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Does handling reduce the winter body mass of the European hare?

Research Article

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Abstract: Winter body mass of the European hare *Lepus europaeus* Pallas 1778 was analyzed with a special focus on changes induced by handling. Data were obtained from large scale translocation (net catchments) during 1960-1980 in Poland. The influence of handling was compared using the mass of first-time captured and repeatedly-captured hares, and, in case of repeated capture, individuals' mass changes were investigated. The average body mass ranged from 2.1 kg to 5.0 kg. Generally, fewer factors influenced the hare's body mass than expected. Body mass was related to age and winter precipitation, while the date of catching, sex and temperature did not have an effect. Body mass of first-captured hares were significantly higher than the re-captured ones (3.99±0.42 *vs.* 3.88±0.48, mean ±SD). Body mass change between captures was related to the date of the first capture, and the duration between the first capture and re-capture. Following the initial capture, a slight (2.8±2.6), but significant decrease in body weight occurred. Thus, the handling of hares should be used with caution during studies or management of the species.

Keywords: *Body mass • Hare • Farmland • Lepus europaeus • Handling effect*

1. Introduction

Capturing and handling is a stressful situation for animals, in some cases increasing mortality, [1] and often inducing changes in body mass. Birds that have been handled enter a period of intensive feeding; whereas rodents lose body mass following capture [2-5]. The main focus of this paper is to check if capture affects body mass in the European hare. The effect of handling on European hares is as yet unknown; we expect some decrease in body mass following the capture, similarly to the response of other mammal species [4,5]. To see the relative importance of handling-induced mass changes we analyzed other factors' influences, including weather effect and initial body mass of the hares.

Winter at high latitudes is a challenging period for wild animals, although European hare populations are relatively resistant to harsh winter conditions [6]. Food shortage, and the increased need for thermoregulation, often causes body mass loss during the winter [7,8]. Moreover, these factors can affect the impact of handling on the individuals. Thus, we expected an influence of temperature and precipitation on hare body mass, and on the mass changes following handling.

Body mass is an indicator of general body condition. Heavier adults have a better chance of survival [9-11]

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and higher reproductive success in a given population [12]. On the other hand, a larger body size is more difficult to maintain [7,13,14], and the necessity for longer feeding increases predation exposure [2,15-17]. Mechanisms underlying changes in winter body mass can be species-specific and, in the case of medium-size mammals, such as hares, they are not fully understood [18].

For other hare species and for small mammal species, it has been shown that heavier individuals gained relatively less body mass and more often lost mass following handling or predator exposure, when compared to individuals with less initial body mass [4,9,19,20]. We expected similar responses following the handling of European hares.

European hare populations show a strong decline in many parts of their geographical range, including Poland [21-23]. In Europe, the most likely reason for the decline is the intensification of agriculture [24]. Amongst other factors, the hare is sensitive to pasture structure and the disappearance of grazing stock [25]. One of the conservation measures involves relocating individuals from stronger populations to weaker ones. Hares can be caught alive using nets [26]. Potentially, this method could be used widely in the future and thus information collected on the effect handling has on body mass could be used for management. We believe that results presented in this paper will help to increase the understanding of hare populations and provide some practical information to help in species management.

2. Experimental Procedures

2.1 Study area, material and methods

The material was collected from the experimental area of the Research Station of Polish Hunting Association and has been partially published in relation to movements, home ranges, longevity of life, and body weight of hares [27,28]. In this paper, the data has been recalculated using contemporary statistical methods to answer new questions.

The study area of 150 km^2 was located near Czempiń, south of Poznań, in western Poland (52°08'N, 16°45'E). Most of the area was within an open agricultural landscape comprised mainly of cereal fields. Forests covered 7% of the area. In autumn, the density of hares in the study area in the years 1966-1974 ranged from 42 to 52 individuals per km^2 [28]. After 1975, there was a strong decline (nearly 50%) in the hare population, similar to other parts of Europe [29].

