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A TEN-YEAR STUDY OF LOUSE POPULATIONS ON DEER MICE[1]

By J. R. Beer and E. F. Cook[2]

Abstract: From 1952 to 1961 over 2800 specimens of *Peromyscus maniculatus gracilis* (Le Conte) were collected in northern Minnesota. Of these 2452 were suitable for the study of louse populations. The host population density varied considerably from year to year with the density being over 5× as large during the peak year as during the low years. Only the louse *Hoplopleura hesperomydis* was found.

The infestation rates varied from 17.5 to 58.0% with an overall rate of 33.8% on the ♂, and from 12.3 to 48.4% with an overall rate of 26.9% on the ♀ hosts. There was no demonstrable relationship between the rate of infestation and the density of the host population. There was a positive relationship between the infestation rates from ♂ and ♀ hosts over the several years. There was no significant change in infestation rate with age of the ♀ host but they did increase with the age of the ♂ host. The infestation rates were similar on the young ♂ and ♀ hosts but were significantly higher on the old ♂♂ than on the old ♀♀.

The average infestation on infested ♀ hosts was 19.8 but varied from 1 to 1261. The median population size was 5. On the ♂ hosts the average was 16.2 with extremes of from 1 to 758. The median population size was 6. There was no correlation between infestation size and infestation rate. The average population sizes on ♂ and ♀ hosts showed positive correlation for the years studied.

The louse population on the ♀ hosts was composed of 31.5% adults of which 41.8% were ♂♂. The immature portion of the population was composed of 73.9% 1st, 19.1% 2nd, and 6.9% 3rd instars. On the ♂ hosts the population was composed of 46.6% adults of which 40.8 are ♂♂. The immature portion of the population was composed of 69.6% 1st, 19.7% 2nd and 10.7% 3rd instars. The immature-to-adult ♀ ratio was 2.74 on the ♀ and 1.94 on the ♂ hosts. The immature-adult ♀ ratio varied positively with the louse population size.

The factors which cause variation in infestation rate and population structure of the lice are apparently different from those which affect the host population.

The present study was designed to examine the inter-relationships of louse population density and structure with the population density, structure and trends of the deer mouse. It was postulated that there would be a relationship between the host population density and infestation rate and size of louse population; that there might be a relationship between the louse population and population trends in the host; and that there would be parasite population characteristics associated with the several age classes and sex of the host.

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To date there have been relatively few studies dealing with the dynamics of Anoplura populations on rodents. These have been based on various techniques for obtaining the data so that it is often difficult to compare the results of these studies. Likewise, the studies deal with a number of species of small rodents and lice and are concerned with collections taken over relatively short periods of time.

METHODS AND MATERIALS

The present study deals with populations of lice (*Hoplopleura hesperomydis* Osborn) on deer mice (*Peromyscus maniculatus gracilis* Le Conte) sampled over a 10-year period. The samples were taken between 24 June and 5 August from 1952 to 1961 in the vicinity of the Quetico-Superior Wilderness Research Center on Basswood Lake in Lake County, Minnesota. Most of the hosts were collected between 2 and 21 July. The samples were taken from comparable chronological but not necessarily comparable phenological periods each year. Reproduction normally ceases in these mice during late July so that the sampling comes at the period of near maximum host population density. The mice were collected by the use of break-back traps which were set out in lines of 50 stations with a single trap at a station. The stations were placed in a line at 9 m intervals, and the traps were baited with peanut butter. The traps were left out for 3 days and were checked each day, and each animal captured was placed in its own polyethelene bag as soon as it was taken from the trap to prevent loss and transfer of ectoparasites from 1 animal to another (Cook 1954a).

The hosts were skinned, the skins dried and then stored in the original polyethelene bag until they could be examined. Each animal was skinned on a separate piece of paper to prevent loss and transfer of lice. The recovery of the lice was accomplished by placing the skins in a buffered 1% solution of trypsin for 24 hours at 38 °C followed by enough KOH to dissolve the fur and the rest of the skin. The lice were collected by pouring the resulting solution through a 100 mesh bronze screen (Cook 1954b). The lice were then identified as to species, sex, and instar (Cook & Beer 1959).

