

SURVEY OF INDOOR COCKROACHES IN SOME DWELLINGS IN BANGKOK

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Abstract. This study aimed to investigate the species distribution of indoor cockroaches in dwellings in Bangkok. Commercial sticky traps were used to catch cockroaches in 128 private residences (40 single houses, 49 townhouses, 39 apartments), 34 offices, and 30 small groceries. The cockroaches were identified as *Periplaneta americana*, *Supella longipalpa*, *Blattella germanica*, *Neostylopyga rhombifolia*, *P. brunnea*, *P. australasiae*, *Pycnoscelus surinamensis*, and *B. lituricallis*; two were unidentified species. The most common species were *P. americana*, *S. longipalpa* and *B. germanica* - most of which were nymphal stages. *P. americana* and *S. longipalpa* infested all kinds of buildings, especially private residences (50.0% and 17.2%, respectively) and offices (61.8% and 58.8%, respectively); they were also found mostly (15.1%) in mixed infestation and with no predominant species. *B. germanica* (26.7%) were significantly predominant in groceries. Air conditioners have no influence on cockroach distribution.

INTRODUCTION

Problems associated with domiciliary cockroaches in urban environments are well documented (Roth and Willis, 1957; 1960); cockroaches are a basic source of contagious exposure and allergy (Sastre *et al*, 1996; Baumholthz *et al*, 1997; Rosenstreich *et al*, 1997). In recent years, there has been a rising prevalence of asthma and allergic diseases (Ninan and Russell, 1992; Peat *et al*, 1994). This increasing prevalence has also been noted in Taiwan and Thailand (Hsieh and Shen, 1988; Bunyarittipong *et al*, 1990; Vichayanond *et al*, 1998). Asthma, allergic rhinitis and eczema in urban areas of Thailand are common among Thai children (Vichayanond *et al*, 1998). More than 40% of asthmatic children were sensitized by cockroach allergens as shown by skin pick testing (Kongpanichkul *et al*, 1997). These allergens are also the sensitizing agents in the induction of rhinitis and nasal polyp among Thai patients (Denariyagulom and Manochanone, 1998; Pumhirun *et al*, 1997; 1999).

Cockroach infestations in households have been reported in both rural and urban communities of Malaysia (Lee and Yap, 1993; Vithilingam *et al*, 1997). In Thailand, Navy ships were infested with *Periplaneta americana*, *Blattella germanica*, *Blatta orientalis* and *Parcoblatta pennsylvanica* (Chaloryu *et al*, 1960).

Asahina and Hasegawa (1981) found 9 cockroach species in a survey of houses and small restaurants of 5 villages in Chanthaburi, *P. americana*, *P. australasiae*, *P. brunnea*, *N. rhombifolia*, *Hebardina concinna*, *B. germanica*, *B. lituricollis*, *P. surinamensis*, *Nauphoeta cinerea*. Domiciliary cockroaches: *S. longipalpa*, *B. germanica*, *Neostylopyga rhombifolia*, *P. americana*, *P. brunnea*, *Pycnoscelus indicus*, *B. lituricallis*, *P. australasiae* and *N. cinerea* were found in houses, libraries, museum, groceries, and rice-mill in 5 northeast provinces of Thailand (Jungwiwattanaporn, 1984). Regarding cockroach infestations in Bangkok, *P. americana*, *P. brunnea*, *B. germanica*, *N. cinerea*, *N. rhombifolia* have been found only in the food areas of some hospitals (Benjapong *et al*, 1997) and *S. longipalpa* in residences (Asahina, 1988). However, the infestation of predominant species of indoor cockroaches in various types of residences should be studied. This study aimed to investigate the current distribution of various indoor cockroach species in some dwellings in Bangkok, Thailand.

MATERIALS AND METHODS

Study sites

Cockroach distributions were studied from September 2000 to May 2001 by the random selection of 40 single houses in 22 districts, 49 townhouses in 14 districts, 39 apartments in 9 districts, 34 office units in 5 districts, and 30 small groceries in 5 districts (of the total 26 districts) in Bangkok.

Dwelling types

Five types of dwellings were included in the survey: 1) 2-storey single houses with a living room,

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bedrooms, and a kitchen; 2) townhouses in 1 to 4-storey buildings with contiguous housing units and each unit consisting of a living room, bedrooms and a kitchen; 3) apartments that consisted of various units located in 1- to 12-storey buildings with a single room in each unit; 4) office units located in 1- to 11-storey buildings; they were composed of 3 separate rooms using for working, dining and working room / dining rooms; 5) small grocery stores that were randomly selected: all these groceries were located on the ground floor of the building.

