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STUDIE ON THE EUROPEAN HARE XXI.

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# Winter Food Intake in European Hare (*Lepus europaeus* Pallas, 1778) in Experimental Conditions

[With 1 Fig. & 2 Tables]

Food intake of 24 *L. europaeus* (13 ♂♂ and 11 ♀♀) was quantitatively examined. Experiments were made in February 1967, in metabolic cages. Mean temperature of air in this period was —4.3°C (—12.8°C — +5.0°C). It was established that the daily intake of experimental food of examined hare individual was about 0.5 kg *i.e.* 756.5 kcal. Mean daily loss of energy was 151.0 kcal and 15.1 kcal in feces and urine respectively. Digestibility coefficient estimted in these experiments was 80.1%. No statistically significant differences relating to sex were found. It was stated that there is correlation between the amount of food intake expressed in kcal/kg of body weight/day and environmental temperature ($r = -0.5433$). Environmental temperature decrease by 1°C caused increase in food intake of hare of about 14 kcal/animal/day or 3.6 kcal/kg/day.

## I. INTRODUCTION

In spite of great economical value and common ubiquity of hare (*Lepus europaeus* P a l l a s, 1778) its physiology is known rather weakly.

Except of scarce and incomplete reports on quality and amount of food consumed by hare (K o k e š, 1948; J e z i e r s k i, 1956; K o e n e n, 1956; M ü l l e r - U s i n g, 1954; P a s ł a w s k i, 1956; M a t u s z e w s k i, 1966), there is a lack of bibliographical data on energy requirement of this species. Data based on observations of above cited authors were not experimentally proved till now. Therefore decision was taken to establish the amount of food consumption of hares in the most interesting time of hunting husbandry, namely in winter-time, when extra food is given to the game.

## II. MATERIAL AND METHODS

In experiment 24 hares (13 ♂♂ and 11 ♀♀) were used. They were caught on the grounds of Experimental Hunting Centre of Polish Hunter's Union in Czempiń, Poznań district. Experiments were made in metabolic cages similar to these used by Szczygieł & Ziombski (1960), but modified and adapted to animals of hare-size.

Cylinder shaped cages made of zincplated wire-cloth were 0.5 m high and their diameter was 0.5 m. Under each cage was hanged a funnel made of poly-vinyl and 0.40 m high. The upper diameter of the funnel was equal to this of the bottom of the cylinder the lower opening diameter of the funnel was 0.05 m, wide.

In the funnel a pear shaped glass bulb was hanged; the diameter of the most wide part of bulb was 5.5 cm. Urine flowed down the bulb and was collected in the Erlenmeyer glass. Because of the small distance between the wall of bulb and of the funnel, feces could not flow together with the urine and were separately collected in the cuvette. Food was given in metalic vessels size of which was 20×15×15 cm. In some cases the small in size food particles, oats chiefly, were thrown out of the feed-box and had fallen down a cuvette together with feces. In such a case they were accurately separated.

The cages were placed in the open air on the wooden standings built so, that their three walls were tight sheltered and the fourth one opened. In one of the standings the air temperature was registrated by means of thermograph and the mean daily values were estimated. Before the experiment hares were placed for 3—5 days in large wooden cages size of which was 180×72×100 cm. During this period animals were given the same food as it was used in experiment.

In the initial experiment with three hares fed only on carrot, and two ones fed on oats, it was established, that after 2 days nearly the all food residues found in feces originated from the actually consumed food. During this 3—5 days lasting initial period individual differences in reaction of hares on arranged conditions came distinetly out.

To the further experiments individuals were chosen between more numerous group according to their calmness against the worker which took care of them during the whole time of experiment. Animals were kept 3 days long in metabolic cages where the first day was accepted as the period of adaptation. Every day in the morning all the animals were weighed and in this way body weight differences during experiment could be estimated.

