POLSKA AKADEMIA NAUK — ZAKŁAD BADANIA SSAKÓW

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

VOL. IX, 16: 233—248. BIAŁOWIEŻA 30.XII.1964

Krystyna CABOŃ-RACZYŃSKA

Studies on the European Hare. II. Variations in the Weight and Dimensions of the Body and the Weight of Certain Internal Organs

Badania nad zającem szarakiem. II. Zmienność ciężaru i wymiarów ciała oraz ciężaru niektórych narządów wewnętrznych

[With 1 Fig. & 9 Tables]

I. Introduction . . . 233
II. Material and methods . . . 234
III. Weight of body . . . 235
IV. Dimensions of body . . . 233
V. Weight of internal organs
1. Heart . . . 239
2. Kidneys . . . 240
3. Spleen . . . 241
4. Liver . . . 242
VI. Discussion . . . 243
VII. Results . . . 246
References . . . 246
Streszczenie . . . 247

I. INTRODUCTION

Research so far carried out on the variations in the body weight of the hare (*Lepus europaeus* Pallas, 1778) has been based exclusively on material obtained during the shooting period and has been treated solely from the hunting point of view, and could therefore constitute a basis for estimating the suitability of young hares, in the sense of biomass, during a period of planned shooting. Material was examined either jointly, without splitting it up into age classes, using only the mean values obtained from a whole population (Szederjei, 1959; Eickhoff, 1962; Pielowski, 1962), or divided into the group of young hares "born that year", and the group of old hares (Hell & Farkaš, 1963). In the first case, increase in the mean body weight was observed in consecutive months of the shooting period as the result of the young animals attaining the weight of adult specimens. Hell & Farkaš (1963) in considering the weight of young and old hares, shot during the hunting period, in material obtained over a period of 3 years, found that the date on which shooting begins should depend each year on the time by which the young animals could attain a suitable body weight. This conclusion, although undoubtedly interesting from the point of view of correct hunting methods, may rouse certain objections concerned with the methods of determining age. The method in general use for identifying the age of hares, i.e. the Stroh mark, makes it possible to err in favour of young hares in estimating numbers (Bujalska, Caboń-Raczyńska & Raczyński, in preparation).

Research has not so far provided a basis for tracing the variations in the weight of the body and internal organs at different seasons of the year and from the age aspect. The present study is an attempt at examining these phenomena on the basis of material from a full year's cycle, treatment including splitting the material into four age groups *(I—IV)*.

II. MATERIAL AND METHODS

The material, consisting of 432 specimens of the hare, came from the Poznań province (West Poland). The hares were shot from December 1958 to February 1960. Shoots were as a rule arranged over a period of one week in the second half of each month, and ensured that the samples obtained were random ones.

Analysis was made of the weight of the body and of certain internal organs (heart, kidneys, spleen and liver) and of the four basis measurements: Head and body, of tail, of hind foot and of ear. The weight of the liver was in addition examined in a separate series of 147 specimens caught in the same area at the end of January and beginning of Febbruary 1963. The hares were killed in a way preventing bleeding from the liver, and thus results obtained can be taken as reliable. Weight of the liver was examined in three only of the age classes represented in the series discussed.

The hares were weighed and measured from 2—3 days after they had been shot, i.e. after they had been delivered to the laboratory in Warsaw. The basic measurements of the body were made by means of a steel tape measure. They were next dissected and the internal organs removed, which after having been thoroughly cleaned of fatty tissue and rinsed free of blood clots, were weighed on a laboratory scale with accuracy of up to 50 mg. Specimens exhibiting pathological changes were rejected during dissection by specialists in animal diseases, and were not included in this study.

The material was divided into four age classes according to the degree of ossification of the sutures of the skull and other supplementary criteria of age, by means of the method described in the study by Caboń-Raczyńska (1964). The following age classes were distinguished: class *I* — specimens aged up to 6 months, class *II* — 6—8 months old, class *III* — about 1 year old, class *IV* — specimens in the second year of their life or older.

Weights of the internal organs were considered both in absolute and relative values (in relation to the gross body weight). The Student test for two independent mean values was used as a criterion of the significance of differences between mean values.

