Reports

Age of Weaning in Two Subspecies of Deer Mice

Abstract. *Weaning age in deer mice is defined as the age at which the young mice maintain or gain weight during a 24-hour period of isolation; mice younger than weaning age lose weight. Two subspecies of deer mice differed in weaning age; the age for* Peromyscus maniculatus bairdii *was 18 days; for* P. m. gracilis, *24 days. Age and food consumption were better predictors of the weaning condition, as defined in terms of weight change with isolation, than body weight.*

The weaning age in a young mammal is critical for its survival, important in the formation of its later behavior, and instrumental in determining the population dynamics of the species (*1*). Weaning is usually a gradual process resulting from the ability of the young to subsist on food other than mother's milk, and from the mother's resistance to nursing the young. Because of the many variables in this complex mother-young interaction, the age of weaning has not been established for many mammals. Determination of weight change after isolation was suggested by Read (*2*) as a means of establishing a minimum weaning age in mice. We have used a modification of his method to establish weaning age for two subspecies of deer mice which exhibit different rates of development (*3*).

The mice were from a laboratory colony of *Peromyscus maniculatus bairdii* and *P. m. gracilis* which had been maintained for approximately 13 years (*4*). Selection and inbreeding had not been deliberately carried out, but both had occurred to a certain extent.

The age of the young mice was established by checking pregnant females twice a day for births. A constant litter size of four young was maintained in order to eliminate any nutritional differences that would arise from differences in the size of the litters. Litters of less than four were not used. Litters of more than four were reduced to four during the first 3 days after birth of the young; the young were removed at random. The mice isolated and weighed at a given age were all from different litters. On an average, 13 *bairdii* were isolated and weighed for each age from 15 to 24 days and 13 *gracilis* were isolated and weighed for each age from 18 to 27 days. In all, individuals from 65 litters were isolated and weighed—124 *gracilis* and 122 *bairdii.*

Usually 4 to 12 mice of different ages were isolated each day, the number depending upon the ages of young in the colony. The young mouse was randomly selected from the litter, weighed, and placed alone in the test cage with food and water. Each test cage measured 6 by 12 by 6 inches and had a screen cover which supported the water bottle. A pellet (50 to 60 g) of Purina Mouse Breeder chow was held by a Hoffman tubing clamp over a screen-covered depression 1.5 inches in diameter. Twenty-four hours later the mouse was weighed again; the remaining food, including waste crumbs collected in the screened depression, was weighed; and the mouse was returned to the litter. Usually a littermate was selected for the succeeding test. The number of young being suckled in a litter was never less than three. The tests were begun at ages when most mice lost weight during the 24-hour isolation period, and they were terminated when all or most of the mice gained weight during the 24-hour period (Table 1). Age of the weaning was defined as the age at which the young first maintained or gained weight during the 24 hours of isolation.

A multiple regression analysis (*5*) of body-weight change with age and of total body weight yielded equations as follows (where y = change in body weight, x_1 = age in days, and x_2 = total body weight): for *gracilis*, $y = -1.989 + 0.131x_1 - 0.101x_2$; for *bairdii*, $y = -1.711 + 0.108x_1 - 0.024x_2$. The multiple correlations R were .606 for *gracilis* and .507 for *bairdii*. The first-order correlations between weight change and age, the slopes for age, and the multiple correlations were all significantly different from zero ($p <$ .05) in both subspecies. However, the first-order correlation between total body weight and weight change in

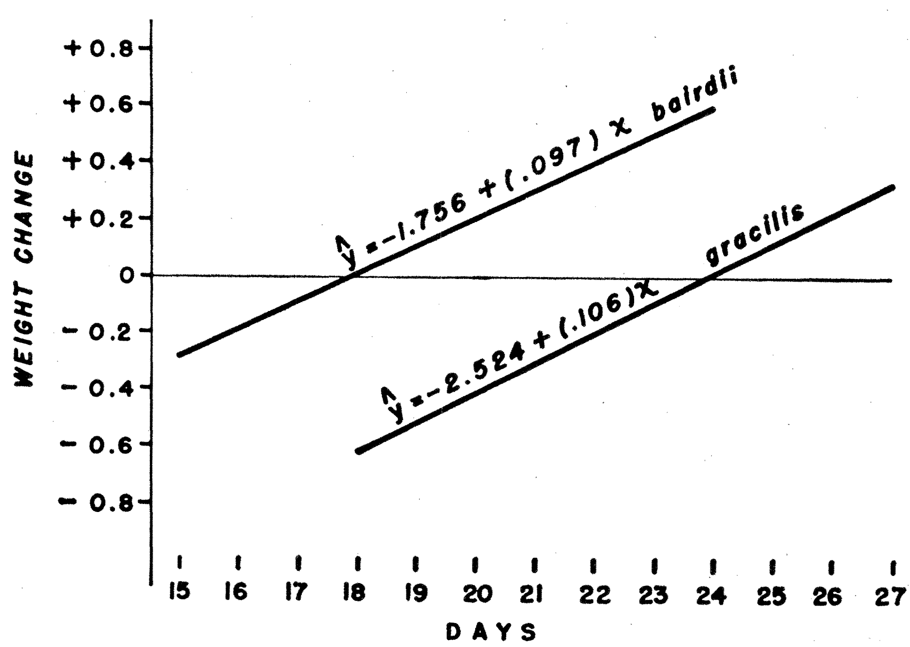

Fig. 1. Regression lines of mean weight change with age (in days) for *Peromyscus maniculatus bairdii* and *P. m. gracilis.*

Table 1. Numbers of individuals losing or not losing weight, and mean weight change at specified ages, in two subspecies of *Peromyscus maniculatus*.

