HARBORAGE PREFERENCE BY *PERIPLANETA AMERICANA* (L.) AND *PERIPLANETA FULIGINOSA* (SERVILLE) (DICTYOPTERA: BLATTIDAE) IN A HOME IN CLEMSON, SOUTH CAROLINA[1]

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ABSTRACT

A home in Clemson, South Carolina, known to be infested with *Periplaneta americana* (L.) and *Periplaneta fuliginosa* (Serville), was partially dismantled and the harborage sites were identified. *Periplaneta americana* harborages centered around the basement furnace room and first floor bathroom. *Periplaneta fuliginosa* harborages were distributed more widely throughout the structure. Both species tended to center around moist areas of the house where the relative humidity and water availability were stable.

Key Words: *Periplaneta americana, Periplaneta fuliginosa,* harborage, oothecae.

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INTRODUCTION

In the southeastern United States, *Periplaneta americana* (L.), the American cockroach and *Periplaneta fuliginosa* (Serville), the smokybrown cockroach, are serious urban pests (Cornwell 1968; Ebeling 1978). *Periplaneta americana* has been considered a pest since the 1700s (Rehn 1945) or possibly earlier (Roth 1982). *Periplaneta fuliginosa* is a more recent invader of the United States, being first described in Florida by Serville (1839). In the last 35 years, however, *P. fuliginosa* has become the most prominent and troublesome southeastern *Periplaneta* species (Hetrick 1981).

Both species are present in outdoor habitats but are adaptable to becoming household pests. Once established in a home, *P. americana* tends to harbor near water pipes, sinks, baths, and toilets where the microclimate is suitable for their survival (Roth 1982). Usually, they remain around the basement and first-floor levels, unless food is readily available on upper floors (Cornwell 1968). There is very little information available concerning *P. fuliginosa* harborages inside a home. In a survey of 350 pest control companies in South Carolina, typical *P. fuliginosa* domiciliary harborages reported by the operators encompassed all areas of the home, from the attic to the basement (Benson and Zungoli, personal communication). The purpose of the present study was to thoroughly examine and identify harborage sites in a home where *P. americana* and *P. fuliginosa* were known to occur.

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MATERIALS AND METHOD

The home examined for *Periplaneta* harborage sites was a two-story, wood-frame, colonial constructed in 1935. The first and second floors of the house faced north and had 295 m^2 of living area (11.5 m deep $\times$ 12.8 m wide) with a full basement and attic. Also, a covered porch (6.6 m deep $\times$ 4.6 m wide) and chimney on the east side and a carport and chimney of the same dimensions on the west side were attached to the structure. A small porch (1.3 m deep $\times$ 2.0 m wide) covered the back entrance to the home.

Initially, the home was built as a private residence with apartments in the basement and on the second floor, each with kitchen and bathroom facilities. Thus, the home had 3 kitchens and 4 bathrooms. In 1975, the home was purchased by a local church. The apartments remained occupied, while the main section of the home served as a recreation center for church functions. The house was sold in September 1985 and plans were made to move the home several kilometers to a new location. In mid-October 1985, the electricity and water were turned off and the house remained this way until it was moved by professionals in April 1986.

To move the main section of the home, the porches, carport and two chimneys had to be systematically dismantled. Many interior areas of the ceilings, walls and flooring had to be removed for new wiring and plumbing. Besides the professional contractors, entomology students spent approximately 130 man-hours dismantling the home while noting cockroaches, cockroach spotting and oothecae found. In addition, the author spent 35 hours searching the entire structure for cockroach harborages.

All observations made on cockroach infestations were recorded. Adult cockroaches and oothecae were identified to species (Cornwell 1968). The many cockroach remains found in these areas made actual counting or identification of individuals impossible. Oothecal remains were used for species identification.

Just as a single cockroach may be found away from a group harborage, oothecae also may be deposited apart from others. However, in this study, oothecal remains were nearly always found in conjunction with fecal and oral spotting and cockroach body parts. Consequently, for the purposes of this paper, oviposition sites and harborage are synonymous.

To summarize oothecal placement, the home was divided into 7 areas: 1) furnace room in the basement, 2) remainder of the basement, not including the kitchen or bathroom, 3) kitchen areas, 4) bathroom areas, 5) porch areas including the carport, 6) attic, and 7) living areas including all bedrooms, closets, hallways, dining room, living room, and study. The observed oothecal distribution was evaluated by chi-square analysis (X^2).