This paper will examine rates of infestation, population size and population structure of the lice found on the deer mice in relation to density, sex, and age of host population as well as year to year differences. In this study all host density related data are given as index figures in captures per 1000 trap station days. This gives good information with which to compare the relative abundance of a given host species from year to year since all of the collecting was done on the same area, during the same chronological period and under similar conditions. The trapping was not intense enough to affect the host population.

THE DEER MOUSE POPULATION

During the 10-year period starting in 1952, over 2800 deer mice were captured of which 2452 were suitable for the study of their louse populations. The population indices for this host varied from 14.0 to 81.6 captures per 1000 trap station days suggesting that during the year of greatest abundance the deer mouse population was over 5 times as dense as during the year of least abundance (TABLE 1). The population in 1952 was at a low level (CI = 22.4) and comparable to the population level of the previous year when the CI was 20.6. From this point it climbed to 81.6 in 1955. The low population as shown by a CI of 14.0 in 1954 was due to a catastrophic snow storm during late May which reduced the population of most species of small mammals (Beer, unpublished data) and a number of species of small birds (Frenzel & Marshall 1954). This loss did not seem to have a lasting effect on the small mammal population since in 1955 the population was at the highest level recorded during this study with a CI of 81.6.

TABLE 1. Relative abundance of deer mice (*Peromyscus maniculatus gracilis* Le Conte) based on a capture index (CI = captures per 1000 trap days) and gross infestation rates.

YEAR	TRAP DAYS	NO. OF CAPTURES	CI	% INFESTED
1951	4865	100	20.6	—
1952	9801	219	22.4	41.9
1953	3964	285	71.9	15.0
1954	10399	146	14.0	25.3
1955	5896	481	81.6	27.6
1956	8309	503	60.5	49.8
1957	5987	357	59.6	28.5
1958	5848	303	51.8	21.0
1959	5449	114	20.9	37.1
1960	5403	114	21.1	35.3
1961	4550	307	67.5	29.1
				30.5

After 1955 the population declined steadily until in 1959 and 1960 capture indexes of 20.9 and 21.1 were recorded, respectively. The populations recovered dramatically in 1961 with a CI of 67.5. During the period of this study we started with a relatively low population followed by a climb to a peak population and subsequent decline. The increase in 1961 was comparable to that found in 1953 and the low levels recorded in 1959 and 1960 were comparable to the 1951 and 1952 population levels. Thus we appear to have data for all phases of a host population fluctuation.

ANOPLURA POPULATIONS

The only species of Anoplura taken regularly from the deer mouse was *Hoplopleura hesperomydis* (Osborn). Of the 10,496 lice examined only 9 were *Hoplopleura acanthopus* (Burm.) which was found regularly on the microtine rodents taken in the same area. It is felt that these could be contaminants rather than stragglers and, consequently, are not considered in the population analysis.

On checking the work of the laboratory technicians we found that there were apparent errors involving the structure of the louse populations from the 1959, 1960, and 1961 samples. Since it was not possible to re-examine all of these samples, as some had inadvertantly been discarded, the data involving louse population structure for these years is not used in the following analysis.

Infestation rates. Of the 2452 deer mice examined over the 10-year period 30.5% were infested with lice (TABLE 1). However, the rate of infestation varied from year to year with the highest rate recorded being 49.8% in 1956 and the lowest rate 15.0% in 1959. These figures are based on both sexes and the several age classes of hosts and as such are useful only for comparison with studies where further breakdown is not given.

Several workers have reported on the infestation rates of *H. hesperomydis* on various species of mice in the genus *Peromyscus* and these rates have varied considerably. Some of the very low infestation rates reported are probably due to inadequate collecting techniques. Harkema (1936) examined 54 white-footed mice and found no lice. Morlan (1952) examined 249 cotton mice and 243 old field mice and found only 5.2 and 0.4% infested, respectively. Morlan & Hoff (1957) reported on several collections from 4 species of *Peromyscus* from New Mexico and Mexico. They reported on 2 collections of *P. maniculatus* in which they found 38.5 (65 hosts) and 0.2% (445 hosts) infested, 2 collections of *P. truei* in which they found 20.0 (25 hosts) and 0.9% (662 hosts) infested; 1 collection each of *P. leucopus* and *P. nasutus* in which 0.7 (285 hosts) and 4.8% (21 hosts) were infested, respectively. These workers used the brushing technique to obtain the lice.

