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The distribution of overwintering brown marmorated stink bugs (Hemiptera: Pentatomidae) in college dormitories

John Cambridge, Allison Payenski, and George C. Hamilton*

Halyomorpha halys (Stål) (Hemiptera: Pentatomidae), commonly known as the brown marmorated stink bug (BMSB), is an invasive, non-native agricultural and domestic pest in North America. Since its introduction into eastern Pennsylvania in the mid 1990s (Hoebeke & Carter 2003), it has spread to or been detected in at least 42 states (Leskey 2014). Like many other pentatomids (Saulich & Musolin 2014), BMSB undergoes facultative diapause and overwinters as sexually immature adults (Nielsen & Hamilton 2009). Prior to diapause, this species seeks out and clusters in secluded dark areas, where it remains dormant until spring (Toyama et al. 2006, 2011). In the mid-Atlantic Region of the United States, adults begin moving into overwintering sites in Sep and Oct. They remain in these sites until they emerge in the beginning of spring between Mar and Apr (Nielsen et al. 2008). In its native range of eastern Asia, BMSB is known to be an arboreal species (Bernon et al. 2005) that overwinters in dead standing trees such as oaks, locusts, and paulownias (Lee et al. 2014). In addition to natural overwintering sites, BMSB has a well-documented behavior of moving into structures to overwinter (Kobayashi & Kimura 1969; Wantanbe et al. 1994; Hamilton 2009; Inkley 2012; Leskey et al. 2012). Entrance into these structures is thought to occur though gaps in the window and door trim, roof flashing, and other gaps around doors and ventilation holes (Welty et al. 2008).

Understanding the overwintering ecology and behavior of this insect will be critical in developing effective management techniques for suppressing it (Lee et al. 2014). To address this issue, we conducted a study in 2 student dormitories to determine how overwintering BMSB are distributed within this type of structure. Given BMSB's behavior of seeking out overwintering locations in trees more than shrubs or ground litter (Lee et al. 2014), we hypothesized that BMSB utilizes the height of its overwintering locations and as such will prefer higher areas in urban structures. This is the first report on the overwintering pattern of BMSB inside a multi-unit residence building that details the distribution of the pest throughout the structure.

This study investigated the distribution of overwintering BMSB inside 2 student dormitory halls located on the Rutgers University Cook Campus in New Brunswick, New Jersey, USA. The survey portion of this study was conducted between 21 Feb and 14 Mar 2014. The survey asked the participants to identify the dorm unit in which they lived and whether or not they had observed any BMSB in their dorm since Sep 2013. A life-sized color picture of BMSB was included with each survey to help respondents with proper identification. No information about infestation magnitude or insect position within a dorm room was used in the analysis due to the non-uniformity and incompleteness of the responses. Information about observed BMSB in common areas, utility rooms, storage spaces, and bathrooms in the building was not collected in this study. The Perry residence hall and Voorhees residence hall contain 93 and 115 dormitory units, respectively. All rooms were of approximately equal size (~30 m^3). Both buildings had nearly identical floor layouts on the 2nd, 3rd, and 4th floors (Fig. 1). The 1st floor of each building had fewer dorm units than the other floors because it included the common area, utility rooms, and other storage spaces. Data were combined from both dorms and analyzed using a Kruskal–Walis test with R 3.0.1 statistical software (R Core Team 2015).

Ninety out of 113 units and 69 out of 93 units were surveyed successfully in Voorhees and Perry, respectively. From the 1st floor to the 4th floor in Voorhees, the percentage of rooms with observed BMSB was 20.0, 20.0, 19.2, and 34.5%, respectively. In Perry, the observed

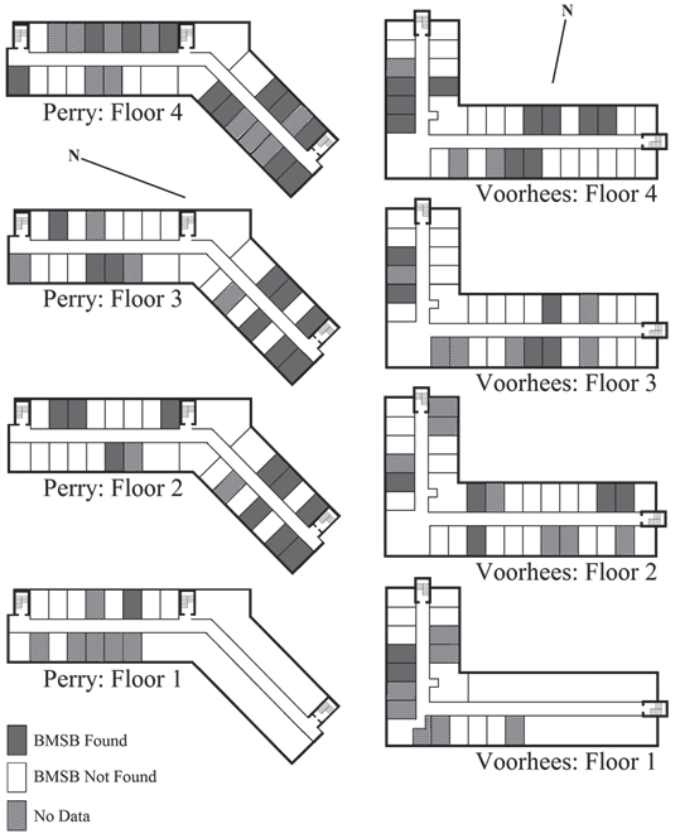


Fig. 1. Floor plans for Perry (left) and Voorhees (right). Gray and white rooms represent rooms where overwintering BMSB was and was not observed, respectively, by the occupants. Diagonally patterned rooms represent rooms where no data were collected.