III. WEIGHT OF BODY

Variation in body weight due to age is shown in table 1. The whole of the material has been given jointly here without division into sex, as no significant differences were found between males and females. When thus compared class *I* — the youngest hares up to 6 months old — differs most markedly. The maximum weight of this series does not exceed 3.10 kg. Class *II* containing specimens aged 6—8 months has the narrowest range of variation (2.65 — 4 kg) probably due to the narrow age limits. This range of variation applies both to younger and older specimens, and it would therefore be impossible to split this group on the basis of body weight only. Hares aged about 1 year and over are characterised by similar values for their weight, and differ only as to mean and maximum values, which are higher in age class *IV*. Therefore, on the basis of the body weight, it is possible to identify with complete certainty specimens not exceeding 3.10 kg as young animals, 8 months old at most. Hares 1 year old and over have already attained a body weight greater than 3.20 kg. Increase in body weight expressed in the mean values and percentages of increase is observed in the age classes. An even increase occurs from age classes *I* to *III*, while between class *III* and *IV* the increase is slightly smaller. The total increase in body weight in age class *IV* is over 100% in relation to class *I*.

Table 1.

Weight of body (in kg) in age classes.

Age class	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50	4.75	5.00	5.25	N	$\bar{x}$	%
I	1	5	5	11	8	8	6	7	2										53	2.04	100
II								9	17	5	12	2	1						46	3.02	147.7
III										9	26	29	26	15	9	1			117	3.84	188.0
IV										1	17	41	54	52	28	17	5	1	216	4.12	201.9

The distribution of the body weight of the hare in different age classes in months is illustrated by figure 1, in which the values of the body weight are represented by dots. The whole of the material in the life cycle is concentrated here in order to show the transition of the young specimens through the successive higher age classes and the occurrence of the classes in each month of the yearly cycle. Specimens from age class *I* occur from April to December inclusively in the material. During the breeding season up to September

