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Species composition and level of infestation of cockroaches in three areas in Hanoi

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Abstract. A study on the species composition and the level of infestation of cockroaches was carried out from April 2013 to October 2014 in three localities of Hanoi, Vietnam, namely the Lan Ong-Old Town, Linh Dam condominium and Tan Da Resort. Out of the 187 units of premises examined, 44.9% of units were infested with cockroaches. A total of 576 cockroaches were trapped, of which six species were identified: *Periplaneta americana* (L.) was the most dominant species (72.1%), followed by *Blattella germanica* (L.) (14.8%), *Pycnoscelus surinamensis* (L.) (7.3%), *Periplaneta australasiae* (Fabricius) (2.9%), *Periplaneta fuliginosa* (Serville) (1.9%) and *Supella longipalpa* (Fabricius) (1.0%). Infestation was the highest in Lan Ong (74.0%), followed by Linh Dam (40.5%) and Tan Da (25.9%). Cockroaches were abundantly found in warehouses (100%), electrical distribution room (56.3%), and kitchens (46.7%).

INTRODUCTION

Cockroaches are important insect group and are considered as urban pests (Lee, 2007). They infest dwellings, contaminate food products, damage clothes, instruments, cause bad odor and also a nuisance pest (Salehzadeh *et al.*, 2007). Cockroaches could serve as mechanical vectors for various viruses, bacteria and other parasites (Brenner, 1995) via their faeces, saliva and carcasses (Tatfeng *et al.*, 2005). In addition, there is a also close association between cockroach infestation and allergies and asthma (Dubus *et al.*, 2001). Due to its importance, cockroaches are one of the most targeted pests in the pest management industry (Lee *et al.*, 1993). In Vietnam, cockroaches were the most important pests after mosquitos and termites (Ta *et al.*, 1995). Bruijning (1993) reported two cockroach species found in the north of Vietnam, namely *Protagonista lugubris* Shelford, *Miropanesthia discoidalis* Sausure. (Ta *et al.*, 1995). Leonit *et al.* (2013) described a new cockroach genus, *Macrostylopya* with 2 species *M. grandis* Anisyutkin and *M. bidupi* Anisyutkinin southern Vietnam (Anisyutkin *et al.*, 2013). Information on cockroach distribution and diversity in the urban area is limited. Hence, there is an urgent need to carry out such survey so that the information could assist in the management of cockroaches in Vietnam. Hanoi, the capital of Vietnam – is a highly urbanized city over the past 2 decades. Hanoi has 3 major types of urban settings: (1) old part of the city at the centre of Hanoi, (2) man-made structures in the edge of the city, and (3) developing areas with new high rise building. Rapid urbanization in Hanoi in the recent years has led to the increase awareness on the importance of cockroach management. In 2013, a project sponsored by the Vietnam Ministry of Science & Technology on "Research on methods to manage pests (termites, ants, cockroaches) in the urban environment of Hanoi" was conducted. This

study consisted of initial part of the project. In this study, we determined the species composition and status of cockroach infestation in the above mentioned three localities. This was also the first survey of the pest cockroach species in the urban area of Hanoi, Vietnam.

MATERIALS AND METHODS

Locations

The study was conducted from April 2013 to October 2014 in the three localities in Hanoi, namely Lan Ong street -300 years old structures representing the Old Town; Linh Dam condominium representing the new high-rise building, and the Tan Da Resort representing the man-made ecological structure. The numbers of units surveyed were 50, 79, and 58 in Lan Ong, Linh Dam and Tan Da, respectively.

Cockroach sampling and identification

Cockroaches were trapped using glass jars (10 cm diameter x 15 cm height) baited with beer-soaked bread (Lee & Heng, 2000). The inner upper section of jars was smeared with petroleum jelly to avoid the cockroaches from escaping. The traps were placed in the locations where cockroaches were frequently sighted, eg. kitchen cabinets, under the sink, beside or under the refrigerator, inside the drawers, near the water drainage, etc. The traps were left after 2100 hour and were collected the following day. All trapped cockroaches were preserved in 70% ethanol and transferred to the Laboratory of Biodiversity at the Institute of Ecology and Works Protection for identification. The cockroaches were identified based on identification keys by Khomkam (2002), Choate *et al.* (2008), Cochran (1999) and Lee & Ng (2009).

Data analysis

The numbers of cockroaches caught in each location were compared using one-way analysis of variance (ANOVA) at P = 0.05. The analysis was carried out using SPSS Program for Windows, version 20.1.

