DISPERSAL OF *PLECIA NEARCTICA* (DIPTERA: BIBIONIDAE)[1]

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ABSTRACT

The dispersal and flight activities of *Plecia nearctica* Hardy were studied by 2 mark-recapture techniques. First flies were collected with a D-Vac® and agitated in a 1-gal jar containing Day-Glo® fluorescent dust. Then the flies were released in an area containing sticky traps placed in a circular pattern around the release point at distances of 100, 200, 300, 400, and 500 ft. The second marking technique involved dusting resting flies in a grassy area with Day-Glo® pigment in the late afternoon after the flies had settled for the evening. With the release technique, more flies were recaptured at 100 ft than at any distance greater than 100 ft from the release point. Beyond 100 ft and up to 500 ft similar numbers of marked flies per trap were recollected. With the dusting technique the number of marked flies recaptured decreased at increasing distances from the center of the dusted area. No significant differences were found in the distances moved by single males and females or copulating pairs with either marking technique. There were also no differences in the directions moved by the 3 categories of flies after either marking technique. Dusting flies on the vegetation is the more desirable marking technique because no handling of the flies is necessary.

The lovebug, *Plecia nearctica* Hardy, is considered a pest in Florida because of the large numbers of flying adults (primarily copulating pairs) that occur over roadways in September and May. Lovebugs are apparently capable of dispersing great distances: Hetrick (1970) reported the observation of adult *P. nearctica* several miles from land in the Gulf of Mexico and at altitudes ranging to 1,500 ft. Sharp et al. (1974) reported on the flight ability of the lovebug in the lab, and Buschman (in press) discussed the migratory spread of lovebugs in the southeastern U.S. The objective of this investigation was to obtain information on dispersal of adult lovebugs in nature by observing the movements of marked flies. Studies were made at the University of Florida Beef Research Unit (BRU) near Gainesville during September 1974.

MATERIALS AND METHODS

Two techniques were used to mark adult lovebugs. First, flies were collected in the field with a D-Vac®, transferred to 1-gal glass jars containing a pinch of Day-Glo® fluorescent dust and then the jars were agitated. A different color dust was used for each of 4 releases. After being marked with fluorescent pigment, the flies were released in the center of the

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study area by dumping them on the grass (Fig. 1). Wind velocity and direction were measured with a cup-anemometer and dial-indicating weather vane at the time of each release. Fifty sticky traps were placed in circles around the release point at distances of 100, 200, 300, 400, and 500 ft on 11 Sept. Traps were constructed from 18 × 18 in. pieces of Formica® painted white and screwed to 4-ft stakes driven in the ground. A flat surface of each trap was oriented toward the release point. The top edge of each trap was 42 in. above the ground. Unpublished results indicate that lovebugs primarily fly at heights of 30 to 40 in. above ground level (J. Whitesell, Fla. Agr. Exp. Sta. Rec. Book No. 2256). Both sides of the traps were cleaned and resprayed with Tanglefoot® every 2 or 3 days. Marked flies were detected on the sticky traps by examination with a blacklight (ULV 22) after dark (8:00-11:00 PM EDT) and the marked flies were removed after their locations with respect to the release point were recorded.

