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COMPARTMENTALIZATION OF BODY OF A FAT DORMOUSE *Glis glis*

Boris KRYŠTUFEK

ABSTRACT. The study is based on 88 adult and 25 young edible dormice collected in central Slovenia between May 17 and September 13, 1997. The sex ratio of adults did not deviate from 1:1, but June sample was significantly male biased while the August sample was significantly female biased. As evident from trapping results, females terminated hibernation and appeared aboveground ca 40 days later than males. Reproductive activities started at the beginning of July and pregnant females were collected between July 28 and August 9; litter size varied between 4 and 9, mean 5.8. The young of the year were collected for the first time on September 13. Body mass of adult dormice was between 62 and 214 g and fat contributed 0 – 22.5% of the total weight; it was highest in May and June and lowest in July and August. Sex dimorphism was evident only in the weight of the spleen and kidney which both had higher values in females. Liver weight was significantly more variable in males. The skin did not deviate from the isometric relation with the body weight, while all the remaining morphometric structures showed negative allometries. Reproductively active females were heavier than non-active ones and also attained significantly higher values in muscle, heart, liver, and kidney weights. A major fraction of the dormouse body was muscle (52%), followed by skin (15.7%) and skeleton (5.3%), while the internal organs (heart, liver, kidneys, spleen) contributed 5.4%.

Key words: *Glis glis*, life history, seasonal variation, morphometrics, allometries

BİR YEDİUYUR *Glis glis'* DE VÜCUT AĞIRLIĞI BÖLÜŞÜMÜ

ÖZET. Araştırma,17 Mayıs - 13 Eylül 1997 tarihleri arasında Orta Slovenya ' dan toplanan 88 ergin ve 25 genç yediuyur örneği ile yapılmıştır. Erginlerin eşey oranı 1:1 'den sapma göstermez. Ancak Haziran örneklerinde erkeklerin sayısında , Ağustos örneklerinde ise dişilerin sayısında önemli bir fazlalık vardır. Tuzağa yakalanan örneklere göre dişilerin kış uykusundan kalkması ve toprak üstünde görülmeleri erkeklerden yaklaşık 40 gün daha geç olmaktadır. Üreme faaliyetleri Temmuz'un başlarında başlamaktadır. 28 Temmuz ile 9 Ağustos arasında toplanan Hamile dişilerde yavru sayısı 4-9 arasıda, ortalama değer 5,8' dir. O yıl doğan gençlerin ilk toplanma tarihi 13 Eylül' dür. Ergin yediuyurlarda vücut ağırlığı 62g ile 214 g arasındadır Yağların total ağırlığa katkısı ise % 0-22,5 arasında değişir, en yüksek yağ katkısı Mayıs ve Haziran aylarında, en düşük katkı ise Temmuz ve Ağustos'tadır. Eşeysel dimorfizm yalnız dalak ve böbrek ağırlıklarında görülür, her ikisi de dişilerde daha ağırdır. Karaciğer ağırlığı erkeklerde önemli ölçüde daha değişkendir. Deri vücut ağırlığı ile izometrik bir ilişki göstermesine rağmen tüm diğer morfometrik yapılar negatif bir allometri gösterir. Dişilerin üreme bakımından aktif olanları olmayanlara göre daha ağırdır ve kas, kalp, karaciğer ve böbrek ağırlıkları önemli derecede yüksek değerler gösterir. Vücudun ana bölümlerinden kasların yediuyur ağırlığına katkısı %52 iken bunu %15,7 ile deri ve %5,4 ile iç organlar (kalp, karaciğer, böbrekler ve dalak) izler.

Anahtar sözcükler: *Glis glis*, yaşam öyküsü, mevsimsel varyasyon, morfometrikler, allometriler

INTRODUCTION

The fat or edible dormouse *Glis glis* (Linnaeus, 1766) is a medium sized sciurognathous rodent, whose range coincides with the deciduous forests of Europe, northern Anatolia, the Caucasus, and north-eastern Iran (1, 2). Deciduous forests are vertically structured ecosystems with several different strata; however they display greater changes in seasonal appearance than any other ecosystem (3). Seasonality affects all