During 1960-1980, the hare populations of the study area were exploited to restock populations in other areas. The 'catching' efforts took place between late November and early February. Approximately 1 km^2 plots were enclosed with nets, and hares were flushed by beaters into the nets. We assume that a high proportion of hares from the enclosed plots were captured, therefore the possibility that more experienced (adult, therefore heavier) individuals can avoid being captured is not considered in this study. A detailed description of the 'catching' methods used has been documented [26,27]. Every year, up to 35% of individuals from the autumn hare population were caught, and most of them were transported to other areas, but periodically, about 5% of the captured hares were marked with ear-tags and released in the same area [29,30]. From 1966 to 1975, a total of 1645 hares were marked, 438 of which were caught several times. Their sex was determined on the basis of external genital organs, and their age (young, adult) was estimated using Stroh's method [31,32]. 648 hares were weighed to the nearest 0.1 kg, 68 of which were repeatedly captured and weighed.

Body mass changes were checked as a function of year, date of catching within the season, age, sex, and handling. The influence of handling was checked *via* comparing the mass of first time captured and repeatedly captured hares, and also by investigating weight changes in those individuals that were repeatedly captured. For those re-captured individuals, data from the first and second capture were used where the recapture occurred within the same season (between November and February). Such recaptures occurred in 3 seasons, 1969-1970, 1970-1971 and 1971-1972. During 1969-1970 the winter was especially harsh, with high hare mortality recorded [8].

Over the whole data set, the effect of handling was measured by comparing the body mass of hares handled previously (within 25 days) with the body mass of those not handled before (but caught within 5 days before and after the recapture event).

The change in the re-captured individual's body mass was related as a function of time in between the two captures. Since there has been no previous work undertaken on how long the handling effect might last, the division of the time periods between first and second captures was arbitrary.

Meteorological data were obtained from meteorological yearbooks monthly average values were taken for the time period before the captures.

Data analysis was undertaken using STATISTICA for Windows software (version 7.1., 2005, www.statsoft.com). Data follows assumptions for parametric analysis, the sample selection was random, the weight of hare showed normal distribution, and

homogeneity of variances. There was no need for data transformation to use parametric statistical tests. Throughout the text, mean values are presented with standard deviation (SD).

3. Results

The average body mass of all 'first caught hares' was 3.86±0.40 (N=648) and ranged from 2.1 kg to 5.0 kg (Figure 1).

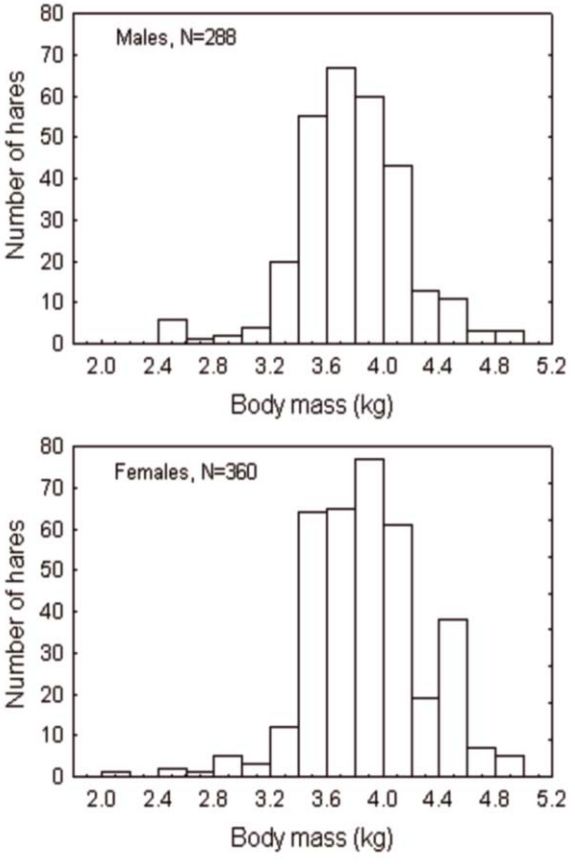

Figure 1. Body mass distribution of European hares in Czempiń during the study period; N=648.

