A C T A T H E R I O L O G I C A

VOL. XIII, 25: 427—433. BIAŁOWIEŻA 30.X.1968

Gabriela BUJALSKA & Joanna GLIWICZ

Productivity Investigation of an Island Population of *Clethrionomys glareolus* (Schreber, 1780). III. Individual Growth Curve*)

[With 2 Figs. & 1 Table]

An individual curve of growth of males was drawn for four cohorts and a mean for one free-living population of *Clethrionomys glareolus*. In the case of trappable animals (from about the 43rd day of life) empirical weights of individuals of a known age (the whole population was marked) were taken as a basis, and in the case of young individuals up to the first capture the shape of the growth curve for laboratory animals was used, correcting the values by data obtained from field investigations. The growth curves of individuals born in the early spring and the autumn are almost identical. The weight of overwintered animals is uniform for all the cohorts.

Investigations of the variations in numbers of an isolated population of *Clethrionomys glareolus* (Schreber, 1780) living on an island in Lake Bełdany, where the whole trappable part of the population was marked with individual numbers and recaptured several times (Table 1), supplied data on the weight of individuals. Monthly censuses carried out by the »general census« method lasting for two weeks made it possible to define the relatively short time in which young animals were born (34—56 days) and define the mean day of birth of individuals (Bujalska *et al.*, 1968; Petrusewicz *et al.*, 1968) registered during the next census. This in turn made it possible to distinguish four cohorts, that is, groups of individuals born within a relatively short time during the study season (Gliwicz *et al.*, 1968) and to trace their subsequent fates up to their death.

The age of the cohort at a given moment was taken as the time from the mean balanced date of birth of a given cohort up to that moment.

* This study was carried out under the Small Mammal Project of the International Biological Programme in Poland.

These materials were used to draw individual curves of growth of the trappable part of the population for different cohorts (Fig. 1). The curve of individual growth from about the 43rd day of life was thus based completely on empirical material from the area, the absolute age being defined in days. The estimate of mean age and weight is burdened with some error. As however the mean value of age and weight were used, the age of the cohort attributed to the given weight might differ from the real age only by a few days at most.

When calculating the growth curve of the trappable part of the population only the weight of the males was taken as a basis. Exclusion of females from these calculations would appear justified for two reasons. During some periods of the population there is a large number

Table 1.

Numbers and average age of individuals of *Clethrionomys glareolus* belonging to different cohort ($K_1 - K_4$) during successive censuses.

Cohorts \ Census		16th June 1966	31st July	18th Sept.	2nd Nov.	29th April 1967
K_1	N	114	80	51	32	12
	age (days)	42	87	136	181	359
K_2	N	—	203	164	111	51
	age (days)		42	91	136	314
K_3	N	—	—	41	16	5
	age (days)			47	92	—
K_4	N	—	—	—	6	0
	age (days)				53	—

of pregnant females, the weight of which consists both of the weight of their own body and of the embryos. Inclusion of these females would distort the picture of growth rate of the average individual. In addition comparison during the period June—November 1966 of the weight of non-pregnant females from cohorts $K_1 - K_3$ with the weight of males of the same cohorts did not reveal any statistically significant differences between them [1]). The fact, known in literature (Bergstedt, 1965) of different growth rate of males and females was thus not observed. It was taken that growth curves describe the average individual belonging to the given cohort.

[1]) On account of the small numbers of cohort K_4 this comparison was not made.

Information on the growth rate of individuals from birth up to the first capture was based primarily on data in literature (D r o ż d ż, 1965). These data, however, refer to bank voles living under laboratory conditions and the growth rate is markedly overestimated in comparison with field conditions. This is shown by the body weight of individuals at the time of the first capture. The minimum weight recorded was 7 g (found in 11 individuals), which according to D r o ż d ż (1965) corresponds to the weight of young animals about 13 days old. It is,

