A STICKY SITUATION

POO'S CAN TAKE ADVANTAGE OF MALE GERMAN COCKROACH DISPERAL PATTERNS TO MAXIMIZE STICKY TRAP CATCHES.

BY DR. JAMES BALLARD AND DR. ROGER GOLD

German cockroach exploratory behavior is the result of attempts to locate food, water, harborage and mates. Cockroaches spend the majority of the time (75 percent) in harborage with exploratory activity occurring during the evening. Eighty five percent of German cockroach adults were found congregated between objects 5 mm apart. When adult and nymphal German cockroach females were released in an arena bounded by compartments, 80 percent were found hiding in groups of six or less during their inactive period. Large numbers of German cockroaches harbored in selected areas of the kitchen, specifically in cabinets, under sinks and in refrigerators.

Placement of sticky traps to monitor German cockroach populations in infested housing is performed with an attempt to place traps in areas frequented by cockroaches. Therefore, traps should be located under sinks, in cabinets, adjacent to stoves and refrigerators, on shelves and in corners. When traps are used to monitor German cockroach populations, the dispersal pattern that cockroaches utilize in leaving their harborage should be considered.

The objectives of this investigation were:
- To determine male German cockroach dispersal patterns in relation to harborage locations.
- To determine whether trap distance from the harborage influenced trap catch.
- To compare male German cockroach dispersal patterns to that of a randomly dispersed population of marbles.

**METHODS.** Experiments were conducted in a dark, concrete and tile testing room which measured approximately 8-by-9 feet in size. The room was fitted with an electric shock barrier to confine populations of field-collected, male German cockroaches. Room temperature was 78 degrees Fahrenheit with relative humidity of 40 percent.

A 1-foot, hollow, Plexiglas cube was used as a harborage for the cockroaches. This harborage was provisioned with water, Purina Dog Chow and cardboard. In experiments involving cockroaches, the harborage containing 300 cockroaches was introduced into the test room. After a 24-hour adjustment period each of the side openings (1-inch diameter) were opened, allowing the cockroaches to disperse from the harborage.

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<tr>
<th>Circle of Traps</th>
<th>Average* Cockroach Catch/Trap</th>
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<th>Average* Marble Catch/Trap</th>
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<td>1.6</td>
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<td>All Traps Averaged</td>
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*No significant difference in trap catch between cockroaches and marbles nor between any circles of traps.

Table 1. Average catch of 300 German cockroach males as they dispersed from the center of a room and of 300 marbles as they were dropped from a height of 5.5 feet into the center of the same room.
Mr. Sticky™ traps — distributed by Brody Enterprises, LTP Inc. and others — were used to capture both cockroaches and marbles, depending upon the experiment. In all cases, unbaited traps (with the sides removed) were used. Thus, a simple flat sticky surface was used to measure cockroach/marble dispersal.\textsuperscript{2,3,4}

All cockroaches caught in traps were counted and removed, and the number caught replaced into the harborage on a daily basis. Dead cockroaches were removed from the harborage and floor of the room each day, and an equal number were replaced. Thus, the harborage/room population was maintained at 300 cockroaches. One nightly catch of cockroaches in traps was considered a replication with six replications completed per experiment. A brief review of each experiment follows.

**Experiment one.** The harborage was placed in the center of the floor of the room and two circles of sticky traps (see photo on page 94) were placed around the harborage. The inner circle (4-foot diameter) consisted of eight traps spaced 14 inches apart. The outer circle (8-foot diameter) consisted of 16 traps spaced 14 inches apart. The cockroach catch was recorded by trap location and the catch data averaged.

