles.

MATERIALS AND METHODS

The flight mill used in this study was a modification of one designed by Chambers, Sharp, and Ashley (1976). The mill is suspended rather than being rested on a platform. This ensures a true vertical orientation (fig. 1). The mill itself consists of an almost frictionless Teflon@ bearing and a rotor support that rides on a magnetic cushion. The rotor arm is 16 cm from its axis to its tip and circumscribes a circle 1 m in length. Six mills are housed on an enclosed table and each mill provides data to a recorder that tallies time and distance flown for that particular mill. This information is stored in a memory circuit after cessation of a beetle's flight. Counting will not resume if an individual beetle begins a second flight after a brief resting period. Therefore, the data presented here is for only the initial, uninterrupted flight. After each flight the beetles were removed from the rotor and examined for gender.

Infested loblolly pines (*Pinus taeda* Linn.) were felled, cut into bolts and transported to the laboratory where they were held in emergence boxes. Emerging beetles were collected at hourly intervals and from these collections beetles were selected at random for testing. Plastic rubber cement was used to attach the beetles to a pin attached to the rotor arm. All tests were carried out in a still atmosphere at 18–26°C, 22-28 percent R.H., under constant illumination of about 500 luxes.

RESULTS AND DISCUSSION

In October 1981, 13 *D. frontalis* (69 ♀, 7♂♂) were collected and flown. The approach of cooler weather and resulting lack of beetles precluded additional flights. Thirteen *I. calligraphus* (6♂♂, 7♂♂) were flown in the fall of 1981 (Sept.-Dec.) and an additional 8 *I. calligraphus* (4♂♂, 4 ♀♀) were flown in August 1982. No significant differences in duration, distance, or velocity of flight were noted between female and male southern pine beetles (table 1), nor between female and male six-spined engravers (table 2).

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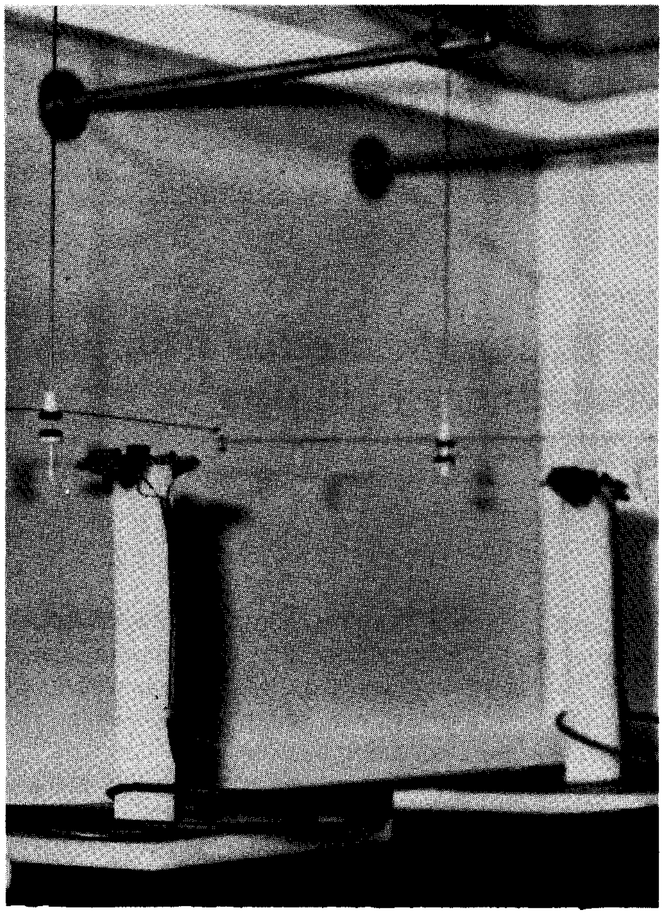

Figure 1 .-Suspended *flight mill and sensing device used to test flight capabilities of the southern pine* ***beetle*** *and eastern* ***six-spined*** *engraver.*

The maximum distance flown by a single southern pine beetle was 1.6 miles with the average being slightly over one-half mile. The six-spinned ips, being a more robust insect, flew farther than the southern pine beetle. The maximum distance flown by ***I. calligraphus*** in a single flight was 4 miles with an average flight of slightly over 1 mile. A similar study revealed that ***Ips confusus*** **LeConte** can fly non-stop for a distance of 7.8 miles with the average flight distance being 2.6 miles (Kinn 1971). The greater flight range of engraver beetles may have significance for the proliferation of southern pine beetle infestations. In nonepidemic periods the southern pine beetle is associated with ***Ips*** beetles, with the latter often attacking first **(Hain** and McClelland 1979).

