POLSKA AKADEMIA NAUK — ZAKŁAD BADANIA SSAKÓW

ACTA THERIOLOGICA

VOL. VI, 1. BIAŁOWIEŻA 30.VI.1962

Stanisław SKOCZEŃ

Age Structure of Skulls of the Mole, *Talpa europaea* Linnaeus 1758 from the Food of the Buzzard *(Buteo huteo* L.*)*

Skład wiekowy czaszek kreta, *Talpa europaea* Linnaeus 1758 z pokarmu myszołowa zwyczajnego *(Buteo buteo* L.*)*

[With 4 tables]

I. MATERIAL AND METHODS

It is generally assumed that the activities of predators are often directed against the juvenile stages of their prey and as such may constitute an effective factor reducing population (Allee et al., 1958). This principle also fully applies to a species leading an almost entirely underground way of life, such as the mole. The present work is a contribution to our knowledge of this aspect of the biology of the mole.

From 1953—55 the authors Czarnecki & Foksowicz (1954) carried out investigations on the composition of the food of the buzzard (*Buteo buteo* L.) at Turew near Kościan in the Poznań province. A detailed description of the methods used for collecting study material is given in the work referred to above.

These authors presented me with the mole skulls which they had collected, totalling 302, of which 209 (68.7%) skulls were undamaged. Included in the figure of the missing skulls 114 (the total number of moles carried by the birds was 416) are specimens without heads, carried by the buzzards, or specimens in which the skull was badly damaged. Unfortunately the fragments were not kept.

Identification of the age of moles was made using the Deparma (1954) method, taking as a guide the degree of wear of the teeth, in particular of the molars, the appearance of the canines and incisors and the morphology of the skull. It is well known that the skull is convex and smooth in young moles. With increasing age the skull undergoes visible flattening, while prominences and thickenings appear on the surface (Stein, 1950; 1959).

With each skull were included the hindlegs of the respective individual which provided an additional feature for diagnosis, especially in the case of young moles, in which the legs possess a characteristic dark pigmentation.

The material was divided according to D e p a r m a (1954) into the following age classes:

Group „0" — young moles under one year old
„ „I" — adult individuals (having survived one winter) [1])
„ „II" — „ „ „ „ two winters)
„ „III" — „ „ „ „ three „
„ „IV" — „ „ „ „ four „

I did not find representatives of the Group V distinguished by D e p a r m a in my material.

II. DISCUSSION OF METHODS

According to D e p a r m a (1954) identification of age groups in the case of mole by means of the degree of wear of the molars and canines is perfectly feasible in series collected over a period not exceeding 2—3 months, on condition that series collected from different areas are considered separately. Comparison of specimens collected in different months, and even more so from different areas may, in the authoress's opinion, lead to considerable errors, as the rate of wear of the teeth differs not only in different geographical forms but in different periods of the year. S t e i n (1959) referring to the work by H a l l et al. (1957) on the ringing of bats, states that it is not possible in the case of long-lived animals, amongst which is included *Talpa europaea*, to segregate the animals into age groups according to the degree of wear of the teeth. Nevertheless the formation of the aboral root of the canines and its correlation with the wear of the molars, and the height of the skull, are considered by that scientist as a good basis for estimating the age of individuals.

The material worked on complied with the following conditions. In the first place it was collected over a very short period of time, in fact within a period only slightly exceeding one month, chiefly June (only 6 specimens were taken in May and 18 in July). This fact was of fundamental importance in identifying the young animals born that year, and the young animals one year old (having survived a winter). The majority of the material, chiefly from 1953, was probably all from the same habitat. From the information supplied by Dr Z. C z a r n e c k i I knew that the buzzards' nests were situated near wet meadowland. The remainder of the soil which I found between the teeth in some of the skulls indicated that these were meadows on peaty soil. A few of the skulls of older individuals which exhibited a different type of wear of the teeth most probably came from different areas and were carried from them by the buzzards during the years 1954—55.

---

[1]) The definition „having survived the first, second etc. winter" was introduced by the author only in relation to the material on which he himself worked.

The age of the young animals born that year was established with 100% certainty. Figures relating to other age groups should be treated as approximate only.