Ignoffo (1959), using the flotation technique, examined 192 *P. maniculatus* from the Great Salt Lake Desert in Utah and found 50.0% of them harboring *H. hesperomydis*.

Cook & Beer (1958) examined 1904 *P. maniculatus* from southern Minnesota and found 33.7% of them infested. A collection of 194 *P. maniculatus* from Oregon had 57.0% infested (Beer & Cook 1958). In collections from Arizona, Beer, Cook & Schwab (1959) examined 193 *P. boylii*, 19 *P. nasutus*, 210 *P. maniculatus*, and 13 *P. eremicus* finding infestation rates of 34.2, 57.8, 0.0 and 15.4%, respectively, with lice of the *H. hesperomydis* complex. These data were obtained by the dissolving technique (Cook 1954b).

Including the collections in this study we have available infestation rate data from 25 samples of mice of the genus *Peromyscus* which have been examined for lice of the *H. hesperomydis* complex. When the methods of obtaining the data are taken into consideration the expected infestation rate of lice of the *H. hesperomydis* complex on mice of the genus *Peromyscus* is between 30 and 35% with rates as low as 20 and as high as 50% to be found occasionally. It appears that it is only in unusual situations that the infestation rates are outside of these limits, such as the complete lack of these lice on *P. maniculatus* (Beer, Cook & Schwab 1959).

The first 2 years' data, which have been previously reported by us (Cook & Beer 1955) showed that the rate of infestation on male deer mice was higher than that from the female hosts as does the data from deer mice from Oregon (Beer & Cook 1958), while the data on infestation rates of lice on *P. maniculatus* from southern Minnesota (Cook & Beer 1958) and for *H. ferrisi* from *P. boylei* from Arizona showed no statistical difference in the infestation rate for the 2 sexes. In the Minnesota sample 32.6% of the females and 34.4% of the males were infested, and in the Arizona sample 33.5% of the females and 30.0% of the males were infested. The present data allow us to examine this problem further.

In 9 of the 10 samples reported here the infestation rate was higher on the males than on the females with only the 1961 sample deviating from this pattern (TABLE 2). When the individual samples were examined in a 2 × 2 contingency table only the 1952 and 1955 samples were found to be significantly different (X^2 = 11.472 and 7.915, respectively). By combining these data a X^2 value of 27.084 was obtained which is highly significant with 8 d.f. These data suggest that the normal situation is to have a slightly higher proportion of the males than females infested with lice.

TABLE 2. Infestation rates of *H. hesperomydis* on ♂ and ♀ *P. maniculatus*.

YEAR	% INFESTED		X^2
	♂	♀	
1952	58.0	25.5	11.472**
1953	17.5	12.3	0.906
1954	27.3	23.6	0.352
1955	33.3	21.0	7.915**
1956	51.2	48.4	0.310
1957	33.3	22.9	3.768
1958	22.7	18.7	0.502
1959	40.7	32.3	1.083
1960	29.2	22.0	0.766
1961	29.7	30.2	0.010
			27.084**

**Significant at the 99% level.

The infestation rates of lice on male hosts varied from 17.5 to 58.0% and on females hosts from 12.3 to 48.4% (TABLE 2). Inspection of the data suggested that the infestation rates of the males and females varied together. The correlation coefficient, r = 0.674 with 8 d.f., is significant at the 95% level. All of the samples, except the one from 1952, fall nicely into this pattern showing the positive relationship between the rates of infestation on the 2 sexes of hosts.

Since there is considerable difference from year to year in both host population density and rate of infestation with lice, it seemed logical that there should be a relationship between these 2 population attributes. Regression lines were calculated for infestation rates of both males and females against host population density ($\hat{Y}$ = 41.129–0.145 X for males and $\hat{Y}$ = 27.537–0.039 X for females). There was a slight negative slope to both lines, but when correlation coefficients were calculated, r = 0.284 and r = 0.098, the values were so low that one must consider as purely chance the possible negative relationships shown by the regression lines. Thus, there is no demonstratable relationship between infestation rate on either sex and host population density. This suggests that the factors which control the infestation rates are at least partially independent of those factors which control the population density of the host.