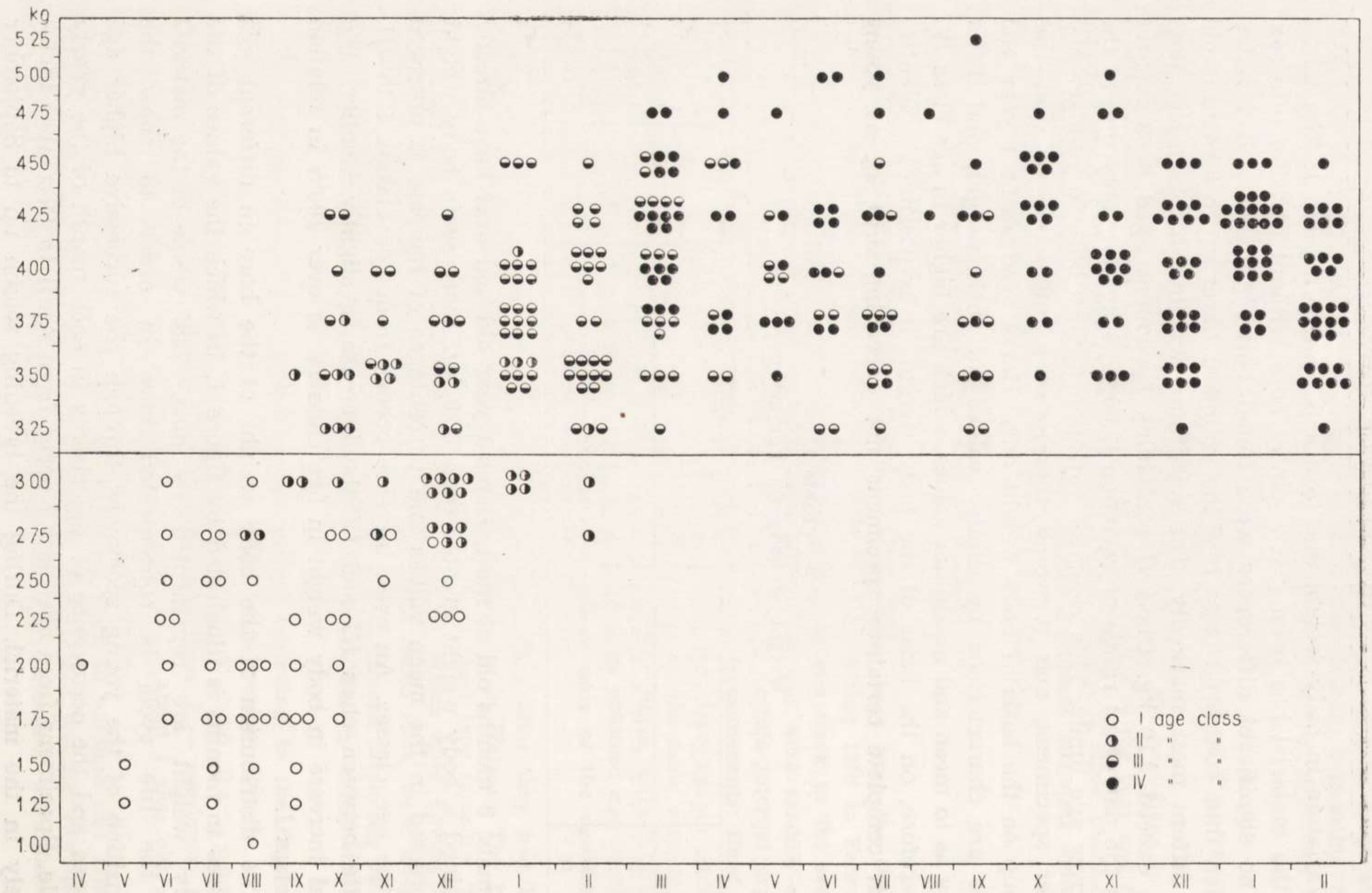

Fig. 1. Variations in body weight of the European hare during its life cycle.

considerable range of weight is observed in this group due to the presence of individuals of different ages within this class. Even slight differences of 2—3 months in age are expressed by great diffferences in body weight. It is not until November and December that hares in class *I* have a more balanced body weight of over 2 kg. Their maximum age during this period is approximately 4—5 months.

Hares in class *II*, aged about 8 months, occur in the material from August to February, during the season 1959/60, whereas they only occur up to January inclusively during the season 1958/59. Variations in body weight are maintained within more or less stable limits during this period. Increases in body weight in this class are not observed during the winter months.

Age class *III* (specimens from 9—12 months old) is represented in all the months of the year. While this class is formed during the summer by hares born the preceding year, as from October it must be assumed that specimens from the first litters of the last breeding season are included in this group. The relations prevailing during the winter are the most interesting in the figure showing the body weight in age class *III*. From December to February the body weight of these animals, in the mean values and divisions of variations, is very similar to the weight of old hares (in age class *IV*). They come from the early litters of the last breeding season and are in the phase preparatory to the first oestrus, or have already begun to participate in reproduction (Raczyński, 1964). It would therefore seem that the time of attaining sexual maturity coincides in time with the attainment by the hares of their final dimensions.

The oldest animals in age class *IV*, that is, at least one year old, occur throughout the year. This material has so far been examined from the aspect of the occurrence of possible differences in body weight at different seasons of the year. No statistically significant seasonal differences were, however, found in the material studied.

The distribution of the weights of hares shown in Fig. 1 split into age classes, makes it possible to trace the growth of the young specimens and their transition to the older age groups during the autumn-winter period. From October to December (1959) individuals from age class *I* occur in the material, individuals from age class *II* are fairly numerous and there is a small number of young animals about 9—10 months old (age class *III*). In January and February (1960) only individuals from age class *I* occur, with an increasing number of specimens from age class *III*. In March, on the other hand, only two classes are represented, classes *III* and *IV*. It may therefore be assumed that in

1960 relative equalisation of the body weight of the whole hare population took place as late as March, while in the preceding year (1959) this occurred in February.

IV. DIMENSIONS OF BODY

1. Head and body was measured on the ventral side, noting the distance from the end of the muzzle to the anus. For this reason the results of measurements are smaller than those usually given in keys (Zimmermann, 1959; Gaffrey, 1961; Gureev, 1963), where measurement of the length of the body was most certainly made in a different way. There was, however, considerable agreement with the diagrams given by Popov (1960).

The smallest values of this measurement are shown in age class *I* (Table 2), in which the widest range of variation in this character occurred simultaneously. In older specimens the range of variation is narrowed down and classes *III* and *IV* have a uniform maximum value of 62 cm. The greatest differences occur between class *I* and *II*, and *II* and *III*: the last two classes differ only inconsiderably as to their mean

Table 2.

Length of body (in cm) in age classes.