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Slovenian Museum of Natural History, P.O. Box 290, SI-1001 Ljubljana, Slovenia.
e-mail: boris.krystufek@uni-lj.si

aspects of the plant cycles, from flowering and ripening to leaf shedding in trees, shrubs, and herbs. Seasonal availability of resources is further exacerbated by synchronous flowering (early spring) and ripening (autumn) with a mid-summer nutritional crisis when food supplies from the previous year are decreased (4). The availability of resources is further affected by the multi-annual variability in mast production as key trees in the majority of deciduous forests of the Holarctic region (*Quercus* spp., *Fagus* spp.) are mast seeders, producing large seed crops every two to six years, while production in the intervening years is low or even fails (5). Kitchings & Walton (6) consider migration, hibernation and the seasonal timing of reproduction as major physiological events in the annual cycle of many animals from the deciduous forests. The majority of rodents living here are generalists with much broader fundamental niches than actually realised in undisturbed habitats (7). Among rodents of the temperate forests of the Western Palaearctic, the fat dormouse is one of the very few hibernators and possibly the only species timing its reproduction with the autumn seed and fruit ripening. Young fat dormice are born in August (8, 9, 10; this paper), *i.e.* at the peak of mast availability but reproduction can even fail in years of low mast production (9, 10, 11).

Considering the fluctuations in resource availability which so evidently affect reproduction in the fat dormouse, it is not surprising that populations fluctuate considerably over the years (8, 12; personal observations). What is unusual for such a hibernator as the fat dormouse is, is a delay in litter delivery late in summer. Rodent hibernators of comparable size (*e.g. Spermophilus*) reproduce immediately after they emerge from hibernation (13). This gives females enough time to re-establish fat reserves after being exhausted by pregnancy and lactation, and allows young animals to gain adequate weight before entering hibernation. But in the fat dormouse the post-reproductive time is very short. It is likely that delay in reproduction, a parameter with a profound effect on an individual's fitness (14), could be disastrous for reproductive success. The dependency of reproductive success on the animal's physical condition is thus expected to be even more crucial in the fat dormouse than is in other mammals. If so, an easily measurable parameter of physical condition would be a useful tool in predicting population dynamics over the years.

As a hibernator, the fat dormouse accumulates considerable amounts of fat before entering hibernation. This parameter, however, is not easy to monitor in larger samples (15). Nevertheless, some internal organs are known to fluctuate in their mass seasonally or as a response to temperature stress, due to somatic metabolic activity changes or to other influences (16). Deviations in masses of particular organs are thus likely to also reflect physiological conditions of an individual animal. In this paper, I focus on the mass of different organs of the fat dormouse's body. My aims were (i) to describe relations between the total body mass and masses of organs, (ii) to detect possible deviations from a "normal" condition due to seasonal oscillations or other changes and (iii) to examine differences between sexes. I also describe life history traits as observed in the population studied in 1997.

MATERIAL AND METHODS

The specimens were collected between May 17 and September 13, 1997, mainly on Mt. Krim (ca $14^0$25'E $45^0$55'N) and Mt. Kočevski Rog (ca $15^0$05'E $45^0$40'N). Two specimens in the August sample were from Vransko ($14^0$57'E $46^0$15'N) and two specimens in the May sample came from the vicinity of Šentjernej ($15^0$20'E $45^0$50'N). All localities are situated in the Dinaric karst of central and southern Slovenia with Vransko from the very southern fringes of the calcareous Alps being the only exception. In any event, the vegetation is similar in all sites: mainly beech *Fagus sylvaticus* forests on corroded limestone bedrock, occasionally with the fir *Abies alba* and spruce *Picea abies*. Disturbed patches also included the hop hornbeam *Ostrya carpinifolia*, the hornbeam *Carpinus betulus*, and the hazel *Corylus avellana*. The specimens were collected by different types of native kill traps, by Elliot live traps, or picked up directly from hollow trees. The traps were placed either on branches in the canopy (kill traps) or were used to close exits from the underground caverns presumably inhabited by dormice (kill and live traps). The main goal was to provide monthly samples of ca 20 specimens. Details on material are provided under the Results section.

Live-trapped specimens were sacrificed by a di-ethyl-ether overdose then individually placed into plastic bags and frozen at ca –25^{0}C until processed. Before subjected to autopsy they were weighed to the nearest gram. The weight to the nearest 0.1 g was also scored for the skin, the skinned and the eviscerated body. The internal organs were weighed to the nearest 10^{-4} g. The amount of fat was also recorded, separately for subcutaneous and abdominal fat. It was removed by scissors and scalpel, so its content was likely to have been underestimated. The bodies were preserved in alcohol and then dried. The skeletons were prepared from the dry bodies by *Dermestes* beetle larvae. Muscle weight was estimated by subtracting the skeleton weight from that of deviscerated and skinned bodies. This likely involves some bias; brain and bone marrow were not subtracted as was not considered the water content lost during drying bones. The animals were also examined for the condition of their reproductive organs (number and size of embryos, presence of teats, size and position of testes) and for damage which might suggest antagonisms within a population. Age was estimated on the basis of enamel abrasion of the cheek teeth (17).