Results of only 24 animals weight of which was basically unchanged during experiment were taken into account. The mean weight value of these hares before experiment was 3.78 kg (3.6 kg — 4.09 kg) and after about one week lasting experimental period 3.80 kg (3.56 kg — 4.12 kg) respectively. All the animals were given at the same time four different kinds of food (*ad libitum*) as white carrot, red carrot, beetroot and oats, caloric value of which was previously determined. Each kind of food was weighed before and after one day of experiment. It enabled estimation of daily food consumption of each hare under experiment. These estimation included correction for water vaporisation of experimental foods, which was calculated for every day from the weight differences of additional food sample placed into the empty metabolic cage.

Feces after collecting were weighed and further dried in vacuum thermostate at 60°C and in presence of $CaCl_2$; then weighed again for estimation of water content. All the feces of the daily experiment of one hare were dried, afterwards ground down in electric grinder and mixed together. Five samples of feces were

burnt in Berthelot system KL-3 calorimeter and that way their caloric value was determined. Caloric equivalent of urine excreted was determined by the Nijkamp method (1965) in each urine portion; 5 samples 10 ml each were taken and then dried in vacuum thermostate in the vessels bolstered up with polyethylene foil of known weight. The dry reminder was burnt in calorimeter together with foil. The estimated caloric value, after substraction of caloric value of polyethylene foil gave the value of caloric equivalent of urine.

For all indices estimeted experimentally or calculated mean values were found; they were characterised by means of confidence intervals based on variable *t*. Mean values of indices estimated for males and females of *L. europaeus* were compared by means of *t*-Student test with regard to difference of mean value for two independent groups. Having in view description od dependence between food intake of hare and environmental temperature, a line of regression was drawn and correlation coefficient was estimted.

## III. RESULTS AND DISCUSSION

The caloric values of experimental kinds of food given to hares are collected in table 1. In the situation of accessibility of four different kinds of food hares ate always chiefly beetroot (mean 240 g a day) less oats (125 g) and white carrot (100 g), and 50 g of red carrot only. Daily food intake of one animal was over 0.5 kg and concentrate played the

**Table 1.**
Caloric values of experimental food.

| Kind of food | N | Water content % | Dry mass cal/g | Biomass kcal/g |
|---|---|---|---|---|
| White carrot | 10 | 83.57 | 4 683.55 | 0.77 |
| Red carrot | 10 | 88.69 | 4 171.45 | 0.47 |
| Beetroot | 10 | 83.75 | 4 211.21 | 0.68 |
| Oats | 10 | 12.28 | 4 681.65 | 4.11 |

significant role in composition of this food. High level of food intake of hares during experiment expressed in energy units is given in table 2. Ratio of energy excreted with feces by hare to this ingested with food is of only 20%.

This resulted in very high digestibility coefficient (80.1%) of animals under experiment. Such a high value of digestibility coefficient of hares is close to that found by Golley (1960) and Drożdż (1966) for small feeding on grass rodents (estimated by the same method), proving great digestive ability of this species. Composition of mean values of above mentioned indices for males and females of *L. europaeus* (Table 2) shows no statistically significant differences.

Daily ingestion of food was equal by males and females. Caloric value

of this requirement was over 750 kcal; 150 kcal of which was excreted with feces, and about 605 kcal was assimilated. Mean energy value of hare's urine is rather low amounting to 84.1 cal/ml *i. e.* about 15 kcal/ /day/animal.

Results of above mentioned experiments bring to light new conceptions on the magnitude of food demands of *L. europaeus*. Authors working on problems of rational management of hunting grounds (Kokeš, 1948; Budzyński, 1953; Jezierski, 1956; Koenen, 1956; Pasławski, 1956) are of opinion that hare is an animal which has no great demands for energy even in winter — the most unfavourable season of the year. According to their estimations extra-food ought to be given during three months but jointly not more than 5 kg oats in sheaf, 1 kg of cloverhay and 4 kg of rootcrops (beet, carrot, turnip) per one animal. Such an amount of food, according to these authors, ought to be given in the case of cold winter combined with deep snowfalls only.