In the case of several skulls I encountered disproportions in the wear of the canines and molars, a fact also mentioned by D e p a r m a (1954). Observations of moles kept in captivity show that when they eat earthworms it is chiefly the incisors, canines and premolars which are used. The canines are used to the extent of having their posterior sharp edge blunted by the teeth in the lower jaw. The molars are not used to grind up the earthworms, as the mole swallows them in pieces. When eating wireworms the mole seizes them with its incisors, then shifts them to the molars and finally grinds them up for a relatively long time, shifting them from first one to the other side of its jaws. Moles which feed chiefly on insect food wear their molars to a greater degree.

With reference to the bifurcation of the mesostyle, particularly in M_1 and to the use of this feature as a guide when estimating the degree of wear of the molars (D e p a r m a, 1954), examination of the morphology of the teeth of young animals born the same year as the examination was made (chiefly those from June) gives rise to the following observations:

Of 257 specimens examined, bifurcation of the mesostyle in M_1 occurred in 179 specimens (69.6%), and of this number in 40 specimens (22.3%) bifurcation occurred on one side only. In one specimen I found bifurcation of the mesostyle absent on one side of the jaws in all three molars. In 31 individuals (17.3%) bifurcation of the mesostyle in M_1 was very little developed. In 12 moles bifurcation of the mesostyle in M_2 was very faintly developed, while I found complete absence of bifurcation of the mesostyle of M_1 in 78 individuals (30.7%), of which in 4 specimens bifurcation of the mesostyle was completely absent in all three pairs of molars.

III. RESULTS AND DISCUSSION

As will be seen from table 1 the participation of young animals under one year old in the whole of the material and in relation to the remaining age groups is 86.5%. D e p a r m a (1954) estimates this relation as 60 to 65%, and S t e i n (1959) from 60—70%. In the captures I made from June 1956 this relation is 71%. In the material examined this proportion is considerably higher. This is undoubtedly caused by the very characteristic activity near the surface of the soil, and sometimes even on the surface of young moles in the initial period of their independent life. This usually occurs at the end of May, June and July. The moles were undoubtedly caught by the buzzards when the former were penetrating the layer of grass nearest soil level, especially in meadows covered by high grass. The buzzards presumably took advantage of the moment when the moles were excavating surface corridors. The earth or blades of grass moving at the end of the tunnel might be a signal for the buzzards to attack. The older individuals defend themselves better here as they save themselves by a lightning escape to the deeper parts of the corridors, while the young inexperienced moles curl up in the blind end of the corridor in an endeavour to hide until danger is past.

Deparma (1954) states that under natural conditions the number of moles in the 4th age group is almost four times less than the number in group III. These ratios are according to Stein (1959) directly dependent on the habitat. In optimum habitats the number of old individuals is considerably smaller (♂♂ — 5.04%, ♀♀ — 4.18%) than in pessimum biotopes (♂♂ — 14.34%, ♀♀ — 12.37%). Taking the estimates quoted above of

Table 1.

Material from 1953—55 divided according to age group.

Year	Total		Sex determined			Age - class				
			N	♂♂	♀♀	0	I	II	III	IV
1953	166	n	139	104	35	139	15	6	5	1
		%	83.7	74.9	25	83.7	9	3.6	3	0.5
1954	96	n	76	65	11	86	5	3	2	-
		%	79.2	85.5	14.5	89.7	5.2	3.1	2.1	-
1955	40	n	24	15	9	36	1	2	1	-
		%	60	62.5	37.5	90	2.5	5	2.5	-
Total	302	n	239	184	55	261	21	11	8	1
		%	79.1	77	23	86.4	7	3.6	2.6	0.3

population structure in moles as a basis, the results of captures in 1953 (Table 1) might be taken as a certain kind of approximate picture of these relations in the given area, particularly with regard to the older groups. In captures made in June 1956, most of which were made by hand, during the forenoon or afternoon, moles belonging to groups III and IV formed 11% of the population.

The data on captures made at different times of the day would appear interesting (Table 2). What primarily is striking here is the same percentage of young moles in the numbers captured in the morning, at noon and in the evening. Results suggest that both young moles and individuals from the older age groups are uniformly active throughout the whole day. From my direct field observations, however, it appears that the moles are more active before sunrise and at dusk. Absolute figures in table 2 rather reflect the specific activity of the buzzard.

It proved impossible to obtain objective weight ratios, since the moles were often carried by the birds to the nests in a damaged condition. The data available show that certain young specimens attained the weight of 115 g. as early as midway through June, which indicates the exceptionally favourable ecological conditions in which this population lived.

