DOI: <http://dx.doi.org/10.15679/bjwr.v1i1.14>**REPRODUCTIVE PARAMETERS OF FARMED BROWN HARE
(*LEPUS EUROPAEUS*) FOR RESTOCKING PURPOSES***Slamečka, J.,^{1,2}, Jurčík, R.,¹ Mertin, D.,¹ Rajský, M.¹*

Summary: The population of European brown hare (*Lepus europaeus*) declined dramatically last decades in Slovakia. In many areas, originally with high density of hares, these are almost absent. Improving of the habitat is one of the main tasks for maintaining of hare populations. To increase the population density, we examined the hare farming for restocking purposes. Hares were kept in cages in couples all over the year. Leverets were weaned at the age of 28 days. During three consecutive years, 11.05 leverets were born and 7.06 leverets were weaned per 1 fertile female on average. The losses were 29.3 % (dead born and mortality up to weaning). We registered 21.5 % of couples having no offspring (due to various reasons). Average number of leverets in the litter was 2.57; average number of litters was 4.32 per fertile female. Hare does are able to have up to 8 litters in the year (due to superfoetation), the highest number of weaned leverets from one female in one year was 20. The adaptation of hares to the nature conditions is a very important role. Hares for releasing were gradually fed with green fodder and after 2 weeks were released as groups with sex ratio 1:1 into enclosures offering diverse composition of green food. The adaptation improves the musculature of hares (average weight gain after adaptation was 0.95 kg and prepares the animals to natural food. After 6 weeks the hares are prepared for restocking purposes. The precondition for releasing success is the improvement of habitat.

Key words: brown hare, *Lepus europaeus*, farming, reproduction, adaptation for restocking

Introduction

In the past found brown hare in Slovakia optimum life conditions and it reproduced very well in the agrarian landscape with substantially lower degree of intensification in agriculture. At that time was the recruitment of the population very high and hunters had rich bags in spite of the fact that they did not put much effort into management and protection of hares and their care was restricted mainly to damp the predators or modest additional feeding during winter. Despite of it were the bags many times as high that the hunters often did not know how to treat them rationally. Hares always belonged to the most important game species; it produced 77% of total venison production in Slovakia yearly. During the years 1973 – 1974 were shot almost 350 000 hares annually. Then followed a rapid decrease and since 1983 varied annual production on the level about 50 000 animals. At present is the production on the level about 11 thousand animals, which is only 3 % of the maximum. Also spring stocks of hares began to decrease during the last years, and they decreased to 175 thousand individuals during 5 years (a decrease by 15 %). In spite of efforts to reduce the amount of bag, to maintain the landscape partially and to protect from negative impacts, the hunters do not succeed either to keep back or to stop the decline.

However, the present population of brown hare is impaired to a high degree and the development of numbers goes in negative direction. Therefore it is necessary to engage not only in optimization of conditions for this game but also look for possibilities to add individuals into impaired populations.

Therefore we started the tests with rearing of brown hare in cages, which should serve as genetic reserve for the case if artificially reared animals are to be added to the populations.

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There exist some literary sources about the possibilities of farm rearing of hares. Hediger (1948) was one of the first authors, who published results from farm rearing of hares in Switzerland. Followed French publications (Olier et Montet, 1981), which brought a complex view of the hare rearing, and scientific works on reproduction of hares e.g. by Caillol et Martinet (1979) or Martinet (1980). From the former Czechoslovakia are known works by Kučera (1988) and Fanta et al. (1984). Swedish authors Lemnell, Lindlöff (1982) report that although hare breeding is prospective mainly from the view of medical research, it is not profitable to rear hares for release. In Luxemburg was established an association for hare breeding for the purpose of supporting of free-living hares' population through releasing (F.L.E.L., 1985). The association joins and manages private breeders, keeps files of release and survival in the wild.

Material and Methods

Cage rearing of hares is managed in the area of the Research Institute for Animal Production (RIAP) Nitra. Breeding hares were obtained gradually from other breeders or from catching centres for export of hares. The observation period lasted 4 years (2010 – 2013).

The cages are made of wood and their ground plan is 2 x 1.74 m (Hell et Slamečka, 1999). The skeleton is made of squared logs 6 x 8 cm, side walls are covered with boards 2 cm thick. The front wall is covered with network of wire 1.5 mm thick with meshes 2 x 2 cm, which enable light to come into the cage.

