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COMPARISON OF TWO AGE DETERMINATION METHODS OF THE EUROPEAN HARES (*LEPUS EUROPAEUS* PALLAS, 1778) IN SOUTHWEST LITHUANIA

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In performing European hare population analysis one of the most difficult task is to determine the age of hares. Age analysis is a necessary condition for controlling the population dynamics. Rapidly breeding animals displays a consistent that they are not long-lived. Practically determining hares age usually attribute by ulna coalescence (Stroh's method), but exist some reasons that during the hunting in January – February this attribute can not determine the age of these animals exactly. The aim of our work was to determine the age structure of hunted hares by using two diferent methods and statistically to compare the results. 50 European hares, which were hunted during the years 2008 – 2011 in Vilkaviskis and Marijampole district territories in Southwest Lithuania were examined for estimating their age. The hares was hunted during Nowember-January. The age of hares was determine – by ulna coalescence (Stroh's method) in dissection and by dry eye lenticular weight. After examination by eye lenticular weight method, it was estimated, that 52% of hares were under to one year old. While examined by using Stroh's feature – young, under 1 year old, hares, it was found 10 % more comparing to results, achieved by using eye lenticular method - total 62%. It was found, that using visually identification of hare ulna ossification, there is a tendency to reduce an age of hares. Also it was identified that results achieved by using Stroh's method, statistically corresponds to eye lenticular method's results. Examined hypothesis allows to allege that between both methods results exist a reliance, and Stroh's feature can be successfully used instead of eye lenticular weight method to determine an age of European hare. While formulating the conclusions of scientific research it is expedient to compare the results of Stroh's method with results of eye lenticular weight results.

Key words: European Hares (*Lepus europaeus* Pallas, 1778), age, weight of dry eye lens, Stroh sign.

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INTRODUCTION

The strong reduction of European hares (*Lepus europaeus* Pallas, *1778*) is being explored in a long run of decades (Reynolds, Tapper 1995, Edwards et al. 2000). According to the research made, the abundance of European hares in Lithuania is decreasing as well (Pėtelis & Brazaitis 2009). Factors making the impact for this phenomena are biotic and abiotic, like contagious hares' diseases, reproductive disorders, natural (obvious) enemies and the increasing amount of it in nature, also cultivation of monocultures, agricultural machinery used to process the harvest (Kozdrowski 2007).

Presumably increase of hares abundance depends on the reproductive success (Marboutin & Peroux 1995), however, there is not much statistically reliable sources on the reproduction of these particular hares, juvenile survival and distribution among the population. Hares do not tend to be long-lived creatures as are other rapidly procreating animals. According to research, hares can live maximum 8-12 years (Steineck 1996, Gehle 2002).

The age analysis is a necessary condition for controlling the game population dynamics. One of the most difficult task on hares' population research is the age recognition as the dimorphism according to the sex, weight or age is not clearly expressed (Broekhuzen & Maaskamp 1979, Frylestam 1980). For hunters, in order to plan further hunt, it is important to determine the age of hares at the time of first hunting period. Defining the age of hares, the whole population is divided into juvenile and adult. Juvenile hares are the ones born ongoing year, hunted at the age of 5-9 months. The rage of juvenile hares is varying from 30 to 40 % among the whole population. In order to maintain the population at the same level, it is recommended to hunt no more that 25-30 percent of hares.

Defining the age of the hares, several methods are used; however, their reliability is varying. The methods for defining the age vary, depending on fact whether the research subject is alive or not, as it is with reasearching all mammal species (Morris 1972). To determine the age of hunted hares it is possible to analyze the thickness of lacrimal bone (placed in the skull) outgrowth- for juvenile hares the outgrowth is fragile. Also, the age can be identified by paying attention at the maturity of different body parts such as skull, jaw, genitals maturity, the level of pelvis ostification (Bujalska 1964). Contrary to cervine animals, hares' age cannot be determined according to teeth deterioration as hares' teeth are growing all their lives (Gacic et al. 2005).

