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EXAMINATION OF AGE DISTRIBUTION, TIME OF BIRTH AND SURVIVAL IN A BROWN HARE POPULATION

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ABSTRACT

Our research goal was to examine the (1) age distribution, the (2) date of birth and the (3) survival rate of a brown hare (*Lepus europaeus*) population. We would like to contribute new data to the results so far. Data were collected between 2014 and 2016 in an agricultural region (Jász-Nagykun Szolnok and Békés county) of Hungary. We examined altogether 346 shot animals from the hunting bag.

(1) There was no statistical difference between the years 2014 and 2015 when examining the homogeny of the age distribution of the whole autumn population. At the same time, age distributions between 2015-2016 and 2014-2016 can be considered to be different. The age distribution of under one year old individuals in 2014-2015 and 2015-2016 were different, but it can be considered homogeneous between 2014 and 2016.

1. (2) Most of the young hares were born between March and July in all three consecutive years, in detail: III-IV. 22%, IV-VI. 27% and VI-VII. 16% (altogether 65%) of all offspring.

(3) The survival rate (l_x) of the whole population was 0,55 in T_1 period (from 2015 to 2015), and 0,45 in T_2 (from 2015 to 2016) by under 1 year olds, while in the group of 1-2 years old or older, it was 0,79 in T_1 and 0,81 in T_2. Examining the survival rate of the two age groups, no significant difference can be seen during the examined periods. Examined by age groups and sex, the survival rate was 0,62 for under 1 year old males in T_1 period, while it was 0,37 in T_2; furthermore by the age group of 1-2 years old and older the survival rate was 0,74 in T_1, and 0,64 in T_2. The survival among males was homogeneous in the two years. The survival of females by under 1 year olds was 0,49 in T_1, while 0,54 in T_2. By the age group of 1-2 years old and older, the survival rate was 0,81 in T_1, and 0,91 in T_2. The survival of females between the two years was also homogeneous.

Keywords: brown hare, demography, birth, survival, age distribution

INTRODUCTION

It is essential to be familiar with the population dynamics of small games, especially the amount of reproduction is inevitable while planning rational utilization. (KOVÁCS, 1988; KOVÁCS and HELTAY, 1993; MAJZINGER, 2013, 2014, 2017; MAJZINGER and BARTA, 2015; MAJZINGER and CSÁNYI, 2017; FARKAS, 2021). We examined the young-adult ratio and the age structure of raised offspring in the autumn population in a cultivated area (1) as others have done before (BEUKOVIĆ ET AL., 2011; WASIŁEWSKI, 1991; PINTUR et al., 2006; BENSINGER et al., 2000; HANSEN, 1992; STANKEVIČIŪTĖ ET AL., 2011). Based on the analysis (2), we estimated the birth date of the offspring as other authors had been done before (POPOVIĆ ET AL., 2015; SHAI-BRAUN ET AL., 2020; BRAY ET AL., 2007). From this we could conclude that in which months the highest reproduction within a certain breeding season was.

For the analysis we only used the raised offspring of the current year. As for the survival, the question raised that how it varied among the years and whether there was any difference between the survival patterns of the sexes (MARBOUTIN and HANSEN, 1998; MEREGGI and VERRI, 1990; BROEKHUIZEN, 1979; HUŠEK ET AL., 2015; MARBOUTIN and

PEROUX, 1995; VOIGT and SIEBERT, 2020). From the data obtained during hunting bag investigation of consecutive hunting years (3), we estimated the survival pattern of the total stock and also the survival patterns of the two sexes separately by the age groups.

MATERIAL AND METHOD

The place of origin of the samples were from Túrkeve (47° 7' 9" N and 20° 49' 15.5" E) in Jász-Nagykun Szolnok county and from Békéscsaba (46° 43' 49.5" N and 20° 56' 12" E) in Békés county. Most parts of the two areas are under agricultural cultivation: mainly arables, meadows and pastures. The sample consisted of 346 hares, shot in the hunting seasons of 2014-2016 (1st October – 31st December) from which 183 were young animals (under 1 year old) (Table 2). During the huntings (from 1st to 31st October) 141 animals were shot from which 63 were young (Table 3.) The age of the individuals was estimated based on the dried eye lens weight (CABOŃ-RACZYŃSKA AND RACZYŃSKI, 1972; KOVÁCS and HELTAY, 1993). Based on the weight of the dried eye lenses, firstly, we categorized the individuals into young (where the dried eye lenses weigh <280mg) and old age groups (where the dried eye lenses weigh >280mg) (KOVÁCS and HELTAY, 1993). After that, the old hares were divided into further groups according to SUCHENTRUNK ET AL., (1991) (Table 1) The last two age groups were merged in order to have enough individuals for the statistical test.

