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Hunting the European hare (*Lepus europaeus* Pallas, 1778) and fox (*Vulpes vulpes* Linnaeus, 1758) in the Western forest-steppe of Ukraine

Keywords: agrocoenoses, dynamics, European hare, Lepus europaeus, hunting, forest-steppe, fox, Vulpes vulpes, population, Ukraine

Introduction

For most Ukrainian hunters, the European hare and fox are currently the main species of game animals (Fig. 1). Since the process of their bagging is associated with a long and pleasant stay in the natural environment, the opening of the hunting season for these species is perceived as a long-awaited holiday. To this we should add that the hare meat is very tasty, has a high nutritional value and is impossible to purchase in our shops. Therefore, almost all members of different hunting societies take part in the opening of hunting. As a consequence, at the first hunting day they bag one of the highest number of animals destined for this purpose. The European hare hunting in Ukraine is usually carried out without dogs. Recently, as in most European countries, the state procurement of hides of fur-bearing animals has been stopped, and the demand for their fur also declined. The consequence of this was a sharp decrease in the number of fox terriers, jagdterriers and hounds, thanks to which the hunters had bagged many foxes. That is why, approximately since 1993, the shooting of these animals has been mainly

Fig. 1: The European hare and fox in Ukraine. Photo by V. Popenko & M. Shestopal

Fig. 2: The study area

carried out during the hare hunting, which usually held in Ukraine from 1 November to 1 February. And only after closing the hunting season some hunters pay special attention to the shooting of foxes that is licensed till 1st of March (Zakon Ukraini 2000).

It should be recognized that there are very few scientific works devoted to the hunting of the European hare and fox (Rozhenko 2006; Volokh, Rozhenko 2013; Volokh 2016) and all of them refer to the steppe zone of Ukraine. Therefore, we have decided to investigate characteristics of the hunting of these animals in the western forest-steppe zone, well-known in our country for the long history of their hunting traditions.
The territory of Khmelnytskyi and Vinnytsia regions lies in the west of Ukraine and characterized by favorable climatic conditions and abundant wildlife (Fig. 2). However, the dominance of fertile chernozem and grey forest soils has promoted the intensive development of arable farming and other branches of agriculture. Thus, to-date 76.1 % of the whole region consists of agricultural lands, and 63.3 % are agrocoenoses (Table 1), dominated by plantations of sugar beet, sunflower, corn, rape, soya and other crops.

Until the middle of the 20th century the oak and hornbeam forests in the study area were intensively cut and further replaced with pine trees. This has shrunk the woodland area from 69.9 to 14.1% and brought about the significant deterioration of the feeding and protection conditions for most hunting animals. These changes had started already in the 19th century since from 1873 to 1923 the forest area in the study region

Table 1: The structure of main habitats (thousands of ha)

Administrative region	Total area	Agricultural lands	Arable lands		Area of meadows	Area of forests	Area of wetlands
			total	% of total area			
Khmelnytskyi	2062.9	1569.6	1254.3	60.8	274.4	285.8	24.2
Vinnytsia	2649.2	2017.6	1729.9	62.3	238.8	377.5	29.7
Overall:	4712.1	3587.2	2984.2	63.3	513.2	663.3	53.9

Fig. 3: Hunters for hares (A) and foxes (B). Photo by R. Kurnosov & V. Kiriljuk

decreased by 16.4, and that of marshes – by 10.0 % (Averin 1923).
To increase the yield of agricultural crops, mineral fertilizers and various pesticides are widely used in the region, and their amount for the studied period has increased from 0.634 (2001) to 3.298 (2015) kg/ha. Along with intensive mechanical processing of soil this resulted in a growing mortality of the European hare and other species of field game.

Material and methods

The paper is based on results of the original research carried out by us in 2003 in central districts of Khmelnytskyi Region on 113 randomly selected sites with a total area of 7322.5 ha. There, during 18 hunting days, a comparatively small number of hunters found 723 hares, of which 344 (47.8 %) were bagged. In addition, they found 98 foxes, 39 of them were bagged (39.8 %). In 2017/2018 in the neighboring Vinnytsia Region on 64 sites covering 4053.4 ha the hunters found 120 hares, and shot 42 or 35.0 % of them. Apart from this, they revealed 74 foxes, and bagged 43 (58.1 %) of them (Fig.3).

