

RE-INTRODUCTION OF RED DEER (*Cervus elaphus* L.) IN THE AREA OF SOKOLOVICA - STATUS AND PROBLEMS

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Summary: Red deer reintroduction to the area of Sokolovica, financed and realised by PE "Srbijašume" (Belgrade) through FE "Toplica" from Kuršumljija was researched. The study objective was to assess the red deer effect on forest flora in the fenced rearing centre "Miloševa Voda", to which the initial stock of 14 calves (8 ♂ and 6 ♀) originating from the hunting ground "Kozara" (Vojvodina) was settled in 1997. The data were collected by detailed surveying of the entire rearing centre in summer 2010. All the damaged trees were classified by tree species and by intensity of bark stripping. The most frequent bark-stripped species were hornbeam (92.1% or 840 trees) and white ash (6.1% or 56 trees). The incidence and intensity of hornbeam bark stripping were the highest in the diameter classes from 5.0 to 9.9 cm (252 trees) and from 10.0 to 14.9 cm (303 trees). The incidence of damage by red deer is not high and does not have an adverse effect on forest structure and composition.

Key words: reintroduction, red deer, management, Serbia

Introduction

The present density and structure (sex and age), and the degree of utilisation of red deer populations in the greater part of Serbia, particularly in the wild (in the so-called "open" hunting areas), are significantly below the natural potential of forests and forest regions (about 2.5 million hectares, or 30% of the total area) [4, 17, 18]. According to the official data (Statistical Office of the Republic of Serbia), the estimated red deer density is the highest in Vojvodina (about 3,100 individuals in spring 2009). It is significantly lower in the regions of Southern and Eastern Serbia (about 800 individuals) and especially in the regions of Šumadija and Western Serbia (about 80 individuals). Also, the registered hunt of red deer was the highest in Vojvodina (587 individuals), which accounts for 88% of the total red deer hunt in Serbia.

Numerous data indicate that in the past red deer were widely distributed and very abundant in hill and mountain areas of central Serbia (south of the Sava and the Danube). However, many autochthonous populations were completely exterminated thanks to excessive and uncontrolled hunting, disturbance, competition with livestock, and habitat destruction or deterioration [2, 21]. For this reason, after the Second World War, red deer was reintroduced to central Serbia - to several forest areas which used to be parts of its natural range: Mali Jastrebac (1954), Deli Jovan (1960), Južni Kučaj and Severni Kučaj (1962). The newly formed red deer populations in North-Eastern Serbia were the subject of multiannual investigations [11], which showed that red deer density increased significantly (about 1,500 individuals in 1984) compared to the initial stock settled over the period 1960-1964 (96 individuals). However, it was found that these populations were not managed in an adequate way, because hunting grounds were not formed within forest complexes (rearing sites for red deer), and also because of the absence of a unique management policy and because of insufficient number of professional staff. Unfortunately, this situation was not improved in the subsequent period [17].

In recent times, red deer was reintroduced to the areas of Veliki Jastrebac (1997), Sokolovica (1997), Cer (1998), Čemernik (2000), Bukovik (2005) and the National Park "Fruška Gora" (2009). The comparative analysis of fenced rearing centres "Lomnička Reka" (Veliki Jastrebac), "Miloševa Voda" (Sokolovica), "Kumovac" (Cer) and "Valmište" (Čemernik) [7, 8] shows that red deer reintroduction was not fully performed pursuant to IUCN guidelines for reintroduction [10], because the pre-project activities did not eliminate the previous causes of the species destruction (primarily illegal hunting). Also, the mistakes in the phase of preparation and settling the initial stock (the unfavourable structure of the initial stock and the delay in fencing) significantly jeopardised the entire programme and increased the total costs. The red deer effect on forest flora was researched in detail only in the rearing centre "Lomnička Reka" [3, 5, 6] and, to a significantly lower degree, in the rearing centre "Miloševa Voda" [9, 14].