The possibility that age of the host might affect infestation rates for the 2 sexes of host was examined. The animals were not of known age but since it has been shown that mice of the genus *Peromyscus* continue to grow until at least 2 years of age (Dice & Bradley 1942), it appears that the use of body length as an indicator of relative age is valid. This approach is justified also by the fact that very few *Peromyscus* survive for more than a year (Beer & MacLeod 1966). The hosts were grouped by 5 mm increments of body length and the infestation rates calculated for each size class (TABLE 3).

TABLE 3. Infestation rate and size of *H. hesperomydis* on ♂ and ♀ *P. maniculatus* by body length classes.

	♂ HOSTS			♀ HOSTS		
BODY LENGTH CLASS	NO.	% INFESTED	AV. INFEST. SIZE	NO.	% INFESTED	INFEST. SIZE
60–70	25	20.0	132.5	30	26.7	28.5
71–75	77	29.3	18.0	77	26.0	9.3
76–80	217	27.6	8.4	181	23.8	12.2
81–85	388	34.0	10.6	252	26.2	10.5
86–90	331	34.4	14.5	210	24.3	8.5
91–95	190	44.7	15.6	268	29.9	42.3
96 +	46	34.8	36.6	159	28.9	21.9

Regression lines were calculated for both series. The regression lines for both the males ($\hat{Y} = 15.798 + 0.575\ X$) and females ($\hat{Y} = 17.868 + 0.104\ X$) suggest a positive relationship. A correlation coefficient, $r = 0.821$ with 5 d.f., for the males is significant at the 95% level, but the $r = 0.507$ with 5 d.f. for the females is not. By using the regression formula for the 2 sexes we calculated expected infestations for animals with 70-mm and 100-mm body lengths. The 70-mm body length was chosen because it is the size at which the young normally leave the maternal nest and become independent. The 100-mm figure is within the range of fully adult animals and large enough to be beyond the size obtained by subadult though sexually mature animals. Expected infestation rates of 24.5 and 25.2% for the 70-mm size classes and 38.1 and 28.3% for the 100-mm size classes were obtained for the male and female hosts, respectively. The expected infestation rates for the 70-mm classes are very similar and show that there is little or no difference in infestation rates on the 2 sexes when they first become independent and before they mature sexually. The expected infestation rates for the fully adult animals show little change in infestation rates on the females but an increase in rate on the males of over 50%. From this we conclude that there are sex-associated factors which inhibit further infestations on the females and allow an increase in the number of infested male mice. These factors could be physiological or behavioral in nature. Studies by Murray (1961) show that grooming may control population size.

Infestation size. The size of infestation presents problems of analysis which are difficult to handle statistically. The 233 infested female mice from the 1952–1958 period had an average infestation size of 19.8, a median of 5 and a range of from 1 to 1261. The 335 infested males had an average of 16.2, a median of 6 and a range of from 1 to 758. Other studies of *Hoploplura* populations on *Peromyscus* have shown similar distributions. Cook & Beer (1958) reported on 381 infested male *P. maniculatus* from southern Minnesota with an average infestation of 5.7 and a range of 1 to 104 and 260 infested females with an average of 6.0 and a range of 1 to 165. Beer, Cook & Schwab (1959) found averages of 12.8 and 11.8 and ranges of 1 to 76 and 1 to 71 for *H. ferrisi* on male and female *P. boylii*, respectively, for a collection from Arizona. Beer & Cook (1958) also reported averages of 12.3 and 11.3 with ranges of 1 to 247 and 1 to 106 from a sample of *P. maniculatus* from Oregon. Ignoffo (1959) reported an average of 7.6 *H. hesperomydis* on *P. maniculatus* from Utah and Morlan (1952) reported an average infestation of 8.2 *H. hesperomydis* on the cotton mouse. From these data we can conclude that the average *Hoplopleura* population on *Peromyscus* normally lies between 5 and 20 lice per infested host. Also, a relatively low proportion of the infested mice contribute a high proportion of the lice. To demonstrate this point we find in the present study that for infested male hosts 65.4% have 10 or fewer lice and contributed about 15.7% of the total number of lice. Only 19.7% of the hosts have over 20 lice each but contribute 70.8% of the lice. The 6 mice with over 100 lice each had 29.6% of the lice collected. The pattern for the female hosts is similar.