To obtain information about efficiency of the hunting, in which the authors were also involved, we used a method of inquires. A total of 177 sites covering an area of 11375.9 ha were studied in the forest-steppe zone. Within their territory, 847 hares and 172 foxes were recorded. Of them, 388 (45.8%) hares and 82 (47.7%) foxes were bagged by hunters.

Discussion

Hunting lands and hunters

In the study area, the hunters most often hunted in forest areas (65.3%), represented by fragments of deciduous, coniferous and mixed forests of artificial origin. The main species in them were the Scots pine (*Pinus sylvestris*), Norway spruce (*Picea abies*), common oak (*Quercus robur*), aspen (*Populus tremula*), hornbeam (*Caprinus betulus*), alder (*Alnus glutinosa*) and silver birch (*Betula pendula*). The size of each forest area equalled to 162.6 ± 19.57 (10–400) ha (Table 2).

Here we also included shrubs, most of which were plantations of the wild privet (Ligustrum vulgare), Tartarian honeysuckle (Lonicera tatarica), elderberry (Sambucus nigra), Russian olive (Elaeagnus angustifolia), and also natural associations of the dog rose (Rosa canina) and blackthorn (Prunus spinosa), where foxes like to rest and wolves often arrange their lairs. The area of each of them was 48.6 ± 9.38 (0.4–200) ha. Important areas for the hare and fox hunting are agricultural lands (24.9 %), occupied by different crops, and temporarily abandoned fields (Fig. 4). The size of these lands was 41.0 ± 8.60 (0.5–500) ha.

Table 2: Type and size of hunting lands

Habitat	n	Mean	Min	Max	Sum	Std. Dev.	St. Error
Marsh	8	16.5	2.0	50.1	132.0	15.37	5.43
Deciduous forest	21	109.8	10.1	336.0	2196.0	98.99	22.13
Coniferous forest	4	240.0	180.0	300.0	960.0	69.28	34.64
Mixed forest	12	224.7	80.0	400.0	2696.0	119.09	34.38
Clearing	2	12.5	10.0	15.0	25.0	3.54	2.50
Winter wheat	11	37.8	5.0	200.0	416.0	55.66	16.78
Fresh arable land	7	27.2	0.5	60.0	190.5	21.08	7.97
Old arable land	16	66.2	5.0	500.0	1058.0	135.98	34.00
Abandoned field	33	33.7	2.0	150.0	1113.0	26.38	4.59
Shrubs	33	48.0	0.4	200.0	1554.4	52.30	9.10
Meadow	11	62.3	10.0	180.0	685.0	57.07	17.21
Garden	2	18.0	16.0	20.0	36.0	2.83	2.00
Weeds	15	17.6	1.0	60.0	264.0	19.01	4.91
Beet*	2	25.0	20.0	30.0	50.0	7.07	5.00
Total:	177	65.0	0.4	500.0	11375.9	89.58	6.73

* Har vested in November-December

Fig. 4: Typical hunting lands in the western forest-steppe zone:
A – small areas of forest and shrubs; B – abandoned field. Photo by A. Volokh

In the western forest-steppe zone during the hare and fox hunting, an average size of a hunting team was 7.0 ± 0.27 (1–17) persons. Most frequently it consisted of 4–10 (75.2 %) persons, while small groups of 1–3 or large ones – of 11–17 hunters were extremely rare (Fig. 5). The smallest hunting teams in Ukraine are common in rural areas, where hunters live next to hunting areas. Some larger teams are typical for the urban hunters, who live at a significant distance from hunting lands, and most frequently have to use cars to reach them.