We checked the simultaneous effect of age, sex, season and time of capture on the body mass. The body mass differed between age classes only (ANCOVA, whole model R^2=0.17, $F_{3.623}$=6.56, P<0.001; age $F_{1.623}$=40.6, P<0.001). No significant influences of sex ($F_{1.623}$=0.008, NS); season ($F_{5.623}$=1.49, NS) and date of catching ($F_{1.623}$=1.03, NS) were found. This means the lack of sexual dimorphism (Figure 1) and also the lack of clear mass changes over winter (Figure 2).

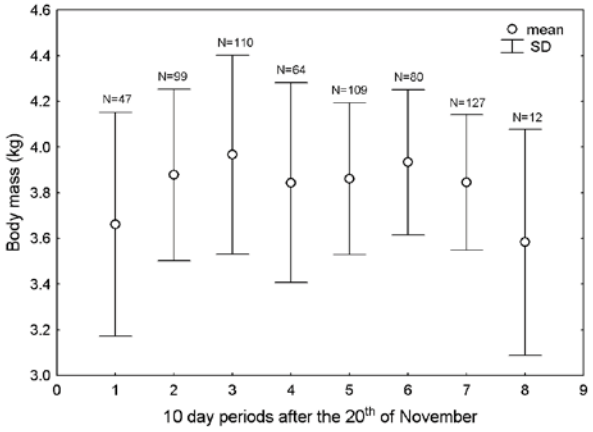

Figure 2. Changes of hare's body mass during the winter season, expressed in 10 day periods after the 20th of Nov. (1.=20-30 Nov, 2.=01.-09. Dec. ...); N=648.

Average body mass of 're-captured' and 'first caught hares' was compared *via* checking simultaneous influence of season, age, and meteorological factors adding as covariates (deviation of the average monthly temperature, and monthly precipitation from the 100 years average – both factors for 30 days before the capture commenced). Capture event, age, season, and precipitation significantly influenced the body mass (ANCOVA, R^2=0.37 capture event $F_{1.273}$=5.58, P<0.05; age $F_{1.273}$=54.55, P<0.01; season $F_{2.273}$=7.49, P<0.01; precipitation $F_{1.273}$=11.78, P<0.05 in both cases), while temperature had no influence on body mass ($F_{1.273}$=3.5, NS). The effects of capture event, age and season on the body mass are shown in Figure 3. The average mass of 'first caught' individuals was slightly higher than for 're-captured' individuals measured at the same time (3.99±0.42 *vs.* 3.88±0.48; see Figure 3).

Re-captured individuals' body mass changes were inversely related to the date of capture during the season and positively related to the time between the first and second capture (ANCOVA, R^2=0.25, $F_{1.39}$=5.30, P<0.005; date of capture:$F_{1.39}$=12.5, P<0.01, Figure 4; time between the first and second capture: $F_{1.39}$=9.28, P<0.05, Figure 5a), while sex, and initial body mass had no significant influence ($F_{1.39}$=0.78, NS, $F_{1.39}$=0.02 NS, $F_{1.39}$=0.01, NS, respectively).

Following the initial capture, body mass decreased (Figure 5a,b). The average mass loss observed in the first 15 days after the initial capture was 2.8±2.6. The handling effect was checked against time periods (1-5, 5-15, 16-25, 25+ days after first catching, one-way ANOVA, $F_{3.49}$=5.10, P<0.05). *Post hoc* test showed a difference among the categories immediately after the handling and later on (LSD test P<0.05 level difference between the 1-5 and the 16-25, 1-5 and 25+, 5-15 and 16-25, 6-15 and 25+ categories).