Statistical analyses were performed using Statistica 5.1 '97 (StatSoft). The following references were consulted regarding the application of statistical tests: Lewontin (18), Pollard (19), and Sokal & Rohlf (20).

RESULTS AND DISCUSSION

Composition of the material

General. In total, 88 adults and 25 young of the same year were collected. The sampling effort necessary to achieve the goal of ca 20 dormice per month was the highest in May, *i.e.* at the time of emergence of animals from hibernation. The effort decreased in June and remained approximately the same until August, while it dropped again in September when the year's young started leaving the nests (Table 1).

Table 1. Sampling effort according to months. The sampling effort is given as a quotient of the number of sampling days with the number of collected dormice as the denominator. Trapping was performed until a monthly sample contained *ca* 20 dormice.

Month	*No. days*	*No. dormice*	*Effort*
May	5	5	1.00
June	5	18	0.27
July	6	34	0.18
August	3	25	0.12
September	1	31	0.03

The first specimen, a male, was collected on May 17, and all dormice (N = 16) for the subsequent 40 days were males. The first female was obtained on June 28. The time of emergence thus differed significantly between the sexes with males becoming active much earlier in the year (Fig. 1). Such a pattern is evidently common among rodent hibernators; for example it has also been reported in ground squirrels (13, 21).

Age structure. Results are summarised in Table 2. The absence of two year old dormice suggests a lack of reproduction in 1996 when mast production nearly failed and dormice population densities were very low (unpublished data). Although such a reproductive failure was also reported by Bieber (9, 10) and Morris (11), the present results require verification of age estimation before firm conclusions are to be drawn. The average age did not differ between the sexes (Mann-Whitney U = 761.5, p = 0.62).

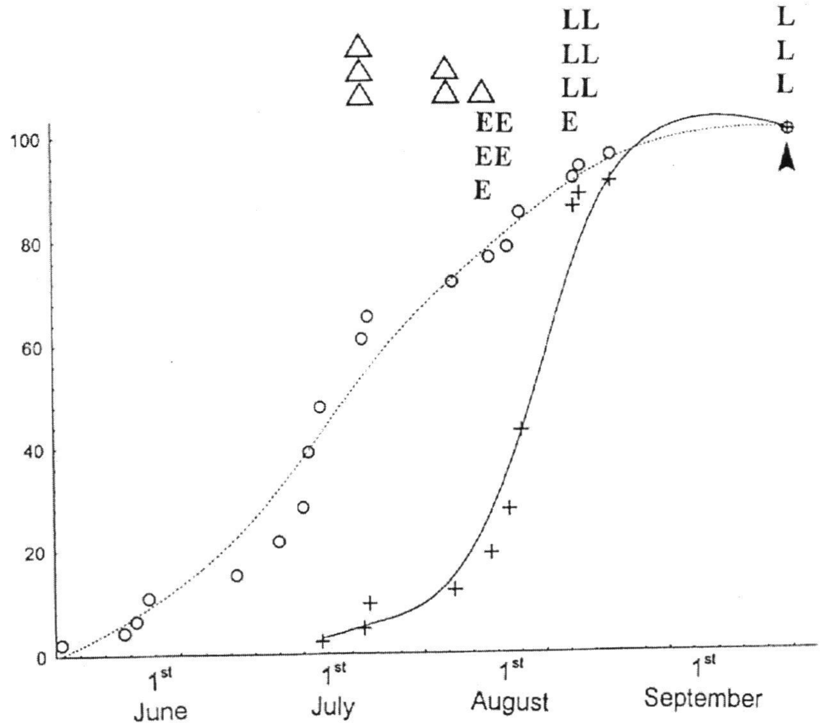

Fig. 1. Cumulative frequency (Y axis) of dormice collected between May 17 and September 13, 1997. Only adults were considered and sexes were treated separately. Circles are males and crosses are females. Fitted lines are based on distance weighted least squares. Symbols at the top of the diagram summarise reproductive and antagonistic activities; each symbol representing one specimen. Triangles – animals with wounds on their back; E – females with embryos; L – females in lactation. Arrow indicates date when first young of the year were trapped.

Table 2. Age of dormice (years of life) according to sex. Animals in their 1st year were not considered. SD – standard deviation.