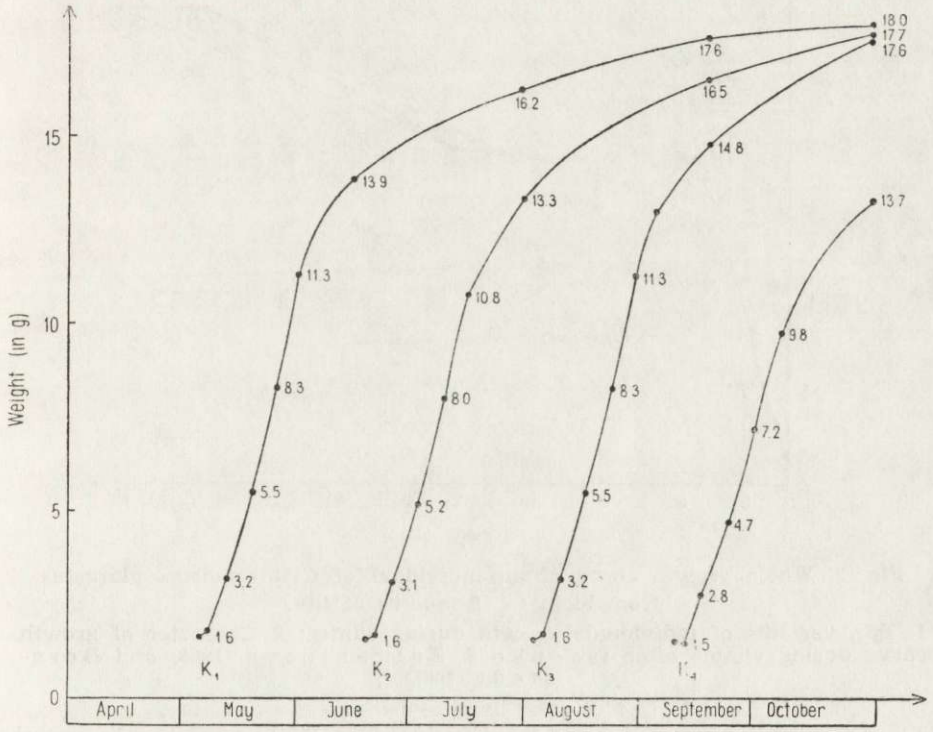

Fig. 1. Growth curves of individuals of *Clethrionomys glareolus* belonging to different cohorts (K_1—K_4).

however, known from the biology of this species (S v i r i d e n k o, 1959) that young animals of this age are not yet capable of leading even a semi-independent life, and it would be difficult to suppose that they would be capable of leaving the nest and getting caught in the traps.

The growth curve of body weight was therefore reduced by means of the following method. The ratio of body weight possessed by voles under laboratory conditions at an age corresponding to the mean weight of the given cohort on the day of the first capture was defined in rela-

tion to the mean body weight of voles belonging to the cohort for which we desire to draw a growth curve. The quotient of these values served as an index by which the successive points on the growth curve of captive voles fed on standard food (D r o ż d ż, 1965), were reduced. Similarly, on the basis of the mean balanced weight of cohorts K_1 — K_4 (13.7 g) and their mean balanced age (43 days) at the time of capture, a general curve of growth was drawn for the young animals from the time of birth to their first capture (Fig. 2).