Usually, while hunting, the distinction between juvenile and adult hares is based on the osstification of epiphyses cartilage of ulna (Stroh 1931). Because of its convenience, especially for identifying the ages of games the method has been widely applied in game management and field research. For juveniles, this bone is not completelly formed, the lower part of it, approximatelly 1 cm away from the wrist, is thicker. The state of this part of ulna is identified by closely touching and can be specified after dissection. Many scientists claim that this particular thickness disappears at the age of 6-8 months (Andersen & Jensen 1972, Haehn 1974, Suchentrunk et al. 1991).

Previous analysis has proved that as the time of hunting goes later, it is harder to discern the adult hares from the ones born ongoing year (Pegel 1986). In addition, climate factor plays significant role when using Stroh's method (Nyenhuis 1995). Hares' sexual activeness becomes late on the circumstances of cold and humid spring, possibility for the first brood to survive remains tiny as well. On such occasion, possibility to apply Stroh's methods efficiently grows bigger. Analyzing the age of game animals, the method of weight of dry eye lens is usually used (Lord 1959, Gacic et al. 2005). The weight of eye lens increases because of accumulation of insoluble proteins in it and this process correlates with animal's age pretty well. This feature is not related with season and climate, thus this method was adjusted for describing the age of European hares' and the point, showing the difference of juvenile and adult hares' eye lens weight was set (Rieck 1962).

The aim of work – to determine the age structure of hunted European hares by using two different methods and statistically to compare the results.

METHODS

50 European hares, hunted during the period of 2008-2011 hunting season on November-January in Vilkaviskis and Marijampole district, southwest Lithuania were examined. The age of hares' was determined by two methods. Using the method of dry eye lenticular weight (Rieck 1962), eyes were being prepared and fixed in 10% formalin solution. Afterwards, the lenses were dried in 100°C temperature for 48 hours until reaching the stable mass and were weight in 1mg accuracy. Using Stroh's method, hares were dissected and their age was determined by ulna coalescence visually. After determining the age visually, some additional measurements of biometrical parameters were performed (mm): length of epiphyses ossification in ulna; width of epiphysis cartilage in ulna; high of epiphyses in ulna-radius; width of ulna-radius at the thickest part (Fig. 1).

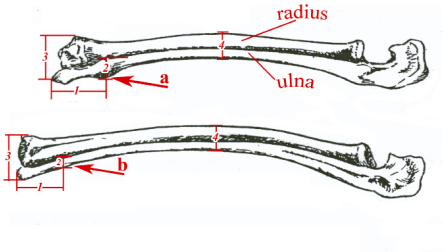

Fig. 1. The measurements of ulna-radius of the European hares.
a – juvenile, b- adult; 1 - length of epiphyses ossification in ulna; 2- width of epiphysis cartilage in ulna; 3- high of epiphyses in in ulna-radius; 4 - width of ulna-radius at the thickest part .

The results were processed using descriptive statistics and dispersive analysis, with Exel subsystem Data Analysis.

RESULTS AND DISCUSSION

The analysis was aimed at determining the structure of age of hares and weight of dry eye lens among 50 hares was established.

Graph (Fig. 2) on 270mg range shows the boundary separating juvenile and adult hares' eye lens weight. The biggest percentage – 36 % - was of 200-250 mg eye lenses and the least – 4 % of 150-200 and 280-300 mg.

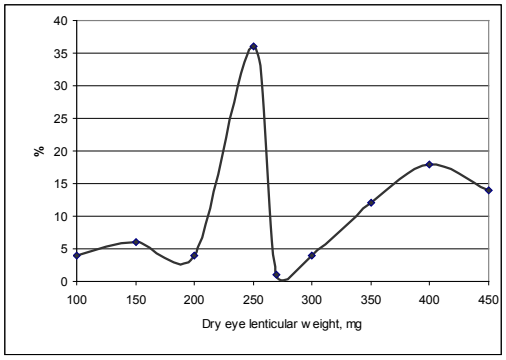

Fig. 2. The dry eye lenticular weight distribution of European hares (n=50).