In connection with the seasonal character of the composition of the buzzard's food, Czarnecki & Foksowicz (1959) state that in the first half of June moles formed 31% of the food carried to the nest. In the second half of this month the figure was only 15%, in the first half of July 7% and in the second half only 1%. In August and September the birds did not bring a single specimen to their nests. These facts reflect on the one hand the exhaustion of the supply of this species in the given biotope, and on the other the transition of the young moles with their progressively independent life from penetration of the surface to penetration deeper into the soil. Moisture conditions also affected the situation here. The spring, particularly in 1953, was a very dry one (Table 3).

Table 2.

Comparison of moles caught at different times of the day.

Hour	7				13				19			
Age	♂♂	♀♀	*	%	♂♂	♀♀	*	%	♂♂	♀♀	*	%
0	58	12	95	88.0	62	22	104	85.2	34	16	62	86.1
I	4	1	5	4.6	8	1	12	9.8	2	–	4	5.5
II	3	1	4	3.7	3	1	4	3.3	1	1	3	4.2
III	3	–	3	2.7	1	–	2	1.6	2	–	3	4.2
IV	1	–	1	0.9	–	–	–	–	–	–	–	–
Total	69	14	108	×	74	24	122	×	39	17	72	×
%	83.1	16.9	×	100.0	75.5	24.5	×	100.0	69.7	30.3	×	100.0

*) Together with individuals of undefined sex.

There were also differences in the number of moles carried to the buzzards' nests in different years, since in 1953 they formed 51% of the buzzards' prey, in 1954 18% and in 1955 14%. It must be added that material from 1954—1955 was taken from a total of 13 nests and therefore there were from approximately 4—6 to 15—17 moles per nest during a month. I am inclined to assume that the buzzards concentrated their „attention" in 1953 on the biotope densely populated by moles, on account of the scarcity of rodents in the area over which they hunted.

The mole occurs in considerable percentages in the composition of the food of buzzards in investigations made by other authors. For instance, Y a k s h i s (1952) states that in one nest, out of a total of 107 mammals, 48 were moles (45%). The next place after the mole is occupied by *Microtus arvalis* (P a l l a s, 1779) (40%). In a second nest, out of 178 mammals, 74.7% were moles (131 specimens).

Moles occur in very small percentages in the food of other birds such as, for instance, owls. As an example, in the food of the barn owl (*Tyto alba guttata* C. L. Br.) of 13.014 mammals collected during 1950—52, 11 were moles (0.08%) — C z a r n e c k i, G r u s z c z y ń s k a & S m o l e ń s k a (1955). In the food of the horned owl (*Asio otus otus* L.), of 11.399 specimens of mammals from the winter period (from January to March 1955) moles formed 0.09%. During the Summer months the percentage of moles in the food of the horned owl was far higher, e.g. in July 1955 it was as much as 7.3% (C z a r n e c k i, 1956). In U t t e n d ö r f e r's materials 1952) (cited after C z a r n e c k i, 1956) the mole formed 0.07% (of 54.168 mammals).

Table 3.

Mean monthly rainfall in mm. Data from the Turew station near Poznań.

Month / Year	IV	V	VI	VII
1953	21	28	35.9	61
1954	63	36	39	137
1955	49	46	42	96

In the material (owl pellets) collected by B u c h a l c z y k in 1956 (not published) of 18.000 specimens of mammals, 23 were moles (0.08%). On the other hand in material collected by B u c h a l c z y k & R a c z y ń s k i in 1958 (not published) in one place only — Bajłkowo — of 519 mammals 4 were moles (0.77%).

Measurements of the condylobasal length of the skulls are set out in table 4. The fact of finding 2 skulls of Cb. equal to 37.9 mm and 38.3 mm is worthy of note. In the first case the skull belongs to ♂ from age group „III" weighing 67.5 g. caught 4.VI.1953. In the second case the skull belongs to a young mole under one year, ♂ weighing 92.5 g., caught 15. VI.1953.