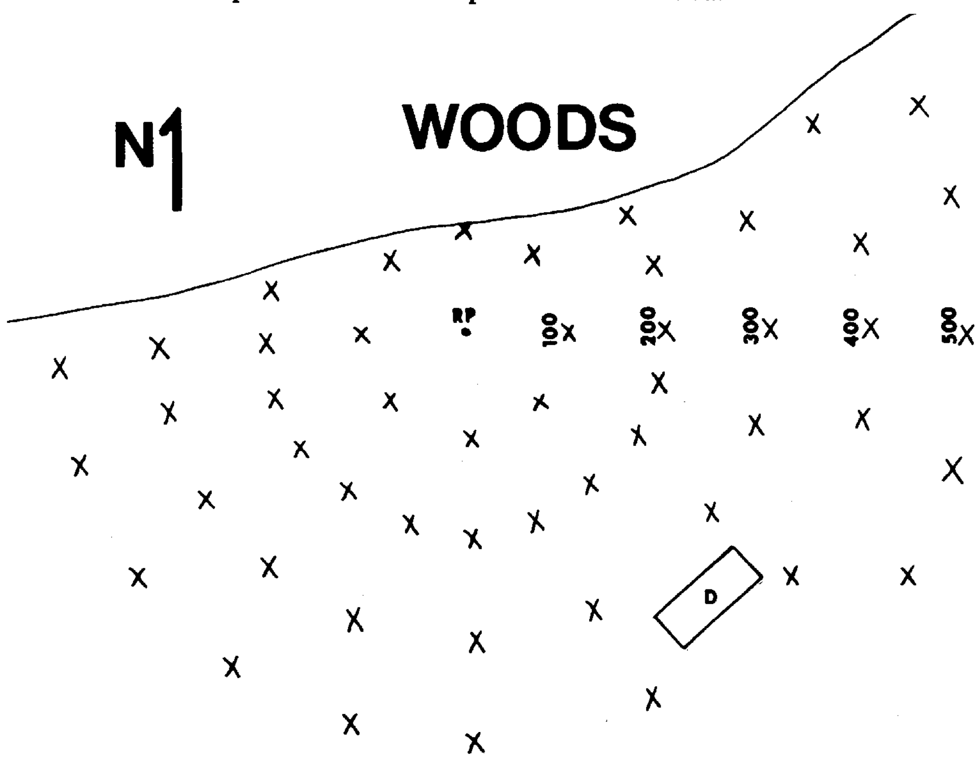

Fig. 1. Study site at the Univ. of Fla. Beef Research Unit near Gainesville. RP—release point; X—location of a sticky trap; D—area dusted with fluorescent pigment.

The second marking technique involved waiting until the flies had settled on the vegetation for the evening (around 7:30 PM EDT) and then dusting the area with fluorescent pigment delivered by a hand-held crop duster. The area dusted (Fig. 1) was 40 × 60 ft and was selected because it was a moist area of heavy adult emergence and thus contained large numbers of mated pairs and single flies at dusk.

Flies marked by dusting the area where they were resting or by agitation in a gallon jar seemed to experience no ill effects. Flies marked by both techniques and unmarked flies were provided with sugar water and held in small screen cages at the study area. Approximately equal numbers of both marked and unmarked flies lived up to 6 days. The marked flies remained fluorescent up to 15 days, even after their death.

Results and Discussion

Similar proportions of mated pairs, and single males and females were recaptured after all the releases, with more single males than single females and more single females than copulating pairs recaptured (Table 1). Marked pairs made up a larger proportion of the lovebugs recaptured after dusting than with the release technique ($X^2 = 18.9$; $p < 0.005$). About equal proportions of marked females and copulating pairs were collected by the dusting technique. Both members of the pair were marked in all cases of recaptured copulating pairs. The D-Vac® used to collect the flies for marking and release separates many pairs as they are being collected as does also marking flies by agitation in jars containing fluorescent pigment. This probably accounts for the small number of copulating pairs recaptured in comparison to the number recovered after dusting the flies on the vegetation.

I first consider the results of the 4 releases and then compare these data with those obtained by dusting resting flies on the vegetation. More pairs, and single males and females were collected per trap at a distance of 100 ft than at any distance greater than 100 ft (Table 2). Beyond 100 ft similar numbers of marked flies of each of the 3 categories per trap were collected except the average number of females captured at 500 ft declined. Obviously 500 ft is not great enough a distance for the placement of traps for studying lovebug dispersal because of the similar numbers of marked flies recaptured at distances beyond 100 ft. As expected, the marked flies were generally recaptured at increasing average distances from the release point as time elapsed after each release (Fig. 2).

Statistical analysis of the data with respect to the distances moved from the release point by the 3 categories of flies revealed no significant differences. Sharp et al. (1974) found that under laboratory conditions copulating females fly faster than either single females or males. These authors predicted that copulating pairs might fly greater distances in less time than a single male or female.