Age	*Males*	*Females*
2	1	0
3	27	26
4	19	12
Mean	3.3	3.4
SD	0.48	0.50

Sex ratio. Although the total sex ratio in a pooled sample of adults was balanced (46 males v. 42 females), there were significant departures from the 1:1 ratio in two monthly samples. The sex ratio was male biased in June ($\chi^2 = 14.22$, $p < 0.001$) and female biased in August ($\chi^2 = 9.00$, $p < 0.01$). Males dominating the sample in June might reflect a genuine predominance of males due to their earlier emergence from hibernation. On the other hand, the high share of females in August when the ratio was 1 male to 4 females seems enigmatic. The sex ratio was skewed in a larger sample of adult dormice (N = 112) collected between September 25 and October 10, 1999, on Mt. Krim (*i.e.* in the area where the majority of the 1997 samples came from), however, the predominance of females was not as obvious in 1999 when the ratio was1 male to 1.49 females; $\chi^2 = 4.32$, $p < 0.05$ (unpublished results). Morris (11) reports dormancy in August among free living dormice, however, it is unknown whether such phases of summer inactivity are sex biased. Nevertheless, late summer dormancy is more likely in males who terminate their reproductive activity in mid July, but unlikely in females since July and August coincide with pregnancy and lactation.

Reproduction. At the beginning of July dormice appeared with deep wounds on their backs; the skin was perforated and small holes showed evidence of recent bleeding. The number of wounds varied between 2 and 8 per animal (median = 5.5, N = 6) and was recorded in both sexes (three males and three females). The first pregnancies were recorded 20 days after the wounds appeared, *i.e.* on July 26. Considering the advanced stage of embryos at that time (mass of the largest embryo was 2.01 g), as well as the reported length of pregnancy of 30-31 days (22) the wounds evidently originated from the mating period. This also suggests mating to involve strongly antagonistic behaviour in the edible dormouse.

Based on the size of the testes (Table 3), as well as their position (scrotal *v.* abdominal), males were already reproductively active when they emerged from hibernation and remained in such a condition until mid July. Although One Way ANOVA demonstrated significant heterogeneity among temporal samples ($F = 3.56$, $p < 0.05$) very few pairwise comparisons were significantly different; this however, might be an artefact of the small sample sizes.

Table 3. Mass of left testis in grams according to the month. Same year animals were excluded.

Month	*N*	*Mean*	*SD*	*Min – Max*
May	4	0.780	0.371	0.386 – 1.184
June	17	0.712	0.307	0.330 – 1.632
July 1-15	11	0.816	0.177	0.606 – 1.133
July 15-31	8	0.377	0.172	0.126 – 0.644
August	5	0.355	0.127	0.194 – 0.548

The last pregnant female in 1997 was collected on August 9; the embryos were large with an average mass of 2.08 g. The pregnancy evidently started at the beginning of July and lasted until mid August. The litter size, based on embryos and placental scar counts, varied between 4 and 9 (mean = 5.8, N = 9). Litters presumably occurred in the 1^{st} half of August. Considering the long weaning period in the edible dormouse (22), the young may have started leaving nests at the beginning of September, but they were recorded on September 13, 1997 (Fig. 1). Differentiation between young and adults did not provide any difficulties at that time; the former were obviously smaller (see Fig. 2), of different body proportions with relatively larger head and hind feet, and of a different colour as well as pelage texture.

Conclusions.

Life history traits as observed in 1997 correspond well with data from central Germany (10). This includes retarded emergence of females from hibernation and thus a male based sex ratio in May and June, as well as the timing of different phases of reproductive activities (mating, birth, weaning, lactation).

Body and organ masses

Body mass. The body mass varied in adults between 62 and 214 g (Table 4); the smallest specimens were a female collected on June 28 and a male obtained on July 20. One Way ANOVA did not detect any significant heterogeneity between the sexes ($F = 0.02$, $p = 0.90$). In any event, monthly samples did show significant heterogeneity ($F = 4.19$, $p < 0.01$) due to a larger size in September (Fig. 2). Although autumn gain in body mass is genuine (8; personal observations) fat accumulation still had not started by September 13. The young of the same year formed a very homogeneous group in respect to body mass which suggests synchronous delivery.

Masses of left and right kidneys were combined.

	Males					Females				
	N	Mean	SD	Min.	Max.	N	Mean	SD	Min.	Max.
Total weight	45	124.4	29.96	64.0	214.0	38	123.7	25.74	62.0	168.0
Skeleton	42	5.71	1.07	3.58	7.89	30	5.67	1.09	3.38	7.50
Muscle	41	62.6	12.33	35.0	96.1	30	62.8	11.80	31.7	82.8
Skin	44	19.5	5.40	10.0	37.8	38	19.3	5.55	10.5	36.7
Heart	45	0.760	0.228	0.335	1.560	38	0.805	0.199	0.399	1.254
Liver	45	4.377	1.565	1.837	9.545	38	4.795	1.210	2.585	7.701
Kidneys	45	1.055	0.199	0.708	1.634	38	1.192	0.235	0.749	1.724
Spleen	43	0.214	0.102	0.095	0.493	38	0.285	0.201	0.118	1.091

