

Some Observations on the Japanese Field Vole, *Microtus montebelli* (MILNE-EDWARDS) in Captivity I

Postnatal growth and development

By

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Summary : The experiment in this paper involves thirteen litters totalling from fifty to thirty-eight (20 females and 18 males) Japanese field voles, *Microtus montebelli* (MILNE-EDWARDS), born in captivity.

The young voles at birth are reddish in colour, hairless and blind. When the young are approximately one day old, the dorsal surface of the body becomes pigmented, and by two or three days of age fine hairs appear. The incisors erupt between the third and fifth day of age, the pinnae of the ears become erect by the fourth day, and the eyes open between the seventh and fifteenth day. The young are usually weaned when about twenty days of age.

Mean body weight and measurements at birth are as follows : weight ; $2.61 \pm .32$ grams, tail length ; $8.38 \pm .87$ mm and hind foot length ; $7.00 \pm .36$ mm. All the curves show a more rapid increase rate during the early period of growth than in the later. Various parts of the body, however, do not grow at the same rate. The hind foot reaches adult size much earlier than the tail. The hind foot and the tail have become fully grown by the twenty-fifth day and the fortieth day respectively. At the sixtieth day the weights are still increasing, although at a greatly reduced rate. It is also known that there is no sexual difference in body weights and dimensions at birth between the females and males of this species. The males, however, show an advantage over the females from about the third day up to the age of four months in body weight and all the dimensions.

Introduction

Much is not known about the growth and development of the Japanese wild small mammals, apart from some reports (e. g., SHIRAIISHI 1959 and 1969, HIRAIWA and HAMAJIMA 1960, KUMAZAWA 1964, ABE 1968, and IMAIZUMI and TSUJIMURA 1971). Similar studies were made, however, by dealing with domestic or laboratory animals such as lambs (KATADA 1963), cattle (KUMAZAKI *et al.* 1955), rats (KOYAMA *et al.* 1959), mice (MURAMATSU *et al.* 1965, and IBARAKI and NOMURA 1967).

The object of this experiment is to secure growth curves and to clarify developmental processes of the Japanese field voles, *Microtus montebelli* (MILNE-EDWARDS), born in the laboratory. This species of rodents was selected as material for the following reasons : they are the most abundant in numbers and most widely distributed of all our native mammals; great outbreaks of this species often cause much damage to not only farm products, but also forest products. It often becomes a serious pest to farms and forests in the region of its greater abundance.

Materials and methods

The voles involved in this experiment were from the laboratory stock initially captured at Sugadaira Plateau, Nagano Prefecture, Japan, during the spring of 1972. This included the litters born from the fourth of June to the seventh of September, 1973.

The voles were fed with a balanced solid food for the experimental rats and mice. In addition to this basic diet, sweet potatoes and cabbage trimmings were provided every day, and drinking water was supplied *ad libitum*. The voles were kept under artificial rearing conditions at 20~25°C. All cages containing mating pairs of voles were carefully examined daily and all new litters recorded. Notes on the subsequent development process of the young voles were taken for each litter in parallel with the growth data.

Weights in grams and measurements in millimeters of a maximum of fifty and a minimum of thirty-eight voles (20 females and 18 males), or thirteen litters which ranged in size from one to seven and averaged 3.8 voles per litter (Table 1), were taken every five days at ages between ten and one hundred and twenty days, although the young, from birth to the age of ten days, were weighed and measured at two or three-day intervals. Tail length was measured from the rump to the tip of the tail. Hind foot length was measured from the heel to the tip of the middle toe.

Table 1. Number of voles used in the present study

Litter size	No. of litters	No. of individuals
1	2	2 (1)
2	1	2
3	2	6 (1)
4	4	16 (4)
5	1	5 (1)
6	2	12 (5)
7	1	7
Total	13	50 (12)

() : Dead ones during the present study

The measurements and weighing were all made by the author in order to avoid any personal error.

In reckoning, the day of birth was considered as the zero day.

Results

At birth the young voles are reddish in colour, hairless, with eyes closed and ears closed by the pinnae folding down over the otic opening. The back of the young becomes pigmented within a short time, usually twenty-four hours. When the voles were from two to three days old, a few dandruff-like flakes of epidermis became visible on the back. The incisors are visible just below the surface of the gums by the third to fifth day of age. By the fourth day the pinnae of the ears become unfolded and erect. The time required for the eyes to open varies from seven to fifteen days. The more or less gradual process of weaning is usually completed by about the twentieth day. The stomach of a young vole killed in inter-

necine struggle at about twenty days of age contained only solid food. At sixty days of age body weight and tail length are still growing slightly, though in general appearance they have become fully matured.