Age class	36.0	37.5	39.0	40.5	42.0	43.5	45.0	46.5	48.0	49.5	51.0	52.5	54.0	55.5	57.0	58.5	60.0	61.5	N	$\bar{x}$	%
I	1		2	2	1	4	2	8	4	5	2	2							33	46.04	100
II									1	4	4	19	8	4	1				41	52.65	114.4
III										2	3	14	17	35	17	19	4	3	114	55.72	121.0
IV											1	12	26	62	38	43	24	11	217	56.75	123.3

values. Similar relations are observed in the increases in the dimensions of the skull, especially in measurement of length (Caboń-Raczyńska, 1964), which indicates that the course taken by growth changes in the body and skeleton is similar. Total increase in body length is 23.3% in relation to age class *I*. Maximum length of body is in principle attained as from age class *III*. This phenomenon confirms the result of the correlation of body length with body weight. In age classes *I* and *II* the coefficient of correlation $r = 0.93$, while for age classes *III* and *VI* it is distinctly lower ($r = 0.48$).

2. Length of tail was measured from the anus to the end of the caudal vertebrae. Variations in this measurement from the age

aspect are slight, but the minimum values were, however, observed in age class *I*. In the remaining classes the range of variation was from 6.2 to 11.5 cm.

3. Length of hind foot. It was only in age class *I* that this measurement differs in its value from the remainder of the specimens in the other age classes, the range of measurements for which was from 13 to 16 cm. These values are similar to those given by Gaffrey (1961), Gureev (1963) and others. In one case only the length of the foot was found to be 17.5 cm.

4. Length of ear. The range of this measurement is the most stable and comes within limits of 9 to 11 cm. Only 4 specimens from age class *I* exhibited a lower value.

Table 3.

Weight of heart (in g) in age classes.

Age class	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	N	$\bar{x}$	%
I	1	2	3	13	6	7	8	6	1									47	22.02	100
II							3	16	9	11	4							43	32.79	148.9
III								2	13	20	47	18	5	1	1 -	1		108	38.67	175.6
IV								1	11	21	41	46	35	13	8	5	1	182	41.84	190.0

Table 4.

$$\frac{\text{Weight of heart}}{\text{Weight of body}} \times 100$$

Age class	0.80	0.85	0.90	0.95	1.00	1.05	1.10	1.15	1.20	1.25	1.30	1.35	1.40	1.45	1.50	1.55	N	$\bar{x}$
I	1	2	4	4	5	8	7	9	4	2						1	47	1.068
II		2	3	2	8	9	11	5	2			1					43	1.055
III		5	16	20	30	24	11	9	2		1			1			119	1.012
IV	2	13	17	33	38	33	24	16	4	2	1	1					184	1.015

V. WEIGHT OF INTERNAL ORGANS

1. Heart

The distribution of absolute data for weight of the heart and the body is similar (Table 3). There are also similarities in the distribution of the ranges of variations in different age classes and in the percentages of increase, which is 90% for class *IV* in relation to class *I*. This similarity is due to the reciprocal connections of the weights of heart and body within each age group. The coefficient of correlation for the whole material is $r = 0.89$.

The relation in percentage of the weight of the heart to that of the body is similar for all the age groups and varies within limits of 0.80 to 1.55% (Table 4), and in the case of 96% of the specimens this range is narrowed down to the values 0.83 — 1.22%. The mean index for the heart is very similar in all the age classes, being from 1.01 to 1.07. These results would seem to be fairly reliable on account of their being based on abundant material. They differ from the data given by Hesse (1921), who obtained a mean value of 0.89% from small number of specimens, with a maximum relation of 0.98%.

Table 5.

Weight of kidneys (in g) in age classes.

Age class	5.0	6.5	8.0	9.5	11.0	12.5	14.0	15.5	17.0	18.5	20.0	21.5	23.0	24.5	26.0	27.5	29.0	30.5	N	$\bar{X}$	%
I	1	1	2	8	6	7	9	7	1	4									46	12.66	100
II							4	7	15	8	6	2							42	17.39	137.4
III								10	17	27	24	14	5	3	1	1			102	19.28	152.3
IV								10	18	30	37	29	24	7	5	5	2	1	168	20.59	162.6

Table 6.

$$\frac{\text{Weight of kidneys}}{\text{Weight of body}} \times 100$$

Age class	0.37	0.40	0.43	0.46	0.49	0.52	0.55	0.58	0.61	0.64	0.67	0.70	0.73	0.76	0.79	0.82	0.85	N	$\bar{X}$
I	1	1	1		2	1	1	1	4	2	6	1	1	2	1		1	26	0.622
II			1	4	5	7	8	6	3	1	2	1						38	0.546
III		5	9	20	19	21	14	8	3	2				1				102	0.505
IV	2	10	23	35	29	31	20	8	7	2	1							168	0.494

Differences were not found in the material studied in the values for the heart index in different seasons, neither were differences found between males and females.