The average numbers of marked single males and females and copulating pairs per trap captured in each direction from the release point are shown in Table 3. The average numbers varied from 24.5 recaptured southwest to 85.3 recaptured south of the release point. A chi-square test revealed that the numbers of single males and females and copulating pairs recaptured per trap from north to east, southeast to south, and from southwest to northwest were not significantly different for any 1 release or all releases. However, wind speed and direction undoubtedly influence the flight activities of lovebugs. On the day of the first release, the wind was blowing from the east at 5 to 7 mph. With the exception of 1 marked copulating pair collected on a trap 300 ft west of the release point, all marked flies were captured on traps from north to south of the release point on the day of release. On the days after the first release, winds were very light (2 mph or less), and flies were recaptured on traps in all directions. On the days of the other releases winds were from the east at 1 to 2 mph or non-existent, and marked flies were collected on traps in all directions

TABLE 1.—THE DATES AND TIMES (EDT) OF RELEASES AND DUSTING OF *Plecia nearctica*, APPROXIMATE NUMBER RELEASED, AND THE NUMBERS RECAPTURED.

Release Date and Time, or Dusting Date and Time	Color Pigment	Wind Speed and Direction	Approx. Number Released	No. Recaptured			
				Copulating Pairs (%)	Males (%)	Females (%)	Total (Prs. Counted as Single Recaptures)
Releases:							
Sept. 12, 1 PM	Fire Orange (FH-14)	5-7 mph, East	4,000	39 (17.6)	121 (54.8)	61 (27.6)	221
Sept. 13, 1 PM	Arc Yellow (FH-16)	No wind	8,000	86 (19.4)	222 (50.0)	136 (30.6)	444
Sept. 14, 12 AM	Rocket Red (D-13)	2 mph, East	15,000	123 (15.3)	426 (53.0)	225 (31.7)	804
Sept. 15, 1 PM	Horizon Blue (A-19)	1-2 mph, East	20,000	159 (16.4)	492 (50.7)	320 (33.0)	971
Dusting:							
Sept. 12, 7:45PM	Saturn Yellow (FH-17)	No wind	?	122 (30.0)	154 (41.2)	108 (28.9)	374
			Totals:	519	1415	880	2814