Higher values for Cb. in an adult mole (38.5 mm.) were found by S t e i n (1959). This author states that the Cb.-length in the mole does not attain the limit of growth by the end of the first calendar year. By statistical calculations he demonstrated that the average value of Cb.-length for young ♂♂ up to 6 months is 35.6 mm., up to 9 months 35.7 mm. and 36.01 mm. for individuals over 12 months. The occurrence in the material investigated of the extreme Cb.-length of 38.3 in a young ♂ not one year old justifies the assumption, on the basis of S t e i n's calculations, that this individual would, after the period of one year, attain a Cb.-length within the limits or even over the „record" one found by S t e i n.

The mean Cb.-length for young ♂♂ under one year old (35.87 mm., Table 4) obtained from the material examined is, in comparison with S t e i n's calculations, the more interesting in that it refers to moles which in general had not attained the age of 3 months. I am of the opinion that these data also indicate the origin of a population with exceptionally favourable habitat conditions, which was hunted by the buzzards.

The participation of the different age groups in extreme Cb. values is in agreement with S t e i n's calculations (1959). Of 30 moles ♂♂ juv.

Table 4.

Variations in condylobasal length.

Sex & age	33.1	33.5	33.9	34.3	34.7	35.1	35.5	35.9	36.3	36.7	37.1	37.5	37.9	38.3	n	M
♂♂, juv.			3	4	7	18	8	7	12	16	9	4		1	89	35.87
♂♂, ad.			2	1	4		1	1	4	5	6	6	4		34	36.50
♀♀, juv.	1	4	7	12	2	8	7	5							46	34.66
♀♀, ad.		1		2	2	1	1		1						8	34.80

+ ad.) in which Cb. came within the limits of 36.8 to 38.3 mm., 14 individuals (46.6%) were young animals not one year old, and the remaining group of 16 individuals (53.4%) was composed of 6 specimens in group I, 7 specimens in group II and 3 specimens in group III.

What is striking in the material collected is the very considerable preponderance of ♂♂ over ♀♀. The sex ratio is approximately 3:1 (Table 1). These data would presumably change with a full knowledge of the sex of the whole material, nevertheless a preponderance of males was found in all the results known to me from research work by other authors.

Acknowledgments. I should like to thank Dr. Z. C z a r n e c k i and T. F o k s o w i c z for placing their interesting material at my disposal, Professor Dr. W. S k u r a t o w i c z for his kindness in reading my typescript and his favourable opinion on the work, and Professor Dr. A. D e h n e l for his valuable comments.

The present work is part of the subject "Investigation of the biology and ecology of the mole (*Talpa europaea* L.) in Poland".

IV. SUMMARY

Work was carried out on the collection of skulls of the mole, *Talpa europaea* Linnaeus 1758, 302 in number (209 of them being undamaged) taken from the food of the buzzard *(Buteo buteo* L.). Analysis of the age structure of the population was made on the basis of Deparma's method (1954). A very large number of young animals under a year old occurred in the collection (86.4%). The total figure for the older age groups is 13.6%, of which 7% is in group I, 3.6% in group II, 2.6% in group III, 0.3% in group IV. The ratio of young animals under one year old (group 0) to the older age groups is relatively constant in the different years and at different times of the day. The results obtained depend on the population dynamics of the mole in the spring period (June) and are connected with the period of surface penetration by young animals which begin an independent way of life at this time.

In the list of condylobasal lengths of skulls given, the occurrence of a skull of a young ♂ with Cb.-length 38.3 is worthy of note. Higher values for Cb. (38.5 mm.) were found by Stein (1959) in an adult ♂. In investigations by other authors (Yakshis, 1952) on the composition of the food of the buzzard *(Buteo buteo* L.) the mole also occurred in large numbers (45—74.7%). In the food of other birds such as owls, the mole occurs in a very small percentage only (from 0.09 to 7.3%). The buzzard takes up a large amount of carrion and apart from this probably attacks moles digging surface corridors.