Table 1: The estimated age of the individuals based on the weight of dried eye lens

Dried eye lens weight (mg)	Estimated age (month)	Estimated age (year)
280>	2-9	1>
281-340	14-23	1-2
341-360	26-35	2-3
361<	38-47<	3-4<

Source: Suchentrunk et al. (1991).

During the demographical investigation we examined the date of birth and the age specific survival pattern. Based on the weight of dried eye lenses and the date of test hunting, we estimated the birth date of individuals under one year old. The survival pattern was modelled according to hunting bag data of consecutive years. We examined the survival probability (l_x) from 2014 to 2015 (fist period: T_1) and also from 2015 to 2016 (second period: T_2) at the stock level differentiating the sexes as well. The samples were rated according to age. The age groups are the following: hares under one year (1 year >) and one or two years old or older (1-2 year and <).
For the analysis of age structure and survival rates we used Chi-square test.

RESULTS

1.) Age distribution of autumn population

Examining the homogeneity of the age structure of the whole autumn population between 2014 and 2015, there was no statistical difference ($\chi2$=3,05 P=0,05 df=2). At the same time, between 2015 and 2016 ($\chi2$=6,73 P=0,05 df=2) and 2014 and 2016 ($\chi2$=14,93 P=0,05 df=2), age structure can be considered to be different (Figure 1).

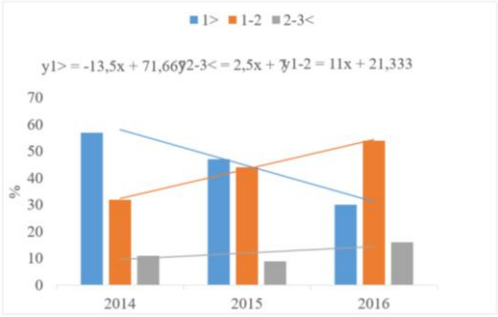

Figure 1. Age structure of the autumn population (1>: under 1 year old, 1-2: 1-2 year old, 2-3<: 2-3 year old or older) N=346

2.) Time of birth

Examining the homogeneity of the age structure of young (1 year>) hares, based on the sample, there were significant differences between the years 2014-2015 ($\chi2$=37,32 P=0,05 df=7, Figure 2/A) and 2015-2016 ($\chi2$=15,57 P=0,05 df=7, Figure 2/B). Age structures can be considered to be homogenous between 2014 and 2016 ($\chi2$=4,74 P=0,05 df=7, Figure 2/C).

Table 2: Age structure of young hares in the complete bag.

Year		Age (months)								
		1>	1-2	2-3	3-4	4-6	6-7	7-9	9-10	Total
2014	N	0	1	9	15	35	28	7	6	101
2015	N	2	11	9	10	7	5	9	4	57
2016	N	0	1	2	1	8	7	3	3	25

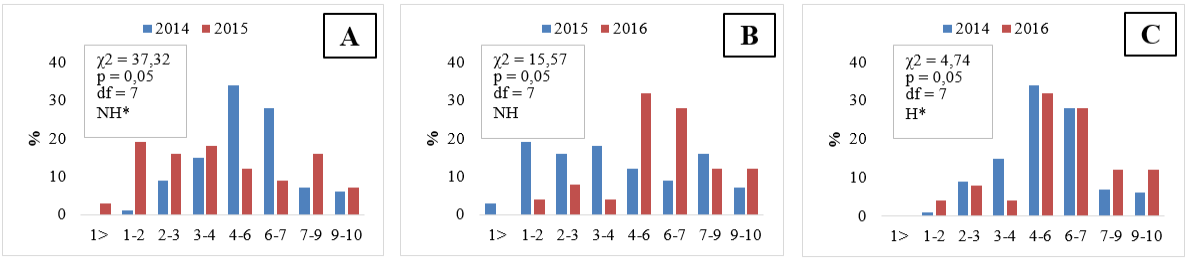

Figure 2. Age distribution of young (1 year>) hares (expressed in percentage of Table 2)
*: H: homogeneous, NH: not homogeneous

The approximate time of birth can be deduced from the age distribution of young hares (Table 3).

Table 3: Age structure of young hares in the sample bag and the calculated time of birth

Year		Age (months)								
		9-10	7-9	6-7	4-6	3-4	2-3	1-2	1 >	Total
2014	N	1	1	5	10	5	3	0	0	25
2015	N	3	2	4	1	5	5	2	1	23
2016	N	2	2	5	6	0	0	0	0	15
Total	N	6	5	14	17	10	8	2	1	63
Time of birth		I-II	II-III	III-IV	IV-VI	VI-VII	VII-VIII	VIII-IX	IX	