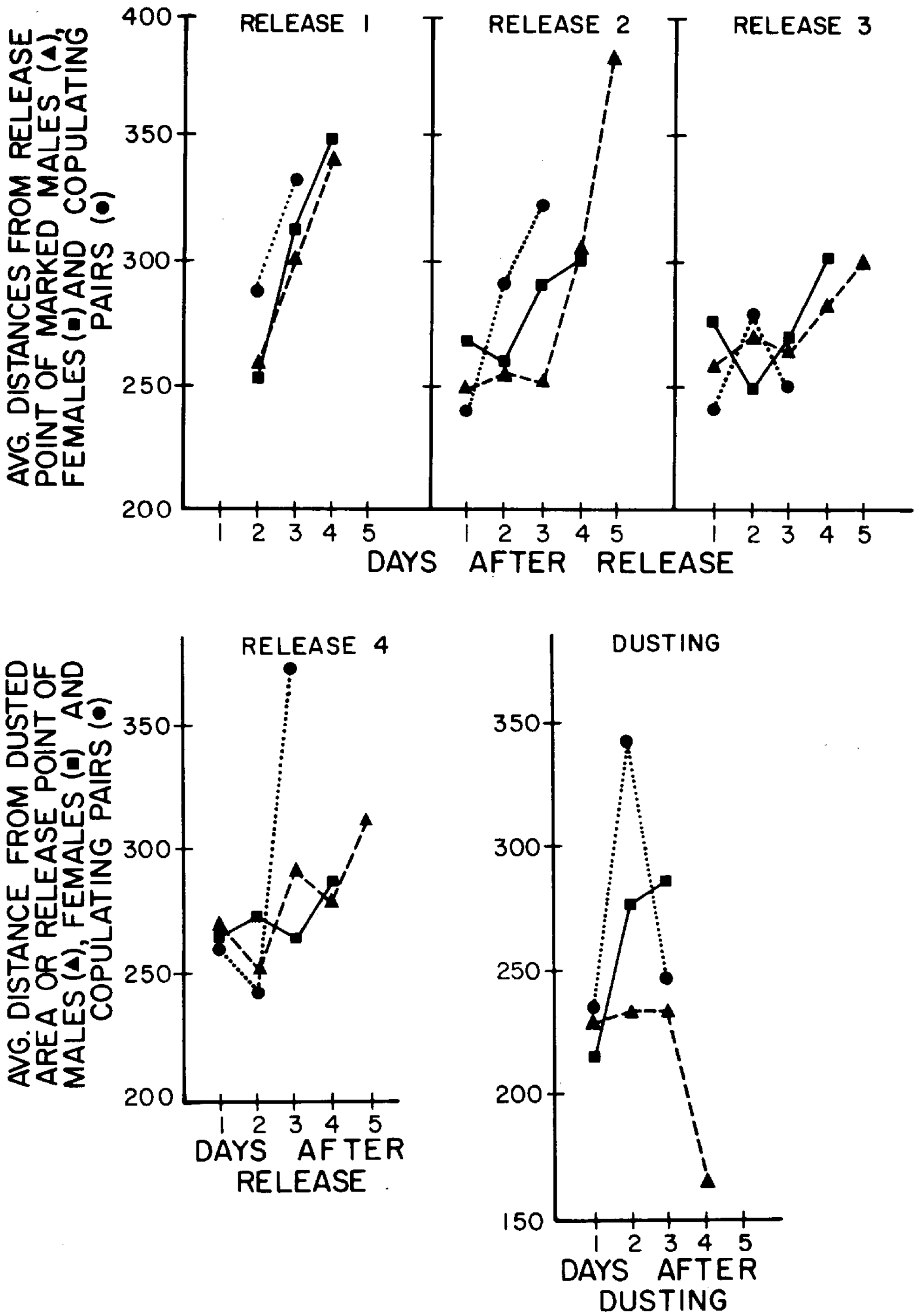

Fig. 2. The average distances moved by marked lovebugs in relation to elapsed time after marking.

from the release point. These observations suggest that at wind speeds of 5 to 7 mph lovebugs disperse into or across the wind; when there is no wind or wind no more than 2 mph, lovebugs disperse in all directions.

TABLE 2.—AVERAGE NUMBERS OF SINGLE MALES AND FEMALES AND COPULATING PAIRS OF *Plecia nearctica* RECAPTURED PER TRAP AFTER 4 RELEASES.

Distance from release point (feet)	No. Traps	Avg. No./Trap		
		Prs.	Males	Females
100	8	13	37	25
200	14	4.4	22.6	12.5
300	11	7.6	24.4	14.7
400	12	6.6	22.3	15.3
500	5	6.8	21.4	9.8

The relationships of numbers of marked flies recaptured on all traps as time elapsed after each release and the dusting are shown in Fig. 3. In all cases, the greatest numbers of marked flies were trapped on the day of release (or day after in the case of dusting the flies resting on the vegetation). Copulating pairs were collected up to 3 days after their release. Pairs remain *in copula* up to 4 days in the laboratory (Thornhill, in manuscript); therefore, the 3 day maximum for marked copulating pairs in nature corroborates the laboratory observations. Single females were collected up to 4 days and single males up to 5 days after release.

TABLE 3.—AVERAGE NUMBERS OF SINGLE MALES AND FEMALES AND COPULATING PAIRS OF *Plecia nearctica* RECAPTURED PER TRAP WITH RESPECT TO DIRECTION FROM THE RELEASE POINT.

