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Bożenna W O J C I E C H O W S K A

The Growth and Net Production in the Common Vole During Postnatal Period

[With 4 Tables & 3 Figs]

The litter size in *Microtus arvalis* (Pallas, 1778) depends on the female body weight. In individuals of 15—30 g of biomass the average litter consists of 4.9 new-borns, and in heavier females (30—45 g) — of 5.9. The weight of a new-born vole is not related to the female weight and ranges from 1.26 to 2.64 g (avg. = 1.8 g). The net production due to reproduction estimated for average European conditions amounts in this species to 50.9 kcal/litter. The amplitude of body weight changes during a year is equal to 7.15 g for males and 8.32 g for females. The determinations carried out in field conditions show the agreement of results obtained either from the material deriving from snap-traps or by repeated weighing of the same individuals.

I. INTRODUCTION

The purpose of the present study was to evaluate the net production of suckling *Microtus arvalis* (P a l l a s, 1778) in the period from birth until weaning. The effect of mother body weight and litter size on the production was estimated. Moreover, the information on the increase of weight of adult specimens in natural conditions was compared.

The net production in the postnatal period of small rodents comprises an important section of the production process in a population. In this period a significant proportion of the produced energy is transferred to a higher trophic level. The estimation of these processes on the ground of hitherto employed methods of field studies is impossible. The new-born rodents cannot be trapped and subjected to repeated weighing in natural conditions hence all data concerning the biomass production are based on laboratory results. *M. arvalis* is easily bred in the laboratory and owing to this fact first studies on the increase of biomass in the nest

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period go back to the beginning of our century (Rörig & Knoche, 1916). Until now this problem has been resumed by many authors and the relevant literature was selected by Bashenina (1962). In the present study an attempt was made to employ laboratory observations for the estimation of production in natural conditions.

II. MATERIAL AND METHODS

The data concerning the increase of biomass of baby voles were collected in the laboratory stock during 1966—67. In this period 99 litters of the common vole were investigated. The body weight was determined on a technical balance with the accuracy of 0.01 g. The suckling voles were weighed once in a day from the moment of birth during the whole lactation period (17 days). The body weight of a female determined immediately after parturition corresponds in approximation to her weight at the moment of fertilization.

The data on seasonal changes of weight of adult individuals in natural conditions were obtained by weighing the specimens captured every month in snap-traps. The increases of body weight of the same specimen were determined by weighing in field conditions the males and females captured repeatedly in live-traps during 1967.

III. RESULTS

1. Average Increase of Body Weight after Birth

The average weight of an individual immediately after birth varies between 1.26 and 2.64 g and is equal to 1.79 g on the average. Bashenina (1962) obtained the range of 1.2—2.3 g in the material of 2000 litters, and Reichstein — 1.0—3.1 g (Stein, 1958). In all cases the average values are similar. The body weight increments (Fig. 1) during 36 days after birth are more or less proportional to time. The increased rates of growth between 21st and 28th day of life, reported by Rörig & Knoche (1916) and Bashenina (1962), were not observed in this study. Such trend could be traced in the growth curves of some specimens only. On the other hand the accelerated rate of the biomass increase was found between 12th and 18th day of life. In the first 11 days the average increase of body weight amounts to 0.296 g/day while during the period of 12—18 days is equal to 0.536 g/day. Hence the rate of production during last days of lactation increases by approximately 1.8 times. The average weight of a baby vole on 17th day amounts to 9.18 g and exceeds by five times the weight of the new-born. The net production during the lactation of a female is equal to 7.39 g, and after assuming the caloric value of biomass as equal to 1.3 kcal/g (Grodziński & Górecki, 1967) it amounts to 9.607 kcal/individual.

2. Effect of the Female Weight on the Litter Size

The number of born and reared young voles constitutes another element qualifying the net production. The litter size varies to some extent in relation to the season, female age, and other factors. In laboratory investigations, when the animals live in optimum conditions, the female weight becomes a decisive factor in the production. Less heavy

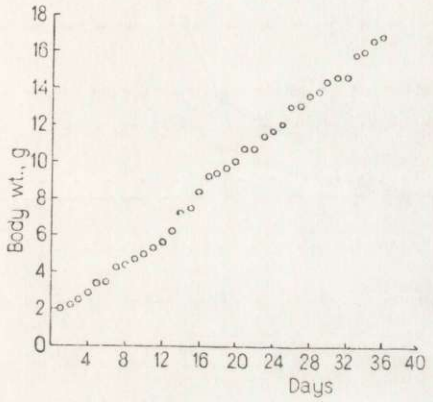

Fig. 1. The body weight of new-born voles in consecutive days of postnatal life.