RESULTS

Evidence of both *P. americana* and *P. fuliginosa* infestations were identified. Only two adult specimens were found alive; two *P. fuliginosa* adults were captured in the ceiling void of the large porch. Since the heat was off during the fall and winter months, many individuals probably left or died. However, many oothecal remains along with fecal and oral spotting and cockroach body parts were found.

A total of 214 *P. americana* and 161 *P. fuliginosa* oothecae was located (Fig. 1). The *P. americana* oothecal distribution was clumped ($X^2 = 648.18$, $P < 0.0001$, df = 6), with 73% of all oothecae found in the ceiling void in the furnace room. Body parts, frass, and spotting also were heavy in this area. An additional 20% of the *P. americana* oothecae were found in the wall void of the first-floor bathroom directly above the furnace room. Six percent were deposited in the ceiling void of the basement near the furnace room walls. The final 1% of the oothecae found were in the ceiling void of the big porch.

The 161 *P. fuliginosa* oothecae were more widely spread throughout the house (Fig. 1), but were not statistically uniform in distribution ($X^2 = 214.26$, $P < 0.0001$, df = 6). In the ceiling voids of the two porches and carport, 51% of the oothecae, as well as heavy spotting and body parts, were located. In the furnace room, 12% of the *P. fuliginosa* oothecae were clustered in an upper corner by the exterior wall. Twenty-three percent were found behind the walls and ceiling tile in the rest of the basement. In the wall voids behind the sinks of the basement and first-floor kitchens, an additional 7% were found. Only one upstairs bathroom had *P. fuliginosa* oothecae, comprising 1% of the total, and in the attic, 2% of the oothecae were found near the chimney on the east side of the house. The remaining 5% of all *P. fuliginosa* oothecae were found throughout the general living areas of the home (Fig. 1).

Blattella germanica (L.) infestations also were observed. In the first and second floor kitchens, a total of nine dead specimens were found. In addition, 14 oothecal remains were located in these two kitchens and six oothecal remains were identified in the first-floor bathroom. The first-floor kitchen had fecal spotting in three areas behind the wall cabinets but no other signs of *B. germanica* were found in the house.

Moisture damage also was observed. The sill, especially around the exterior wall of the furnace room, showed signs of water damage. Clogged low points of the gutters on the northeastern corner of the big porch and the northwestern corner of the carport had resulted in extensive water damage to supporting members. In the attic there were signs of leakage, particularly around the chimneys. Overall, most of the oothecae, spotting, and body parts of the two Periplaneta species were found near those moisture centers, especially in the furnace room, porch, and carport ceiling voids.

DISCUSSION

The opportunity to dismantle a house is a unique situation for an entomologist in that potential cockroach harborage sites that can only be surmised in an intact structure can be fully investigated. Of course, much can happen in a home over a period of 51 years and one must be careful in extrapolating information based on one house. However, oothecae along with cockroach body parts and spotting especially in the ceiling, wall, and floor voids give a good indication of the cockroach history of the structure.

The *P. americana* harborage sites were found where they would be expected: between the basement furnace room and first-floor bathroom where warmth and water were concentrated. Apparently the second-floor kitchen was not a strong enough stimulus to attract *P. americana* individuals to the second floor. Though *B. germanica* harborage identification was not a priority of this investigation, signs