Admittedly, tethered flight has many disadvantages over free flight. The beetles are continually attempting to correct for a straight line flight (Hocking **1953),** and they only have to supply thrust. Lift requires the expenditure of more energy than thrust (Hocking 1958) and the former is provided by the mill. Even considering these limitations, the flight capability of tethered southern pine beetles agrees with limited field observations.

In a study conducted in October and November, radioactively tagged southern pine beetles were found to travel downwind a distance of 364 meters (1194.3 **ft)** (Moore et al 1979) and beetles dusted with a fluorescent powder in June were found one mile from their emergence site (Gara 1967). In the absence of an attractant or at distances greater than 20-25 feet from an **attractant**, the southern pine beetle will tend to disperse (Gara 1967, Gara and Coster 1968). Southern pine beetles, dusted with a fluorescent powder and released in an open area in the absence of any attractant, were observed to fly upward at a steep angle of ascent (Kinn, unpublished observation). In contrast, in an understory, southern pine beetles tend to fly 4 to 18 feet above the forest floor (Gara, **Vité,** and Cramer **1965).** It is possible that beetles flying vertically could be carried considerable distances by upper level winds. This is the conclusion reached by Forsse and Solbreck (1985) in their studies on the dispersal of ***Ips typographus*** L. They estimated that approximately 10 percent of the beetle population flies above the canopy and can be carried distances in excess of 11 miles. It has been reported that southern pine beetle infestations occur in the direction of prevailing winds (Coster et al. **1978),** at least during the summer **(DeMars** and **Hain** 1980).

It is presumed that cut-and-leave reduces beetle populations by creating higher temperatures under the bark and through drying of the bole. However, the entire beetle population is not eliminated using either **cut-and-**leave or cut-and-top (Hodges and Thatcher 1976). Surviving beetles may disperse to other areas (Coster 1977). In view of the limited observations that have been made, this dispersal distance may be considerable. The present southern pine beetle outbreak in Louisiana and east Texas is likely to continue for several more years and it may move eastward if past patterns are repeated. Also, it can be assumed that outbreaks will continue to occur in a sporadic pattern once the present outbreak subsides. A thorough understanding of the dispersal capability of this species throughout the year and the factors affecting dispersal are essential if we are to predict or control this pest in the future.

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Chambers, D. L.; Sharp, J. L.; Ashley, T. R. Tethered

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Table I-Time, *distance and* velocity *of* Dendroctonus frontalis *flights*

	No.	Time (min.) Range	Mean	SD	Distance (meters) Range	Mean	SD	Velocity (m/min.) Range	Mean	SD
♀♀	6	6-131	75.7	23.6	133-2566	962.7	363.3	6.1-19.6	13.6	2.4
♂♂	7	14-224	97.3	30.7	224-1930	994.3	265.2	7.2-I 6.0	12.1	1.5
Both	13	6-224	67.3	32.1	133-2566	979.7	207.6	7.2-I 9.6	12.9	1.3

Table 2—*Time, distance and velocity* of Ips calligraphus *flights*

	No.	Time (min.) Range	Mean	SD	Distance (meters) Range	Mean	SD	Velocity (m/min.) Range	Mean	SD
♀♀	10	4-166	50.5	16.9	50-4025	1425.4	497.7	12546.7	29.5	3.6
♂♂	11	4-206	63.5	19.6	107-6416	2261.7	615.5	9.0–44.3	29.4	3.9
Both	21	4-206	67.6	13.5	50-6416	1673.9	393.0	9.0–48.7	29.4	2.6

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