2. Kidneys

The weight of the kidneys in the age classes differs in a way similar to the weight of the heart, exhibiting slightly smaller increases with age (Table 5). The maximum increase in age class *IV* was 63%. The greatest increase is observed in age class *II*, and is expressed in relation to the youngest specimens by an increase of 37%. The considerable individual variations in the weight of this organ, particularly in age classes *III* and *IV* (from 15 to 31 g) are remarkable.

The index of the weight of the kidneys enables the phenomenon of the formation of the proportions of this organ in relation to age to be grasped. In age class *I* the index exhibits the maximum mean value and the greatest range of variations (Table 6). In successive age classes a reduction in the mean values of this index can be observed. It is true that no statistically significant differences were found between consecutive classes, but such differences were found between classes

Table 7.

Weight of spleen (in g) in age classes.

Age class	0.20	0.45	0.70	0.95	1.20	1.45	1.70	1.95	2.20	2.45	2.70	2.95	3.20	3.45	3.70	N
I	1	13	10	5	8	3			1		1					42
II		3	5	12	9	4		1			1					35
III		2	13	12	16	18	12	4	4	4	3	1	1	1		91
IV		7	16	17	17	22	13	12	11	11	8	3	4	2	5	148

I and *III*, and *II* and *IV*, and thus between *I* and *IV*. The tendency exhibited by the index to decrease with age is due to the stability of the weight of this organ after the early attainment of the final dimensions, while the increase in body weight continues. The index of the weight of the kidneys, established on the basis of the present material, was expressed by figures within limits of 0.37 to 0.85%.

3. Spleen

In the series of hares examined the weight of the spleen has a uniform minimum value in all the age classes (Table 7). Considerable individual variations are distinctly apparent in classes *III* and *IV*, the maximum values then attaining 3.700 g. Single specimens (not included in the table) attain higher values, even above 5 g. Changes with age are expressed chiefly in the widening of the ranges of variations in the direction of higher values.

The index of weight of the spleen comes within limits of 0.010 to 0.090, and in the case of 92% of the material from all age classes, it ranges from 0.015 to 0.060%. The distribution of values of the index shows that it is fairly constant irrespective of age.

On account of the great degree to which the weight of the spleen is dependent on the physiological condition of the animal, the greater or lesser loss of blood in the animals shot and the difference within certain limits of the time from the moment at which they were killed to the time at which they were weighed, the results obtained must be interpreted with a certain degree of caution, nevertheless comparison of the weight with an additional series of 147 hares (males) revealed considerable agreement in the distribution of values and range of variations.

4. Liver

The weight of the liver was analysed in 147 individuals (males) representing three age classes. There were no representatives of age class *I* in the material examined. The values of the weights show that

Table 8.

Weight of liver (in g) in age classes.

Age class	3.35	3.50	3.65	3.80	3.95	4.10	4.25	4.40	4.55	4.70	4.85	5.00	5.15	5.30	5.45	5.60	5.75	5.90	6.05	N	$\bar{x}$
II						1	2	1	3	2	2	4	2	2	3			1	2	25	5.000
III				1	4	6	3	5	6	5	4	9	5	1	4	3				56	4.710
IV	2	1	1	8	4	8	9	9	5	9	4	4	1	1						66	4.327

Table 9.

$$\frac{\text{Weight of liver}}{\text{Weight of body}} \times 100$$

Age class	125	130	135	140	145	150	155	160	165	170	175	180	185	190	195	200	205	210	220	230	N	$\bar{x}$
II			1	1	6	1	4	3	1	4		2		1		1					25	1.596
III		2	1		1	1	10	6	1	5	3	7	3	5	5	4	1	1			56	1.731
IV	1	2	2		5	1	7	2	6	4	7	6	8	5	1	2	4	1	1	1	66	1.729

there are no differences between each age class (Table 8). It is only possible to speak here of considerable individual differences in the weight of the liver, which can be observed both in age class *II*, characterised by the narrow age limits of the animals (6—8 months old) and in the other classes. The widest range of variations is that in age class *IV* (125—230 g).