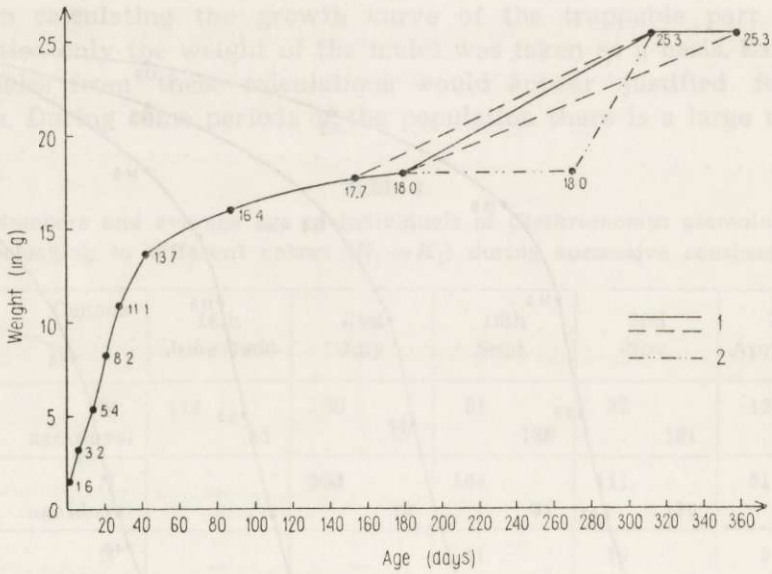

Fig. 2. Whole growth curve of an individual of *Clethrionomys glareolus* from birth to 12 months of life.

1. Two variants of individuals' growth during winter; 2. Character of growth curve during winter after I l y e n k o & Z u b č a n i n o v a (1965) and B e r g s t e d t (1965).

One common curve of growth (Fig. 2) describing changes in weight of an average male (and non-pregnant female) during the reproduction period irrespective of the time the animal was born and entered the trappable part of the population, was formed from the mean values of weight of trappable individuals in the various cohorts obtained from successive censuses.

For this purpose the weighed mean was calculated from the mean weight of different cohorts during the census, during which they were caught for the first time: that is, from the weight of K_1 on June 16th, the weight of K_2 on July 31st, K_3 — Sept. 18th and K_4 — Nov. 2nd. The balanced mean of weight caculated in this way was placed on the point indicating the mean age of individuals caught for the first time

(balanced mean from age of K_1, K_2, K_3 and K_4) *i. e.* at the age of 43 days (Table 1).

Identical procedure was followed for the weight of cohorts at the next point of time, *i. e.* after 46 days (mean from intervals between the first and second census for each cohort). There are no data for cohort K_4 which occurred only in one census, the final one for the season.

The next point was drawn analogically on the basis of the weight of K_1 and K_2 after the lapse of 93 days from the first capture of these individuals. Finally the last point of the curve is solely the weight of cohort K_1, since it was only possible to trace increase in weight for a period of 138 days for these individuals, from their first census (in June).

A section of the growth curve was obtained in this way from the 43rd to 181st day of the life of individuals which survived to trappable age.

The character of changes in the weight of individuals during the winter is not known for this population, since no measurements of weight were made from November to April of the following year. For individuals which overwintered the differences between mean values of weight of the various cohorts was not statistically significant in April 1967. It may therefore be assumed that all the overwintered animals were of uniform weight. When the curve of growth is continued difficulties arise due to the fact that individuals of uniform weight in April vary in age: K_1 on an average 359 days old (more accurately after Petrusewicz *et al.*, 1968, from 337—370 days old), K_2 average — 314 days (more exactly 292—337 days), K_3 — 267 days (more exactly 245—292 days) and K_4 — 221 days [2]) (more exactly 209—239 days). As only a few individuals from cohort K_3 (5) survived the winter, and no individual survived from cohort K_4, further reasonings were based only on individuals from the early spring cohort K_1 and the late spring cohort K_2.

In the autumn of 1966 the average age of individuals from cohort K_1 was 181 days, and thus in April 1967 they were 359 days old. As there are no intermediate points of assessment of the weight of these individuals, changes in the weight of K_1 can only be presented by a straight line [3]) connecting these two weight estimates. Analogically the point

[2]) For K_4 age is calculated theoretically, since in reality no individual from this cohort survived the winter.

[3]) Ilyenko and Zubianinova (1963) did not observe growth in *C. glareolus* during the winter period until February, and Bergstedt (1965) until the end of March, when a sudden increase in the weight of individuals took place (Fig. 2). As no measurement of the weight of individuals was carried out during the period from November — April and the moment of acceleration of growth rate is unknown, it was assumed that growth during this period takes the form of a straight line.

indicating the weight of K_2 in the autumn of 1966 at the age of 136 days can be connected by a straight line with the April 1967 point, *i. e.* at the age of 314 days.