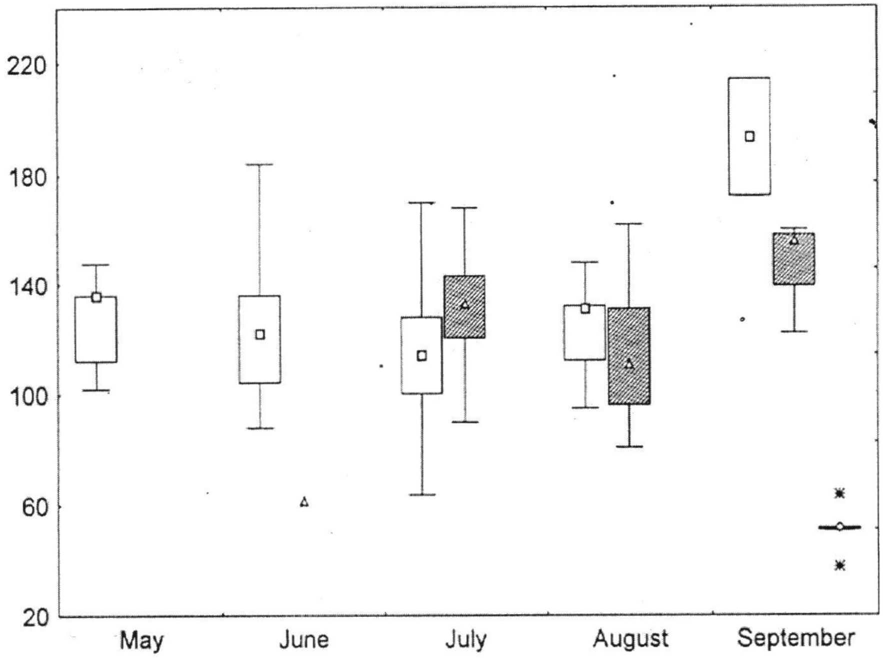

Fig. 2. Box and whisker plot of weight changes (Y axis; in g) during the season according to sex. Squares (males) and triangles (females) indicate position of median; boxes (shaded in females) are central quartiles (25 – 75% of specimens); whiskers are non outlier minimum and maximum; asterisks – outliers in young dormice (pooled sexes).

Fat content was between 0 and 22.5% of the total weight. There was more subcutaneous fat than abdominal (Table 5). Males contained on average 7 g of fat as opposed to 3.4 g in females; the difference, however, was not significant (One Way ANOVA, F = 3.41, p = 0.07). As suggested by the Coefficient of Variation (Table 5), it was subjected to enormous individual variations. Although between months heterogeneity was significant (One Way ANOVA, F = 5.30, p < 0.001), the only significant pairwise comparison was between July and August samples (Fig. 3). Fat content was the highest in May and June, *i.e.* just after the emergence from hibernation. This fat was presumably a residual from the previous year, rather than a gain of the same spring. By August and the 1st half of September, dormice evidently exhausted fat reserves but still did not started accumulating new ones.

Table 5. Fat content as per cent of total weight. CV – coefficient of variation

Fat (%)	*Range*	*Mean*	*CV*
Subcutaneous	0.0 – 17.7	2.53	160.1
Abdominal	0.0 – 7.3	1.30	153.1
Total	0.0 – 22.5	3.83	253.5

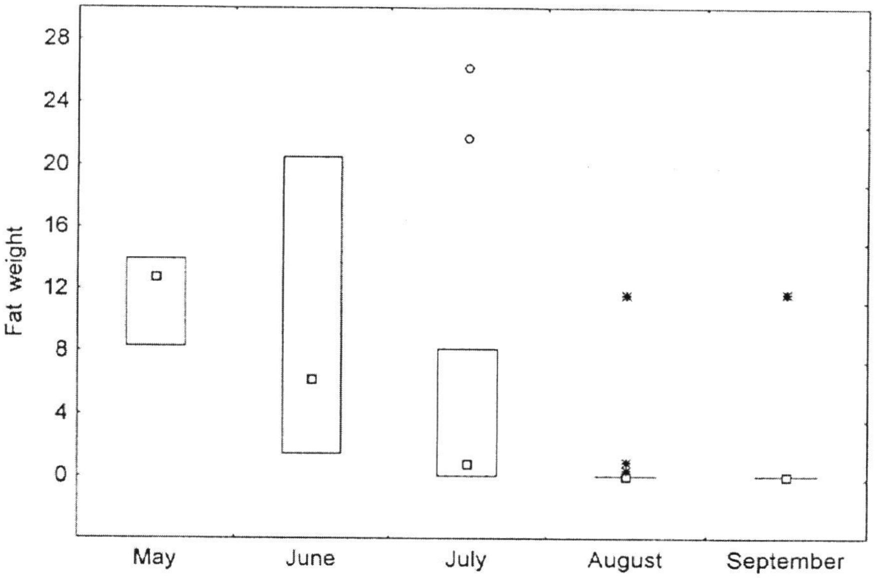

Fig. 3. Box plot of changes in fat content during the season. Sexes were pooled. Squares indicate position of median and boxes are central quartiles. Circles represent outliers and asterisks represent extremes.

