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STUDIES ON THE POPULATION ECOLOGY OF FIVE SPECIES OF DOMESTIC COCKROACHES

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Abstract: Regular survey for one year was conducted to find out the pattern of infestation of cockroaches in different habitats of Dabhaura, Rewa M.P. The survey revealed that *B. germanica* was the most abundant species in vegetable and fruit shops and also in mud huts (kachcha houses). Almost similar pattern of distribution was observed in pakka houses/flats, except that *Blatta orientalis* was the second most abundant species, while *periplanata americana* ranked second in the mud huts. In hotels, *P. americana* figured at the top while in shops *Blatta* was the most frequently occurring species

In kachcha houses, all the infested kitchens were having incidences of *S. supellectilium* and *Neostylopyga*. Almost all the infested toilets were having *P. americana* while 50% of the toilets were found having *B. orientalis*, similarly only these two species were observed in the bathrooms and drainages. *P. americana* and *P. orientalis* were found in less than 5% kitchens. In stores, *B. germanica* and *Neostylopyga* were found in nearly in 60% of the infested properties.

Supella and *Neostylopyga* were recorded from more than 90% of the infested kitchens of the pakka houses/flats, while only less than 10% of the kitchens showed the infestations of *P. americana* and *Blatta orientalis*. Stores proved to be most suitable for *Blatella* as more than 70% of them were found infested with this species.

The variations in the abundance of cockroaches in these five habitats can be attributed to the prevailing microclimatic conditions, variability of food available to cockroaches and also to the physical features of these habitats.

Key Words: Ecology, Microclimatic condition, Infestation, Predators-, Parasite-, Habitat

I. INTRODUCTION

Mobile animals arrange themselves in space by preferentially occupying particular parts of the environment. The pattern of distribution for a species is influenced by such factors as the number of competing species encounter in a given area, the population densities of those areas, availability of resources (food, water, shelter etc.) and the number of predators, both absolute and relative. Insect populations may also have specific temperature and humidity requirements for optimal growth rates (Edney et.al.1978). In other words this can be expressed that individuals occur in several different proportions as a function of habitat and patch type i.e. resource availability.

Accurate statistics on the incidence of pest insects are difficult to obtain and hence remained a neglected area till recently. Only since last two decades we have begun to recognize the value of factual data on pest abundance, especially of "common" agricultural and household pests, when the control of insects is being considered by management of the environment as opposed to the use of chemicals (Garton 1979).

Only a few workers have made attempts to study the pattern of distribution of cockroaches in living areas and also in wild. (Wright 1965, a, b, Ragge 1965, Gorton 1979). Considering the widespread importance of cockroaches as rural, urban and industrial pest, this is very unfortunate. The data of the pattern of infestation could have provided insight to the "biological", "physical" and "environmental" requirements of various roach species. Key factors that regulate insect population include food, water, harbourage, temperature, predators / parasites and competition (Clark e.t. al.1967).

In cockroach infested structures, the level of general sanitation represents a manipulation of some level of three key factors, i.e. food, water, and harbourage availability. The other factors though important are secondary.



II. MATERIALS AND METHODS

A preliminary questionnaire based survey was conducted and five habitats were recognized which differed both in physical features and also in magnitude of the infestations. These five habitats were:

- 1) Vegetable and fruit shops
- 2) Mud (Kachcha) houses
- 3) Pakka houses/flats
- 4) Hotels
- 5) Other shops

The sampling technique was focus and count. The observations were recorded in the late hours of night from July 2013 to June 2014. Censusing was done along the same route and time devoted for sampling on each occasion was

also constant. Each cockroach observed at the site was identified to species without killing the insect. Substrate, habitat and the number of individuals were recorded for each sampling effort.

III. OBSERVATIONS

1. **Microclimatic data:** Table 1.1 presents the data on temperature and relative humidity. Month-wise variations in these parameters have been recorded for a period of one year in the five habitats. From the table it can be seen that the temperature data clearly shows significant seasonal variations. With onset of rain in late June, a gradual drop in temperature in July and August months had been observed.