The distribution of the population sizes suggested a possible poisson series. Expected poisson curves were calculated and compared with the data from our samples. Very little similarity was shown, with our samples having far too many animals without lice or with a single louse and too many with large infestations. This suggests that the frequency distribution of louse populations of various sizes is not randomly distributed. An unusual number of the hosts are either resistant to infestation or have not had an opportunity to become infested. The fact that the infestation rates do not increase with age of the females and that the increase is relatively low in the males suggests that the former is probably correct. There are also an unusual number of mice with very large infestations suggesting that a segment of the host population is very susceptible.

It was postulated that the average infestation size (TABLE 3) would correlate with the infestation rates and possibly other population attributes for the several yearly samples. However, when correlation coefficients were calculated for average infestation size in relation to infestation rates for the 1952 to 1958 period, values of $r = 0.131$ for female and $r = 0.399$ for male hosts indicated that the probability of any relationship was slight. When correlation coefficients were calculated for average infestation size in relation to the host population density values of $r = 0.239$ and $r = 0.346$ were obtained for the male and female hosts, respectively. When average infestation size on male hosts was correlated with that on female hosts a value of $r = 0.368$ was obtained. None of these values suggests relationships.

Since there was no apparent relationship between average population size of the louse population and any of the population attributes examined, it was postulated that the rather sporadic appearance of a few mice with very large populations was masking any possible relationships. In order to minimize the effect of these large populations the median population sizes were used. When the median population sizes on females were related to the median population sizes on males a value of $r = 0.811$ was obtained, which with 5 d.f., is significant at the 95% level. This is in agreement with the relationship between infestation rates found on the 2 sexes. When median population sizes were correlated with host population indices r values of 0.171 and 0.004 were obtained for female and male hosts, respectively. Thus, there appears to be no relationship. Correlation coefficients of $r = 0.115$ and $r = 0.600$ for female and male hosts, respectively, for the relationship between median population size and body length (age) of host. These values are not significant though $r = 0.600$ for the males is suggestive and should not be completely dismissed since infestation rate increased with age in the male segment of the host population.

Population structure. There are few studies of anopluran populations on wild rodents which give population structure. Data for those studies where over 500 lice were collected are summarized in TABLE 4. These studies show considerable variation in the adult sex ratio and the nymph-to-adult-female ratio. The sex ratios varied from 30.8 to 50.8% males with the median sex ratio being about 41% males. The samples of *H. hesperomydis* from *P. maniculatus* varied from 40.4 to 46.3% males. The ratio of young to adult female was more variable in these studies. Ratios were reported as low as 0.25 young per female for *H. acanthopus* on *Microtus arvalis* (Vysotskaia 1950) to as high as 6.92 for *H. arboricola* on *Eutamias dorsalis* (Beer, Cook & Schwab 1959). The ratios for *H. hesperomydis* and the closely related *H. ferrisi* ranged from 0.7 to 2.5. These data are for general host populations and are not broken down by sex or age of the host.

TABLE 4. Population characteristics of lice of the genus *Hoplopleura* reported in other studies.

Species	Reference	Av. Infest. Size	% ♂	Young/Adult ♀
H. hesperomydis	Cook & Beer 1955	5.9	46.3	2.29
	Cook & Beer 1958	5.8	40.4	0.73
	Beer & Cook 1958	11.8	41.7	0.77
H. ferrisi	Beer, Cook & Schwab 1959	12.3	43.0	2.49
H. arboricola	Beer, Cook & Schwab 1959	210.2	50.8	6.92
H. acanthopus	Cook & Beer 1955	8.7	40.9	1.96
	Cook & Beer 1958	19.0	47.2	1.42
	Vysotskaia 1950	21.7	30.8	0.52
	" "	66.3	33.1	0.25
	" "	27.0	32.2	0.25

The sex ratios in the present study varied from 33.3 to 58.1 with a composite of 41.2% males on the male hosts and from 35.9 to 44.2 with a composite of 43.1% males on the female hosts (TABLES 5, 6). However, if we take only those samples where 200 or more lice were collected, we find the sex ratios from 39.1 to 43.9% males. These data show that there are normally more females than males in the population. The variation shown appears to be in line with what would be expected from the sizes of the samples involved and not correlated with any observed attribute of the parasite or host population.