Masses of organs. For descriptive statistics see Table 4. The Two Way ANOVA with sex and age as factors detected significant variations in all organs, except the skin, for at least one factor (Table 6). Sex dimorphism was evident only in two organs, the spleen and kidney, while age variation affected the mass of five organs in addition to the total body mass. The kidneys were affected by both sources of variation but age was more important; there was however no interaction between the factors. In both cases of sexually dimorphic structures, females attained higher values. In accordance with expectations, 4th year dormice were heavier in all the characters affected by variation in age. Differences were particularly evident in the weight of the skeleton, followed by muscle weight.

Since the absolute weight of partial structures is likely to depend on the size of the animal, I evaluated sex dimorphism also by ANCOVA. Sex was selected as the independent variable, the weight of a particular organ as a dependent variable and body mass as a covariate. The results are summarised in Table 6. Such an approach was more sensitive than ANOVA and the liver was also found to be dimorphic, in addition to the kidneys and spleen. Again, kidney mass was most affected by sex. Wood et al. (23) argued that heart weight is a more constant measure than body weight which responds too readily to changes in environment and as such a more useful base in regression analyses. However, using heart mass as a covariate, the liver weight did not differ significantly between the sexes any more (Table 6).

Sexual dimorphism in the spleen mass was due to two female outliers which attained very high values. As a consequence, the distribution of spleen mass deviated from normality (Fig. 4). Both females were collected on August 9, *i.e.* at the peak of nursing. Judging from their body mass of 140 and 130 g, they were both in good shape. One female was lactating with 7 placental scars while the other had a large cyst on her right ovary and was evidently not reproductively active in 1997. Deviations from normality in spleen weight is apparently a common phenomenon in mammals. *E.g.* Cavallini (24) reported it in wild foxes from Italy while Wood et al. (23) ascribed outliers in mink to possible splenic pathology.

Table 6. Differences between sexes in morphometric variables in the fat dormouse. Results are derived from Two Way ANOVA (sex and age as factors) and ANCOVA (total mass or heart mass as a covariate and sex as an independent variate). There was no interaction between factors in the Two Way ANOVA. P-values are given; n.s. – not significant.

	ANOVA sex	*ANOVA age*	*ANCOVA total weight*	*ANCOVA heart*
Total weight	n.s.	0.01		
Skeleton	n.s.	0.000001	n.s.	
Muscle	n.s.	0.0001	n.s.	
Skin	n.s.	n.s.	n.s.	
Heart	n.s.	0.05	n.s.	
Liver	n.s.	0.01	0.05	n.s.
Kidneys	0.01	0.001	0.0002	0.005
Spleen	0.05	n.s.	0.05	n.s.