RESULTS

Species composition of cockroach in Hanoi

Six cockroach species were found recorded in this survey *P. americana* (72.0%), *B. germanica* (14.8%), *P. surinamensis* (7.3%), *P. australasiae* (2.9%), *P. fuliginosa* (1.9%) and *S. longipalpa* (1.0%) (Table 1). *P. americana* was the most dominant species. In contrast, *S. longipalpa* was trapped with the smallest number. In terms of species diversity, Tan Da had the most number of species (n = 6), followed by Lan Ong (n = 5) and Linh Dam (n = 3).

Cockroach infestation in three areas of Hanoi

Of the 187 units surveyed, 44.9% were infested with cockroaches. The Lan Ong had the highest percentage of cockroach infestation

Table 1. Species composition of pest cockroaches in three locations in Hanoi, Vietnam

Scientific name	Number of cockroaches trapped at each studied sites (number of survey units in each location)				
	Lan Ong (50)	Linh Dam (79)	Tan Da (58)	Total	%
Periplaneta americana	122	218	75	411	72.1
Periplaneta australasiae	7	5	5	17	2.9
Periplaneta fuliginosa	3	7	3	15	1.9
Blattella germanica	63	0	22	85	14.8
Supella longipalpa	0	0	6	6	1.0
Pycnoscelus-surinamensis	8	0	34	42	7.3
Total	203	230	145	576	

(74%), followed by Linh Dam (40.5%) and Tan Da (25.9%) (Table 2). In term of the number of cockroaches trapped per house, there were no significant differences between the three studied sites (P>0.05). In all infested units, cockroaches were found in all warehouses in Lan Ong (100%), electrical distribution rooms (56.3%), ground floor (35.7%) in Linh Dam condominium and restaurant (46.7%) in Tan Da resort (Table 3).

The percentage of units infested by single species or mixed species was showed in the Table 4. The maximum number of mixed species was 3. Of the 84 units examined, 78.6%, 15.5% and 5.9% units were infested by single cockroach species, two species and three species, respectively. *P. americana* was the only species found in premises with single species infestation with an average of 66.7% of the units surveyed. For the mixture of two species, the combination of *P. americana* and *P. australasiae* was found higher than the remaining species with an average of 11.9% of the units. The presence of 3 species was only recorded in Lan Ong and Tan Da, with low number of units (3.6% and 2.4% of units, respectively).

DISCUSSION

Cockroach infestation in households have been reported in the urban areas in Southeast Asian countries such as Malaysia, Singapore, Thailand (Yap *et al.*, 1991; Lee *et al.*, 1993; Yap, 1997; Lee & Ng, 2009, Sriwichai *et al.*,

Table 2. The status of cockroach infestation in three areas of Hanoi

Location	No. of surveyed units	No. of positive units	%
Lan Ong	50	37	74.0
Linh Dam	79	32	40.5
Tan Da	58	15	25.9
Total	187	84	44.9

Table 3. Type of premises examined in the three localities of Hanoi

Studied area	Type of examined	No. examined units	Infested examined units (%)	Species recorded
Lan Ong	herbal medicine shop	42	29 (69.0%)	*P. americana* *P. australasiae* *P. fuliginosa* *B. germanica* *P. surinamensis*
	warehouse of herbal medicine shop	8	8 (100%)	*P. americana*
Linhdam	flat in condominium	49	18 (36.7%)	*P. americana* *P. australasiae*
	electrical room in all floor	16	9 (56.3%)	*P. americana*
	Ground floor, parking place	14	5 (35.7%)	*P. americana* *P. fuliginosa*
Tanda Resort	living room or rest room	43	8 (18.6%)	*P. americana* *S. longipalpa* *P. australasiae*
	Restaurant, kitchen, bar, warehouse	15	7 (46.7%)	*P. americana* *P. australasiae* *P. fuliginosa* *B. germanica* *S. longipalpa* *P. surinamensis*

Table 4. Percentage of unit infested by single species or mixed species of cockroaches

Sampling sites	No. of infested units	Percentage of units infested by single species or mixed species (%)									
		1 species					2 species			3 species	
		Pa	*Bg*	*Ps*	*Pau*	*Pf*	*Pa* + *Pau*	*Pau* + *Pf*	*Pau* + *Ps*	*Pa* + *Ps* + *Bg*	*Pa* + *Bg* + *Sl*
LO	37	70.3	2.7	0	2.7	2.7	8.1	0	5.4	8.1	0
LD	32	75	0	0	0	6.3	15.6	3.13	0	0	0
TD	15	40	6.7	20	0	6.7	13.3	0	0	0	13.3
Total	84	66.7	2.4	3.6	1.2	4.8	11.9	1.2	2.4	3.6	2.4