Cockroach trapping

Cockroaches were caught by commercial sticky traps (TRAP-A-ROACH HOY HOY[®], ARS Chemical Thailand). A cardboard trap (10.0 × 20.5 cm) has one side covered with an adhesive substance and a bait placing in the center of the cardboard. The sticky traps were placed on the floor close to the wall of a room and left there for three days. One trap each was placed in a living room, a bedroom, a kitchen of single houses and townhouses, in each unit of apartments, in small groceries and each room of the office units (a working room, a dining room and a working room with dining room). All traps were collected and transported directly to the laboratory of the Department of Parasitology, Faculty of Medical Technology, Mahidol University, Bangkok and stored at 4°C until identification by the methods described by Cornwell (1968), Asahina (1988) and Harz and Kaltenbach (1976).

Statistical analysis

Data were entered into worksheets of the Epi Info package Version 6.04b. The chi-square test or Fisher's exact test were used to analyze the incidences of cockroach species in different types of dwellings. The relationship between air conditioner use and cockroach positivity was analyzed by chi-square test. The correlation of mixed infestation of *P. americana* and *S. longipalpa* was analyzed by linear regression.

RESULTS

Cockroaches were collected from 49 bedrooms (range = 9-121 m², mean = 37 m²), 43 living rooms (range = 9-81 m², mean = 37 m²) and 47 kitchens (range = 6-28 m², mean = 16 m²) in 40 single houses; from 54 bedrooms (range = 12-32 m², mean = 16.7 m²), 50 living rooms and kitchens (range = 12-64 m², mean = 23.15 m², and range = 9-16 m², mean = 9.39 m², respectively) of 49 townhouses. The 39 apartment units and 30 small groceries had an area range of 12-50 m², mean = 24.44 m² and a range of 18-60 m², mean = 44.6 m², respectively. For the study of offices, 34 units from 5 office buildings were selected: 14 working rooms had an area range of 6-28 m², mean = 26.17 m²;

8 dining rooms had an area range of 6-28 m², mean = 27.75 m², and 12 working rooms with dining rooms had an area range of 6-28 m², mean = 18.25 m².

The cockroach species that infested the dwellings (Table 1) were *P. americana*, *S. longipalpa*, *B. germanica*, *N. rhombifolia*, *P. brunnea*, *P. australasiae*, *P. surinamensis* and *B. lituricallis*. The major cockroach species were *P. americana*, *S. longipalpa* and *B. germanica*; all stages were found with the nymph as the predominant stage. *P. americana* and *S. longipalpa* were found in all types of 128 dwellings: with 50.0% (64/128) and 17.2% (22/128), respectively, in private dwellings 61.8% and 58.8% in offices and 56.7% (17/30) and 20% (6/30) in groceries. *B. germanica* (26.7%) infested more groceries than private dwellings (8.2%). Other minor cockroach species collected were *P. brunnea* (5-10%), *N. rhombifolia* (2.5-3.3%), *P. australasiae* (2-10%); only one female *P. surinamensis* (2.0%) and *B. lituricallis* (3.3%) were found. The infestations of American cockroaches (*P. americana*) did not differ significantly among all types of dwelling (X^2 ; $p > 0.05$). Infestation by *S. longipalpa* was significantly different among the 5 kinds of dwellings (X^2 ; $p < 0.001$). Interestingly, office units were significantly more infested by *S. longipalpa* than private residences (Fisher's exact tests; all $p < 0.02$). Small groceries infested by German cockroaches were also significantly different from infestations in other types of dwellings (Fisher's exact test; $p < 0.05$).

The numbers of cockroach species that infested different types of dwelling, offices and groceries are presented in Table 2. Seventy-seven out of 128 dwellings (61.1%) were infested by a single cockroach species, while 49 dwellings (38.9%) were infested by 2-3 species of cockroaches. Of single species infestation, townhouses (20/56) were infested most by American cockroaches followed by apartments (12/56). Mixed infestations of *P. americana* and *S. longipalpa* were mostly found (29 of 192; 15.1%) in all dwellings, with no statistical correlation between the numbers of species of mixed infestation ($r^2 = 0.00$; $p > 0.05$). Sixteen offices were infested by *P. americana* and *S. longipalpa*, while 5 small groceries had mixed infestations of these two species. Only one townhouse was infested with 3 species: *P. americana*, *S. longipalpa* and *B. germanica*. Mixed infestations of *P. americana* and *P. australasiae*, *P. brunnea*, *B. lituricallis*, *P. surinamensis* could be found in only a few cases.

For the correlation between bedrooms with and without air conditioners (25 vs 68) and cockroach distribution, there was no significant difference in infestation by *P. americana* (X^2 ; $p > 0.05$) and by *S.*

longipalpa (Fisher's exact test; $p>0.05$). Thirty-three and 54 living rooms with and without air conditioners, respectively, were not significantly different for the positivity of *P. americana* (Fisher's exact test; $p>0.05$).

DISCUSSION

In the present study, *P. americana* was the commonest species; this finding agreed with previous studies (Benjapong *et al*, 1997; Lee and Yap, 1993; Vithilingam *et al*, 1997). Generally, the infestation of *P. americana* can be both indoor and outdoor. *P. americana* adapts itself to urban dwellings that have sewage pipe-lines. These pipe-lines, connected to a building, are suitable for this species growth, reproduction and distribution (Schoof and Siverly, 1954).