	N	NE	E	SE	S	SW	W	NW
No. Traps	1	8	5	13	4	13	4	2
Avg. No. Prs./Trap	13	8.3	13.6	4.8	16	4.2	10.5	14.5
Avg. No. Males/ Trap	26	24	41.8	18	44.5	12.1	42.8	33
Avg. No. Females/ Trap	26	15.9	26.8	10.3	24.8	7.9	23	25.5
Avg. No. Males, Females and Cop. prs./ Trap	65	50	85	33.5	85.3	24.5	79.5	71.5

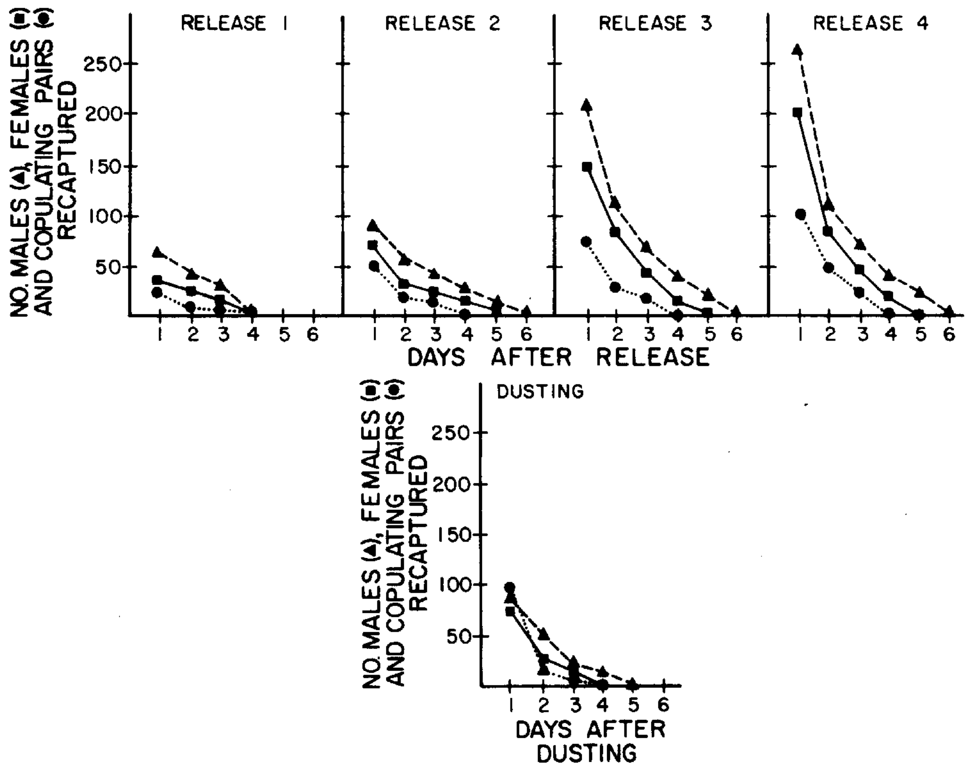

Fig. 3. The numbers of marked lovebugs recaptured in relation to elapsed time after marking.

Most females apparently mate soon after they emerge: single females invariably were observed to be grasped by a hovering male before they could leave the emergence site. Also, a survey of single females on the flowers of *Bidens* and goldenrod revealed that they had all mated. Females upon emergence copulate and feed for 2 to 4 days and then oviposit and die. Under laboratory conditions, males live longer than females and may seek out another female upon termination of the first copulation (Thornhill, in manuscript). That males live longer in the field is suggested by the recapture data (Fig. 3).

Table 4 contains the average numbers of single males and females and copulating pairs re-collected per trap at various distances from the center of the area dusted (40 × 60 ft) with fluorescent pigment (Fig. 1). The average numbers of marked single males and females and copulating pairs recaptured decreased at increasing distances from the center of the dusted area. The average distances moved by single females and copulating pairs increased with each successive day after marking for up to 2 days for copulating pairs and 3 days for single females. The average distance moved by males did not increase as time lapsed after dusting (Fig. 2). This suggests that males tend to remain in the vicinity of the area where they emerge. A chi-square test revealed no significant differences in the distances moved from the area dusted by single males and females or copulating pairs.