Table 1.1 Microclimatic data of five habitats at Dabhaura, Rewa, M. P.

<i>Mont h</i>	<i>Vegatable & Fruit shop</i>			<i>Mud huts</i>			<i>Pakka houses & flats</i>			<i>Hotels</i>			<i>Shops</i>		
	<i>Tem p. °C Max.</i>	<i>Tem p. °C Min</i>	<i>R H %</i>	<i>Te mp. °C Ma x.</i>	<i>Tem p. °C Min.</i>	<i>R H %</i>	<i>Tem p. °C Ma x.</i>	<i>Tem p. °C Min</i>	<i>R H %</i>	<i>Temp . °C Max.</i>	<i>Temp . °C Min.</i>	<i>R H %</i>	<i>Tem p. °C Ma x.</i>	<i>Temp . °C Min.</i>	<i>R H %</i>
<i>Jul. 2013</i>	31.5	25.8	88	32. 3	27.4	82	31.8	26.6	80	35.4	28.1	82	32.5	26.8	77
<i>Aug.</i>	30.7	24.6	92	31. 6	27.0	81	31.9	25.7	80	32.1	27.0	85	32.0	26.0	81
<i>Sept.</i>	30.3	23.6	94	30. 7	25.8	80	30.1	25.7	78	32.3	26.4	83	31.4	26.2	80
<i>Octo.</i>	29.2	20.6	93	30. 4	20.4	73	30.2	23.4	72	33.8	26.9	88	31.2	25.4	85
<i>Nove.</i>	24.4	15.8	90	26. 8	10.2	65	24.5	14.6	65	34.0	26.4	92	28.6	20.4	83
<i>Dece.</i>	23.0	11.4	91	23. 6	7.1	64	23.8	9.5	62	30.1	15.8	91	26.4	14.2	88
<i>Jan. 2014</i>	22.4	8.4	73	22. 2	6.2	68	22.8	8.4	65	24.5	15.0	91	24.6	14.2	92
<i>Feb.</i>	23.4	9.1	65	24. 9	9.6	60	23.8	8.6	60	27.4	14.8	87	25.5	11.5	74



Marc h	27.4	10.6	63	32. 0	12.9	50	32.0	11.4	50	33.5	15.8	66	33.0	13.2	65
Apr.	32.5	21.0	46	35. 4	21.2	46	35.6	22.3	48	38.7	24.6	60	35.1	22.3	63
May	38.7	26.6	35	40. 2	27.3	30	39.5	27.4	35	41.3	30.2	58	40.5	27.6	46
June	38.0	29.6	45	39. 5	30.0	40	38.7	31.6	42	42.0	29.9	58	39.8	32.5	31

Hotels and shops had the higher mean, maximum and minimum temperature as compared to other habitats. In the month of June, hotels recorded a maximum temperature of 42.0⁰ C while in shops highest mean maximum temperature 40.5⁰ C was recorded in the month of May.

In the vegetable shops the temperature recorded were the lowest as compared to mud huts and pakka houses/flats.

The data on the average monthly variations in the relative humidity have shown that vegetable and fruit shops had more humidity while the lowest humidity was found in shops. The second most humid environment was provided by hotels.

1. Cockroach Infestation:

Survey Sites: Table 1.2 represents the observations on the types localities surveyed and also the data on the type of infestations observed.

Table 1.2 Cockroach Survey: Infested properties

Types of Property		Number surveyed	% infested by only one species	% infested by two species	%infested by more than two species
(A)	Vegetable and fruit shops	10	30.0	40.0	30.0
(B)	Mud (Kachcha) houses	100	20.0	20.0	50.0
(C)	Pakka houses and flats	50	22.0	56.0	14.0
(D)	Hotels	15	66.7	26.7	6.6
(E)	Shops	20	10.0	30.0	60.0

