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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 kichens 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.

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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.

Month	*Vegatable & Fruit shop*			*Mud huts*			*Pakka houses & flats*			*Hotels*			*Shops*		
	Temp. ^0C Max.	*Temp. ^0C Min.*	*RH %*	*Temp. ^0C Max.*	*Temp. ^0C Min.*	*RH %*	*Temp. ^0C Max.*	*Temp. ^0C Min.*	*RH %*	*Temp. ^0C Max.*	*Temp. ^0C Min.*	*RH %*	*Temp. ^0C Max.*	*Temp. ^0C Min.*	*RH %*
Jul. 2013	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
Aug.	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
Sept.	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
Octo.	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
Nove.	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
Dece.	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
Jan. 2014	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
Feb.	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

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March	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 42.0^0 C while in shops highest mean maximum temperature 40.5^0 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.

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

Month	***Cockroch 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	12	305	29	28	22	20	23	18	19	15	10	5	19	3	5	1	10	24	20	15	22
Aug.	25	24	22	22	18	130	51	28	23	21	34	21	18	11	6	2	31	5	4	5	10	28	23	14	28
Sept.	30	29	21	28	16	125	48	35	21	23	27	23	16	14	8	15	19	9	6	3	14	27	21	17	26
Oct.	36	19	27	18	12	93	28	30	20	20	29	24	17	16	9	12	16	11	10	7	24	20	15	11	22
Nov.	13	19	22	15	10	38	23	22	22	10	14	15	12	18	8	14	8	7	8	5	13	20	18	9	20
Dec.	9	14	21	16	16	27	20	15	18	15	16	10	18	17	6	13	3	3	11	2	12	17	22	11	26
Jan. 2014	8	16	17	18	10	20	18	13	21	10	21	14	19	16	4	5	5	1	13	3	11	18	20	14	20
Feb.	6	12	8	18	8	12	14	9	19	8	15	7	8	10	8	3	5	5	9	1	9	13	7	11	18
Mar.	11	13	24	24	12	23	26	14	23	14	30	6	10	9	8	3	3	9	7	3	16	15	19	13	22
Apr.	10	28	22	28	14	42	39	20	20	19	32	18	12	11	6	6	16	7	9	5	12	14	24	14	24
May.	30	31	22	29	11	56	34	21	22	9	36	22	14	12	7	13	17	8	6	4	15	30	26	15	21
Jun.	20	39	23	31	12	46	42	20	25	12	39	26	19	16	8	15	17	9	8	1	13	21	28	18	22

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 Blattela germanica is found to be the most dominant one numerically, followed by Spella supellectilium, Blatta Orientalis, Periplaneta Americana and Neostylopyga. As many as 305 Blatella 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, Blatella 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

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roach species, their number ranging from 11 in the month of Februry 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 genra followed by Blatta. Their number varied from 9 ton 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 cockroach0 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 Blatella 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 Blatella 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 Blatella, 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 Blatella. 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 Blatella germanica, Periplanata 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 speciesin the stores were Periplaneta and Blatta. Very few individuals of Periplaneta and Blatella 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).

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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

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

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 fond 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

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

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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 and4.3:5:2.3:1:7.6 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.

V. REFERENCES

1. Behavioural Ecology of Cockroaches By Coby Schal, J.-Y. Gautier and William J. Bell'(Received 8 April, accepted 7 October 1983)
2. Studies on the Population Ecology of the Smokybrown Cockroach, Periplaneta fuliginosa, in a Texas Outdoor Urban Environment 2R. R. Fleet G. L. Piper G. W. Frankie Environ Entomol (1978) 7 (6): 807-814. 2014
3. Eads, R. B., F. J. Von Zuben, S. E. Bennett, and O. L. Walker. 1954. Studies on cockroaches in a municipal sewerage system. Am. J. Trop. Med. Hyg. 3: 1092-8.
4. Fleet, R. R., and G. W. Frankie. 1974. Habits of two household cockroaches in outdoor environments. Texas Agric. Exp. Stn. Misc. Publ. 1153
5. Characteristics of insect populations on habitat fragments: A mini review, Teja Tscharntke, Ingolf Steffan-Dewenter, Andreas Kruess, Carsten Thies, Ecological Research, Volume 17, Issue 2 March 2002 Pages 229–239
6. **LANDSCAPE STRUCTURE, HABITAT FRAGMENTATION, AND THE ECOLOGY OF INSECTS MARK D. HUNTER, AGRICULTURAL AND FOREST ENTOMOLOGY VOLUME 4, ISSUE 3 AUGUST 2002 PAGES 159–166**
7. Population Ecology of Insect Invasions and Their Management, Andrew M. Liebhold and Patrick C. Tobin, Annual Review of Entomology, Vol. 53:387-408, 2008
8. The role of temperature variability on insect performance and population dynamics in a warming world, Sergio A. Estay, Mauricio Lima,Francisco Bozinovic, *Synthesising Ecology* , Volume 123, Issue 2 February 2014 Pages 131–140
9. ***A summary of estimates of optimal and minimal conditions for population increase of some stored products insects, R.W. Howe, Journal of Stored Products Research, Volume 1, Issue 2, November 1965, Pages 177-184s***
10. Predicting insect pest status under climate change scenarios: combining experimental data and population dynamics modelling, S. A. Estay, M. Lima, F. A. Labra, *Journal of Applied Entomology*, Volume 133, Issue 7 August 2009 Pages 491–499
11. Edney, E.B.; Franco, P. and Wood, R. (1978). The response of Arenivaga investigate (Dictyoptera) to gradients of temperature and humidity in sand studied by lagging with techtinium 99m. Physiol. Zool. 51:241-225.
12. Graton,R.E. Jr.(1979). Behaviour and Ecology of the cockroaches of north eastern Kansas. Ph.D. thesis University of Kansas, Wright, C.G. (1965 a). Cockroach species in apartment projects in N. Carolina. Pest Control, 33 (6), 14-15.
13. Wright, C.G. (1965 b). Identification and occurrence of Cockroachs in dwellings and business establishments in N. Carolina. J.econ. Ent. 58(5): 1032-1033.
14. Clark, L. R. ;Geier, P.W. Hughes R.D. and Morris R.F. (1967). The ecology of insect population in theory and practice. E.L.B.S. and Chapman and Hall London.
15. Ragge, D. R. (1965), Grasshoppers, Crickets, and Cockroaches of the British Isles. Warne & Co. Ltd. London. 299 pp.

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