The relative weight of the liver varies in age class *II* from 4.03 to 6.12%, and in age class *IV* from 3.28 to 5.37% (Table 9). Both in the mean values and in the divisions of variations there is a gradual reduction in the value of the index, similar to that observed in the case of the kidneys. The differences between mean values of classes *II* and *III*, with $P = 0.05$, are statistically significant, while with $P = 0.01$ they are nonsignificant. On the other hand, the differences examined between classes *III* and *IV* are statistically significant for both probabilities. Thus there is a greater tendency to reduction in the value of the liver index with age than in the case of the kidneys.

VI. DISCUSSION

The results obtained permit of presenting data on the differences between the sexes and ages and the effect of the percentage of different age groups on the mean value of the body weight of hares in a population.

In the present material, covering a full year's cycle, statistically significant sex differences were not found within classes *III* and *IV*. They were not expressed in either the comparisons, for different months or seasons, or in the joint comparison of the whole material, consisting of adult individuals. Data in literature on differences in body weight between males and females are contradictory. Reynolds & Stinson (1959) in examining material formed by *Lepus europaeus hybridus* Desmarest, 1822, during the period from February to April in two different years, found slight differences in the mean weights of the body between males and females, in favour of the females. Kröning (1963), on the basis of a series of 191 specimens from Göttingen, obtained slight differences, not in any case statistically significant, which he took as grounds for stating that in his material females were heavier than males. Hell & Farkaš (1963) make different observations on material from two years taken from Czechoslovakia. These latter authors are inclined to assume that males are heavier than females (differences from 0.3 to 2.3%), explaining this result by the effect of pregnancy and lactation and the greater susceptibility of the females to disease. In the present material it might be expected that sex differences would be found as the result of the gross weight of pregnant and nursing females being taken into account — the percentage of such individuals in the whole material is so slight however, that it may be overlooked. From the data given it may be concluded that sex dimorphism is not distinctly evident in the body weight.

The problem of the seasonal differences in the body weight was raised by Szederjei (1959). This author observed a decrease in the mean body weight during the winter months (January, February) during a period of hard winters, and explained it by the effect of the unfavourable conditions. No such differences in the present material were found at any season of the year in the case of adult specimens.

Many authors draw attention to the formation of the mean body weight of hares during the shooting season and to the causes of the differences in different years (Rieck, 1956; Szederjei, 1959; Hell & Farkaš 1963). This question was usually connected with the age structure of hare populations during the autumn-winter period. It is generally considered that young hares relatively quickly — as early as the age of 5—6 months — attain the weight of adult individuals and thus affect the increase in weight during the shooting season. This view is probably based on observations of artificially reared animals. Hediger (1948) observed rapid increase in body weight during the first months of life, and Reynolds & Stinson (1959) give an example of a young hare having attained the weight of 4.10 kg within 6 months under artificial breeding conditions. It would seem possible that under natural conditions the young hares are not characterised by such rapid growth rate, even during the height of the growing season. In the material presented here young hares aged 6 months attain a maximum weight of 3.10 kg. Observations of the distribution of body weight of the youngest hares (age classes *I* and *II*) during the winter months (December—February) show that a large number of individuals do not exceed 3 kg in weight. It may therefore be assumed that young hares from the later summer litters may grow more slowly than hares born in the spring.

During the shooting season the mean body weight of the hares shot is reduced and depends on the percentage of young hares in a population. When comparing the body weight of hares from different regions, even those not geographically distant from each other, it is not possible to take the calculated mean body weight for a population as a basis, since this result depends on several factors such as: the season at which investigations were made, the occurrence or non-occurrence of a late litter, or intensification of growth of the young hares during the reproduction season. It is impossible to assess these factors without making specially detailed examination, and it is particularly risky to take as a basis the mean weight in a population when reaching conclusions as to the Bergmann rule, as was done, for instance, by Pielowski (1962), and Hell & Farkaš (1963). These examples show that when working on material from the comparative aspect it is essential to take into consideration division into at least two age groups: the young specimens from the last breeding season and old hares.

It is quite understandable that only the data on this latter group are of importance for taxonomic purposes. In principle, as shown by the investigations discussed in this paper, hares aged one year and over may be considered fully grown.

A knowledge of the weight of internal organs in healthy hares may prove of diagnostic importance when judging pathological cases. It is a question here both of establishing the absolute and the relative weight in relation to the body weight. The studies known to me are based on small series of material (H e s s e, 1921; B o u v i e r, 1963) or would appear to refer to collections with a predominance of pathological cases (F r e u n d, 1939).