Out of the ten vegetable and fruit shops surveyed, 30% shops were found infested with only one cockroach species while 40% were infested with two cockroach species. The rest of the shops were infested with more than two species. In all 100 mud huts (kachcha houses) were surveyed, of which nearly 50% were found infested with more than two species while 20% were infested with one species only. Of the remaining 30% one third did not have any infestation, while 20% of the huts were having infestation of two roach species. A major

portion of the hotels (66.7%) was found infested with only one cockroach species i.e. *Periplaneta americana*. While only 6.6 % of the hotels were having more than two cockroach species. Rests of the hotels were infested by two species. Of the 20% shops surveyed, 60% were having infestation of more than two species, while only 10% shops were having only one roach species. Two species of cockroaches were recorded from the rest of shops.



Table 1.3 Monthly Variations in the cockroach numbers amongst the five habitats

Mont h	Cockroach species																								
	Periplaneta americana					Blattella germanica					Supella supellectilium					Neostylopyga sp.					Blatta orientalis				
	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E
Jul. 2013	18	22	18	26	1 2	30	2	2	2	2	2	1	1	1	1	5	1	3	5	1	1	24	2	1	2
Aug.	25	24	22	22	1 8	13	5	2	2	2	3	2	1	1	6	2	3	5	4	5	1	28	2	1	2
Sept.	30	29	21	28	1 6	12	4	3	2	2	2	2	1	1	8	1	1	9	6	3	1	27	2	1	2
Oct.	36	19	27	18	1 2	93	2	3	2	2	2	2	1	1	9	1	1	1	1	7	2	20	1	1	2
Nov.	13	19	22	15	1 0	38	2	2	2	1	1	1	1	1	8	1	8	7	8	5	1	20	1	9	2
Dec.	9	14	21	16	1 6	27	2	1	1	1	1	1	1	1	6	1	3	3	1	2	1	17	2	1	2
Jan. 2014	8	16	17	18	1 0	20	1	1	2	1	2	1	1	1	4	5	5	1	1	3	1	18	2	1	2
Feb.	6	12	8	18	8	12	1	9	1	8	1	7	8	1	8	3	5	5	9	1	9	13	7	1	1
Mar.	11	13	24	24	1 2	23	2	1	2	1	3	6	1	9	8	3	3	9	7	3	1	15	1	1	2
Apr.	10	28	22	28	1 4	42	3	2	2	1	3	1	1	1	6	6	1	7	9	5	1	14	2	1	2
May.	30	31	22	29	1 1	56	3	2	2	9	3	2	1	1	7	1	1	8	6	4	1	30	2	1	2
Jun.	20	39	23	31	1 2	46	4	2	2	1	3	2	1	1	8	1	1	9	8	1	1	21	2	1	2

A. Vegetable and fruit shops, **B.** Mud (kachcha) houses, **C.** Pakka houses, **D.** Hotels and **E.** Shops

The five locations (habitats) selected for the present study were surveyed for the cockroach censusing and the month wise variations were recorded for a period of one year starting from July 2013 to June 2014. The five species which occur more regularly in this area are *Periplaneta americana*, *Blattella germanica*, *Supella supellectilium*, *Neostylopyga*, and *Blatta orientalis*.

In vegetable and fruit shops all the five cockroach species are observed. They occur singly, or in groups but *Blattella germanica* is found to be the most dominant one numerically,

followed by *Spella supellectilium*, *Blatta Orientalis*, *Periplaneta Americana* and *Neostylopyga*. As many as 305 *Blattella* individuals have been found in the month of July from vegetable shops in one sampling effort, while in winter, their number went down to 12 in the month of February.

In the mud house, *Blattella* again is the most dominant species. Their number varied from 14 in the month of February to 51 in August. As regards the distribution of *Periplaneta*, the number varied from 12 in February to 29 in September. *Blatta orientalis* has been the next most frequently occurring



roach species, their number ranging from 11 in the month of February to 30 in May month. *Supella* and *Neostylopyga* followed in this order with numbers ranging from 7 to 26 and 2 to 15 respectively for these two species.