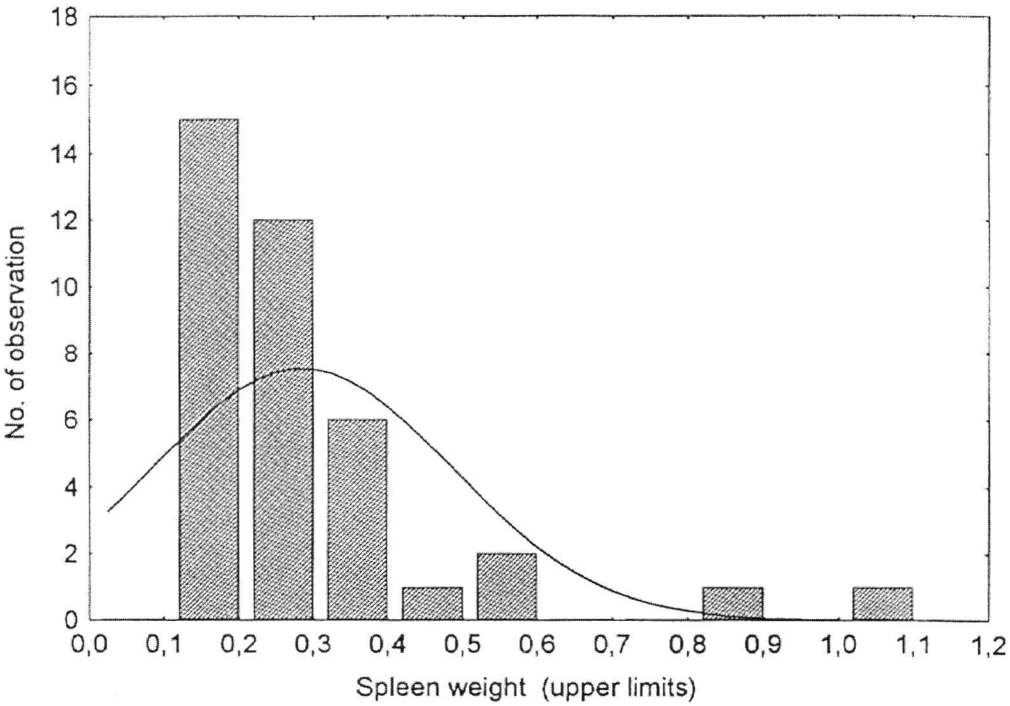

Fig. 4. Frequency distribution of the spleen weight in female edible dormice. Fitted line is expected normal curve. Data deviated from normal distribution: Kolmogorov-Smirnov d = 0.181, p < 0.50.

The kidneys appeared far more dimorphic than any other internal organ. Sex dimorphism in kidney mass has been found in the red fox (23) but not in the collared peccary (25). Prothero (26) detected no significant differences in the slopes of the regression lines of kidney weight against body weight between sexes in 63 mammalian species. Results by Coblentz and Van Vuren (27) on the Indian mongoose suggests that kidney mass increases in both sexes due to reproductive activity and also during lactation. The variation of kidney mass might result not only from the differences in somatic metabolic activities but is also likely to reflect body water kinetics (26). There was no difference between males and females in microhabitat selection which would link one sex with more mesic conditions. Consequently, sex dependent body water kinetics is little likely in the edible dormouse, and observed differences are more probably associated with different levels of metabolic activities.

Relative variation. The coefficient of variation (CV) attained high values in all the morphometric structures (> 18% in both sexes), thus suggesting also their high variability (Table 7). The only difference in CV between sexes was in liver weight which was more variable in males ($F = 1.96$, $p < 0.05$). Skeleton and muscle showed slightly lower CVs than total weight in both sexes. This is not surprising since the total weight is likely to include more noise due to the nutritional and reproductive condition of an individual. Skin was more variable than either skeleton, muscle, or total weight; in females skin CVs was significantly higher than those for the skeleton ($F = 2.02$, $p < 0.05$).

The spleen was the most variable of the internal organs; its CV was significantly higher (at $p < 0,05$) than in any other organ, except in the liver of males. The kidney mass showed the lowest CV in both sexes.

Table 7. Relative variability expressed by Coefficients of Variation (CV), of morphometric structures in the edible dormuse according to sex.; SE – standard error.

	Males		*Females*	
	CV	SE	CV	SE
Total weight	24.1	2.68	20.8	2.49
Skeleton	18.7	2.11	19.2	2.57
Muscle	19.7	2.26	18.8	2.51
Skin	27.7	3.17	28.8	3.57
Heart	30.0	3.44	24.7	3.00
Liver	35.8	4.23	25.2	3.07
Kidneys	18.9	2.06	19.7	2.35
Spleen	47.7	6.20	70.5	16.13

Allometries. The subject of this paragraph are changes in size of edible dormice's morphometric structures as a consequence of changes in total size, *i.e.* static allometry. Quantification of relative growth is possible through the simple allometric equation, $Y = aX^b$, or its logarithmic equivalent: $\log Y = \log a + b \log X$. See Leamy and Bradley (28) for a more thorough discussion of this topic. The value of "a" is of questionable biological significance (23), however, "b" is generally interpreted as an allometric coefficient. A coefficient $b > 1$ suggests positive allometry, *i.e.* an increasing Y/X ratio, while a coefficient $b < 1$ indicates negative allometric relations, thus a decreasing Y/X ratio; at $b = 1$ there is no change in the ratio or isometry.

Skin was the only structure not deviating from the isometric relation with body weight. All other structures showed negative allometry with general body size (Table 8), thus gaining weight at a slower rate than the increase of the total body mass. Spleen mass evidently did not depend on overall size and the correlation coefficient to body weight did not differ significantly from zero (see Table 8). Muscle followed a general increase in size more closely, that is with a higher allometric coefficient than the skeleton. Of the internal organs, the heart was closest to an isometric pattern. Males attained higher allometric coefficients than females in livers, while the opposite was true for kidneys.