**Table 2.**

Food intake and coefficients of digestibility in *Lepus europaeus* L.

| Sex | N | Food intake (kcal/animal/day) | Feces (kcal/animal/day) | Ingested energy (kcal/animal/day) | Coefficient of digestibility | Urine (kcal/animal/day) |
|---|---|---|---|---|---|---|
| ♂♂ | 13 | 764.3±109.6 | 151.9±27.5 | 612.4± 98.7 | 80.2±3.1 | 18.5±7.8 |
| ♀♀ | 11 | 746.6±138.0 | 149.8±39.9 | 596.7±104.4 | 79.9±1.1 | 10.6±3.4 |
| ♂♂+♀♀ | 24 | 756.5± 79.5 | 151.0±21.5 | 605.5± 79.3 | 80.1±1.1 | 15.1±4.7 |

When winter is mild with long periods without snow 1 kg of extra food per 1 animal is to be sufficient. Budzyński (1953) is even of the opinion that only »during extremely heavy winters when getting natural food is impossible« extra-food is to be given. It seems that all the above mentioned norms are too low and must be corrected even when supposition is made that all extra-food was eaten by hares. This thesis may be supported by observed influence of environmental temperature, on the amount of consumed food by hares.

The line of regression bringing into relationship consumption expressed in kcal/kg body weight/day and the mean temperature of a day measured during experiments inside of metabolic cages, illustrates doubtless that process of adaptation to the low environmental temper-

atures is very »expensive« to hares (Fig. 1). Value of correlation coefficient estimated in this relationship was —0.543, and statistically significant. The graph, shows that the lowering of environmental temperature by 1°C caused the increase of food consumption, expressed in energy units by about 3.6 kcal/kg/day or 14 kcal/animal/day.

May be such a high level of consumption was influenced by the conditions under which experiments were made, and above all by the fairly low environmental temperatures observed during some of investigations. Yet mean temperature inside of metabolic cages estimated for the whole period of experiments was —4.3°C (—12.8°C — +5°C) and so by 1.5°C higher than that of environment. Moreover metabolic cages were from three sides tight sheltered and placed in this manner that animals were isolated from blasts of wind.

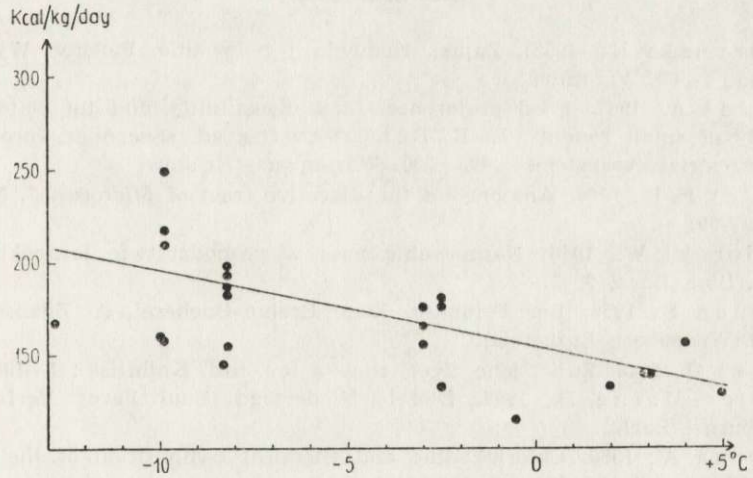


Fig. 1. Dependence of food consumption (kcal/kg/day) on environmental temperature.

$$y = -3.108x + 200.9 \qquad r = -0.5433$$

Therefore one can think the climate conditions under which hares lived during experiment were to some extent close to these of their natural environment. As an argument for rather high value of energy expenses of hare in winter-time may serve the increasing amount of adipose tissue in autumn (M y r c h a, 1968). Dried body of hares shot in the middle of December consisted in about 20% of fat. Caloric value of it was about 9 kcal/g.