Indeed, it seems that the greater is the group of hunters, the greater is the area it can cover during their hunt. However, we did not reveal such a relationship (r = 0.06), since the latter is influenced by many factors, the most important of which include weather conditions and population density of animals. Since, according to the Ukrainian laws, a hunter has the right to bag only one hare per day, usually in hunting lands with high population density, the less time is spent to reach this norm and a smaller area is surveyed. The same is true for the fox

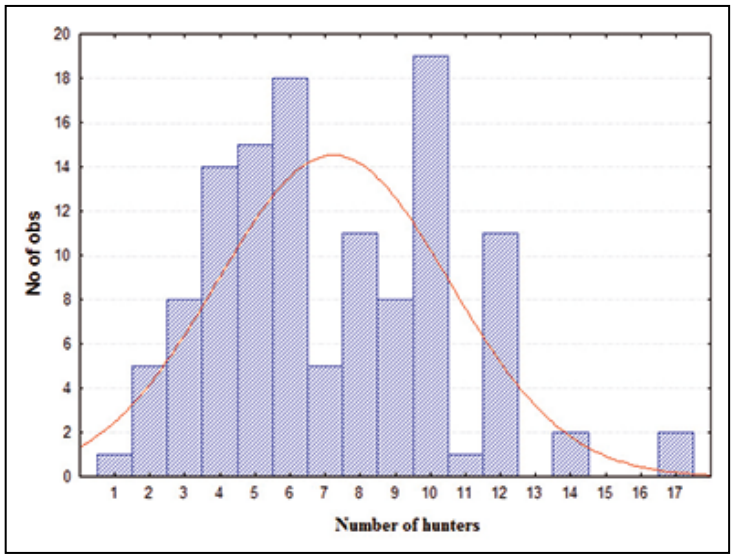

Fig. 5: Distribution of teams according to the number of hunters

given that it is bagged simultaneously with the hare.

Hares, foxes and hunting

It is quite understandable that with the increase in the number of hunters not only the covered area of the lands should increase, but also the number of the frightened away and discovered animals. However, with a general positive trend, we did not find a reliable correlation between these parameters (Fig. 6).

The European hare, being a steppe species, avoids large forest tracts. Despite the negative impact of agriculture, its highest density was found in agrocoenoses. For their rest, the animals especially preferred abandoned fields, located close to fields of winter wheat – their main feeding habitat. In some areas (beet plantations, gardens, weeds), animals formed gatherings in the small area, giving them a good shelter (Table 3). It is interesting that the highest hunting success – the ratio between the number of bagged animals and the number of found animals (%) with $P < 0.05$ does not coincide with the hare population density ($r = 0.44$) but has a significant negative correlation with the size of a habitat ($r = -0.33$). In other words, the success of the hare hunting, which most of all depends

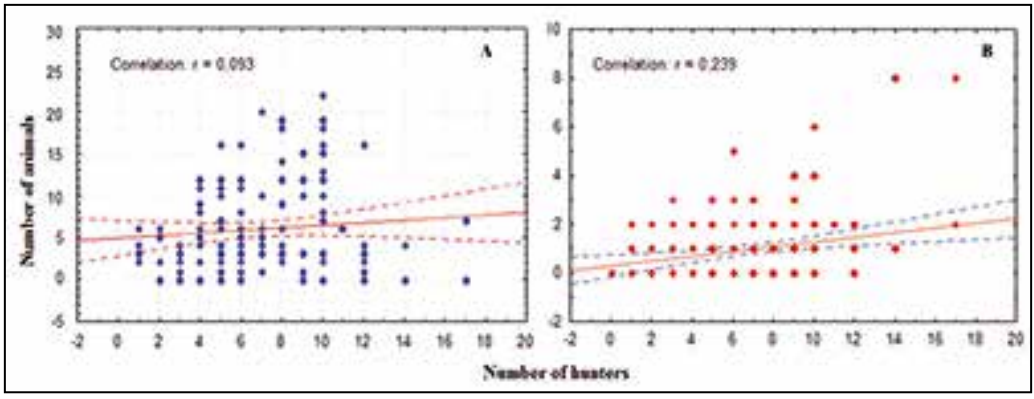

Fig. 6: The correlation between the number of animals and the number of discovered hares (A) and foxes (B)