As Andersen and Jensen claimed (1972), the eye lenticular weight may provide a precise measurement to the juvenile age in month and is suitable to distinguish the hares under 1 year from those older than 1 year. According to this method, hares can be divided in four age groups – I group: < 280 mg, under 1 year, II group: <280 – 310 mg, 2-3 years old, III group: 320-370 mg, 3-4 years old, IV: >370 mg, more than 4 years old.

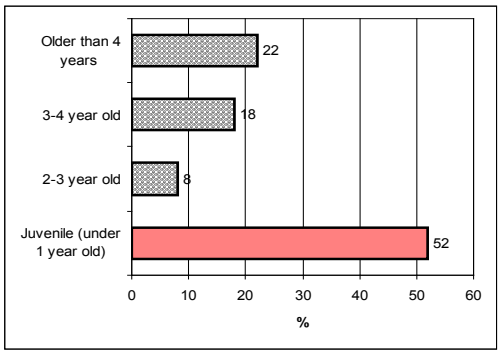

Fig. 3. The age distribution of European hares based on dry eye lenticular weight.

The results show (Fig. 3) that more than 52 % of

hunted hares is at the age of I group, younger that 1 year. The least amount of hares was at the age of 2-3 years – 8 %, 18% of animals were at age of 3-4 years. 22 % of hares were older than 4 years. After testing the Stroh's method, the results gained were compared with dry eye's lens' ones. (Fig. 4).

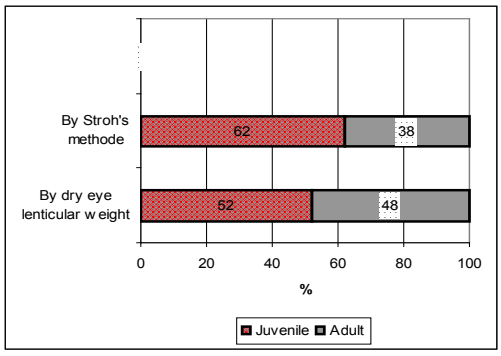

Fig. 4. The age distribution of European hares based on eye lens weight and Stroh'sign.

It was found that using Stroh's method, juvenile hares (under 1 year old) percantage was 10% bigger than using dry eye's lens method. Paying attention to this fact, the conclusion comes: a tendency for reducing the age of hares appears while determined ulna coalescene. For hunters, it is worth paying attention to, whilst determining the hares' age on the outside conditions.

The samples of juvenile and adult European hares the age of which was determined using the dry eye lenticular method and the Stroh's method were assessed statistically based on various data of biometric parameters. After a visual assessment of the hare age using the Stroh's method, the following measurements of biometric parameters (in mm) were assessed: length of epiphyses ossification in ulna; width of epiphysis cartilage in ulna; high of epiphyses in ulna-radius; width of ulna-radius at the thickest part.

First of all, the probability (portion) comparison hypothesis applied to the young hares assessed using both methods was verified.

The probability (portion) comparison hypotheses are usually formed for populations that show features typical of both categories. The hypothesis was formulated as follows: the null hypothesis H_o - the portion of juvenile hares assessed using both methods is the same against alternative K - the portion of juvenile hares assessed using both methods is not of equal value.

Therefore, an assumption is made that the comparison criterion of the two portions is of usual standard distribution.

$$T = \frac{\overline{p}_1 - \overline{p}_2}{\sqrt{\overline{p} \cdot (1 - \overline{p}) \cdot (2 / n)}} \quad (1)$$

Here – $\overline{p}_1$ – the portion of juvenile hares as-

Table 1. An average values of the biometric measures

Meaning	Based on dry eye lenticular weight*	Based on Stroh'sign*
Juvenile		
Dry eye lenticular weight, g	0,203 (12,1)	0,243 (14,5)
Length of epiphyses ossification in ulna, mm	13,29 (4,1)	13,43 (3,1)
Width of epiphysis cartilage in ulna, mm	6,24 (21,6)	6,47 (19,5)
High of epiphyses in in ulna-radius, mm	10,87 (9,5)	11,11 (8,7)
Width of ulna-radius at the thickest part , mm	9,07 (4,5)	9,15 (3,3)
Adult		
Dry eye lenticular weight, g	0,368 (5,1)	0,336 (10,6)
Length of epiphyses ossification in ulna, mm	13,01 (3,1)	12,74 (4,1)
Width of epiphysis cartilage in ulna, mm	5,89 (24,7)	5,50 (27,8)
High of epiphyses in in ulna-radius, mm	11,26 (9,4)	10,99 (11,2)
Width of ulna-radius at the thickest part , mm	8,90 (4,8)	8,76 (6,2)