The tail lengths of the newly born voles varies from 6.0 to 10.2 mm with a mean of $8.38 \pm .87$ mm. Increase in tail length is most rapid until about the twentieth day, when the tail length is about from 3.5 to 4.0 times as long as it was at birth. A break in the growth curve occurs after this time and by the fortieth day the tail length becomes nearly that of an adult in size. The mean value at this time is 35.91 ± 2.69 mm for females and 39.55 ± 2.95 mm for males. The mean value at the 120 th day is 38.81 ± 3.12 mm and 45.36 ± 3.96 mm respectively (Figure 1).

The length of the hind feet of newly born voles varies from 6.2 to 7.8 mm with a mean of $7.00 \pm .36$ mm. Growth is most rapid up to about the fifteenth day. By this time the original mean length becomes more than doubled. Its growth then slows down and by the twenty-fifth day it attains practically the size of an adult (Figure 2).

In weight the baby voles varies from 2.0 to 3.4 grams with a mean of $2.61 \pm .32$ grams on the day of birth. The rate of increase is a gradual but constant one, and the vole gains about from 0.67 to 0.77 grams a day. By the thirtieth day the mean weight increases as much as about from 9 to 10 times. At sixty days of age the mean weight of the voles is 25.57 ± 4.09 grams for females and 37.13 ± 7.46 grams for males. Thereafter, body weight continues to grow at a perceptible rate up to at least four months of age, when the mean weight is 31.53 ± 6.41 grams and 45.21 ± 9.08 grams respectively (Figure 3).

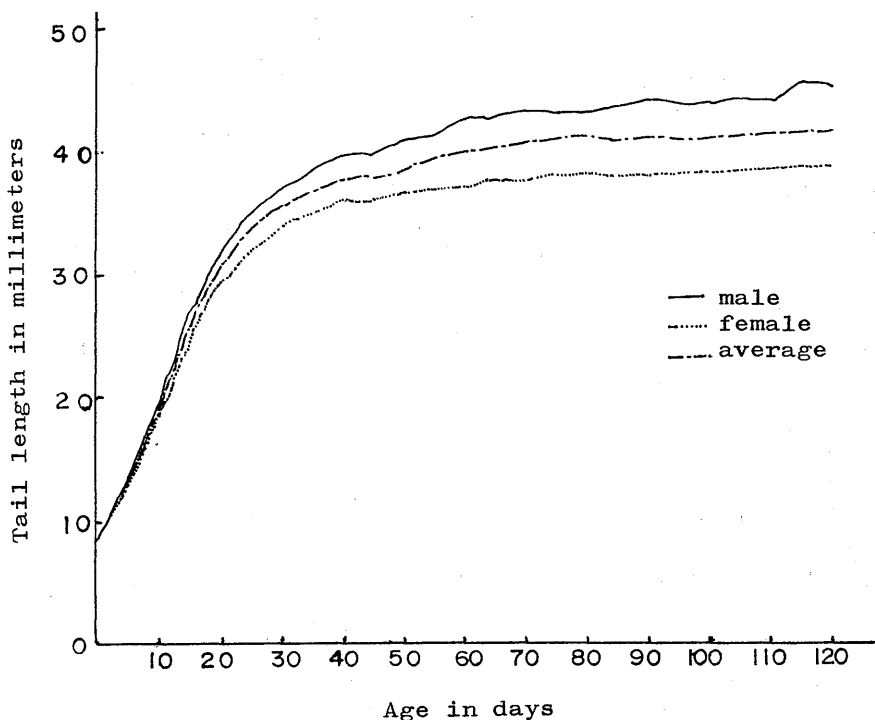


Fig. 1 Growth in length of tail of *Microtus montebelli*.