In pakka houses/ flats, *Blattella* is the most frequently occurring genera followed by *Blatta*. Their number varied from 9 to 35 in the case of *Blattella* and 7 to 28 in the case of

Blatta. Numerically *Periplaneta* closely followed *Blatta orientalis* (8 to 27), except that the peak *Periplaneta* population has been observed in the month of October 2013 while the peak *Blatta* population was noticed in the month of June. The population of *Supella* (8 to 19) and *Neostylopyga* (1 to 11) varied amongst the months, the peak populations being observed in rainy months (July to October).

The most abundant roach species observed in hotels is *Periplaneta*, whose number ranged from 15 in November to 31 in June. This is closely followed by *Blattella germanica* (18 in December to 25 in June), *Blatta orientalis* (9 in November to 18 in June), *Supella supellectilium* (9 in March to 18 in November) and *Neostylopyga* (4 in August to 13 in January) in this order.

In the shops the most frequently occurring species is *Blatta orientalis*. The number of this species varies from 18 in the month of February to 28 in August month. This is followed by *Blattella germanica* whose number ranged from a minimum of 8 in February to 23 in September. The population of *Periplaneta* individuals sampled per effort ranged from a minimum of 8 in February to 18 in the month of August. The remaining two cockroach species occur in less number in shops. *Supella supellectilium* number fluctuated from a minimum of 4 in February to 10 in July, while the number of *Neostylopyga* varied from a minimum of 1 per sampling effort in the month of February to 7 in October.

These observations have revealed that;

- 1) In vegetable and fruit shops *Blattella* is the most abundant followed by *Supella*, *Periplaneta*, *Blatta* and *Neostylopyga* in this order.
- 2) In mud huts (kachcha houses), the pattern of distribution was slightly different. Though *Blattella* figured as the most frequently occurring species, it

is followed by *Periplaneta*, *Blatta*, *Supella* and *Neostylopyga* in the descending order of their numerical abundance.

- 3) Almost similar pattern of distribution is observed in pakka houses / flats except that *Blatta* was the second most abundant species as against *Periplaneta* which ranked second in the mud huts.
- 4) In hotels *Periplaneta* figured at the top followed by *Blattella*, *Supella*, *Blatta* and *Neostylopyga* in this order.
- 5) In shops the pattern of distribution was quite different. Here *Blatta* was the most abundantly occurring species followed by *Blattella*. Here also *Neostylopyga* figured at the bottom of the list.

Locations of infestations within building:

The environmental requirements for cockroach abundance, reproduction, and survival are warmth, food and water. In the present survey, attempts have been made to find out the nature of infestations within the living area. In each house – kitchen, toilet, bathrooms, drawing room, bed rooms, store and drainages had been examined separately.

In kachcha houses, all the infested kitchens were found having incidences of *Supella supellectilium* and *Neostylopyga*, while the second most dominant species was *Blattella germanica*, *Periplaneta* and *Blatta* were found in less than 5% of the kitchens. All the infested toilets were found having incidences of *Periplaneta Americana*, while only about 50% of the toilets were found having *Blatta orientalis*. No individuals of the other three species were found in the toilets. Similarly only these two species occurred in bath rooms and drainages of the infested houses. In stores *Blattella germanica* and *Neostylopyga* were found in nearly 60% of the cases. The rarely seen species in the stores were *Periplaneta* and *Blatta*. Very few individuals of *Periplaneta* and *Blattella* were found in the bed rooms. Except for *Blatta orientalis* all the species were found infesting drawing rooms, common rooms. The magnitude of infestation differed significantly. Of the infested drawing rooms 42.8% were found infested with *Neostylopyga* while only 1.4% of the rooms showed infestation of *Periplaneta* (Table 1.4).



The number of occasions Cockroaches were reported in each location is expressed as a percentage of the number of premises containing the species.

