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KIDNEY MASS AND KIDNEY FAT INDEX IN THE EUROPEAN HARE INHABITING NORTHWESTERN PATAGONIA

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ABSTRACT: The possible seasonal variation in kidney mass and the pattern of kidney fat deposition were studied in relation to both sex and age of European hare (*Lepus europaeus*). Monthly samples totalling 264 hares were collected near Bariloche, Río Negro province, Argentina, between March 1985 and May 1986. For all categories of age class, the females had greater mean kidney mass than the males but in any category the difference was significant. For adult hares (male and female), there was no evident relationship between body mass and kidney mass. Nevertheless, in juvenile and infantile hares there was a significant relationship between both variables.The frequency distribution of fat in reproductive male and female hares followed a similar pattern but generally the females were fatter than the males. There was a marked seasonal variation in the kidney fat index (KFI) values of reproductive male and female hares, with a gradual increase starting in autumn and reaching a peak in late winter followed by a gradual decline as breeding began. Hares were fattest in August (males) and September (females) and the fact that males gain and lose condition about a month before females, shows that another important function of these fat deposits would be to provide energy for breeding, which starts in August. The kidney fat deposit seems to be a good measure of body condition, at least for European hare, over a relatively wide range of conditions.

RESUMEN: Masa del riñón e índice de grasa renal de la liebre europea del noroeste de la Patagonia. La posible variación estacional en la masa del riñón y el patrón de deposición de la grasa renal en relación con el sexo y la edad de la liebre europea (*Lepus europaeus*) fueron estudiados en el noroeste de la Patagonia. Un total de 264 liebres se cazaron entre marzo de 1985 y mayo de 1986 en las proximidades de Bariloche, provincia de Río Negro. Las hembras presentaron una masa promedio de riñón más grande que el de los machos en todas las clases de edad, pero en ningún caso la diferencia fue significativa. Se observó una relación significativa entre la masa del cuerpo y del riñón en las liebres infantiles y juveniles (machos y hembras) no así en las adultas. Hubo una marcada variación estacional en el índice de la grasa renal (KFI) de machos y hembras con capacidad reproductiva (juveniles y adultos), con un gradual incremento en otoño para alcanzar un pico en invierno y comenzar a decrecer con el inicio de la reproducción. Las liebres tuvieron el mayor contenido de grasa en agosto (los machos) y en septiembre (las hembras), y el hecho de que los machos ganen y pierdan condición corporal un mes antes que las hembras demostraría que una función importante de estos depósitos sería proveer energía para la reproducción, la cual comienza en agosto. El índice de la grasa renal sería un buen medidor de la condición corporal al menos para la liebre europea.

Palabras clave: Lagomorpha, Leporidae, *Lepus europaeus*, Argentina, índice de la grasa renal

Key Words: Lagomorpha, Leporidae, *Lepus europaeus*, Argentina, kidney fat index

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INTRODUCTION

Many of the indices of nutritional status or condition of wildlife populations use measurements of the different fat deposits of the body (Kirkpatrick, 1987). Riney (1955) proposed the kidney fat index (KFI) as a measure of physical condition for red deer. KFI is calculated dividing the wet mass of the perirenal fat by the wet mass of the kidney multiplied by 100. This index is based on the assumption that amount of perirenal fat is a reliable indicator of total body fat. Kidney mass is included in the index to allow the comparison of KFI's among animals of different body size.

This approach to estimate body condition is fast and easy and has been adopted as an indicator of condition for a variety of animals (sensu Ransom, 1965; Dauphiné, 1975; Finger et al., 1981), included the European hare (*Lepus europaeus* Pallas, 1778) in which the kidney is the largest fat deposit in the body (Flux, 1971).

KFI can be also affected by sex, age and season (Johns et al., 1980, 1984). Flux (1967) and Parkes (1989) have described cycles in the amount of fat present in this species in New Zealand, and Pepin (1987) has done the same in France.

The objectives of this study were to examine: 1) the variation of the kidney mass and KFI in relation to sex and age of hares, and 2) the annual pattern of KFI in fertile individuals.