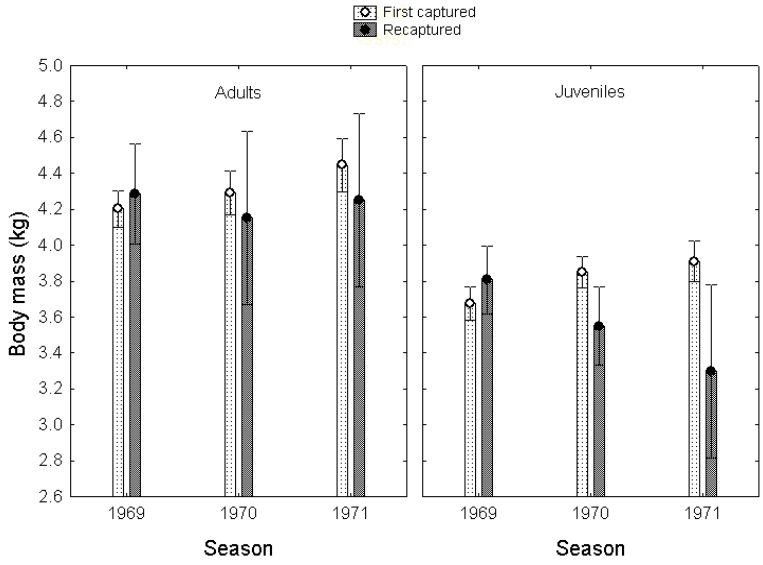

Figure 3. Average body mass compared between re-captured and first-captured within 5 days of the recapture; N=285. Average body mass of first-captured hares is slightly higher than body mass of re-captured hares during the seasons 1971 and 1972, Mean ±95%CL

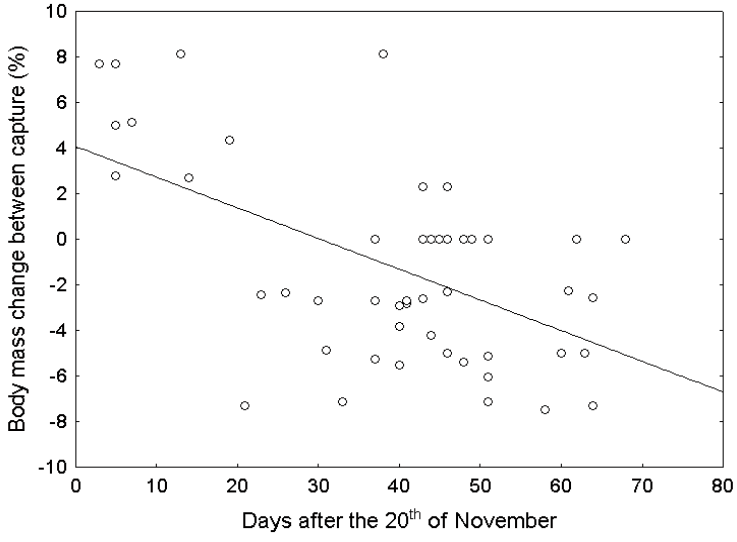

Figure 4. European hare body mass change as a function of date of the first catching in 1970-1971. Linear regression: y=- 4.83 * x + 17.99, N=47 (r=-0.37, P=0.007)

4. Discussion

Generally, fewer factors affected body mass of the studied hare population than we expected. No significant difference in the body mass occurred between the sexes, although in other studies, sexual dimorphism was recorded [33-35]. The similar body mass of males and females in our study can be explained by the fact that captures were carried out during the non-reproductive period.

As with other hare species [9], the studied population did not show clear trends of body mass loss over the winter. However, individual reaction on handling was related to the time of the first capture. Winter precipitation (mainly snow cover) had an influence on the body mass of European hares; however, temperature did not have an effect.

Handling events were followed by a slight body mass decrease (shown by individual mass loss and also by average mass difference of re-captured and first-captured hares). This suggests that European hares react to handling as they would to the increased risk of

