Reproductive Performance in Chinchilla[1]

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A NUMBER of items of interest in the reproductive activity of *Chinchilla* relate to the sex ratio; possible prediction of sex ratios of future litters; incidence of either sex in the litters of individual females; average litter size in successive litters and whether related to lineage; the incidence of defective young[2] and whether related to sex of young, litter size, lineage, litter number, or productivity levels; and the possibility of predicting on the basis of first litters what the expected subsequent output in young will be for succeeding litters. Since no other work has been found which considers these matters in *Chinchilla,* they are considered in the paragraphs which follow, with statistical methods employed as required.

Materials and Methods

The data used in this paper were obtained by sending out 500 questionnaire cards, 25 cards to each of 20 chinchilla ranchers in different parts of the country. Instructions were given to include females with varying records of productivity as a representation of the general population. Only those animals were included whose production records were known from the beginning. Of the original number of cards sent out, 217 were returned and analyzed. These females had varying records from 1 to as high as 20 litters, and abnormal males and females were tabulated separately from the normal males and females for each mother. Statistical analyses were made as required.

Observations and Discussion

A study was made of the sex ratio obtaining among 217 females who had given birth to a total of 2,855 babies in a total of 1,379 litters ranging from 1 to 20 litters in number per female. Of these 2,855 babies, 1,562 were males and 1,293 were females. This is calculated to be 54.7 per cent males

[1] Aided largely by a grant-in-aid, RG-3775, from the Public Health Service, and by a General Research Grant from the Graduate Council of Oregon State College and published with the approval of the Oregon State College Monographs Committee, Research Paper No. 301, Department of Zoology, School of Science.

The authors express their appreciation of the valued assistance given by Drs. J. C. R. Li and R. F. Link in the statistical analysis of data.

[2] Defective young include such as are still-born, have herniated viscera, have gross body disproportions, etc.

and 45.3 per cent females, or a balance of 9.4 per cent in favor of males. This difference in percentage is statistically significant since x^2 equals 25.4 with one degree of freedom. Thus selective factors operate to produce about 10 per cent more male newborn than female among domestic *Chinchilla.* The sex ratio of future litters cannot be predicted from the sex ratio of the first litter ($x^2 = 0.43$ with one degree of freedom; $x^2_{.05} = 3.84$).

The number of babies in successive litters for 217 females who had from 1 to 20 litters per female were tabulated and sums calculated for the number of babies in the first litter for all females, and similarly for all subsequent litters. Averages were calculated for each sum to derive the average size of litters for successive litters from 1 to 20 litters per average female.

On the basis of the summarized data in Table 1, it is seen that the over-all average litter size per average female tends to begin at 2 babies and continue at that level throughout the reproductive period included. These findings are at variance with the reports in the National Chinchilla Breeder for the

TABLE 1. THE AVERAGE NUMBER OF CHINCHILLA BABIES PER FEMALE PER LITTER FOR SUCCEEDING LITTERS

Litter	Number of Litters	Number of Babies	Average Number of Babies per Litter
1st	217	431	1.98
2nd	206	432	2.09
3rd	184	400	2.17
4th	165	366	2.21
5th	142	284	2.00
6th	114	233	2.04
7th	94	181	1.92
8th	72	157	2.18
9th	52	96	1.84
10th	35	71	2.02
11th	28	57	2.03
12th	22	53	2.40
13th	20	34	1.70
14th	11	24	2.18
15th	6	14	2.33
16th	4	9	2.25
17th	4	9	2.25
18th	1	1	1.00
19th	1	2	2.00
20th	1	2	2.00

years 1953 and 1954 which gives the national average number of 2.1 and 2.0 babies, respectively, per breeding female per year. Assuming an average of 2 litters per year per female, the average litter sizes of the NCB report would figure to be 1.05 and 1.0, respectively, for these two years, or about one half that calculated on the basis of the sample returns used here.

Since each succeeding litter tended to remain at 2, neither progressive age nor parity had any influence on successive litter sizes within the period studied.

The litter records of 217 females with a total of 1,379 litters, ranging from 1 to 20 litters per individual female, were analyzed for the incidence of defective young at birth among the male and female babies to see if more defectives were found in one sex than the other. There was a total of 1,293 females, 1,165 of which were normal and 128 were defective. The total number of males was 1,562, of which 1,421 were normal and 141 defective. Thus there was a total of 269 defective males and females and a total of 2,586 normal males and females out of a total of 2,855 babies. On the basis of a statistical analysis, in which x^2 equals 0.6 with one degree of freedom, it is concluded that the percentage of defective young is not related to their sex; thus defective young occur with equal frequency in either sex. The proportion of defective babies was found to be the same for all litter numbers or succeeding litters as otherwise expressed ($x^2 = 25.4$ with 19 degrees of freedom; $x^2_{.05} = 30.3$), but the proportion of defective babies increases as the size of litter increases ($x^2 = 125.0$ with five degrees of freedom; $x^2_{.05} = 11.1$). Also, while some mothers produce a larger proportion of defective babies than others ($x^2 = 224.0$ with 132 degrees of freedom; $x^2_{.05} = 161$), yet good producers (which regularly have large litters) produce a smaller percentage of defective babies than do poor producers ($x^2 = 8.87$ with one degree of freedom; $x^2_{.05} = 3.84$).