MATERIALS AND METHODS

This study was conducted near Bariloche (41°10'S and 71°05'W), Río Negro province, Argentina. Elevation range from 800-1100 m. Precipitations mostly occurring in fall-winter season and the annual average for the period 1936-1988 was 542 mm. Mean snowfall was 149 mm and it is greatest during August. Annual average temperature is 7.1ºC, with mean monthly extremes of 1.3ºC in July and 12.8ºC in January (Bustos and Rocchi, 1993). The study area lies within the Patagonic Phytogeographical Province described by Cabrera (1971). The vegetation consists mainly of grasslands dominated by "coirón amargo" (*Stipa speciosa* var. *major*) at the lower elevations and by "coirón blanco" (*Festuca pallescens*) at the highest elevations. An important shrub associated with these grasses is "neneo" (*Mulinum spinosum*). The valley bottom is vegetated by moist meadows of "junco" (*Juncus balticus*), "pasto mallín" (*Poa pratensis*), "cola de zorro" (*Hordeum comosum*), and "diente de león" (*Taraxacum officinalis*). Along the water courses there are shrubs such as "calafate" (*Berberis heterophylla*), "chacay" (*Discaria* spp.), "laura" (*Schinus patagonicus*), and "maitén" (*Maytenus boaria*). There are also remnants of mountain forest dominated by "ciprés" (*Austrocedrus chilensis*), and "ñire" (*Nothofagus antarctica*).

Monthly samples totalling 264 hares were collected by shooting between March 1985 and May 1986.

Hares collected were weighed, measured, and dissected within 12 hours of death. Body masses were measured using a triple-beam balance. External measurements were made using a ruler. Liver, heart, spleen and kidney with associated kidney fat were removed and weighed on a top-loading Metler balance; the dissected kidney and the fat free kidney were weighed following the method of Riney (1955).

Discrimination of age classes was carried out by means of dry eye lens mass (Lord, 1959; Brandani et al., 1977; Suchetrunk et al., 1991). The animals were separated into 3 age classes (infantile, juvenile, adult) and the juvenile and adult individuals of both sexes were considered fertile according to Amaya et al. (1979).

The mean value for kidney mass was calculated in each age category. The differences between kidney mass and KFI means were tested by t-tests at the 5% level of significance (Snedecor and Cochran, 1980). Linear regression was used to evaluate the relationship between kidney mass and body mass for all age classes. Data on mass and dimensions of body and internal organs are described by Bonino and Bustos (1994).

RESULTS AND DISCUSSION

For adult hares (male and female), there was no relationship between body mass and kidney mass ($r=0.21$, $P>0.05$), because (as demostrated by Bonino and Bustos, 1994) there was a large annual variation in body mass. Nevertheless, in juvenile and infantile hares there was a significant relationship ($r=0.49$, $P<0.05$ and $r=0.72$, $P>0.05$, respectively) between both variables.

For all age classes, females had greater mean kidney mass than males but in no category these differences were significantly different (**Table 1**). On the other hand, the kidney mass

of adult males was significantly heavier than those of juveniles (t= 3.25, P<0.05) and leverets (t= 7.29, P<0.05). Likewise, the kidney mass of adult females was also significantly heavier than those of juveniles (t= 2.86, P<0.05) and infantiles (t=8.76, P<0.05).

Table 1. Average values of kidney mass and kidney fat index (KFI) in relation to sex and age of the European hare (average ± standard error).

Sex	Age class	Kidney mass (g)	KFI (%)
	Infantile (n=60)	6.99±0.14	12.3
Female	Juvenile (n=34)	7.85±0.23	21.6
	Adult (n=31)	8.80±0.15	37.1
	Infantile(n=76)	6.66±0.13	10.1
Male	Juvenile (n=24)	7.44±0.19	12.7
	Adult (n=39)	8.33±0.18	31.3

In the three age classes of hares, females were fatter than males (**Table 1**). Adult female hares, which average 37.1% in KFI, were significantly fatter than adult males (t= 9.58, P<0.05) which average 31.3%. Juvenile hares had much less fat than adults and the difference between sexes was even greater than for adults, females averaging 21.6% compared with 12.7% for males (t= 8.03, P<0.05). In the infantile class the difference in favour of females was not significantly different.