Flatted floor, made of perforated metal-plate with plastic coating and openings 18 mm at diameter, is in the run. The floor is 0.7 m above the ground to protect hares from rodents and to easily remove droppings and feed rests from below the cages. The hares are kept in pairs during the whole year; young remain with parents up to weaning at the age 28 days. Complete non-medicated pelleted feed mixture for rabbit fattening creates the basis of feed ration for hares; it is completed with good quality lucerne hay. Husked oat or oat-flakes are added to the feed ration for doe-hares during the period of lactation (Semizorová et Švarc, 1987). Daily ration calculated for adult hare are 120 – 150 g of pellets; lucerne hay was administered ad libitum. Drinkers with drinking water were at disposal. Water must be clear and regularly changed.

The main objective of this work was to study and evaluate the most important reproduction parameters (% of non productive couples, number of litters per female, average litter size, number of born leverets per female, number of weaned per female, maximum number of weaned per female, maximum number of litters per female), mortality parameters (losses on leverets up to the weaning, dead born %, mortality before weaning) and preliminary evaluation of possibilities of hares' adaptation in nature through monitoring in adaptation enclosures.

Results

Initial reproduction results were negatively influenced by high mortality in hares caught from the wild for the purposes of rearing. However, after the initial adaptation period stabilized the state of reared animals and a breeding basis for successful reproduction was created. Table 1 presents basic reproduction parameters of brown hares reared in cages at RIAP Nitra. These data are compared with results, which reported the FEDERATION LUXEMBOURGEOISE DES ELEVEURS DE LIEVRES (F.L.E.L., 1985) and with cage rearing that was performed in LZ Litovel (Czech Republic).

Maximum number of litters by doe-hares is 8. Maximum number of young per female and year varies quite a lot; the highest number was 30 young, 20 of them were weaned. The highest number of young in one litter was 9. Pehrson, Lindlöff (1984) reported only 7 young per litter. Losses of young are high during the rearing and they are about 30 %; 5.45 % are dead born and 24 % is mortality before weaning. The mortality rate is the highest during first 7 days after parturition. Quite high shares represent non-productive pairs; we did not succeed to decrease it even with selection.

Climatic conditions varied a lot during the four years. We noticed the first litter in the interval from 26th January to 8th February during the studied years. The difference in the term of the first litter was just 13 days. If we take into consideration 42 days lasting pregnancy it is obvious that hares are mating as early as the mid of December. It means that climatic conditions do not influence reproduction in cage rearing. However, litters in January are rare.

Table 1 Reproductive parameters of hare breeding during 2010 – 2013 compared with F.L.E.L. (Luxembourg) and Litovel breeding (Czech Republic)

Parameter	2010	2011	2012	2013	average	F.L.E.L	Litovel
% of non productive couples	27.5	30.55	8.60	19.20	21.46	24 – 46	22 - 39
Number of litters per female	4.83	4.64	4.22	3.57	4.32	3.4 – 4.0	2.5 – 3.9
Dead born %	4.99	5.72	6.02	5.03	5.45	5.4 – 13.8	
Mortality before weaning %	28.25	20.54	24.10	22.61	23.88	24.0 – 29.2	30.9-63.3
Losses on leverets up to the weaning %	33.24	26.26	30.12	27.64	29.32	29.4 - 43.0	
Average litter size	2.58	2.56	2.46	2.65	2.57	2.2 – 2.5	
Number of born leverets per female	12.45	11.88	10.38	9.48	11.05		
Number of weaned per female	7.38	7.84	6.63	6.38	7.06		4.53-5.35
Top number of weaned per female	20	18	15	17	18		
Top number of litters per female	8	7	7	6	7		

Last litters were observed at the beginning of October. Exactness of the reproduction end showed similarity to the beginning of reproduction period, we noticed the last litter from 1st to 10th October; the difference represented 10 days. From this it results that mating of hares ends in mid of August. The remaining part of October and November are considered to be months of sexual rest in hares, it means no mating or parturitions occur in this period, although Martinet (1976) reported that the animals were fertile during the whole year if light regime was provided, during which were more than 16 hours of light daily.

Most litters were noticed in the period from March to July. We noticed 64.28 % - 76 % of all litters in this period. There were born 69.25 % - 81.14 % of all young.