**Experiment two.** This experiment was conducted to investigate the theory of random dispersal of German cockroach males by comparing cockroach dispersal to the dispersal of a population of marbles. The experiment was conducted as in experiment one except that the harborage was removed and a population of 300 marbles was dropped onto the center of the floor from a height of 5.5 feet. Previous work indicated that marbles dropped into a circular arena were found randomly distributed.\textsuperscript{8}

**Experiment three.** The harborage was placed in a corner of the room and two circles of traps were placed (floor and wall locations) to encircle the harborage. Because dispersal information was to be collected at specific trap locations, the num-

<table>
<thead>
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<th>Trap Pair Location</th>
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<th>Outer Circle</th>
<th>Outer Circle Only</th>
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<tr>
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<tr>
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<td>Intersection</td>
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<tr>
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<td>50.67</td>
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Table 2. Comparison of male German cockroach trap catches when cockroaches dispersed from a harborage located in the corner of the room.
number of equally spaced traps was reduced to six in the inner circle and nine in the outer circle. Care was taken to place traps at all vertical/horizontal intersecting surfaces (Figure 2). A double trap procedure (two traps at right angles to each other at intersections or adjacent to each other on floors and walls) was utilized for all trap locations so the cockroach catch for each pair of horizontal and vertical floor/wall intersection traps could be compared.

Experiment four. This experiment was conducted to measure the influence of trap distance to haborage upon cockroach catch. Procedures were the same as in the third experiment except for removal of the inner circle of traps.

ANOVA and Duncan’s Multiple Range Test were utilized to analyze data and separate means. A significant level of 0.05 was chosen to facilitate the interpretation of results of statistical analysis.

RESULTS. No significant difference was found between the trap mean of the first experiment (3.4 cockroaches per trap per night) and the trap mean of marbles in the second experiment (3.9 marbles per trap per rep). This is illustrated in Table 1 (page 88). Also, no significant differences were found in any experiment between the inner or outer circle of cockroach traps. Traps placed on horizontal surfaces caught significantly more (85 percent) cockroaches than traps on vertical surfaces (15 percent).

When the haborage was moved to the corner of the room the outer circle in the fourth experiment (one circle) caught significantly more cockroaches than the outer circle in the third experiment (two circles), but the total catch of the outer and inner circles in the third experiment was not significantly different from the total catch of the fourth experiment (Table 2, page 32).

Significantly more cockroaches were caught on traps placed along the intersection of the floor/wall than on the floor (Table 2). As cockroaches were dispersing along floor/wall intersections, the traps near the haborage caught significantly

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more cockroaches than traps further away (Table 2).

**DISCUSSION.** In this study, male German cockroaches (or marbles) dispersed randomly when released from the center of the room, as confirmed by sticky trap catches. After initial escape it was reported that German cockroaches entered a search movement pattern consisting of a uni-directional pattern of loops (1.5 to 6 foot diameter) and interspersed straight runs (8-16 feet). It was thought that this search behavior would increase the likelihood of encountering an object [edge].

Cockroach catch after moving the harborage to a corner location revealed that German cockroach males again dispersed along horizontal surfaces (floor) when that surface was adjacent to a vertical surface. It was noted that *Periplaneta fuliginosa* (Serv.), the smokybrown cockroach, tended to move along the vertical edge of floor/wall intersections. Not all stages of the German cockroach should be expected to be equally susceptible to trap catch as harborage and food and water availability influenced German cockroaches, depending upon cockroach sex and age. The Mr. Sticky trap caught more males than any other cockroach growth stage. In this study and in work reported by Ross et al., the closer to the harborage the trap was placed in floor/wall intersection, the more cockroaches that were caught.

**CONCLUSIONS.** The key findings of these experiments from a PFCO's perspective include:

- German cockroaches dispersed along floor/wall intersections. Thus, traps placed in these locations caught more cockroaches than traps in other horizontal or vertical locations in the room. It was concluded that the location of a trap on a horizontal surface adjacent to a vertical surface was the most important factor in maximizing catches of male German cockroaches.
- The data generated in this study is more useful from the standpoint of trap or insecticidal bait placement. The addition of more traps to the floor/wall inter-
section area would not result in a dramatic increase in trap catch, but it would speed up whatever influence the trap would have on the population and prevent small numbers of traps from being overwhelmed by a large cockroach population. Additional traps would also insure that more cockroach harborage would be contacted.

- In the absence of orientation cues (vertical edges), male German cockroaches dispersed randomly from a harborage located in the center of a room. Male cockroach dispersal patterns could be represented by an equal size population of marbles.

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REFERENCES


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