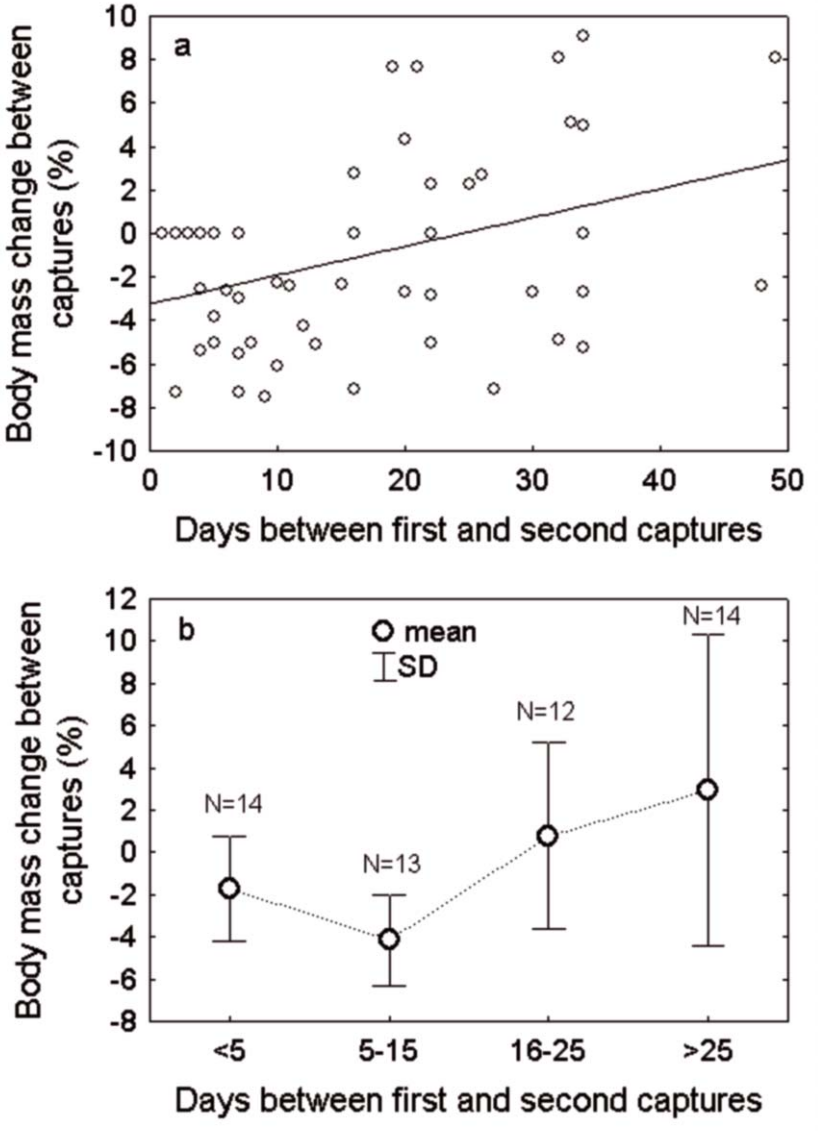

Figure 5. European hare body mass change as a function of time until the following capture.
a.: Linear regression y= 0.17 * x -3,05, N=47, (r=0.32, P<0.001) in 1970-1971
b.: Body mass changes between captures in time periods; N=53 (Here all recapture cases from 3 seasons were taken into consideration)

predation, similarly to small mammal species [4,5]. In the case of passerine birds, handling induced an increase in feeding [2,36], as there was a danger of food shortage.

The average individual mass loss during the first 15 days after handling was 2.8%, less, than observed for small mammal species [4,5]. Moreover, the observed mass change of rodents occurred earlier than in hares. This delayed reaction by hares to handling may be attributed to the fact that their fat assimilation and mobilization is slower [37-40], while small mammals and birds can change fat reserves rapidly on a daily basis [4,41].

To summarize, captures of the studied population of hares resulted in a slight, but significant handling effect on body mass (and probably the overall condition) of the individuals. Body mass of the European hare was found to be less dependent on other factors, than we expected, thus even the slight mass change can be important for hares. One must take into consideration that during this study the handling period was short – captured individuals were freed on the same site after being measured and were not transported to other areas. In case of transporting them the impact could be more severe. Moreover, during the study time, the

agricultural landscape was probably of better quality – providing sufficient food with the possibility of gaining weight relatively soon after handling. Thus, this method of net catching can be used with caution in research projects and for management practices in the future, preferably by testing the extent of the handling effect before hand.

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