Table 1.4 The incidence of Cockroaches in different parts of infested houses

<i>Locations within mud (kachcha) houses</i>								
	<i>Cockroach species</i>	<i>Kitchen</i>	<i>Toilets</i>	<i>Bathrooms</i>	<i>Drawing common rooms</i>	<i>Bed room</i>	<i>Store</i>	<i>Drainage</i>
1	<i>Periplaneta Americana</i>	4.3	100.0	71.4	1.4	0.7	10.0	100.0
2	<i>Blattella germanica</i>	81.25	Nil	Nil	27.5	7.5	60.00	Nil
3	<i>Blatta orientalis</i>	3.03	53.03	83.33	Nil	Nil	15.15	70.00
4	<i>Supella supellectilium</i>	100.0	Nil	Nil	11.1	Nil	37.03	Nil
5	<i>Neostylopyga sp</i>	100.0	Nil	Nil	42.8	Nil	57.14	Nil

Supella and Neostylopyga were found in more than 90% of the kitchens of the infested pakka houses/ flats. Only less than 10% of the kitchens were found infested with Periplaneta and Blatta Orientalis. Amongst the infested toilets Periplaneta individuals were found in all the toilets while nearly 80% of these were found infested with Blatta orientalis. More than 85% of the bathrooms showed the infestation of Periplaneta and Blatta. Only these two species were found infesting drainages in the pakka houses.

Stores provided suitable environment for Blattella as more than 70% of them were found infested with this species. Nearly 40% of stores had Supella and 60% stores had Neostylopyga individuals. Bed rooms and drawing rooms do not provide very congenial environment for roach infestations, except for Neostylopyga which occurred in about 40% of the infested drawing/common rooms in Table 1.5.

Table 1.5 the incidence of cockroaches in different parts of infested

<i>Locations within mud pakka houses and flats</i>								
	<i>Cockroach species</i>	<i>Kitchen</i>	<i>Toilets</i>	<i>Bathrooms</i>	<i>Drawing common rooms</i>	<i>Bed room</i>	<i>Store</i>	<i>Drainage</i>
1	<i>Periplaneta americana</i>	10.0	100.0	85.0	5.0	10.0	10.0	100.0
2	<i>Blattella germanica</i>	86.3	2.5	Nil	13.6	9.0	72.7	Nil
3	<i>Blatta orientalis</i>	11.4	80.0	91.4	5.7	Nil	8.5	82.8
4	<i>Supella supellectilium</i>	95.4	Nil	Nil	13.6	9.0	40.9	Nil
5	<i>Neostylopyga sp.</i>	92.8	Nil	Nil	39.2	3.5	60.7	Nil



Pakka houses and flats .the number of occasions cockroaches were reported in each location is expressed as a percentage of the number of premises containing the species.

IV. RESULTS AND DISCUSSIONS

In the present study when the yearly mean infestation of cockroaches have been considered, *Periplaneta americana*, *Blattella germanica*, *supella supellectilium*, *Neostylopyga* sp. and *Blatta orientalis* occurred in the ratios of 2:8.4:2.8:1:1.4 in the vegetable and fruit shops, 1.6:2.3:1.3:1:1.6 in mud / huts / kachcha houses, 3.5:3.5:2.5:1:3.3 in pakka houses flats, 2.8:2.6:1.7:1:1.7 in hotels and 4.3:5:2.3:1:7.6 in the shops. The vegetable and fruit shops thus offered most suitable environment for *Blatella germanica* while the conditions in shops are suitable for *Blatta orientalis*, *Blattella germanica* and *periplaneta germanica*. Hotels, mud houses and pakka houses provided such uniform opportunities that except for *Neostylopyga* not much difference was found in the distribution of other cockroach species.

These observations have revealed that the habitats differed in respect of cockroaches species found in them. This contention gets support from the temperature and relative humidity data recorded from these locations. The patterns of variations in hotels and vegetable / fruit shops were quite different as compared to other three habitats.

The variation in the abundance of cockroaches in these five habitats can be attributed to the prevailing microclimatic conditions, variability of food available to cockroaches and also to the physical features of these habitats.

Since no other survey is available on the manner in which cockroaches have established themselves in various locations within the infested premises, it is difficult to reach to any conclusion and evolve any generalization at this stage.

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