Table 8. Bivariate static allometric coefficients (b), standard errors (SE) and Pearson correlation coefficients (r) for the weights of seven morphometric structures relative to body weight. Correlation coefficients based on log-transformed data are only given when different from zero at $p < 0.05$. Allometric coefficients differing from isometry at $p < 0.05$ are indicated by an asterisk. Sexually dimorphic structures were treated separately for males (M) and females (F).

		N	*b*	*SE*	*r*
Skeleton		72	0.672*	0.056	0.820
Muscle		71	0.835*	0.037	0.939
Skin		82	1.020	0.078	0.681
Heart		83	0.965*	0.086	0.782
Liver	M	45	0.896*	0.180	0.604
	F	38	0.685*	0.147	0.613
Kidneys	M	45	0.526*	0.090	0.666
	F	38	0.632*	0.105	0.708
Spleen	M	43	0.356*	0.269	n.s.
	F	38	0.300*	0.383	n.s.

Morphological structures and fitness. Since reproduction evidently depends on the shape of the animal, reproductive activity was presumed to indicate the fitness of an individual. All males collected between May and July 15 had testes large enough to be presumably sexually active (Table 3); Joy et al. (29) demonstrate that a paired testes weight > 550 mg indicates spermatogenesis. Consequently, it was not possible to judge the fitness of individual males. Of the 38 adult females, 15 showed signs of reproductive activity (vaginal plug, embryos, placental scars, lactation). This number is likely to be underestimated as macroscopic examination of the uterus for the presence of embryos classified females in an early stage of pregnancy as reproductively non-active. To minimise the bias I excluded females collected before July 20, *i.e.* before the first pregnancies were recorded.

One Way ANOVA detected no significant difference between the age of reproductively active *v.* non-active females (Table 9). Active females were heavier than non-active ones and also attained significantly higher values in all morphometric characters except in spleen weight. Heart weight most strongly depended on the reproductive condition. It was noteworthy that litter size based on embryos and placental scar counts correlated positively with the heart mass ($r = 0.64$, $N = 9$); the correlation coefficient, however, did not differ significantly from zero.

Table 9. Descriptive statistics and One Way ANOVA for age and seven morphometric characters (mass in grams) in reproductively non-active and reproductively active female edible dormice.

	Non-active			*Active*			*ANOVA*	
	N	Mean	SD	N	Mean	SD	F-ratio	p <
Age	19	3.37	0.496	15	3.53	0.516	0.90	n.s.
Total weight	19	111.53	17.78	15	143.67	25.75	18.50	0.001
Skeleton	17	5.48	0.899	11	6.17	1.127	3.20	n.s.
Muscle	17	60.55	9.790	11	69.19	10.01	5.11	0.05
Heart	19	0.708	0.137	15	0.935	0.177	17.75	0.001
Liver	19	4.446	0.759	15	5.543	1.334	9.15	0.01
Kidneys	19	1.104	0.193	15	1.336	0.206	11.40	0.01
Spleen	19	0.277	0.174	15	0.320	0.251	0.35	n.s.

In order to evaluate the discriminatory power of morphometric parameters in predicting female's reproductive conditions, I introduced seven variables (Table 9) into Discriminant Function Analysis. This is a multivariate technique aimed at finding the best possible separation between *a priori* defined groups (30). High value of Wilk's λ ($= 0.52$, $F = 2.64$, $p < 0.05$) indicated low predictability of cases and consequently weak discriminatory power. All non-active females were classified into the actual, *a priori* defined group while four out of 11 active females were missclassified.

Body composition. The composition of the body by main structures is given in Fig. 5. This approach is easily biased for several methodological reasons such as the variable water content of bones; blood mass in capillaries and so on, so the results are tentative. Because composition is given as a ratio of a particular organ within the total body mass, no attempt was made to present results in the form of descriptive statistics. Undesirable statistical properties of ratios (20) were thus avoided.

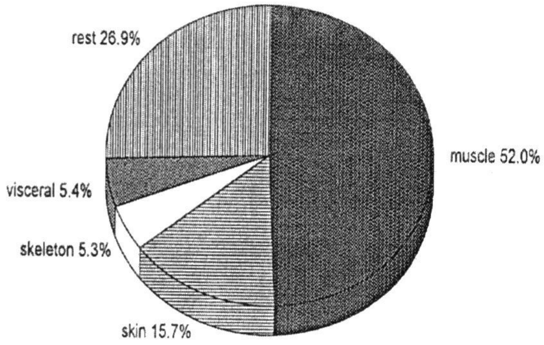

Fig. 5. Body composition of an adult edible dormouse.

Major fraction of the total body mass are muscle (52%), which is a general property of the mammalian body (31). Other values also do not deviate from those given by Calder (31), except that the pooled mass of visceral organs, the heart, liver, kidneys, and spleen are fairly low.

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