No traps were located to the south or southeast of the area dusted but traps were located in all other directions (Fig. 1, Table 5). The largest numbers of marked flies per trap were collected to the north, northeast, and west of the area dusted. No significant differences were found in the numbers of single males and females or copulating pairs re-collected per trap when the directions north to east and southwest to northwest were compared with a chi-square test.

TABLE 4.—AVERAGE NUMBERS OF SINGLE MALES AND FEMALES AND COPULATING PAIRS OF *Plecia nearctica* RECAPTURED PER TRAP AFTER BEING DUSTED WITH FLUORESCENT PIGMENT.

Distance (feet) from center of dusted area	No. Traps	Avg. No./Trap		
		Prs.	Males	Females
0-100	2	6.5	9.5	7.0
101-200	7	4.6	6.9	3.9
201-300	11	3.4	4.7	2.9
301-400	12	1.3	1.4	1.8
401-500	9	1.0	0.7	1.0
501-600	7	0.9	1.0	1.0
601-700	2	0.5	0	0

TABLE 5.—AVERAGE NUMBERS OF SINGLE MALES AND FEMALES AND COPULATING PAIRS OF *Plecia nearctica* RECAPTURED PER TRAP WITH RESPECT TO DIRECTION FROM THE AREA DUSTED WITH FLUORESCENT PIGMENT.

	N	NE	E	SE	S	SW	W	NW
No. Traps	4	8	1	0	0	4	4	29
Avg. No. Prs./Trap	6.3	4.1	5.0	-	-	0.8	3.3	1.3
Avg. No. Males/Trap	4.5	7.3	1.0	-	-	1.5	5.5	1.6
Avg. No. Females/ Trap	4.0	4.6	1.0	-	-	1.0	3.3	1.6
Avg. No. Males, Females & Prs./Trap	14.8	16.0	7.0	-	-	4.3	12	4.5

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UV RADIATION: EFFECT ON SYNTHETIC SEX PHEROMONE OF THE INDIAN MEAL MOTH[1,2]–(*Note*): Exposure of the synthetic sex pheromone of *Plodia interpunctella* (Hübner) to sunlight (film form) results in the degradation of the pheromone into inactive components (Goto, Masuoka, and Hiroga, 1974, Chemistry Letters 11:1275). Thus the stability of the pheromone is an important factor in the practicability of the pheromone in the field. Since short-wavelength (253-nm) UV radiation has detrimental effects on biochemical systems (Giese, 1964, Photophysiology, Academic Press, 441 p.), we studied the effects of UV radiation on the stability of the pheromone as a prelude to determining how the stability of the pheromone could be protected.

The pheromone (*Z,E*)-9,12-tetradecadien-1-yl acetate, 95% purity, was diluted in hexane (1:100). One μl of the solution was placed on each of the bottoms of six 43-ml plastic vials. Filter paper disks (diam. = 2 cm) were then suspended vertically from the lids of each of the vials and secured. After the pheromone had evaporated onto the paper disks for 24 hr, 3 of the disks were exposed to UV radiation; the other 3 served as controls. A set of 6 disks was prepared for each exposure ranging from 0.5-5 hr of UV radiation. The source of UV radiation was two 15-watt germicidal lamps, GE 15T8, in each of 2 lamp fixtures. They emitted ca. 95% of their energy at a wavelength of 253 nm. We made certain that the bulb temperature (38°C) did not itself cause a decrease in biological activity by placing some control disks in a 38 and 65°C oven for 8 hr and bioassaying the disks for pheromone activity. Bioassays (conducted under a chemical hood) were made with 48-hr-old unmated male *P. interpunctella* by inserting a disk through a slit in a paper top covering the jar containing the males. The criterion for a positive response of the males was fluttering behavior within 30 sec. A test consisted of 3 treated disks and 3 control disks bioassayed against 3 groups of 3 males (9 males) each, and a test was replicated 3 times for each exposure period.

[1]Lepidoptera: Pyralidae.

[2]Mention of a commercial or proprietary product in this paper does not constitute a recommendation or an endorsement of the product by the USDA.