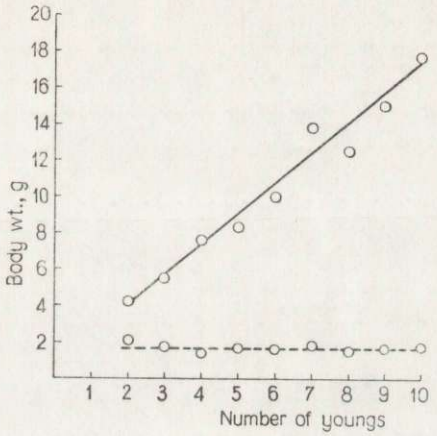

Fig. 2. The effect of litter size on the body weight of new-borns (broken line) and on the litter weight (solid line).

Table 1.

The effect of the female body weight on the litter weight in *Microtus arvalis*.

Females body weight			Sucklings			Production netto kcal/litter
Average	Observed range	Number	No per litter	Average body weight of individual	Average weight (g) of a litter	
24.6	15.0—29.9	67	4.92	1.80	8.87	11.53
34.9	30.0—45.0	32	5.96	1.79	10.73	13.95

females, around 25 g of body weight, give birth to 4.9 young voles on the average whereas the females around 35 g of body weight give birth to almost 6 young voles (Table 1). The production of a heavier female is higher by 2.5 kcal (ca 18 %) in comparison with the lighter one.

The weight of a new-born shows no relationship to the female weight (Table 1) or litter size (Fig. 2) and is constant independently of the number of born specimens.

3. The Effect of Female Weight and Litter Size on the Growth Rate of Young Voles

During first 10 days after birth the weight increments of suckling voles are independent of mother's weight (Fig. 3) and amount to 0.26 g/day. The situation undergoes a change only in the subsequent period of lactation when the weight increases of the whole litters amount to 1.06 g/day in larger females and are almost three times lower in lighter

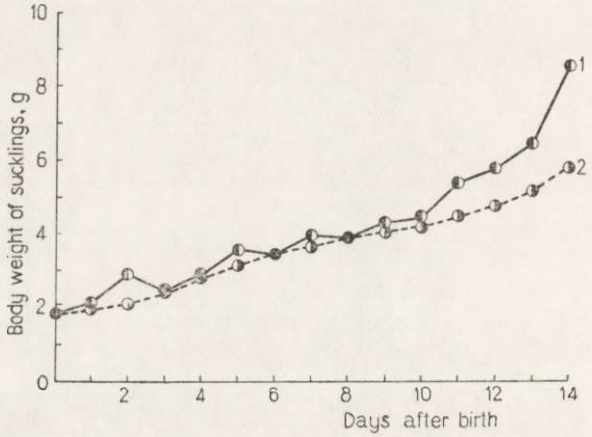

Fig. 3. The effect of body weight of *Microtus arvalis* females on the increase of biomass of young voles; 1 — females of the body weight of 30—40 g; 2 — females of the body weight of 25—30 g.

females (only 0.37 g/day). The litter size has no influence on the rate of increase of the biomass of young voles. Despite differences in the initial weight the curves of weight increase for litters of various size are in principle parallel.

4. Seasonal Changes of the Body Weight of Individuals

The individuals captured many times by means of live-traps show bi-directional changes of the body weight. In all annual seasons some specimens show the increase, and others the decrease of the biomass. The highest percentage of specimens losing weight (48.8%) was found in winter, and in the remaining seasons a marked predominance of voles gaining weight is visible. The highest proportion of specimens putting on weight was observed in spring (85.3%), and slightly less in the summer-autumn period (77.8%). Within the whole year the specimens gaining weight constitute 68.4% of the population, and those losing weight 31.6%. The average daily increase of body weight of males amounts to 0.043 g/day and of females to 0.059 g/day, hence in this latter case is higher by 37%. The rate of daily growth (Table 2) is highest in the

summer-autumn period and smallest in winter. The compared data represent the weighted average of all increases and losses of body weight specimens observed in a given time.

Seasonal changes of body weight (Table 3) may be also estimated from the data obtained from snap-traps. The average weight of females increases more or less uniformly from the middle of February until July when it reaches over 22 g. The decrease of body weight observed

Table 2.

Increases of body weight in *Microtus arvalis* in various seasons of the year determined by multiple captures.

Season	Number of individuals	Increase per individual G	Period of time E (days)	$\frac{G}{E}$
Spring	34	0.67	11.9	0.056
Summer-Autumn	18	1.22	12.4	0.096
Winter	43	0.40	14 6	0.027
Year	95	0.65	13.2	0.049

Table 3.

Seasonal changes of the body weight of *Microtus arvalis* in 1967 based on the field data.