The data contained in the present study come from numerous monthly series from a full year's cycle including animals of varying ages. This made it possible to determine the ranges of values of the weight of the organs examined and to grasp the phenomenon of the establishment of proportions between the organs and the body weight during the life cycle of the hare. The results obtained do not refer to pathological ceses, which were eliminated at the time the material was collected. In the present material it was necessary to take into account only differences due to the effect of transport of the hares during the summer months, when the hares shot might be subject to a certain degree of decomposition. No significant seasonal differences were, however, found. On this basis the whole of the material formed by the organs may be treated as homogeneous and normal.

The results obtained usually differ from data given in literature. The relative weight of the heart proved to be the most constant for all age classes. The results given by H e s s e (1921) correspond to the lower range, while B o u v i e r (1963) gives figures higher than the ones in the present study, and in the case of young hares with a body weight up to 3 kg, the index of body weight is greater than that for individuals weighing over 3 kg. This may due only to using small amounts of material, since the ranges of absolute weights agree with those obtained in the present study.

The relative weight of the kidneys, as has been shown, varies during the period of post-natal life, and it is therefore necessary to use material of a defined age. B o u v i e r's (1963) absolute values of weight agree in principle with data in the present study for old and young hares.

The results of the weight of the liver differ considerably from the data given by F r e u n d (1939) and B o u v i e r (1963). They are in principle incapable of comparison, since it would seem that they were obtained by a different method of sampling. It appears probable that the results given by the authors referred to were obtained from hares which had bled profusely, which causes considerable reduction in the weight of this organ. Proof of this is provided by comparison of hares which had been shot, in which the weight of the liver varied from 60 to 200 g, with a series of hares killed without loss of blood, giving a result of 125—230 g. Shooting undoubtedly distinctly, and to varying degrees, influences the reduction of the weight of this organ, and on this account the principle must be accepted for this type of research, especially in the case of the liver, that results must be obtained solely from hares which have not lost blood, which ensures that results are obtained reflecting relations closest to the real ones.

VII. RESULTS

It was found that intensive increase in the body weight of young hares takes place within the first 8 months of life. Complete equalisation of the body weight of young and old hares does not occur in the population until February or March of the next year. In the material examined animals not exceeding 3 kg in weight were treated as young ones, aged less than 8 months. No seasonal or dimorphic differences were found in the body weight in adult individuals.

The ranges of the basic measurements of the body were determined and it was found that increase in length of the body with age is slight (23.3%).

The weights of heart and body are subject to age changes in direct proportion to each other ($r = 0.89$). The index of weight of the heart to the body weight is constant in all age classes.

The weight of the kidneys changes with age to a lesser degree than the weight of the heart, while the index of the kidneys is distinctly reduced with age.

The weight of the liver depends to a great extent on the amount of blood lost. In material in which there had been no loss of blood, considerable individual variation in this organ was found, with simultaneous absence of changes with age. The index of weight of the liver, like that of the kidneys, decreases with age.

The authoress found that a comparative analysis of the weight of the body and internal organs can only be made on series of material equal as regards age.

REFERENCES

1. Bouvier, G., 1963: Mittlere Organgewichte beim Wild. Z. Jagdwiss., *9*, 1 : 1—6.
2. Bujalska, G., Caboń-Raczyńska, K. & Raczyński, J. (in preparation): Studies on the European hare. VI. Comparison of different criteria of age. Acta theriol., *10*.
3. Caboń-Raczyńska, K., 1964: Studies on the European hare. III. Morphological variability of the skull. Acta theriol., *9*, 17: 249—285.

4. E i c k h o f, W., 1962: Über Gewichte und Gewichtsverschiebungen bei Kaninchen, Hasen und Fasanen der freien Wildbahn. Trans. 5-th Congress Inter. Union Game Biol., *4*, 10: 175—185. Bologne.

5. F r e u n d, L., 1939: Organgewichte von Säugetieren. III. *Lepus europaeus* P a l l a s, Feldhase. Věst. ČS Zool. Společ. v Praze, 6—7: 147—150. Praha.

6. G a f f r e y, G., 1961: Merkmale der Wildlebenden Säugetiere Mitteleuropas. Geest & Portig K.—G.: 1—284. Leipzig.

7. G u r e e v, A. A., 1963: *Lagomorpha* (In Sokolov's, I. I. (Ed.): "Mlekopitajuščije fauny SSSR"). AN SSSR: 218—243. Moskva-Leningrad.