The reintroduction of large mammals in the reserves and other areas where they were once present has become an important method in hunting management [1]. However, the reintroduction is always a very lengthy, complex, and expensive process [10]. The mistakes from the previous programmes are repeated - lack of feasibility studies, utilisation of founders from unsuitable stocks, incorrect schemes of release, insufficient health controls [13]. Many programmes therefore fail, but in most cases, the reasons for failure remain unknown, or the known reasons are

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never published. This indicates that each incentive and programme should be described and analysed in detail, and especially all the mistakes should be emphasized, but also the factors which were decisive for the success. The aim of this study is to analyse red deer reintroduction to the area of Sokolovica and to assess the red deer effect on the forest flora in the fenced rearing centre “Miloševa Voda”.

Material and Method

The study area is the fenced rearing centre “Miloševa Voda” at the altitude of 710-1100 *m*. The area of the fenced rearing centre is 461 *ha*, of which the greatest part is under forest cover (426 *ha* or 92.4%), and meadows occupy 23.9 *ha* (5.2 %). It was established in 1997 by fencing the initial area (\approx 15.0 *ha*), which was settled by the initial stock of 14 calves (8 ♂ and 6 ♀). The bedrock consists of andesite. Mean annual air temperature is 10.8°C, and mean annual precipitation is 654 *mm*. The area of the hunting ground “Sokolovica” is about 16,000 *ha*, of which 12,000 *ha* are productive areas for red deer. The planned red deer spring density (breeding herd) was 240 individuals (2 individuals / 100 *ha*) [14].

Red deer reintroduction to the area of Sokolovica was analyzed based on the data obtained from the professional service of FE “Toplica” - Kuršumlija. The structure of forest areas in the fenced rearing centre “Miloševa Voda” was analyzed based on the data from the Special Forest Management Plan for MU “Sokolovica”. The data on forest origin, age, and mixture, as well as the percentage of ground vegetation and shrubs were of special interest.

The effect of red deer on the forest flora in the fenced rearing centre was assessed in summer 2010. The data were collected by detailed surveying of the entire rearing centre. All damaged trees were classified by tree species and intensity of bark stripping. The diameter of damaged trees was measured at breast height ($D_{1.30}$). In the first diameter class (\leq 4.9 *cm*), only the total number of damaged trees was recorded. Bark stripping incidence is presented by the number of damaged trees in the entire rearing centre area. Bark stripping intensity is presented by the size of wounds on individual trees. It is grouped into four categories [12, 15, 16]: 1 = limited damage (bark removed at the root swelling); 2 = moderate (10-50% of the bark removed); 3 = severe (bark removed on >50% of the stem); 4 = very severe (ring-barked). The wound height was measured only on severely and very severely damaged trees (categories 3 and 4).

Results and Discussion

Red deer reintroduction to the area of Sokolovica started by the elaboration of the appropriate programme (1996), as the integral part of the Hunting Plan of the hunting ground “Sokolovica” [17]. An initial area \approx 15 *ha* (fenced space for red deer adaptation and health control) was established in the subsequent year (1997). The fencing of the rearing centre “Miloševa Voda” was completed in 1998. The initial stock of 14 calves (8 ♂ and 6 ♀), originating from the well-known hunting ground “Kozara” - Bački Monoštor (Vojvodina), was released to the initial area on August 15th 1997. In addition, 5 calves were added in 1999 (2 ♂ and 3 ♀) and 4 calves in 2000 (2 ♂ and 2 ♀). This was significantly different compared to the reintroduction programme, which took into account the economic capacity of the rearing centre, the dynamics of population development and the experiences from the previous reintroductions, and therefore the size of the planned initial stock was 20 adult individuals (5 ♂ and 15 ♀).

The goals of reintroduction are: to establish new free-ranging populations in wild; to ensure long-term economic benefit for the local economy; and to conserve the natural biodiversity. A very important factor in planning the programme is its cost. An expert team decided to establish small fenced rearing centre (“Miloševa Voda”) within the forest complex (Mt. Sokolovica), and then to release the surplus individuals to the surrounding hunting areas. To make this approach economically justified, they planned to rear wild boar in the fenced rearing centre, as it lives regularly along with red deer in the wild, but has a higher reproductive capacity and tolerates high density [17]. However, the fence of the rearing centre “Miloševa Voda” was not made in accordance with the reintroduction programme, so it could not prevent the wild boar migrations and they escaped from the rearing centre to the neighboring hunting areas.