On the basis of data on the weight of K_1 and K_2 jointly, however, the combined curve of growth can be drawn.

On the basis of data on the weight of K_1 and K_2 jointly, however, the combined curve of growth can be drawn.

The final April estimate of weight covered individuals of K_1 at the age of 359 days, but on the basis of data on K_2 it was known that by the age of 314 days they had already attained the same weight as the older K_1. It is therefore possible to connect the point indicating the weight of K_1 in November (18.0 g at the age of 181 days) with a point indicating the weight of individuals in the spring at the age of 314 days (25.3 g) and draw a straight line on this same level to the age of 359 days 25.3 g).

REFERENCES

1. Bergstedt B., 1965: Distribution, reproduction, growth and dynamics of the rodent species *Clethrionomys glareolus* (Schreber), *Apodemus flavicollis* (Melchior) and *Apodemus sylvaticus* (Linné) in soutern Sweden. Oikos *16*: 132—160.
2. Bujalska G., Andrzejewski R., Petrusewicz K., 1968: Productivity investigation of island population of *Clethrionomys glareolus* (Schreber, 1870). II. Natality. Acta theriol., *13*, 24: 415—421.
3. Drożdż A., 1965: Wpływ paszy na dojrzewanie samców nornicy rudej (*Clethrionomys glareolus* Schr.). Zwierz. Lab. *3*, 1: 34—45.
4. Gliwicz J., Andrzejewski R., Bujalska G. & Petrusewicz K., 1968: Productivity investigation of island population of *Clethrionomys glareolus* (Schreber, 1870). I. Dynamics of cohorts. Acta theriol., *13*, 23: 401—413.
5. Ilyenko A. J. & Zubčaninova E. V., 1963: Kruglogodičnyje nabludenia za mečenymi ryžimi polevkami i lesnymi myšami v Podmoskove. Zool. Žurn., *42*, 2: 609—617.
6. Petrusewicz K., Andrzejewski R., Bujalska G. & Gliwicz J., 1968: Productivity investigation of island population of *Clethrionomys glareolus* (Schreber, 1870). IV. Production. Acta theriol., *13*, 26: 435—445.
7. Sviridenko P. A., 1959: Rost i rozvitie evropeiskoi ryžei polevki (*Clethrionomys glareolus* (Schreb.). Zool. Žurn., *38*, 5: 756—766.

Received, April 30, 1968

Institute of Ecology,
Polish Academy of Science,
Warszawa, Nowy Świat 72.

Gabriela BUJALSKA & Joanna GLIWICZ

BADANIA NAD PRODUKTYWNOŚCIĄ WYSPOWEJ POPULACJI *CLETHRIONOMYS GLAREOLUS* (SCHREBER, 1780). III. KRZYWA WZROSTU

Streszczenie

Praca została oparta na materiałach uzyskanych z całorocznej kontroli ciężaru łowionych osobników populacji *Clethrionomys glareolus* (Schreber, 1780). W sezonie rozrodczym badania odbywały się co miesiąc, a w okresie zimy zbadano stan populacji na początku (listopad) i na końcu (kwiecień) redukcji zimowej. Oceny tempa wzrostu dokonano na 4 jednowiekowych grup osobników — kohort (Gliwicz *et al.*, 1968). Znany był średni dzień urodzenia, a więc wiek osobników w momencie pierwszego złowienia (Bujalska *et al.*, 1968; Petrusewicz *et al.*, 1968). Krzywe wzrostu (Ryc. 1) osobników w wieku przedpułapkowym z poszczególnych kohort zostały wykreślone w oparciu o krzywą wzrostu *C. glareolus* w warunkach laboratoryjnych (Drożdż, 1965) skorygowaną danymi empirycznymi. Krzywe wzrostu osobników z różnych kohort od momentu zarejestrowania o pułapki zostały oparte na danych empirycznych. Ogólna krzywa wzrostu (Ryc. 2) została wyznaczona przez średnie ważone ciężaru osobników z poszczególnych kohort i średni ważony wiek osobników w momencie rejestracji w pułapki.