The second argument confirming results of experiments were data gathered by P i l a r s k a (1967). She examined the changes in the

amount of food consumed during postnatal development of hares. Hares were bred in cages and the conditions of breeding were analogous to the above mentioned. Line of regression drawn after experimental data, illustrating the relationship between food consumption of growing up hares in winter and environmental temperature, is almost parallel to the line of regression of fig. 1. Hares examined in experiments of Pilarska (1967) showed even greater food intake as compared with animals used in our experiments. All facts mentioned confirm that European hare needs in very high food amount in winter and that these demands are even greater than norms of extra food established for this species. Results of this work suggest necessity of accurate examination of energy balance not only by means of food experiments but also by respirometric determinations.

## REFERENCES

1. Budzyński E., 1953: Zając. Hodowla i polowanie. Państw. Wyd. Roln. i Leśn.: 1—68. Warszawa.
2. Drożdż A., 1967: Food preference, food digestibility and the natural food supply of small rodents. In K. Petrusewicz ed. »Secondary productivity of terrestrial ecosystems«: 323—330. Warszawa — Kraków.
3. Golley F. B., 1960: Anatomy of the digestive tract of *Microtus*. J. Mammal., *41*: 89—99.
4. Jezierski W., 1956: Normowanie pasz w gospodarstwie łowieckim. Pom. Pozn. Biul. Łow., *9*: 21—28.
5. Koenen F., 1956: Der Feldhase. Neue Brehm-Bücherei, A. Ziemsen Verl.: 1—80. Wittenberg Lutherstadt.
6. Kokeš O., 1948: Zajič, jeho život, chov a lov. Std. Knihitisk.: 1—198. Praha.
7. Müller-Using D., 1954: Diezels Niederjagd. Paul Parey Verl.: 1—367. Hamburg — Berlin.
8. Myrcha A., 1968: Caloric value and chemical composition of the body of the European hare. Acta theriol., *13*: 65—71.
9. Nijkamp H. J., 1965: Some remarks about the determination of the heat of combustion and the carbon content of urine. In Blaxter K. L. ed. »Energy metabolism«. Academic Press: 1—450. London — New York.
10. Pasławski T., 1956: Dokarmianie zwierząt łownych. Państw. Wyd. Roln. i Leśn.: 1—89. Warszawa.
11. Pilarska J., 1967: Dynamika rozwoju postnatalnego i zmienność zapotrzebowania pokarmowego zająca szaraka w warunkach doświadczalnych. Praca magisterska U.W.: 1—30. (Msc.).
12. Szczygieł A. & Ziombski H., 1960: Klatka do badań metabolicznych szczurów. Roczn. Państw. Zakł. Hig., *11*: 461—467.

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# WSTĘPNE BADANIA NAD ZIMOWYM SPOŻYCIEM POKARMU PRZEZ ZAJĄCA SZARAKA (*LEPUS EUROPAEUS* PALLAS, 1778) W WARUNKACH EKSPERYMENTALNYCH

Streszczenie

Zbadano ilość zjadanego pokarmu przez 24 *L. europaeus* (13 ♂♂ i 11 ♀♀). Eksperymenty przeprowadzono w lutym 1967 r. w klatkach metabolicznych. Średnia temperatura powietrza w tym okresie wynosiła —4,3°C (—12,8°C — +5,0°C). Stwierdzono, że badane zające zjadały na dobę po około 0,5 kg pokarmu doświadczalnego, co stanowiło w sumie 756,5 kcal. Zwierzęta wydalały w ciągu doby średnio 151,0 kcal w kale i 15,1 kcal w moczu. Współczynnik strawności wyliczony z tych eksperymentów wynosił 80,1%. Nie stwierdzono różnic istotnych statystycznie związanych z płcią zwierząt. Stwierdzono, że istnieje korelacja pomiędzy ilością spożywanego pokarmu wyrażoną w kcal/kg ciężaru ciała/dobę, a temperaturą otoczenia ($r = -0{,}5433$). Wraz z obniżeniem się temperatury otoczenia o 1°C spożycie pokarmu przez zające zwiększyło się o około 14 kcal/zwierzę/dobę (3,6 kcal/kg/dobę).