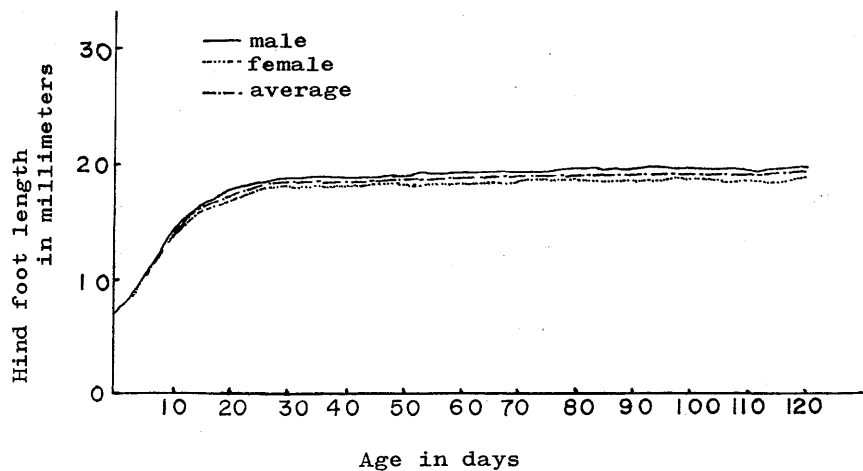


Fig. 2 Growth in length of hind foot of *Microtus montebelli*.

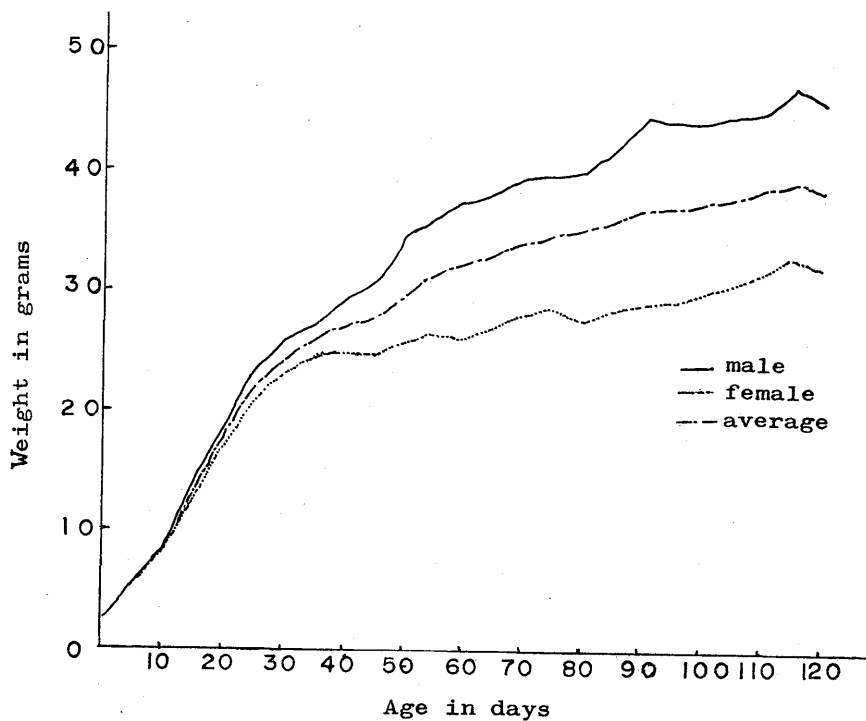


Fig. 3 Growth in weight of *Microtus montebelli*.

Discussion

As shown by the figures presented above, the voles grow most rapidly during their early life, after which the rate of growth gradually decreases. The various parts of the body, however, do not increase at the same rate, but they reach adult size at somewhat different stages of age. The hind foot grows to maturity much earlier than the tails. By the end of weaning on about the twentieth day, the mean hind foot length is almost adult in size, and the mean tail length of adult is more than 3.5 times as long as its original length. Although the weaning process usually begins when the eyes open from about the seventh to fifteenth day, the young voles are still dependent upon their mother's milk. On about the twenty-first day after the first parturition (SHIRAIISHI 1969), the second litter are usually born, and the young of the first litter are forced to take care of themselves. At this time their diet changes and their activities are greatly increased. Thus, at the time when the young begin to go out from the nest after weaning, important structure such as hind foot is well developed and functions fully. The mean weight shows the biggest increase and reaches about from 9 to 10 times that at birth by the thirtieth day. At sixty of age the weight of these voles is still increasing, although at a slow rate.

Comparing the females and males, there is no sex difference at birth in all dimensions of growth, but from about the third day onward the males maintain a slight advantage over the females, followed by a widening space between the two sexes up to about the sixtieth day in the weight and tail length. Thus in the adult voles the males are heavier and have somewhat longer tail length. There is, however, only a slight difference between both sexes in the hind feet length. Sex can not be positively determined until the age of three days. By this time teats become clearly visible in females.