Age (days)	Lost weight (*N*)	Gained weight (*N*)	Mean weight (g)	Percentage that lost weight
		P. maniculatus bairdi		
15	12	3	−0.4	80
16	8	5	−0.1	62
17	6	7	−0.1	46
18	4	9	0	31
19	5	8	+0.2	38
20	3	9	+0.2	25
21	2	11	+0.4	15
22	1	12	+0.2	8
23	1	6	+0.4	14
24	1	9	+0.6	10
Subtotal	43	79		
		P. maniculatus gracilis		
18	12	1	−0.6	92
19	13	0	−0.7	100
20	9	4	−0.3	69
21	9	4	−0.3	69
22	7	6	−0.2	54
23	4	9	+0.1	31
24	5	9	+0.1	36
25	3	10	+0.1	23
26	3	6	+0.1	33
27	3	7	+0.2	30
Subtotal	68	56		

gracilis ($r = .104$) was not significantly different from zero; also, the slope for total body weight in the foregoing equation for *bairdii* failed to reach significance ($t = .83$). Thus, the total-body-weight component appeared to be of little significance as a means of predicting weight change with isolation. This is demonstrated by a comparison of the multiple correlations (R) given above with the first-order correlations (r) between age and weight change: .564 for *gracilis*, .503 for *bairdii*.

Since the first-order correlations of mean weight change with age reveal as much as the multiple correlations, a linear regression analysis based on these variables was performed. The slopes illustrated in Fig. 1 are significantly different from zero ($t = 7.30$ for *gracilis*, 6.38 for *bairdii*) but are not significantly different from each other ($t = .39$; degree of freedom $= 241$). Tests of significance were made at the predicted values of 18 days for *bairdii* and 24 days for *gracilis* when the respective regression lines reached zero weight change rather than at the y intercepts, because the intercepts were for different days for the two subspecies. At 18 days of age *gracilis* lost significantly more weight than *bairdii* ($t = 3.599$; degree of freedom $= 224$). At 24 days of age *bairdii* gained significantly more weight than *gracilis* ($t = 3.970$; degree of freedom $= 244$). The regression lines suggest that 18 days may be accepted as the age of weaning in *bairdii* and 24 days in *gracilis*.

The amount of food consumed was not included in the multiple regression analysis because some values were discarded as representing tests in which consumption was atypical because the mice urinated on the food pellets. A product-moment correlation obtained from the remaining measures provided a positive correlation between weight change and food consumed in each subspecies (for *bairdii*, $r = +.78$; degree of freedom $= 108$; for *gracilis*, $r = +.74$; degree of freedom $= 110$). The behavioral measure of the amount of food consumed proved to be the best indicator of weight change with isolation, the criterion for age of weaning.

Weight change over 24 hours in isolation is an arbitrary criterion for age of weaning. Moreover, the technique of separating the young from the mother introduced many variables which would not occur under normal circumstances. Not only was the mouse deprived of the mother's milk but it was also removed from her warm body, from its littermates, and from the familiar cage when it was placed alone in a strange environment. It is possible that *gracilis* were more disturbed behaviorally by this change in environment than *bairdii* and thus were less able to maintain or gain weight in isolation. A previously reported differential response of the two subspecies to similar early environmental conditions supports the suggestion of a genotypic difference in behavioral responsiveness to isolation (*6*).

Peromyscus maniculatus gracilis is a forest-inhabiting subspecies and develops behaviorally and morphologically at a slower rate than the grassland-inhabiting *P. m. bairdii*. The more rapid development of *bairdii* and its earlier independence in getting food suggest that the grassland community and the forest community impose different selection pressures on the developmental and food-getting characteristics of *Peromyscus maniculatus* (*7*).

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A Stonefly Aquatic in the Adult Stage

Abstract. *An undescribed species of stonefly (Plecoptera) of the genus* Capnia, *taken in Lake Tahoe, California and Nevada, appears to pass its entire life history at depths of nearly 200 to at least 264 feet.*

Among aquatic insects only the Coleoptera, Hemiptera, and Diptera include recorded species which are adapted in both adult and immature stages for living in water (*1*). The adult, and often the pupa, of other aquatic insects are usually terrestrial. Therefore, it is of considerable interest to record the discovery of a species of stonefly (Plecoptera) that evidently passes its entire life history at some depth in Lake Tahoe in the Sierra Nevada of California and Nevada.

This stonefly is an undescribed species in the genus *Capnia*. Both sexes are apterous, and pigmentation is apparently more limited than in other members of the genus. Although they are of rather rare occurrence, wingless, adult stoneflies have been reported for several genera, including two recently described species of *Capnia* from western North America (*2*, *3*).

Unlike most aquatic insects, the adults of this species evidently do not respire at, or above, the water surface but acquire oxygen by absorption through the body covering as they crawl among the plants growing on the lake bottom. Certain bugs of the family Naucoridae depend on dissolved oxygen, and certain beetles—for example, some species of the family Dryopidae —capture and utilize bubbles of oxy-