Month	Females		Males		♀♀ + ♂♂
	n	$\bar{G}$	n	$\bar{G}$	$\bar{G}$
January	23	14.72	31	15.09	14.93
February	18	14.10	31	14.75	14.51
March	26	16.15	40	17.16	16.75
April	18	16.64	28	19.49	18.51
May	11	18.83	7	19.36	19.04
June	14	21.16	10	20.81	20.01
July	16	22.42	7	18.84	21.33
August	13	19.38	2	21.90	19.72
September	7	16.41	6	17.98	17.08
October	1	16.10	2	14.98	15.32
November	—	—	2	23.30	23.30
December	—	—	—	—	—

in subsequent months results probably from a higher proportion of juvenile specimens in the population. In males the minimum average body weight falls also on February and in the remaining months some variations are observed. The amplitude of observed changes during the whole year amounts to 8.32 g in females and 7.15 g in males. The females are heavier than males during two months only. The average body weight of females is higher than that of males in June by 0.35 g

and in July by 3.58 g. Daily increments of weight of females between February and July amount to 0.054 g and for males to 0.039 g. These data are quite close to the average increase obtained by multiple weighing of the same specimens.

The average net production during lactation ranges from 10 to over 57 kcal depending on the litter size (Table 4). Assuming that the production corresponds to the biomass of young voles on the last day of lactation, and that the average number of embryos for the whole po-

Table 4.

The average net production in *Microtus arvalis* during lactation.

Item		Litter size					
		1	2	3	4	5	6
Biomass	Initial	1.79	3.58	5.37	7.16	8.95	10.74
	Final	9.18	18.36	27.54	36.72	45.90	55.08
	Increase	7.39	14.78	22.17	29.56	35.95	44.34
Production, kcal		9.607	19.214	28.821	38.428	46.735	57.642

pulation of *M. arvalis* is equal to 5.3 (after Naumov, 1948; and Bashenina, 1962), then the net production will be amounting to 50.917 kcal/litter.

IV. DISCUSSION

The presented results of investigations of the body weight increase in *M. arvalis* during postnatal period remain in general agreement with those reported by other authors (Bashenina, 1962). Some discussion is only required to explain differences in the rate of the biomass increase between 1—11 and 12—18 days of life which were not observed by other authors. A marked increase of body weight of suckling voles in the last week of lactation seems to be not accidental. It is accompanied by a vehement rise of females metabolism in this period (Trojan & Wojciechowska, 1967). The organism of a mother in the final stage of lactation gives more intensively its reserves to the offspring than at the beginning of this period. This trend is also reflected by a stronger decrease of the female body weight in this period. Such phenomenon was observed in all investigated litters and is very likely that it occurs not only in the laboratory but in field conditions as well.

The application of the laboratory data for the estimation of the population production due to reproduction in field conditions requires that

two additional phenomenons should be taken into consideration: reduction of the number of young voles which in natural conditions may be more pronounced than in the laboratory, and the effect of the female body weight on the growth rate of biomass of suckling voles. Independence of the biomass increase and the litter size (Fig. 2) excludes in principle any eventual effect of reduced number of suckling voles on the production process. The observed differences in the biomass increase of baby voles in relation to the female body weight cannot be applied in the estimation of production in field conditions, since females observed in natural conditions (Table 3) belong to the group of lighter animals and specimens of the body weight over 30 g are encountered there only exceptionally. Thus the employed method of estimation allows to obtain an approximate evaluation of production due to reproduction in natural conditions.

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WZROST I PRODUKCJA NETTO U *MICROTUS ARVALIS* (PALLAS, 1778) W OKRESIE POSTNATALNYM

Streszczenie

Oceniono produkcję netto w okresie od urodzenia do rozpoczęcia samodzielnego pobierania pokarmu, oraz wpływ ciężaru ciała samicy na liczbę i ciężar osobni-

ków urodzonych. Wnioski oparto na materiale 99 miotów z hodowli laboratoryjnej. Dane odnośnie zmian ciężaru ciała osobników dorosłych zebrano w terenie w roku 1967.

Ciężar samicy wpływa na liczbę urodzonych w miocie (Tab. 1). Średnia liczba noworodków dla samic w klasie ciężaru 15—30 g wynosi 4,9; dla samic o ciężarze 30—45 g odpowiednio 5,9. Ciężar osobników urodzonych jest niezależny od ciężaru samicy i wynosi średnio 1,8 g. Wyróżniono dwa okresy w czasie laktacji charakteryzujące się różnym tempem przyrostu biomasy osesków; pierwszy od urodzenia do 11 dnia życia, drugi w 12—18 dniu życia. W okresie pierwszym tempo przyrostu biomasy wynosi 0.296 g/osobnika/dobę, w drugim 0.536 g/osobnika/dobę. Produkcja netto dla przeciętnego miotu liczącego 5,3 osobnika wynosi 50,9 kcal/miot.

Na podstawie wielokrotnych ważeń w terenie określono sezonowe zmiany ciężaru osobników *M. arvalis*. Osobniki zwiększające swą biomasę stanowią w skali rocznej 68,4%, pozostałe osobniki tracą na ciężarze ciała. Przeciętny dobowy przyrost biomasy samców wynosi 0.043 g a samic 0.059 g. Podobne dane uzyskano zarówno przez wielokrotne ważenie osobników przyżyciowo jak osobników zabijanych. Minimalny ciężar ciała osobników przypada na miesiąc luty, maksymalny dla samic na lipiec, dla samców na listopad.