There is a more or less perceptible slowing down in the rate of increase in body weight at about the thirtieth day. This slow rate of the growth may be due in part to insufficient food or crowding in some litters, but probably in part to the approach to sexual maturity (CLARK 1938). Some females have come into estrus at a much earlier age, the youngest does at 30 days old. These ages of attaining sexual maturity correspond almost with the ages at which the young voles slow down the rate of growth.

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References

- 1) ABE, H. : Growth and development in two forms of *Clethrionomys*. 1. External characters, body weight, sexual maturity, and behavior (in Japanese). Bull. Hokkaido Forest Exp. St., 6, 69~89, (1968)
- 2) CLARK, F. H. : Age of sexual maturity in mice of the genus *Peromyscus*. Jour. Mamm., 19, 230~234, (1938)
- 3) HIRAIWA, Y. and F. HAMAJIMA : The life history of the Japanese mouse, *Mus molossinus* TEMMINCK and SCHLEGEL IV. Postnatal development of the sucklings and growth after birth (in Japanese). Sci. Bull. Fac. Agric. Kyushu Univ., 18, 2, 175~179, (1960)
- 4) IBARAKI, T. and S. NOMURA : Studies of the growth in ICR-JCL mice. I. Biometric study of proportional physical growth (in Japanese). Bull. Exp. Anim., 16, 1, 1~11, (1967)
- 5) IMAIZUMI, Y. and M. TSUJIMURA : Postnatal physical and behavioral development of the Japanese wood mice, *Apodemus agrenteus agrenteus*. Bull. Tokyo Med. Dent. Univ., 18, 81~94, (1971)
- 6) KATADA, A. : Statistical genetics of body weight and body size measured at different months of age in corriedale lambs in Japan. Rep. No. 63. Hokkaido Nat. Agr. Exp. St., 1~80, (1963)
- 7) KOYAMA, R., T. KAMEI, and T. FUJII : Studies on the allometric growth of the body weight and tail length to the body length in rats (in Japanese). Med. Biol., 51, 1, 3~8, (1959)
- 8) KUMAZAKI, K., H. TANAKA and Y. KIHARA : Studies on the growth of Japanese breed of cattle. I. (in Japanese), Bull. the Chugoku Agr. Exp. St., 4, 73~108, (1955)
- 9) KUMAZAWA, S. : The growth of *Microtus montebelli* (in Japanese). Mamm. Sci. No. 7, 26, (1964)
- 10) MURAMATSU, S., J. HAYAKAWA, and T. TSUCHIYA : The change in the external appearance of growing mouse (in Japanese). 12th Ann. Meet. Exp. Anim., 14, 3, 121, (1965)
- 11) SHIRAISHI, S. : The growth of the Japanese harvest mouse, *Micromys japonicus* (THOMAS). I. The change in the external characters of the suckling young (in Japanese). Jour. Mamm. Soc. Japan, 1, 6, 121~127, (1959)
- 12) SHIRAISHI, S. : The growth of the Japanese field vole, *Microtus montebelli* (in Japanese). Trans. 80th Ann. Meet. Jap. For. Soc., 259~260, (1969)

飼育下における日本産ハタネズミの研究 (第I報)

出産後の成長と発育

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摘 要

この研究に使用した材料は、1972年の春に長野県・菅平地域で生け捕りされたハタネズミ *Microtus montebelli* (MILNE-EDWARDS) を、人工飼育条件下で約1年間繁殖させたものを用いた。すなわち任意に抽出された13腹、最大50頭から最小38頭(雄18頭、雌20頭)の子獣を材料にして、生後より120日齢までの発育、成長過程における外部形態の変化について観察した。なおハタネズミは本州・九州地区において、しばしば造林木などに大被害を与える害獣である。

新生子の体色は肉塊色、無毛で、両眼は閉じている。生後2～3日齢になると背面部の暗色は増し、白細毛が見え始める。切歯は3日齢になると一部が生え始める。開眼は生後7日齢より始まり、15日齢にはほとんどの個体が開眼する。離乳は生後20日齢までには終了する。新生子の体重、尾長および後足長はそれぞれ $2.61 \pm .32$ g, $8.38 \pm .87$ mm および $7.00 \pm .36$ mm であり、生後3日めですでに各形質ともに雌雄差がみられ、雄は雌より大きい値を示した。その後生時からの直線的な成長は後足長、尾長、体重の順にとまり、しだいにゆるやかになった。