* - the maximum bias for the reliability level of 95% is provided in brackets

sessed using Stroh's method;

$\bar{p}_2$ – the portion of juvenile hares assessed using dry eye lenticular weight;

$\bar{p}$ – total portion of juvenile hares assessed using both methods;

n – sample volume.

The received value of the criterion was $T = 1{,}01$ and the critical value of the 0.95 reliability level of the standard normal distribution was $t_{crit} = z_{1-\alpha/2} = 1{,}96$. As $T < t_{crit}$, based on the statistical results it can be alleged that the portions of juvenile hares assessed using both methods are even and, therefore, the method of dry eye lenticular weight can be impartially replaced with the Stroh's method.

The results of the average biometric measurements are given in Table 1.

Based on the maximum bias (Table 1), one can determine that the average biometric parameter values of the age groups of hares assessed with both methods have been evaluated with sufficient precision.

In all given instances the hypotheses of biometric parameter equality were verified. During the verification of the hypothesis regarding the equality of the averages of biometric parameters of the same age group, the hypothesis was formulated as follows: $H_o : \mu_{eyes} = \mu_{Stroh's}$, i.e., the parameter averages of the age groups determined using both methods were equal with an alternative $K : \mu_{eyes} \neq \mu_{Stroh's}$, i.e. the parameters were not equal.

The hypotheses were verified using Microsoft Excel subsystem software Data Analysis t Test: Two-Sample Assuming Unequal Variances. Having analyzed the data, the received T values in all cases were lower than the critical t_{crit} values. The statistical data did not contradict the statement that the averages of certain biometric parameters assessed with both methods were of equal values.

The hypotheses whether the method of assessing the age of hares had essential influence over the average values of parameters were verified as well. The reasoning of the hypothesis was verified according to the Fisher's criterion using the ratio of intergroup dispersion S_1^2 and intragroup dispersion S_2^2 . The received F values in all cases were lower than the critical values F_{crit} .

Therefore, when evaluating the results of the research the occurrence of differences between the average parameter values can be explained as a result of coincidences rather than the influence of the method applied.

According to the data provided by other researchers (Pegel 1986) when the amount of the tested hares samples is smaller than 100, the portion of young hares assessed using the Stroh's method rarely reflects the age of the entire hare population. Even though a visual study using the Stroh's method suggested that the number of juvenile hares of age up to 1 year old was higher by 10 percent than it was when using the dry eye lenticular weight method, a statistical research implies that the results obtained using the Stroh's method coincide with the results of the dry eye lenticular method. Therefore, it is possible to state that the Stroh's method can be used to assess the age of European hares in field studies. When formulating the conclusions of the scientific studies it is purposeful to carry out a comparison between the Stroh's method results and those of the dry eye lens weight method.

CONCLUSIONS

1. After investigating 50 hunted European hares with eye lens weight method, it was found that 52 % of hares were younger than 1 year. The amount of 2-3 years old hares was the least – 8%. 18% of hares were 3-4 years old and 22 % of animals were older than 4 years.

2. Using Stroh's method, the amount of young hares was 10 % bigger than using dry eye lenticular weight method. It is predicted that while estimating ulna coalescence, there is a tendency

for reducing hare's age.

3. Examined hypotheses allow us to claim that the dependence appears between both methods results. Thus we consider Stroh's method successful enough to define hares' age instead of dry eye lenticular weight method.

4. When formulating the conclusions of the scientific studies on determination of European hares population age it is purposeful to carry out a comparison between the Stroh's method results and those of the dry eye lens weight method.

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