The adult lice made up from 36.3 to 73.8 with an average of 46.4% of the population on the male hosts and from 24.3 to 79.0 with an average of 38.4% of the population on the female hosts. The proportion of each of the developmental instars for the combined samples from the male hosts was 69.6% 1st, 19.7% 2nd and 10.7% 3rd instars and from the female hosts, 73.9% 1st, 19.1% 2nd and 6.9% 3rd instars. There was considerable year-to-year variation, but the sample sizes do not warrant further analysis.

The immature-to-adult-female ratio varied from 0.4 to 5.6 with an average of 2.7 on female hosts and from 0.6 to 3.4 with an average of 1.94 on the male hosts for the years of 1952 to 1958.

TABLE 5. Population characteristics of the louse *H. hesperomydis* on ♂ *P. maniculatus*, 1952–1958.

					Louse Population Characteristics					
								Proportion of Immature Instars in %		
Year	Capture Index for Host	% Infested	Total No. of Lice	Av. Infest. Size	% Adult	%♂	Young/Adult ♀	1st	2nd	3rd
1952	22.4	58.0	486	16.8	37.7	58.1	3.4	69.3	20.5	10.2
1953	71.9	17.5	203	8.1	60.1	42.6	1.2	82.7	7.4	9.9
1954	14.0	27.3	421	17.5	57.5	42.6	1.3	74.1	15.5	10.4
1955	81.6	33.3	622	8.3	73.8	41.4	0.6	71.8	19.6	8.6
1956	60.5	51.2	2595	25.0	36.3	40.3	2.9	71.7	16.9	11.4
1957	59.6	33.3	943	18.5	52.1	39.1	1.5	60.2	31.0	8.8
1958	51.8	22.7	144	5.3	52.1	33.3	1.4	47.8	37.7	14.5
				16.2	46.4	41.2	1.94	69.6	19.7	10.7

TABLE 6. Population characteristics of the louse *H. hesperomydis* on ♀ *P. maniculatus*, 1952–1958.

					Louse Population Characteristics					
								Proportion of Immature Instars in %		
Year	Capture Index for Host	% Infested	Total No. of Lice	Av. Infest. Size	% Adults	%♂	Young/Adult ♀	1st	2nd	3rd
1952	22.4	25.5	188	13.4	44.1	43.4	2.2	81.9	15.2	2.8
1953	71.9	12.3	121	7.6	48.8	44.1	1.9	69.3	20.9	9.7
1954	14.0	23.6	75	3.0	72.0	37.0	0.6	38.1	38.1	23.8
1955	81.6	21.0	453	11.0	61.6	43.7	1.1	72.0	20.6	7.4
1956	60.5	48.4	2183	23.7	39.9	41.0	2.6	77.0	17.8	5.2
1957	59.6	22.9	1530	51.0	24.3	44.2	5.6	71.7	29.1	8.2
1958	51.8	18.7	81	5.1	79.0	35.9	0.4	35.3	29.4	35.3
				19.8	38.4	43.1	2.74	73.9	19.1	6.9

In comparing the immature-per-adult-female ratio of the louse population with the density of the host population, we obtained correlation coefficients of $r = 0.643$ and $r = 0.179$ for the populations on the male and female hosts, respectively. These low coefficients with 5 d.f. are not significant and suggest that the little correlation shown was probably due to chance. This also agrees with the lack of relationship between host population density and other louse population attributes examined.

Correlation coefficients were calculated for the relationship between the average louse population size on infested male and female hosts and the young-adult female ratio of the louse populations; and correlation coefficients $r = 0.964$ and $r = 0.997$ were obtained for the populations on male and female hosts, respectively. These are both significant at the 95% level with 2 d.f. Likewise, the female hosts with a higher infestation size than the males, 19.8 as compared with 16.2, have a higher immature-to-adult-female ratio, 2.1 as compared with 1.9.