There was a marked seasonal variation in KFI values of reproductive male and female hares (**Fig. 1**), with a gradual increase starting in autumn and reaching a peak in late winter followed by a gradual decline as breeding began. Hares were fattest in August and September and the fact that males gain and lose condition about a month before females, does show that another important function of these fat deposits would be to provide energy for breeding, which starts in August (Amaya et al., 1979). This marked seasonal variation in fat deposits of European hare was also observed by Flux (1967) in New Zealand

Individual hares vary greatly in the amount of fat present, which is also correlated with body mass, sex, age, season, and reproductive status (Flux, 1971); but the average pattern in this study is quite clearly an increase in fat during the winter when food is scarce, and the ground is completely covered by snow. The different patterns in male and female hares tie in closely with the breeding season, as they do in New Zealand (Flux, 1971; Parkes, 1989); the same is true for other animals, for example opossums (Bamford, 1970) and red deer and thar (Caughley, 1970).

Regardless of the cause, mean kidney mass of reproductive male and female hares (**Fig. 1**) fluctuated monthly averaging 3% in both sexes; this would not be enough to cause any significant difference in the seasonal patterns of perirenal fat and kidney fat index. Judgments about the effect of kidney mass variation on

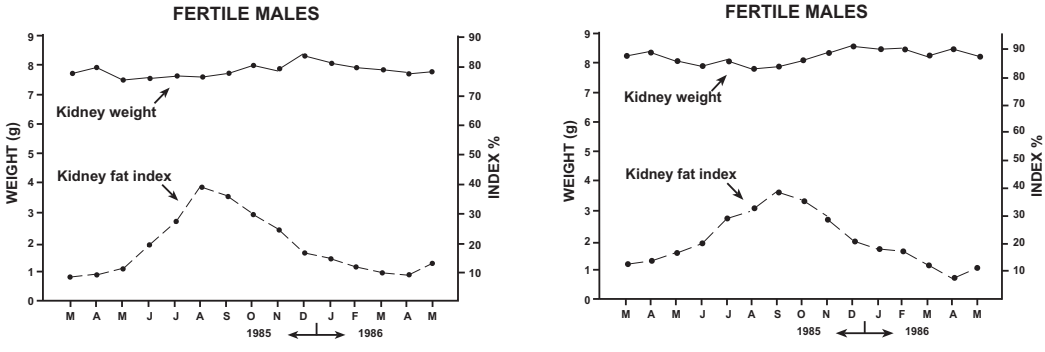

Fig. 1. Seasonal variation in the mean monthly of kidney mass and kidney fat index in fertile male and female individuals of European hare in the northwestern Patagonia.

KFI are inconsistent. Mitchell et al. (1976) and Finger et al. (1981) considered the effect was insignificant, whereas Batcheler and Clarke (1970) argued that variation in kidney mass altered interseasonal comparisons of KFI. Flux (1971) did no agree with Batcheler and Clarke's interpretation and felt that KFI was a valid measure of fat reserves in both red deer and hares. In this study, we considered the effect of kidney mass variation on KFI to be insignificant.

Riney (1955) believed that the KFI was the most satisfactory index of several techniques tested in New Zealand red deer. Ransom (1965) suggested using a combination of the kidney fat index and femur marrow fat to measure condition over a very wide range in white-tailed deer. Smith (1970) reported that KFI was the most satisfactory index of several techniques he tested for appraising nutritional status of several East African ungulates. However, Bamford (1970) found that the perirenal fat was not discrete in the brush-tailed opossum; and, therefore, KFI was not a suitable index in that species. In cottontail rabbits, Jacobson et al. (1978) indicated that both KFI and total loin fat (the total fat store surrounding the kidney) were suitable indices for determining condition on a seasonal basis.

In summary, the kidney fat deposit seems to be a good measure of body condition, at least for European hare, over a relatively wide range of conditions. Several other fat deposits have been used as indices of nutritional status or condition, but most of them either lack objectivity or require elaborate equipment and large amounts of time.

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