When the numbers of babies born to 163 mothers were tabulated, it appeared that those mothers having initially large litters tended to maintain larger litter sizes than those mothers having initially small litters. But exceptions were noted. The question arose as to whether or not one could predict on the basis of first-litter performance, or on the basis of the second-litter performance, or again, on the basis of the combined first- and second-litter performance, what the subsequent litter performance would be as well as what the whole litter record would be for each female.

Provisionally the data for these 163 mothers were so arranged that the calculated average litter size for all the litters of an individual mother who had all the way from 1 to a total of 20 litters was placed in a column according

to whether her first litter had 1, 2, 3, 4, 5, or 6 babies (maximum noted). Similar treatment was given to this data on the basis of whether her second litter contained 1, 2, 3, 4, or 5 babies (maximum found), and lastly on the basis of whether her combined first and second litter contained 2, 3, 4, 5, 6, 7, 8, or 9 babies (maximum size). These litter averages were then totalled for each column and a final average calculated for each litter size. It was found, without exception, that the larger the first litter alone, and the larger the second litter alone, and, again, the larger the combined first and second litters, the greater was the total average litter performance per average mother.

A second look at these data showed that there were increasingly fewer mothers who had a total of more than 6 litters. Only 114 mothers had a total of 6 or more litters. Assuming 100 or more mothers would suffice for a more reliable test of litter prediction, the data were similarly arranged for the first 6 litters only of each of these 114 mothers. When the final averages were calculated, it was found again that the higher the first, the second, and the combined first and second litter, the greater was the total baby yield per mother for her first 6 litters.

But since the preceding calculations were observed to be favorably loaded with the inclusion of the first, the second, and the combined first and second litters in the total litter performance, it was decided to subject the data to a statistical analysis.

Accordingly, the first litter size was excluded from the total output of the combined first 6 litters for these 114 mothers. Then the second litter size was excluded, and, in the third calculation, the sum of the first and second litters was excluded. It was found that, with a confidence coefficient equal to 0.95, one could predict on the basis of the first litter size what the estimated total number of babies would be in the first 6 litters, when the number of babies in the first litter was 1, 2, 3, or 4. There were insufficient data to make any reasonable estimates when the first litter contained 5 or more babies.

Table 2 presents a summary of the pertinent data basic to a prediction with 95 per cent confidence as to what the litter performance would be for the first 6 litters when the first litter contains from 1 to 4 babies. It should be added that similar statistical tests made with second litter excluded, and then with the combined first and second litters excluded showed a similar pattern, yet it was one which could in either case occur by chance alone; but the figures, with an exclusion of the second litter, appeared to represent less chance than the figures obtained by excluding the combined first and second litters. The biological reason for this state of affairs is not explained. No data are available on animal weights at the time of first impregnation to de-

TABLE 2. PREDICTION OF LITTER PERFORMANCE ON THE BASIS OF FIRST LITTER RECORD WITH 95 PER CENT CONFIDENCE

Number of Babies in First Litter	Limits for the Estimated Total Number of Babies in the First Six Litters	Estimated Total Number of Babies in the First Six Litters	Average Number of Babies per Litter	Total Number of Babies per Year per Mother (2 litters)
1	9.6-11.5	10.5	1.75	3.50
2	12.0-13.6	12.8	2.13	4.26
3	13.5-14.7	14.6	2.43	4.86
4	13.8-18.2	16.0	2.66	5.32
5 or more	Not enough data available to make any reasonable estimates.			

termine whether or not high first-litter size performance is related to body weight. Eckstein and McKeown (1955) demonstrated in the guinea pig that litter size was positively correlated with maternal weight at conception; they suggested that this association between litter size and weight is determined mainly by a positive correlation between weight and the number of ova produced. This association was independent of maternal age, and there was no significant correlation between size and age after correction for weight. Similarly Ibsen (1928) showed in the guinea pig that a substantial positive correlation between litter size and weight was independent of both age and parity, but that there was only a trivial correlation with age, and also a negative correlation with parity after correction for weight.

Summary and Conclusions

1. An analysis of the incidence of either sex among 2,855 *Chinchilla* babies showed a balance of 9.4 per cent more males than females. This is statistically significant. The sex ratio of future litters cannot be predicted from the sex ratio of the first litter.

2. The over-all average litter size for 217 females tended to begin with 2 babies per female per litter and to continue at that level throughout the reproductive period studied. Neither maternal age nor parity had any influence on successive liter sizes within the period studied.

3. An analysis of 2,855 *Chinchilla* babies of which 269 were defective to determine whether or not defective conditions at birth favored one sex over the other proved defects not to be related to sex. This finding was shown to be statistically significant. The percentage of defective young was the same in successive litters, but the percentage of defective babies increases with increase in litter size. Some mothers produce a larger proportion of defective young than others, but good producers have a smaller percentage of defective young than do poor producers.

4. A statistical study of the first 6 litters of 114 mothers who had 6 or more litters proved that one could predict with 95 per cent confidence, on the basis of the first-litter size, what the litter performance would be for the first 6 litters when the first litter contained from 1 to 4 babies. Predictions on the basis of the second, or first and second litters combined, were not reliably possible. No figures were available to determine whether high initial litter performance was related to maternal body weight at first conception.

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