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SOME PRELIMINARY RESULTS ON RABBIT ENERGY UTILIZATION BY THE SPANISH LYNX

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The Spanish lynx (*Felis pardina*), at present recognized as a separate species (Werdelin 1981, Honacki et al. 1982), is the most endangered carnivore in Europe (Mallinson 1978). An understanding of its prey requirements is needed to aid in development of a management plan for remaining populations of the species.

About 85% of the prey biomass consumed by Spanish lynx are European rabbits (*Oryctolagus cuniculus*) (Delibes 1980), the most important food of vertebrate predators in the Iberian mediterranean ecosystem (Delibes and Hiraldo 1981).

We here examined the lynx digestion efficiency fed with rabbits following the additive energetics model discussed by Grodzinski and Wunder (1975).

Information was obtained of only one individual lynx, because being a very rare species, we did not know of other individuals kept in captivity when the study was done.

The main objetive of this work is to determine the metabolizable energy obtained by lynxes from wild rabbits. For this we must estimate: 1) the fresh biomass that the lynx did not use from each killed rabbit, 2) the gross energy intake of the consumed biomass, 3) the energy lost in faeces and consequently the digested energy, and 4) finally, the metabolizable energy.

Methods

A three-year-old male Spanish lynx, weighing about 11 kg was used in the study. The animal was kept in an open air cage at Doñana Biological Reserve (SW Spain), for six months to get habituated to. The study period occurred during 26 January to 6 Februaty 1986. Daily mean temperatures ranged from 5 °C to 8° C.

For the first four days skinless deer meat was fed to the lynx to have its gastrointestinal tract free from previous residues. On the fifth and sixth days it was not fed so as to have all the faeces dropped. On the seventh day the rabbit diet was started, eating one individual every day (estimated to be sufficient to satisfay the average food requirements of the felid; Delibes 1980) for five days.

Rabbits were taken at the study area, slaughtered and weighed before being given to the lynx. Rabbit remains and lynx faeces were collected daily. Faeces were ground and dried, estimating with standard methods the energy content and faecal composition (ash, protein, fat) of six samples.

To estimate body composition and energy content of European rabbit, one more individual was trapped at the study area and killed on 31 January 1986. The anatomical parts usually not eaten by the lynx were removed in a percent biomass similar to the average wasted. The rest of the body was ground and frozen. Dry matter content was determined by drying 10 samples in an oven at 105 °C for 24 hours, time enough to obtain a constant dry matter weight.

Energy content was determined with a Parr calorimetric bomb. Body protein was estimated from nitrogen content (macro-Kjeldah method) using the factor 6.25, as recommended in 1965 by European Association of Animal Production. We used the AOAC (1970) method to obtain fat content, while ash was determined by ignition at 600 °C.

By using energy content data of urine amount produced by a similar species, the bobcat (*Felis rufus*) fed with conttontail rabbits (*Sylvilagus floridanus*) (Golley et al. 1965) and shnowshoe hares (*Lepus americanus*) (Powers 1984), we have estimated the energy that lynxes metabolize from each consumed rabbit.

Results

Average weight of the rabbits given to the lynx was 864 g, ranging from 820 to 950 g (N=5), a common weight for rabbits in the study area (Kufner 1986). The wasted prey biomass on each of the five experimental days ranged from 8.4 to 14.7% ($\bar{x}$=12.29%). The gastrointestinal tract, together with tail, patches of skin and parts of the limbs, were the parts ussually left.

Dry matter content of the ground samples was close to 30%, with an energy content of 4.777 kcal/g dry matter (Table 1).

Table 1

Body composition and energy content of the European wild rabbit, and energy content of the faeces of a captive Spanish lynx fed on wild rabbits N=number of samples. GE=gross energy

Composición corporal, energía procedentes del conejo y energía procedente de las heces del lince cautivo alimentado con conejos silvestres. N=número de muestras. GE=energía bruta

Trait	*Wild rabbit* N	$\bar{x}$	range	*Lynx faeces* N	$\bar{x}$	range
% Dry matter (DM)	10	29.75	29.2-30.5	15	56.57	46.6-68.1
% Ash (on DM)	3	16.38	15.7-17.2	6	47.33	39.5-53.7
% Protein (on DM)	3	75.43	74.9-76.1	6	38.14	33.2-40.6
% Fat (on DM)	3	1.85	1.6- 2.4	6	—	——
GE (kcal/gDM)	3	4.78	4.7- 4.8	6	2.89	2.63.3

Faecal biomass varied from 13.1% to 20% of the eaten biomass, averaging 18.6% (Table 2). Water represents 56.6% of the faecal weight. Ash content was substantial 47% of dry faeces. This may explain the low energy content of the faeces (2.891 kcal/g dry matter; Table 1). So, the digestibility (digested energy/energy intake) of the lynx on a rabbit diet is 83.52% (Table 2).