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REFERENCES

Beer, J. R. & E. F. Cook. 1958. The louse populations on some deer mice from western Oregon. *Pan-Pacific Ent.* **34:** 155–58.

Beer, J. R., E. F. Cook & R. G. Schwab. 1959. The ectoparasites of some mammals from the Chiricahua Mountains, Arizona. *J. Parasitol.* **45:** 605–13.

Beer, J. R. & C. F. MacLeod. 1966. Seasonal population changes in the prairie deer mouse. *Amer. Midland Natur.* **76:** 277–89.

Cook, E. F. 1954a. A technique for preventing post mortem ectoparasite contamination. *J. Mammal.* **35:** 266–67.

1954b. A modification of Hopkin's technique of collecting ectoparasites from mammal skins. *Ent. News* **15:** 35–37.

Cook, E. F. & J. R. Beer. 1955. The louse populations of some cricetid rodents. *Parasitology* **45:** 409–20.

1958. A study of louse populations on the meadow vole and deer mouse. *Ecology* **39:** 645–59.

1959. The immature stages of the genus *Hoplopleura* (Anoplura: Hoplopleuridae) in North America, with descriptions of two new species. *J. Parasitol.* **45:** 405–16.

Dice, L. R. & R. M. Bradley. 1942. Growth in the deer mouse, *Peromyscus maniculatus*. *J. Mammal.* **23:** 416–27.

Frenzel, L. D. & W. H. Marshall. 1954. Observations on the effect of the May 1954 storm. *Flicker* **26:** 126–30.

Harkema, R. 1936. The parasites of some North Carolina rodents. *Ecol. Mono.* **6:** 152–232.

Ignoffo, C. M. 1959. Louse populations of some rodents of the great Salt Lake desert. *Parasitology* **49:** 511–18.

Morlan, H. B. 1952. Host relationships and seasonal abundance of some southwest Georgia ectoparasites. *Amer. Midland Natur.* **48:** 74–93.

Morlan, H. B. & C. C. Hoff. 1957. Notes on some Anoplura from New Mexico and Mexico. *J. Parasitol.* **43:** 347–51.

Murray, M. D. 1961. The ecology of the louse *Polyplax serrata* (Burm.) on the mouse *Mus musculus* L. *J. Zool.* **9:** 1–13.

Vysotskaia, S. O. 1950. Seasonal changes in the infestation of the grey vole with lice (in Russian). *Sborn. Zool. Inst. Akad. Nauk SSSR, Leningrad* **12:** 73–79.

TABLE 5. Population characteristics of the louse *H. hesperomydis* on ♂ *P. maniculatus*, 1952–1958.

Year	Capture Index for Host	% Infested	Total No. of Lice	Av. Infest. Size	Louse Population Characteristics: % Adult	%♂	Young/Adult ♀	Proportion of Immature Instars in %: 1st	2nd	3rd
1952	22.4	58.0	486	16.8	37.7	58.1	3.4	69.3	20.5	10.2
1953	71.9	17.5	203	8.1	60.1	42.6	1.2	82.7	7.4	9.9
1954	14.0	27.3	421	17.5	57.5	42.6	1.3	74.1	15.5	10.4
1955	81.6	33.3	622	8.3	73.8	41.4	0.6	71.8	19.6	8.6
1956	60.5	51.2	2595	25.0	36.3	40.3	2.9	71.7	16.9	11.4
1957	59.6	33.3	943	18.5	52.1	39.1	1.5	60.2	31.0	8.8
1958	51.8	22.7	144	5.3	52.1	33.3	1.4	47.8	37.7	14.5
				16.2	46.4	41.2	1.94	69.6	19.7	10.7

TABLE 6. Population characteristics of the louse *H. hesperomydis* on ♀ *P. maniculatus*, 1952–1958.