Figure 1 Number of litters per fertile female during the season

We studied numbers of hares born in individual months of the year and we found out that most of them were born in April (18.56 % in 2010, 17.85 % in 2011) and May (18.67 % in 2012 and 25.13 % in 2013).

Figure 2 Number of leverets per fertile female during the season

Litter size varies during the year; however, it is very balanced in the first two litters. In the first litter were born on average 1.40 – 1.91 young per doe-hare. The highest number of young per doe-hare was noticed in 2nd to 5th litter, namely 2.67 – 2.90 young. Tendency of lower number of young was in sixth litter and the seventh litter shows considerable variability. A case with 8 litters occurred just once.

Figure 3 Number of leverets per fertile female in consecutive litters

Reproduction rate in hares from cage rearing considerably depends on interval in which the females litter their young. Superfoetation of hares can considerably shorten these intervals. On the whole were 55.6 % - 75.85 % of all intervals shortened by superfoetation during the studied period. It is also caused by permanent presence of buck-hare as in nature is the occurrence rate of superfoetation lower (Hell, 1976). Different diseases, bad climatic conditions and other negative phenomena decrease the occurrence of superfoetation. The shortest noticed intervals between litters were 26 days. Both Semizorová (1980) and Kučera (1988) reported pregnancy shortened by 17 days. Intervals longer than 42 days were caused by health disorders in hares.

Figure 4 Occurrence of time intervals between litters in individual years (in %)

Each year we added new, last year born females that replaced older ones, which were culled because of insufficient reproduction. From the results achieved in reproduction during the years 2012 and 2013 is obvious that reproduction depends among other factors also on the age of female. Twenty six females, which were in the first year of reproduction, littered 223 young during two years (2012 and 2013); whereas 27 females in second and further years of reproduction littered 306 young. It appears from this that females in the first year of reproduction do not achieve such parameters as older doe-hares.

Number of weaned young from young females was also lower, namely 142 animals compared with 204 young weaned from older doe-hares. We can state that production of young is higher in older doe-hares compared with one-year old females. In table 2 are reproduction parameters with young and older females calculated per one doe-hare. From the studied parameters is interesting that lower number of young perished up to weaning from young females compared with older females, which is in contrast with other parameters.

Table.2: Reproduction parameters of females in 2012 – 2013

	Number of young per female		Mortality of young till weaning per female		Number of weaned young per female		Number of litters per female	
	young	older	young	older	young	older	young	older
Litter 1	1.85	1.59	0.19	0.59	1.38	0.89	1.00	1.00
Litter 2	2.19	2.67	0.42	0.59	1.38	2.04	0.69	0.96
Litter 3	2.04	2.67	0.50	0.70	1.38	2.00	0.69	0.85
Litter 4	1.46	2.37	0.31	0.70	0.81	1.56	0.62	0.78
Litter 5	0.81	1.67	0.58	0.74	0.15	1.00	0.31	0.67
Litter 6	0.12	0.30	0.04	0.30	0.00	0.07	0.08	0.11
Litter 7	0.12	0.07	0.08	0.07	0.04	0.00	0.04	0.04
Total number	8.59	11.34	2.12	3.69	5.14	7.56	3.43	4.41

Explanatory notes:

Young = female in first year of reproduction (n=26)

Older = female in second and further years of reproduction (n=27)

In the studied period of four years we found the highest mortality of young during the first seven days. This period is critical for the survival rate of young in cage management and great attention is to be paid to the hares.

Figure 5 Mortality of leverets before weaning in selected intervals (in % from total mortality)

Adaptation of artificially raised hares to nature

Rearing of hares in cages has certain negative influence on these animals. Restricted motion causes that muscular substance in hares is not so developed as in free living individuals; in artificially raised hares are partially suppressed reflexes that they gain by “learning”. Hares from cages keep the reflex of shyness; they are able to run fast, however their endurance is much lower compared with the free living individuals. Pépin et Garnelutti (1985) performed an experiment in south-western France, where they released 27 brown hares. Besides them were 5 individuals from this region observed by a transmitter. Within two weeks from release perished 72 % of hares from the total number. In 3/5 of cases are these losses caused by traffic and diseases.