Energy lost through urine by bobcats fed on lagomorphs ranges from 6.9% of the gross energy intake (on a cottontail rabbit diet, Golley

Tabla 2

Matter and energy utilization of a wild rabbit diet fed to a captive Spanish lynx during five days
Utilización de la biomasa y de la energía procedente del conejo de campo por parte del lince cautivo durante los 5 días de experimentación

Trait	Food intake	Faeces	% Digested
Fresh matter (g)	3789.0	706.5	81.35
Dry matter (g)	1127.2	306.8	72.78
Energy content (Kcal)	5384.7	887.0	83.52

et al. 1965), and 14.6% (on an shnowshoe hare diet, Powers 1984). By using the average value, we estimated the metabolized energy by the Spanish lynx on a wild rabbit diet as 72.7%.

Discussion

The percentage of fresh biomass wasted by the Spanish lynx eating rabbits seems to be moderately constant. We present values ranging from 8.4% to 14.7% and an average of 12.3%, while Delibes (1980) feeding a captive female lynx with 52 rabbits of different sizes (from 300 g to 1400 g, $\bar{x}=807$ g) obtained an average of 13.6%. In all cases the large intestine was refused and pieces of legs and skin used to be left. Similar patterns of lagomorphs consumption by other lynx species have been recorded (e.g. Haglund 1966, Nellis and Keith 1968).

Dry matter content of the rabbit (29.75%) agrees closely to other results like those of Golley et al. (1965), which estimated 30% for cottontails, and Moors (1977) who estimated the same value for European rabbits.

Rabbit energy content per gram of dry matter (4.78 kcal) is well under the 6.91 kcal estimated for the domestic rabbit (Fraga et al. 1978) and also less than the 5.68 kcal obtained by Myrcha (1968) with European hare (*Lepus europaeus*) but similar to the 4.97 kcal and 4.66 kcal obtained by Litvaitis and Mautz (1980) and Powers (1984), respectively, for snowshoe hares.

Obviously we must consider the possibility of seasonal and age related changes in energy content and body composition of wild rabbits (see Fraga et al. 1978, for domestic rabbits).

Digestible energy of rabbits by the Spanish lynx (83.5%) is close to the range observed for other carnivores fed with mammalian prey, such as red fox (*Vulpes vulpes*), (85.4%, Litvaitis and Mautz 1976),

coyote (*Canis latrans*) (88.2%, Litvaitis and Mautz 1980), black-footed ferret (*Mustela nigripes*) (84-86%, Powell et al. 1985), fisher (*Martes pennanti*) (81-87%, Powell 1979) and bobcat (88-90%, Golley et al. 1965, 77.3%, Powers 1984).

According to our estimation metabolizable energy for Spanish lynx (72.8%) would range between the 84.8% estimated by Golley et al. (1965) for bobcats on a cottontail diet and the 62.7% estimated by Powers (1984) for the same species on a snowshoe hare diet. Litvaitis and Mautz (1980) estimated for the coyote a range of 81-85% feeding them with some mammalian preys.

The results here reported combined with other ones related to the energy requirements of free-ranging Spanish lynxes could yield an approximation to the rabbit number required annually by an individual lynx. Aldama (1986) estimates it is 120 kcal/$kg^{0.75}$/day, which would represent 360 rabbits (of the average size used in the experiment) per year for a medium size (12 Kg) Spanish lynx.

We are aware that more detailed studies about age and seasonal variations in energy content of the rabbit would be required, but this prelimanary study can give a baseline information to establish the carrying capacity of habitats for such an endangered species, and to support management plans.

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Key words: Energy utilization, Spanish lynx, rabbit.

RESUMEN

Resultados preliminares sobre la utilización de la energía procedente del conejo de campo por el lince ibérico

Se ha procedido a estudiar durante 5 días la utilización por parte de un lince cautivo, de la energía procedente del conejo de campo (*Oryctolagus cuniculus*), presa fundamental del lince ibérico (*Felis pardina*) (Delibes, 1980). En promedio, el lice no consume el 12,3% de la biomasa del conejo. El porcentaje de materia seca en el conejo es del 30% y el contenido energético de 4,77 kcal/g de materia seca. La energía digerida es del 83,5% y la metabolizada del 72,7%.

Palabras clave: conejo, Lince ibérico, utilización de energía.

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