REFERENCES

1. Allee, W. C., Emerson, A. E., Park, O., Park, T. & Schmidt, K. P., 1958: Zasady ekologii zwierząt. Państwowe Wydawnictwo Naukowe, Warszawa.
2. Czarnecki, Z. & Foksowicz, T., 1954: Obserwacje dotyczące składu pokarmu myszołowa zwyczajnego *(Buteo buteo* L.). Ekol. pol., *2*, 4:477—484. Warszawa.
3. Czarnecki, Z., Gruszczyńska, J. & Smoleńska, E., 1955: Obserwacje nad składem pokarmu płomykówki (*Tyto albo guttata* C.L.Br.) w województwie poznańskim w latach 1950—52. Pozn. Tow. Przyj. Nauk, Prace Kom. biol., *16*, 3:1—38. Poznań.
4. Czarnecki, Z., 1956: Obserwacje nad biologią sowy uszatej *(Asio otus otus* L.). Pozn. Tow. Przyj. Nauk, Prace Kom. biol., *18*, 4:1—41. Poznań.
5. Czarnecki, Z. & Foksowicz, T., 1959: Z badań nad pożywieniem myszołowa zwyczajnego *(Buteo buteo* L.). Streszcz. ref. Zjazdu Anat. i Zoologów. Kraków.
6. (Deparma, N. K.) Депарма, Н. К., 1954: К методике определения возраста кротов. Бюль. МОИП, *59*, 6: 11—25. Москва.
7. (Yakshis, Ya. Ya.) Яксиш, Я. Я., 1952: К вопросу об изучении питания хищных птиц. Зоол. Журн., *31*, 6: 948—950. Москва — Ленинград.
8. Skoczeń, S., 1957: Próba chowu kreta *(Talpa europaea* L.) w warunkach sztucznych. Zesz. nauk. WSR 3, Zoot., *1*: 11—34. Kraków.
9. Stein, G. H. W., 1950: Grössenvariabilität und Rassenbildung bei *Talpa europaea* L. Zool. Jahrb. (Syst.), *79:* 321—349.

10. S t e i n, G. H. W., 1951: Populationsanalytische Untersuchungen am europäischen Maulwurf. II. Über zeitliche Grössenschwankungen. Zool. Jahrb. (Syst.), *79*, 5/6: 567—590.

11. S t e i n, G. H. W., 1959: Ökotypen beim Maulwurf, *Talpa europaea* L. (*Mammalia*). Mittl. Zool. Museum, *35*, 1: 3—43. Berlin.

Dept. of Zoology
College of Agriculture,
Kraków, Św. Marka 37.

STRESZCZENIE

Opracowano zbiór czaszek kreta, *Talpa europaea* Linnaeus 1758 w ilości 302 sztuki (w tym nieuszkodzonych 209, 68,7%), pochodzący z pokarmu myszołowa zwyczajnego (*Buteo buteo* L.). Analizę składu wiekowego populacji przeprowadzono w oparciu o metodę D e p a r m y (1954). W zbiorze występuje bardzo wysoka ilość młodych tegorocznych (86,4%). Na starsze grupy wiekowe przypada w sumie 13,6%, w tym na grupę „I" 7%, na grupę „II" 3,6%, na grupę „III" 2,6%, na grupę „IV" 0,3%. W poszczególnych latach procentowy stosunek młodych tegorocznych (grupa „0") do grup wiekowych starszych jest stosunkowo stały. Jest on również stosunkowo stały w wynikach odłowów w poszczególnych porach dnia. Uzykane wyniki stoją w ścisłej zależności od dynamiki populacji kreta w okresie wiosennym (czerwiec) i związane są z okresem powierzchniowej penetracji młodych rozpoczynających w tym czasie samodzielny tryb życia.

W zestawianiu długości kondylobasalnej czaszek, na uwagę zasługuje występowanie czaszki młodego ♂ o długości Cb. = 38,3 mm. Wyższe wartości dla Cb. (38,5 mm), u ♂ dorosłego znalezione zostały przez S t e i n a (1959). W badaniach innych autorów (J a k s z i s, 1952) nad składem pokarmu myszołowa zwyczajnego (*Buteo buteo* L.), kret występował również bardzo licznie (45—74,7%). W pokarmie innych ptaków jak np. sów — kret występuje w bardzo małym procencie (od 0,09 do 7,3%). Myszołów zbiera dużo padliny poza tym prawdopodobnie atakuje krety kopiące chodniki powierzchniowe.

PAŃSTWOWE WYDAWNICTWO NAUKOWE * WARSZAWA 1962

Nakład 1420 egz. Obj. ark. wyd. 0,75, druk. 5/8. Maszynopis otrzymano 15.IV.1962. Podpisano do druku 25.VI.1962. Druk ukończono 20.VI.1962. Papier druk. sat. III kl., 80 g. Format B5. Cena 5 zł.

Białostockie Zakłady Graficzne. Zam. 1571 F-2