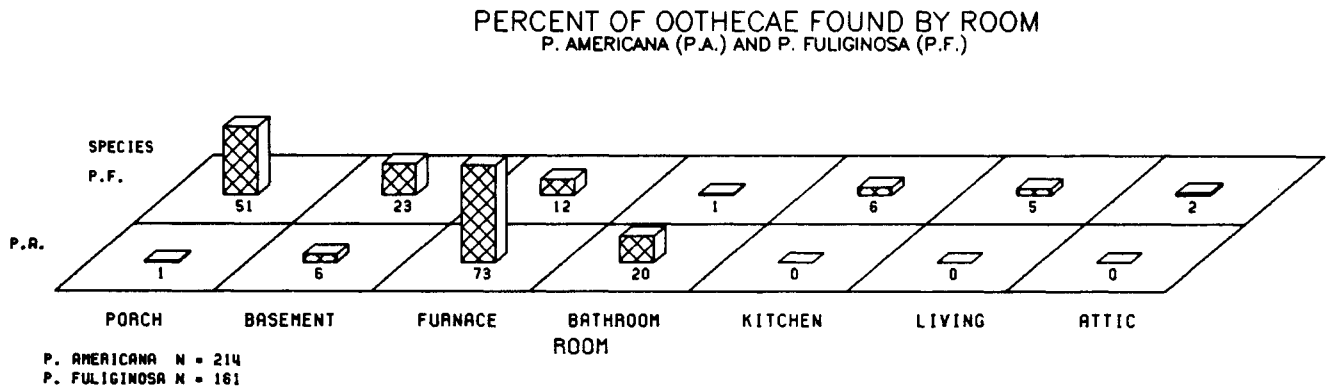

Fig. 1. Oothecal placement by *Periplaneta americana* (L.) and *Periplaneta fuliginosa* (Serville) in 7 areas of a home in Clemson, South Carolina: 1) porch areas including the carport, 2) basement area not including the furnace room, 3) furnace room, 4) bathroom areas, 5) kitchen areas, 6) living areas including all bedrooms, closets, hallways, dining room and study, and 7) attic.

of their infestation also were typical: in bathroom and kitchen areas where they would have ready access to food and water.

As the South Carolina pest control operators indicated in a 1985 survey (Benson and Zungoli, personal communication) and as this investigation determined, *P. fuliginosa* harborage sites can be widely distributed throughout a house. The two main harborage sites in this investigation were established near the water-damaged corners of both the porch and carport ceilings. The porch and carport surrounded each of the chimneys and gaps between the chimney and the main house structure created access routes which probably were used by *P. fuliginosa* to move easily about the house.

The exact reason why *P. fuliginosa* would be widely distributed in a house can only be conjectured. Full harborages or extensive foraging for food may be the reasons. However, searching for stable, relatively moist harborages is the most probable reason because a majority of the *P. fuliginosa* oothecae, bodies, and spotting in this study were found near water damaged areas of the house. This correlates well with the desiccation studies on *P. fuliginosa* reported by Appel and Tucker (1984). They state that *P. fuliginosa* has the highest cuticular water loss rate of all the major cockroach pests; over 6.5 times that of *B. germanica.* Appel and Tucker (1984) further pointed out that habitat selection, movement, and survival of *P. fuliginosa* can probably all be correlated to water relations. In fact, moisture is probably the most critical requirement for the success of most urban pests.

Overall, a house is a complex ecosystem. The ability of a structure to provide the three essentials for insect pests, food, harborage, and moisture, is well accepted but perhaps not well appreciated. First, food sources available for an omnivorous pest go far beyond items in the pantry to include debris that accumulates in the ceiling, wall, and floor voids. Second, potential harborage sites are so numerous that it is essentially impossible to inspect or treat all areas. Finally, the most critical factor, water, can also be available throughout the house. Water, however, may also be the most controllable requirement. All the cracks and crevices in a home cannot be sealed and debris cannot be stopped from accumulating in concealed areas, but water leaks and damage can usually be avoided or repaired. Both builders and homeowners need to be made more aware of potential moisture problems they may create and what measures they can take to avoid them.

In summary, *P. fuliginosa* appears to prefer harborage sites around water pipes and other moist areas as does *P. americana* but the former more readily will use suitable areas throughout the home. This makes location and control of *P. fuliginosa* population centers more difficult. Pest control operators will need to make complete structural investigations for *P. fuliginosa,* with the thoroughness and sophistication employed in termite inspections if they plan to control this troublesome urban pest effectively.

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LITERATURE CITED

Appel, A. G., and J. B. Tucker. 1984. Bionomics and control of the smokybrown cockroach. Pest Management 3(12): 10-13, 38.

Cornwell, P. B. 1968. The Cockroach. Vol. I. A Laboratory Insect and an Industrial Pest. Hutchison, London. 391 pp.

Ebeling, W. 1978. Urban Entomology. University of California, Division of Agricultural Sciences, Berkeley. 695 pp.

Hetrick, L. A. 1981. Notes on smokybrown cockroach. Fla. Entomol. 64: 361.

Rehn, J. A. G. 1945. Man's uninvited fellow-traveller — The cockroach. Sci. Monthly 61: 289-76.

Roth, L. M. 1982. Introduction to *Periplaneta*. pp. 1-14. *In* The American Cockroach. W. J. Bell and K. G. Adiyodi [ed.]. Chapman & Hall, London. 342 pp.

Serville, A. 1839. Histoire Naturelle des Insectes. Orthopteres. Librairie Encyclopedique de roret. Rue hautefeuille, N° 10 Bis. Paris. Imprimerie et fonderie de fain, Rue Racine, n 4, place de l'Odéon.