Year	Capture Index for Host	% Infested	Total No. of Lice	Av. Infest. Size	Louse Population Characteristics: % Adults	%♂	Young/Adult ♀	Proportion of Immature Instars in %: 1st	2nd	3rd
1952	22.4	25.5	188	13.4	44.1	43.4	2.2	81.9	15.2	2.8
1953	71.9	12.3	121	7.6	48.8	44.1	1.9	69.3	20.9	9.7
1954	14.0	23.6	75	3.0	72.0	37.0	0.6	38.1	38.1	23.8
1955	81.6	21.0	453	11.0	61.6	43.7	1.1	72.0	20.6	7.4
1956	60.5	48.4	2183	23.7	39.9	41.0	2.6	77.0	17.8	5.2
1957	59.6	22.9	1530	51.0	24.3	44.2	5.6	71.7	29.1	8.2
1958	51.8	18.7	81	5.1	79.0	35.9	0.4	35.3	29.4	35.3
				19.8	38.4	43.1	2.74	73.9	19.1	6.9

In comparing the immature-per-adult-female ratio of the louse population with the density of the host population, we obtained correlation coefficients of $r = 0.643$ and $r = 0.179$ for the populations on the male and female hosts, respectively. These low coefficients with 5 d.f. are not significant and suggest that the little correlation shown was probably due to chance. This also agrees with the lack of relationship between host population density and other louse population attributes examined.

Correlation coefficients were calculated for the relationship between the average louse population size on infested male and female hosts and the young-adult female ratio of the louse populations; and correlation coefficients $r = 0.964$ and $r = 0.997$ were obtained for the populations on male and female hosts, respectively. These are both significant at the 95% level with 2 d.f. Likewise, the female hosts with a higher infestation size than the males, 19.8 as compared with 16.2, have a higher immature-to-adult-female ratio, 2.1 as compared with 1.9.

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REFERENCES

Beer, J. R. & E. F. Cook. 1958. The louse populations on some deer mice from western Oregon. *Pan-Pacific Ent.* **34:** 155–58.

Beer, J. R., E. F. Cook & R. G. Schwab. 1959. The ectoparasites of some mammals from the Chiricahua Mountains, Arizona. *J. Parasitol.* **45:** 605–13.

Beer, J. R. & C. F. MacLeod. 1966. Seasonal population changes in the prairie deer mouse. *Amer. Midland Natur.* **76:** 277–89.

Cook, E. F. 1954a. A technique for preventing post mortem ectoparasite contamination. *J. Mammal.* **35:** 266–67.

1954b. A modification of Hopkin's technique of collecting ectoparasites from mammal skins. *Ent. News* **15:** 35–37.

Cook, E. F. & J. R. Beer. 1955. The louse populations of some cricetid rodents. *Parasitology* **45:** 409–20.

1958. A study of louse populations on the meadow vole and deer mouse. *Ecology* **39:** 645–59.

1959. The immature stages of the genus *Hoplopleura* (Anoplura: Hoplopleuridae) in North America, with descriptions of two new species. *J. Parasitol.* **45:** 405–16.

Dice, L. R. & R. M. Bradley. 1942. Growth in the deer mouse, *Peromyscus maniculatus*. *J. Mammal.* **23:** 416–27.

Frenzel, L. D. & W. H. Marshall. 1954. Observations on the effect of the May 1954 storm. *Flicker* **26:** 126–30.

Harkema, R. 1936. The parasites of some North Carolina rodents. *Ecol. Mono.* **6:** 152–232.

Ignoffo, C. M. 1959. Louse populations of some rodents of the great Salt Lake desert. *Parasitology* **49:** 511–18.

Morlan, H. B. 1952. Host relationships and seasonal abundance of some southwest Georgia ectoparasites. *Amer. Midland Natur.* **48:** 74–93.

Morlan, H. B. & C. C. Hoff. 1957. Notes on some Anoplura from New Mexico and Mexico. *J. Parasitol.* **43:** 347–51.

Murray, M. D. 1961. The ecology of the louse *Polyplax serrata* (Burm.) on the mouse *Mus masculus* L. *J. Zool.* **9:** 1–13.

Vysotskaia, S. O. 1950. Seasonal changes in the infestation of the grey vole with lice (in Russian). *Sborn. Zool. Inst. Akad. Nauk SSSR. Leningrad* **12:** 73–79.