Table 3: Habitat distribution and hare bags

Habitat	Area of lands, ha	Number of animals				Volume of bags, %
		absolute		Per 100 ha		
		1*	2**	1*	2**	
Marsh	132.0	8	2	6.06	1.52	25.0
Deciduous forest	2196.0	111	58	5.06	2.64	52.3
Coniferous forest	960.0	9	0	0.93	0	0
Mixed forest	2696.0	37	0	1.37	0	0
Clearing	25.0	3	1	12.00	4.00	33.3
Winter wheat	416.0	26	10	6.25	2.40	25.0
Fresh arable land	190.5	40	23	20.97	12.07	57.5
Old arable land	1058.0	78	33	7.37	3.12	42.3
Abandoned field	1093.0	291	151	26.62	13.81	51.9
Shrubs	1554.4	97	47	6.24	3.02	48.45
Meadow	685.0	58	21	9.58	3.56	31.1
Garden	36.0	5	3	13.89	8.33	60.0
Weeds	284.0	58	26	20.42	9.16	44.8
Beet	50.0	26	13	52.00	26.00	50.0
Total:	11375.9	847	388	7.45	3.41	45.8

1* – number of revealed animals; 2** – number of bags

on the hunter shooting skills, is much higher in small areas than in large ones.

Many game biologists of the world believe that the main reason for the reduction in the number of the European hare in anthropogenic landscape of all the European countries is over-exploitation of its populations. This is also true for the Ukrainian forest-steppe zone, where the hunting is often carried out in areas with a very low population density. As a result, there is a local destruction of hares slowing down the reproduction process. With a relatively large size of hunting lands (average size equals to 63.9 ± 6.67 ha), no animal was found in ~ 5 % of the territory. In 33.8 % (3.84 thousand ha), the population density of the European hare was only 3.84, and in 28.2 % (4.34 thousand ha) – 4.54 ind. /100 ha. In total, 93.4 % of the studied area (~ 10.6 thousand ha) supported 564 hares

Table 4: Spatial structure of the hare population and its bags

Number of animals		Area of lands		Number of bags		Area of lands	
absolute	per 100 ha	ha	%	absolute	per 100 ha	ha	%
0	0	537.0	4.7	0	0	4777.0	42.1
1–2	3.43	1543.4	13.6	1–2	1.45	4213.9	37.1
3–4	3.53	2293.5	20.2	3–4	5.36	1193.0	10.5
5–6	3.64	3161.0	27.8	5–6	20.04	499.0	4.4
7–8	6.94	1181.0	10.4	7–8	22.44	303.0	2.7
9–10	6.04	961.0	8.4	9–10	24.57	350.0	3.1
11–14	20.63	979.0	8.6	11–14	30.00	40.0	0.1
15–22	35.56	720.0	6.3	–	–	–	–
Total:	7.45	11357.9	100.0	–	3.41	11357.9	100.0

Table 5: Habitat distribution and fox bags

Habitat	Area of lands, ha	Number of animals				Volume of bags, %
		absolute		Per 100 ha		
		1*	2**	1*	2**	
Marsh	132.0	10	6	7.58	4.55	60.0
Deciduous forest	2196.0	17	4	0.74	0.17	23.5
Coniferous forest	960.0	7	6	0.73	0.63	85.7
Mixed forest	2696.0	20	9	0.74	0.33	45.0
Clearing	25.0	0	0	0	0	0
Winter wheat	416.0	3	0	0.72	0	0
Fresh arable land	190.5	4	3	3.00	1.57	75.0
Old arable land	1058.0	7	4	0.66	0.38	57.1
Abandoned field	1093.0	49	24	4.48	3.20	49.0
Shrubs	1554.4	34	19	2.15	1.20	55.9
Meadow	685.0	9	2	1.31	0.29	22.2
Garden	36.0	3	0	8.33	0	0
Weeds	284.0	9	5	3.17	1.76	55.6
Beet	50.0	0	0	0	0	0
Total:	11375.9	172	82	1.50	0.71	47.7