This study is the first survey of cockroaches in various dwelling types in Bangkok that revealed that the brown banded cockroach (*S. longipalpa*) is the second most prevalent species, especially in offices. Previous studies reported that low numbers of *S. longipalpa* infested dwellings in Bangkok, in northeastern provinces of Thailand and some urban areas of Malaysia (Asahina, 1988; Lee and Yap, 1993; Jungwiwattanaporn, 1984). Brown banded cockroaches can infest areas where food is plentiful or areas with limited food and moisture, such as offices (Robinson, 1996).

The German cockroach is the dominant species infesting multiple-unit dwellings in Europe and America (Robinson and Zungoli, 1985; Tomas and Robinsao, 1986). It has also been reported in Southeast Asia (Benjapong *et al*, 1997; Lee and Yap, 1993; Chaloryu *et al*, 1960). This species was generally found in areas with food, which agreed with this study, since it was commonly found in small groceries. It is possible that indoor places are suitable for its habitat, which is a factor for its survival even in different local climates. The German cockroach could infest townhouses, as shown in this study. This may be by its movement between adjacent units through plumbing facilities (Runstrom and Bennett, 1984; Owens and Bennett, 1982).

Mixed infestations of *P. americana* and *S. longipalpa* showed no predominant species. It is possible that both species can cause health problems for those living in these dwellings. Although indoor places support cockroach distributions, this study showed that air conditioning had no effect on the most common indoor cockroach. Cockroaches are able to adapt themselves to a wide range of temperatures and humidities (Gould, 1941). A room with an air conditioner is a closed area that allows a long exposure to indoor cockroach allergens, because most urban people spend most of their time in their dwellings.

S. longipalpa, the most prevalent species, should be further studied as it is another important species in

Table 1
Numbers and percentage of dwellings infested by cockroach species.

Cockroach species	Dwelling type (Total number =182)					
	Private residence			Total N = 128 (%)	Offices V = 34 (%)	Groceries N = 30 (%)
Single houses N - 40 (%)	Townhouses N = 49 (%)	Apartments N = 39 (%)				
<i>P. americana</i>	17 (42.5)	31 (63.3)	16 (41.0)	64 (50)	21 (61.8)	17 (56.7)
<i>S. longipalpa</i>	6 (15)	5 (10.2)	11 (28.2)	22 (17.2)	20 ^a (58.8)	6 (20)
<i>B. germanica</i>	0	4 (8.2)	0	4 (3.1)	0	8 ^b (26.7)
<i>P. brunnea</i>	2 (5)	5 (10.2)	0	7 (5.4)	0	2 (6.7)
<i>N. rhombifolia</i>	1 (2.5)	0	0	1 (0.8)	0	1 (3.3)
<i>P. australasiae</i>	4 (10)	1 (2.0)	1 (2.6)	6 (4.7)	0	0
<i>P. surinamensis</i>	0	1 (2.0)	0	1 (0.8)	0	0
<i>B. lituricallis</i>	0	0	0	0 (0)	0	1 (3.3)

^a Significant differences between offices infested by *S. longipalpa* and other dwelling types (Fisher's exact tests; all $p<0.02$);

^b Significant difference between groceries infested by *B. germanica* and townhouses (Fisher's exact test; $p<0.05$).

Table 2
Numbers of dwelling infested by single species or mixed species of cockroaches.

Dwelling types	Types of cockroach infestation											
	1 species				2 species					3 species		
	Pa	Sl	Bg	Ps	Pa+Sl	Pa+Bg	Sl+Bg	Pa+Pb	Pa+Pau	O	Pa+Sl+ Bg	O
Single houses	11	3	0	0	1	1	0	0	1	Pb +Pau	0	<u>Pa+Sl+Pau,</u> <u>Pa+Sl+Pb,</u>
Townhouses	20	2	0	1	1	2	0	4	1	0	1	<u>Pa+Sl+Ps,</u> <u>Pa+Bg+Pb</u>
Apartments	12	7	0	0	3	0	0	1	0	0	0	0
Offices	5	4	0	0	16	0	0	0	0	0	0	0
Groceries	8	2	2	0	2	5	1	0	0	<u>Pa+NI,</u> <u>Pa+Bl</u> <u>Pa+Ps</u>	0	<u>Pa+Sl+Pb,</u> <u>Pa+Nr+Pb</u>

Note: Pa = *P. americana*, Nr = *N. rhombifolia*, Sl = *S. longipalpa*, Ps = *P. surinamensis*, Bg = *B. germanica*, Bl = *B. lituricallis*, Pau = *P. australasiae*, O = other patterns of mixed cockroach infestations, O = 1 case of mixed cockroach infestation.

Bangkok dwellings, and the determination of their biological properties, especially its allergen, should be undertaken. *S. longipalpa* has been reported to cross-react with *B. germanica* allergen (Pollart *et al*, 1991). More recognition of the important cockroaches in each type of dwelling should be made in order to protect allergen sensitive patients against exposure to cockroaches.

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