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BMSB infestation rate was 11.1, 31.8, 40.9, and 68.8%, respectively, from the 1st to the 4th floor. Figure 2 shows the pooled data for both buildings on each floor. These results support the hypothesis that BMSB has a tendency to overwinter towards the tops of buildings ($P < 0.05$, df = 3). When tested for cardinal directionality in the buildings, results were insignificant for both individual residence halls ($P > 0.05$, df = 1).

As an arboreal species, this insect is found above ground level for much of its life cycle. A previous study looking at the distribution of overwintering BMSB in forests showed that individuals were much more likely to be found in dead standing trees than on the forest floor in fallen logs or leaf litter (Lee et al. 2014). This finding provides a possible behavioral explanation for BMSB's movement into urban buildings through the doors, windows, and other areas higher in the structures. Our results support the hypothesis and provide evidence that BMSB prefers to overwinter above ground level in urban structures. Control protocols to suppress overwintering populations may use these findings to specifically target areas within an infested structure that are likely to contain the most individuals. By focusing on the upper portions of buildings, treatments may eliminate the majority of BMSB without having to incur the cost of treating the entire structure.

This study examined only buildings that were 4 stories tall, and the findings may not be directly translatable to taller buildings that are beyond the height of the host tree species in which BMSB naturally overwinters. Interpretation of these findings should also take into account the fact that the non-residential portions of the buildings were not surveyed. For the data collected, some results may also be inaccurate due to misidentification of BMSB or observer error, because identification was based on comparing pictures of the insect to encounters over the past several months.

Further investigation into how BMSB distributes itself in large, taller, and less homogeneous buildings should be done to more accurately characterize the behavior patterns governing this insect's overwintering habits. This study sampled BMSB locations towards the end of its overwintering period and the findings should be interpreted as such. It is possible that these insects, upon entering a structure, will continue to move around until they either find a suitable location for diapause or die. This study provides evidence on how BMSB are distributed in multi-floor buildings in late Feb to early Mar. Future investigations should look into where this insect can be found in these types of structures during other portions of the overwintering season.

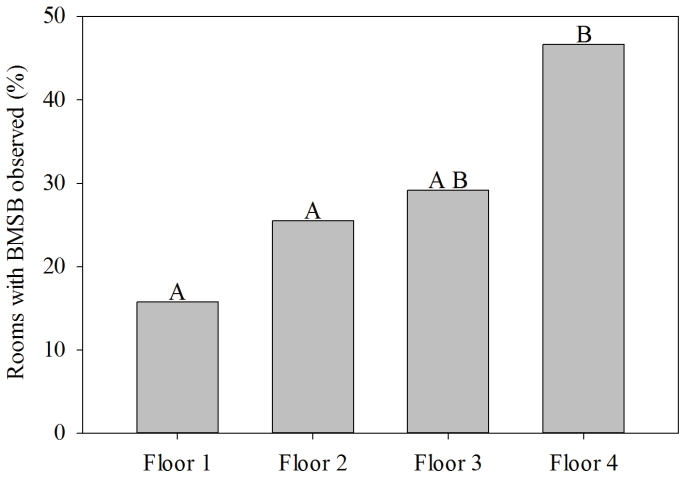


Fig. 2. Percentage of rooms where residents observed BMSB, shown by floor. Data are pooled from Perry and Voorhees residence halls. Bars with the same letter shown above are not statistically different as determined with a Kruskal–Walis test ($P > 0.05$).

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Summary

This investigation into the pattern of overwintering brown marmorated stink bugs (BMSB) used survey data collected between Dec 2013 and Mar 2014 from residents in two 4-story dormitories on the Rutgers University Cook Campus in New Brunswick, New Jersey, USA. Results suggest that a higher proportion of BMSB overwinters towards the top of urban structures than towards the ground level. This finding can be used by pest control operatives for targeted applications that will reduce the total amount of pesticides needed while still suppressing the majority of urban nuisance populations of BMSB.

Key Words: brown marmorated stink bug; dormitory; structure

Sumario

Esta investigación sobre el patrón de hibernación del chinche café marmorado (CCM) utilizó los datos recolectados en un sondeo entre diciembre del 2013 y marzo del 2014 de los residentes de dos dormitorios de 4 pisos en la Universidad de Rutgers, Cook Campus en New Brunswick, Nueva Jersey, EE.UU. Los resultados sugieren que la mayor proporción de CCM pasa el invierno en la parte superior de las estructuras urbanas que en el nivel del suelo. Este hallazgo puede ser utilizado por los trabajadores en el control de plagas para aplicaciones específicas que reduzcan la cantidad total de los plaguicidas necesarios y al mismo tiempo suprimiendo la mayoría de las poblaciones urbanas de CCM que molestan

Palabras Clave: marmorated marrón chinche; dormitorio; estructura

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