1* – number of revealed animals; 2**– number of bags

with a population density of 5.32 ind./100 ha (Table 4). It is not a bad value for further reproduction. However, 388 animals (68.8 %) were bagged in the process of hunting. As a result, by the start of the reproduction season the number of hares in the area did not exceed 160–180 animals (1.4–1.6 hares/100 ha). In some years, with a relatively low level of natural mortality against the high reproductive indices of the European hare, such a significant bagging is entirely safe. But in years with prolonged droughts or severe winters, greatly reducing the annual growth rate, the intensive hunting leads to a significant loss in the resources, intensifies the population depression and promotes the appearance of territories without this eurytopic species at all.

Unlike the hare, the fox prefers well-protected lands, choosing in our study area for this purpose marshy and grass-covered areas. Some specimens also like to rest in the midst of large plowed fields with a good visibility. It is the areas which support the highest fox population density. Despite the seeming maximum hunting efficiency in such places (Table 5), we did not found any significant correlation ($r = 0.41$) between the hunting success and the population density. It is interesting that with $P < 0.05$, the number of hares, bagged by 1 hunter per day insignificantly depended on the covered area ($r = -0.23$) and the population density of animals ($r = 0.53$). This is also true for the foxes with $r = 0.17$ and $r = 0.12$, respectively. Nevertheless, we found a positive correlation between the number of the hares bagged by 1 hunter per day and the number of the hares discovered ($r = 0.75$), and also between the first index and the hunting success in general ($r = 0.53$) that is naturally understandable.

Approximately the same dependence was also found for shooting of foxes: the correlation coefficient between the bags of 1 hunter and the number of the discovered animals was 0.39, and between the first index and the hunting success it made up 0.62.

Despite the fact that for a considerable area (about 40 %) of the western forest-steppe there were no foxes, the density of its population in

Table 6: Spatial structure of the fox populations and its bags

Number of animals		Area of lands		Number of bags		Area of lands	
absolute	**per 100 ha**	**ha**	**%**	**absolute**	**per 100 ha**	**ha**	**%**
0	0	4436.4	39.1	0	0	7063.4	62.2
1	1.59	2776.0	24.4	1	1.79	2177.0	19.2
2	2.35	3067.0	27.0	2	2.08	1445.1	12.7
3	7.34	286.0	2.5	3	2.31	390.0	3.4
4	9.70	82.5	0.7	4	1.33	300.0	2.5
5	16.67	30.0	0.3	–	–	–	–
6	7.50	80.0	0.7	–	–	–	–
7<	2.67	600.0	5.3	–	–	–	–
Total:	1.51	11357.9	100.0	–	0.71	11357.9	100.0

many lands is quite high. With the removal of ~ 50 % of the animals per year (Table 6), it is impossible to achieve a significant reduction in the number of this predator. Meanwhile, all the hunting farms are obliged to comply with the requirements of the World Health Organization, which has determined the maximum fox density at the level of 1–2 ind./1000 ha. The purpose of this is to reduce the probability of spreading the rabies.

Despite the existence of a negative correlation between the hare and fox population densities, it is not statistically reliable (r = –0.07). Nevertheless, the density of the predator should not supposedly exceed 1.0–1.5 ind./1000 ha, and in game breeding areas – 0.1–0.14 ind./100 ha to minimize the impact on the European hare population, This is quite enough for the fox to perform its sanitary and biocenological functions (Erdei 1977), although the necessity of a constant high pressure on its population is controversial (Hewson 1984).