3.) Survival

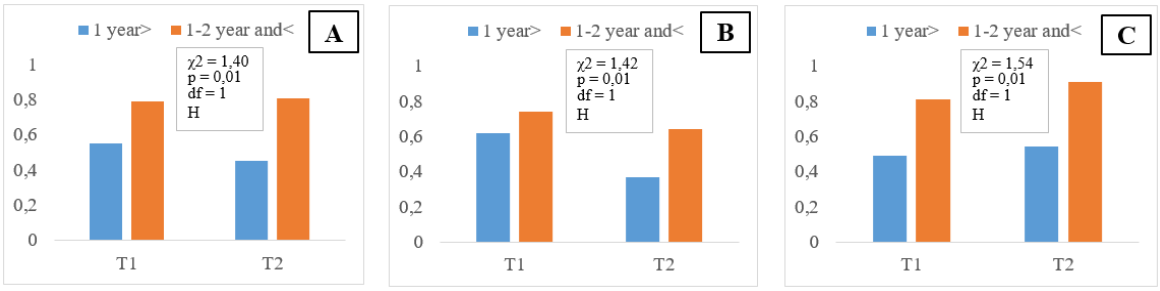

Figure 3. A: Survival rate (l_x) of hares according to age, N=346; B: Survival rate of males, N=143; C: Survival rate of females, N=203

A) The survival rate of the whole population in T_1 by under 1 year olds was $l_x = 0,55$ and $l_x = 0,45$ in T_2, while in the group of 1-2 years old or older $l_x = 0,79$ in T_1 and $l_x = 0,81$ in T_2 (Figure 3, A). Examining the survival rate of the two age groups, no significant difference can be seen between the examined periods ($\chi2$=1,40 P=0,01 df=1).

B) Examined by age groups and sex, in T_1 period, the survival of males under 1 year old was $l_x = 0,62$, while $l_x = 0,37$ in T_2. In the age group of 1-2 years old and older males, $l_x = 0,74$ in T_1 and $l_x = 0,64$ in T_2 (Figure 3, B). The survival among males in the two years was homogeneous ($\chi2$=1,42 P=0,01 df=1).

C) The survival of females under 1 year old in T_1 was $l_x = 0,49$, while $l_x = 0,54$ in T_2. In the age group of 1-2 years old and older females, $l_x = 0,81$ in T_1 and $l_x = 0,91$ in T_2 (Figure 3, C).
The survival of females between the two years was homogeneous ($\chi2$=1,54 P=0,01 df=1).

Table 4: Summary table of Chi-square test and homogeneity

Examined characteristics	Between Years/Period	χ2	P=	df	Homogeneity*
Age distribution of autumn population	2014-2015	3,05	0,05	2	H
	2014-2016	14,93			NH
	2015-2016	6,73			NH
Age distribution of young hares in the autumn population	2014-2015	37,32		7	NH
	2014-2016	4,74			H
	2015-2016	15,57			NH
Survival of the stock according to age groups	T_1-T_2	1,40	0,01	1	H
Survival of males according to age groups	T_1-T_2	1,42			H
Survival of females according to age groups	T_1-T_2	1,54			H

*: H: homogeneous, NH: not homogeneous

DISCUSSION

1.) Knowing and to be familiar with the age structure of the autumn population is one of the most important criteria of reasonable utilization. Bigger proportion of young individuals (1 year >) means the successfulness of growing up the offspring and

determines the usable amount. During the examined years, the age structure of the autumn population showed significant variability. The proportion of under one year old individuals was 30-57%, those of 1-2 year olds was 32-54% and those of older than 2 years was 9-16%. Individuals under 1 year and 1-2 year olds show complementary pattern while those individuals' proportion older than 2 years, indicates relative stability. This result also underlines the relevancy of regular annual examination of the age structure of autumn population.

2.) Comparing the age structure of young hares under one year old in the three examined years, data show significant differences in two cases (Table 2, Figure 2/A and 2/B). In spite of that, in the autumn populations – based on examining the sample hunting bag – most of the young hares in those years were born in the III.-VII. months (41/63) 65% (Table 3): within that between III.-IV. (14/63) 22% of all offspring, between IV.-VI. (17/63) 27% and between VI.-VII. (10/63) 16%. Those individuals who survived the growing up period were mostly born in the III.-VI. months (31/63, 49%). This does not directly mean that most hares are born in these months but previous Hungarian study support this hypothesis (Kovács and Heltai, 1993). Further research could clarify whether these three moths are really the peak period of birth or this was the most fortunate period for the offspring to survive. In the latter case it would be important to know which factors make this period more favourable opposed to the ones standing before and after it.

3.) Knowing the survival rates during the consecutive years is an important information. Using the young hares, we can estimate the annual raised offspring and on the other hand, the probability of survival of the current year's breeding stock. Further important data about the population would be if we made a comparison between the sexes. In the examined population, no differences were found among the survival patterns. It is true on the stock level and for both sexes that the survival of young individuals (1 year >) is worse than the older ones in all cases (1-2 year and<) (Figure 3). Further examinations will be necessary to set to find out, at what time of the year does the greater loss to young individuals occur; in the first winter of their lives, or later. With this in mind, targeted and time-focused game management interventions can be carried out to protect the stock.

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