Therefore it is necessary to accustom the hares to the change before release into nature. It is important to begin with feed. Transition to juicy feed must be very cautious and gradual. Hares digest the feed by means of bacterial microflora and this is very sensitive to changes in feed ration. Bacteria are not able to ferment the feed at sudden change and there arise serious alimentary disorders. The hares should get gradually such composition of feed that is available in acclimatization enclosures. It means daily dosage of stand and gradual serving into cages, from minimum amount up to an amount, which it is able to consume. At the same time the dose of pelleted mixture gradually decreases, however, we keep it approximately in half of the amount, which the hare would consume, during the whole adaptation period. The period of change in the feed ration should be planed in order not to be shorter than 14 days.

Hares that are intended for release are treated with medicaments only in case of emergency. We must take into account that after the hare is released it will be a problem to administer medicaments to the animal and so the hare should cope alone with a possible disorder. Immediately before the release we treat the hares against coccidiosis. We select only healthy individuals; weakened and meager animals or animals showing symptoms of disease are not acceptable for entering the enclosures. They could represent source of an infection for other animals.

After the adaptation period in cages are the hares released into acclimatization enclosures. They are of narrow and long shape for the hares to have enough movement. They are constructed of 2 m high wire netting that is sunk into the earth. Concentration of animals depends on the length of period which they spend in the enclosure. We estimate that the density of hares could represent 20 animals per 1000 m² (0.1 hectare) If we manage a large herd, it is necessary to establish adequate area in enclosures. If the enclosure is covered with wire netting it is an advantage as we protect hares against raptors. They can cause damage mainly if we release young hares into the enclosures.

The hares acquire muscle substance during the adaptation; in our experiment was average weight gain 0.95 kg during 6 weeks.

The enclosure should be seeded with suitable mixtures; the stand should consist of more plant species to offer sufficient varied feed to the hares. At least once in two – three years (or more often if mortality occurs) it is necessary to thoroughly sanitize and plough the area. We change the mixtures with unsown strips, which the hares seek for sun-bathing. These strips can be cut until the hares are released. Hares can be additionally fed with e.g. fodder beet in these strips. In the feeding equipment we serve pelleted mixture and clean water in drinkers all the time.

Hares should be released into enclosures in groups at one time. It is a problem to add further hares to animals that were already released. Those released earlier are already accustomed and they could be aggressive to the newcomers.

The most suitable season for release is probably the end of summer if the hares are released for winter. It is necessary to follow the weather-forecast and to release animals when longer period of good weather is forecasted in order not to release the hares during rainy and cold days. We achieved the best results with release in spring, at the beginning of vegetation. At that time was adaptation to the changed feed simple because nothing grew in the enclosure. Hares became gradually used to the growing vegetation, we noticed no mortality and they gained almost one kilogram muscular substance during 6 weeks. However, in this case it is necessary to keep hares in cages during the whole winter, which increases the costs.

They should spend at least 6 weeks in the enclosure. After this period are the hares adapted to natural conditions and they can be released into hunting grounds. Of course, it is meaningful to release hares only in places with suitable conditions for them and where the original population decreased because of elementary loss or other consequences. Release of hares is of no help in places where they do not reproduce or the original population is without offspring. It is necessary to keep this fact in mind otherwise will run many financial means to waste.

Conclusion

It is possible to produce enough individuals for restocking in farm management of hares. It is necessary to give maximum welfare to the animals in herd as far as feeding, watering and rest are concerned. The reproduction period in hares in captivity lasts from mid December (beginning of mating) to the first third of October (last litters). Although only approximately 80 % of pairs participate in reproduction they are able to produce on average 7 young per doe-hare. The highest mortality in young is noticed during first 7 days after birth. Hare females can have at the most 8 litters and they are able to produce up to 20 weaned young. The most litters per litter are noticed during the months March – July (69.3 – 81.1 % of all litters); the number of litters is lower in the rest of months. The most young are born in April – May (up to 25.1 %). Number of young in the first two litters is very balanced; variability rises from the third litter. In the studied years the length of interval was shortened by superfoetation in 55.6 % - 75.85 % all cases. Females in second and next year of reproduction achieved better reproduction parameters calculated per one female compared with females in the first reproduction period with the exception of number of young that died till weaning.

The weaned hares are prepared in cages by means of gradual change in feed ration for release into the adaptation enclosure. They are released into the enclosures at the end of summer or at the end of winter. Minimum length of stay in enclosure is 6 weeks. After this period are the hares able to survive in the hunting ground if they find suitable conditions in the environment.

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