When carrying out our research, it seemed logical that the higher the density, the more animals can be bagged. With $P < 0.05$, for the European hare, which shooting is strictly limited, this dependence (r = 0.53) was statistically significant but was, however, absent during the fox hunting, which bagging is not limited (r = 0.12). Also, we did not succeed in finding any correlation between the hunting success and the population density of the studied animals (Fig. 7). Probably, the ability of some hunters to shoot well and others miss the target, even when the game

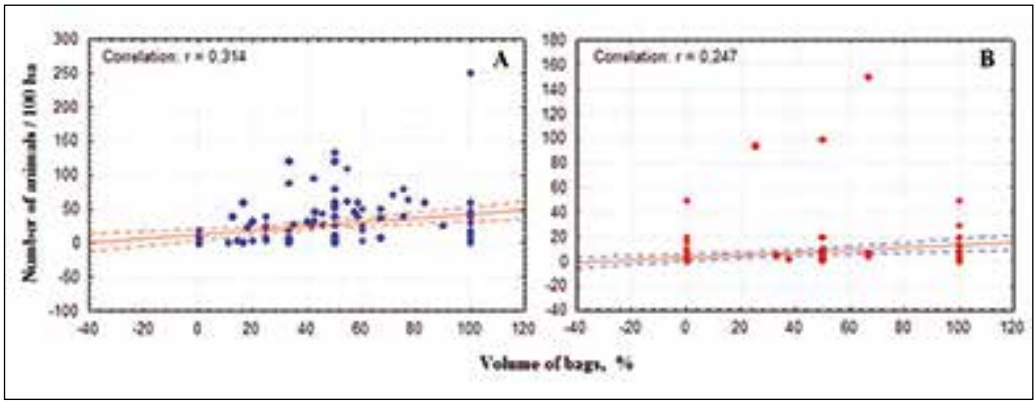

Fig. 7: The relationship between the hunting success and the population density of hares (A) and foxes (B)

is abundant, could not be mathematically analyzed.

With the appearance of a large number of road transport and expansion of road networks, the form of hare and fox hunting has considerably changed. Now in many cases the number of hunters in one team (brigade) is determined by the number of passenger seats in 3–4 cars. After the delivery of people to the hunting areas, the majority of them move creating "a pocket" around fields or woodlands. A few people, mostly car owners and elderly hunters, hide in the opposite direction and shoot the animals running out. Strange as it may seem, but with such almost total coverage of the hunting grounds, the hunters have never managed to shoot all the hares and foxes found. The fox hunting is most effective when several hunters drive animals out of small areas of dense forest, shrubs or thickets of grass, while others shoot them.

Abstract

Hunting the European hare (*Lepus europaeus* Pallas, 1778) and fox (*Vulpes vulpes* Linnaeus, 1758) in the Western forest-steppe of Ukraine

In Ukraine, the European hare and fox hunting starts in November. With a high abundance of hares, it can last until 1 February but most frequently ends in mid-January. The fox hunting is allowed until 1 March. In the study area, the hunters most often hunted in forests (65.3 %) and agrocoenoses (24.9 %). The size of a hunting team consisted of 7.0 ± 0.27 (1–17) persons and most often was 4–10 (75.2 %) hunters.
The highest density of the European hare was in agrocoenoses (16.3/100 ha). The best hunting success – the ratio between the number of bagged animals and the number of found animals (%) does not coincide with the hare population density (r = 0.44) but has a significant negative correlation with the habitat size (r = –0.33). In the process of hunting, no hares were found in ~ 5% of the territory, in 33.8% of the study area the species density was 3.84, and in 28.2 % – 4.54 animals/100 ha. After shooting of 68.8 % of the population just before the start of the reproduction season the density was 1.4–1.6 hares/100 ha), which is not enough for the reproduction of the taken resources. The fox prefers marshy and grass-covered areas where its population density was 1.5 ind./100 ha. Although hunters annually bag 47.3 % of the fox, this is not enough to reduce its population size, the maximum value of which is determined by the World Health Organization as 1–2 ind./1000 ha.
With $P < 0.05$ for the European hare, which shooting is strictly limited, the correlation between the population density and the number of found animals was statistically significant (r = 0.53). However, it was absent for the fox hunting, which bagging is not limited (r = 0.12). Also, we did not find any correlation between the hunting success and the population density of the studied animals.
In many cases, the hunting effectiveness primarily depends on the ability of hunters to shoot well and hit the target and, to a lesser extent, on the number and density of the field game population.

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