Note: Pa: P. americana; Pf: P. fuliginosa; Bg: B. germanica; Sl: S. longipalpa; Ps: P. surinamensis; Pau: P. australasiae; LO: Lan Ong; LD: Linh Dam; TD: Tan Da

2001). The dwelling types, food source and environment conditions are important factors that affected the cockroach population and distribution (Lee, 2007). The typical house structure of Hanoi Old Town is a cognitive unit, small, narrow, shady and very humid (average humidity: 80–85%). The old underground water pipe-line system which connected to all houses in this area likely enabled the cockroaches to spread easily (Schoof & Siverly, 1954). In the surveyed area of Hanoi Old Town, 95% of these units were traditional herbal medicine shops. Their shops contained a variety of plants and fruits with low level of sanitation. These provided conducive conditions to serve as cockroach habitat. Hence, it has the highest level of infestation with 5 cockroach species. Linh Dam condominium had the second highest level of cockroach infestation, but the lowest in term of species number. The emergence of new high-rise condominiums in order to meet the demand for living space leads to some issues, including the incidence of urban pest infestation (Rust & Su, 2012). In this condominium, the rubbish chute system provided suitable harborages for cockroach infestation. The lowest level of cockroach infestation was in Tan Da resort, despite having the highest number of species. This place had a higher level of sanitation than the other locations surveyed. In addition, cockroach bait and residual spray also were used in this location on the frequency of 3 times a year. A study had shown that there was no significant difference between the level of cockroach infestation and sanitation, however with better sanitation, bait performance will be increased (Lee & Lee, 2000). The high species number was likely due to the presence of plants and trees surrounding the premises in this location. One of the species found, *P. surinamensis* is a plant feeder and normally found under stones, and burrow in the soil and loose litter (Lee & Ng, 2009). Sometimes, while foraging, they will enter indoors to look for food.

Cockroaches distribute widely in both tropical and subtropical region due to their ability to adapt to a wide range of temperatures and humidity (Appel, 1995). The subtropical climate and the location of northern Vietnam could be contributing factors that increase the biodiversity of flora and fauna due to the transition zone between South East Asia and China (Ta *et al.*, 1995). Of the 6 recorded species in this study, 5 were common species in South East Asia, while the other (smoky brown cockroach) was reported in China, USA, Japan, etc. (Hu *et al.*, 1994; Fleet *et al.*, 1978; Appel & Rust, 1985; Takahashi *et al.*, 1995). Compared to other urban areas, the similarity of species composition of Hanoi with Bangkok, Singapore, Guangxi province were 5 species, 4 species and 4 species, respectively (Sriwichai *et al.*, 2002; Lee & Ng, 2009).

Similar to other studies of pest cockroach species in South East Asia countries (Lee, 2007; Chompoosri *et al.*, 2004). *P. americana* was the most dominant species in both three studied locations *P. americana* is an indoor and outdoor species which usually inhabits inside sewer tanks, drain systems, under

warm and moist environment (Lee, 2007). The ability to survive in the condition of limited food and water is their success factor to survive in tropical environment (Tee & Lee, 2014). On the other hand, *B. germanica* was the second most abundant species in this study. This species was reported as common pest cockroach in hotels and restaurants in Malaysia and in China (Lee & Heng, 2000; Songwu, 2000), however, there have been an increasing number of report of *B. germanica* infestation in residential premises over the past 15 years (Lee, 2007). They are commonly found in areas where food, water and harborages are abundant with warm and humid environment (Lee, 1996). In contrast to German cockroach, *S. longipalpa* is not restricted to warm and humid environment. They were found in the dry areas of the house, particularly in bedrooms, drawers, furniture, television, etc. (Hamilton *et al.*, 1990). In this study, this species was trapped in the indoor environment of Tan Da resort. *P. australasiae* and *P. surinamensis* were trapped at low numbers in this study. They are reported to be an outdoor species that prefers vegetation (Lee, 1993; Cochran, 1999). *P. fuliginosa*, the smoky brown cockroach was found in the all three areas of Hanoi. This species that distributes widely in temperate zone (Appel & Rust, 1985), is not found in tropical Southeast Asia (Lee, 2007; Lee & Ng, 2009). This species had been recorded in Guangxi (Hu *et al.*, 1994) that has relatively similar climate as that of Hanoi. The occurrence of this species in Hanoi is possibly due to the close proximity to southern China.

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