8. H e d i g e r, H., 1948: Die Zucht des Feldhasen (*Lepus europaeus* P a l l a s) in Gefangenschaft. Physiologia Comparata et Oecologia. *1*, 1: 46—62. Haag.

9. H e l l, P. & F a r k a š, L., 1963: Telesná váha a jatočná výtažnost u zajaca polného (*Lepus europaeus* P a l l.) v období jeho polovníckeho využívania. Sborník VŠP v Nitre: 217—230.

10. H e s s e, R., 1921: Das Herzgewicht der Wilbertiere. Zool. Jb., *38*, 3: 243—361. Jena.

11. K r ö n i n g, F., 1963: Was wiegt ein Göttinger Hase? Z. Jagdwiss. *9*, 3: 107—109.

12. P i e l o w s k i, Z., 1962: Über ökologische Forschungen am Feldhasen in Polen. Beiträge zur Jagd- und Wildforschung. *2:* 41—52. Berlin.

13. P o p o v, V. A., 1960: Mlekopitajuščie Volžko-Kamskovo kraja. AN SSSR, Kazanskij filjal: 1—468. Kazań.

14. R a c z y ń s k i, J., 1964: Studies on the European hare. V. Reproduction. Acta theriol. *9*, 19: 305—352.

15. R e y n o l d s, J. K. & S t i n s o n, R. H., 1959: Reproduction in the European hare in Southern Ontario. Canad. J. Zool., *37*, 5: 627—631.

16. R i e c k, W., 1956: Untersuchungen über die Vermehrung des Feldhasen. Z. Jagdwiss., *2*, 11: 49—90.

17. R i e c k, W., 1962: Analyse von Feldhasenstrecken nach dem Gewicht der Augenlinse. Supp. Ricerche Zoologia App. Caccia. *4:* 21—29.

18. S z e d e r j e i, A., 1959: Beobachtungen über den Feldhasen in Ungarn. Z. Jagdwiss., *5*, 3: 81—94.

19. Z i m m e r m a n n, K., 1959: Taschenbuch unserer Wildlebenden Säugetiere. Urania—Verlag. 169. Leipzig-Jena.

Polish Academy of Sciences,
Mammals Research Institute,
Białowieża, Poland.

STRESZCZENIE

Autorka dysponowała serią 432 okazów zająca szaraka (*Lepus europaeus* P a l l a s, 1778) pochodzących z odstrzału w okresie 15 miesięcy (od grudnia 1958 do lutego 1960 roku) na terenie województwa poznańskiego. Materiał analizowano w rozbiciu na cztery klasy wiekowe, wydzielone na podstawie budowy czaszki (C a b o ń - R a c z y ń s k a, 1964). Badano zmienność ciężaru i wymiarów ciała oraz ciężaru serca, nerek i śledziony. Ciężar wątroby przebadano na oddzielnej serii 147 samców (uśmierconych bez wykrwawienia), pochodzących z tego samego terenu.

Stwierdzono, że intensywny przyrost ciężaru ciała młodych zajęcy dokonuje się w ciągu pierwszych 8 miesięcy życia. Całkowite wyrównanie się ciężaru młodych i starych następuje w populacji dopiero w lutym lub marcu następnego roku. Zwierzęta nie przekraczające 3 kg uznano w badanej populacji za młode w wieku poniżej 8 miesięcy życia. U okazów dorosłych nie stwierdzono sezonowych i dymorficznych różnic w ciężarze ciała.

Ciężar serca podlega zmianom wiekowym, wprost proporcjonalnym do ciężaru ciała. Wskaźnik serca jest stały i niezależny od wieku zwierząt. Ciężar nerek zmienia się w mniejszym stopniu niż ciężar serca, natomiast wskaźnik nerek maleje z wiekiem. Ciężar wątroby oddaje rzeczywiste stosunki tylko wtedy, gdy narząd ten nie podlega wykrwawieniu. Obserwowano dużą zmienność indywidualną ciężaru wątroby przy braku zmian wiekowych. Wskaźnik wątroby obniża się z wiekiem.

Autorka stwierdza, że ciężar ciała i narządów wewnętrznych powinien być analizowany na seriach materiału ściśle wyrównanych pod względem wiekowym.