The present red deer density in the rearing centre “Miloševa Voda” does not differ from the planned (optimal) density foreseen by the reintroduction programme (Table 1). The first red deer were released to the neighbouring hunting areas (hunting ground “Sokolovica”) during 2007. For this reason, the present density in the open part of the hunting ground (wildlife) is about 40 individuals, which is significantly lower than the planned density. In the previous hunting year (2011/12), altogether 6 individuals were hunted: 1 male (trophy value 195 CIC points), 4 hinds and 1 calf.

Forest areas in the fenced rearing centre mainly face east and west slope aspects. The greatest part of the forest area ranges over steep and very steep slopes, and the flat terrains are covered with pasture areas and several forest clearings. The dominant forest categories are high even-aged forests of beech (266 *ha* or 62.6%), high all-aged forests of beech (76 *ha* or 18.0%) and high even-aged forests of beech and hornbeam (38 *ha*).

Table 1. Survey of planned (optimal) stock and breeding stock in 2011

Locality	Stock	Sex	Age class			Total (n)
			1-4 year	5-8 year	≥9 year	
Hunting ground "Sokolovica" (total area 16,000 ha)	Planned	Male	63	31	26	240
		Female	63	31	26	
	Breeding	Male	14	3	1	40
		Female	14	8	-	
Fenced rearing centre "Miloševa Voda" (total area 461 ha)	Planned	Male	27	16	7	100
		Female	27	16	7	
	Breeding	Male	27	16	6	99
		Female	27	16	7	

Evidently, broadleaf forests are dominant compared to coniferous forests and artificially established stands. Middle-aged beech forests aged 41-60 years occupy the area of 204 ha. Well-preserved forests account for 79.3% of the area, and pure forests account for 61.0%. The most represented tree species in this fenced rearing centre is beech. Also, there is a small percentage of hornbeam, sycamore maple, field maple, white ash, flowering ash, aspen, spruce, and some wild fruit trees (cornel tree, wild service tree and wild cherry).

The incidence of bark stripping in the fenced rearing centre "Miloševa Voda" is presented in Table 2. There are altogether 912 damaged trees unselectively distributed throughout the rearing centre area (in 15 Compartments, or on the area of 367 ha). The greatest numbers of damaged trees were assessed in the Compartments 43/a, 19/b, 29/a and 43/c, which is explained by the fact that they are adjacent to the largest and the best-quality pasture areas. The bark stripping wounds on severely and very severely damaged trees (categories 3 and 4) range from the ground level (\bar{x} = 1.9 cm) to the height of 4.0 m (\bar{x} = 190.7 cm).

Table 2. Incidence and intensity of bark stripping by red deer in the fenced rearing centre "Miloševa Voda" (2010)

Locality	Area (ha)	Stem damage category				Total stem (n)
		(1) Limited	(2) Moderate	(3) Severe	(4) Very severe	
19/b	15.28	11	7	64	31	113
19/c	14.00	-	2	7	4	13
20/c	0.17	-	2	4	11	17
20/d	0.50	-	-	2	2	4
21/a	27.02	-	2	6	13	21
22/b	5.60	5	-	-	6	11
22/c	13.57	-	3	7	22	32
23/b	10.50	13	10	13	24	60
28/a	6.80	-	-	1	-	1
28/b	13.00	-	9	19	25	53
29/a	24.10	2	26	41	39	108
29/b	2.60	-	-	2	-	2
30/a	26.30	-	1	-	5	6
30/b	4.90	-	-	1	2	3
31/a	15.87	-	-	2	3	5
31/b	1.40	-	-	-	1	1
32/a	23.90	-	-	1	20	21
33/a	28.28	-	-	10	7	17
34/a	24.35	-	1	-	1	2
35/a	23.52	2	5	19	27	53
35/b	4.60	-	1	5	6	12
42/b	10.70	5	11	29	7	52
43/a	2.35	9	22	123	41	195
43/b	10.20	-	3	6	4	13
43/c	5.50	6	3	24	63	96
43/d	2.20	-	-	1	-	1
Total	367.01	53	108	387	364	912

Table 3. Species composition and number of damaged trees in the fenced rearing centre “Miloševa Voda“ (2010)

Tree species	Stem damage category				Total stem (n)
	(1) Limited	(2) Moderate	(3) Severe	(4) Very severe	
<i>Fagus moesiaca</i> (K. Maly) Czecz	-	-	3	-	3
<i>Carpinus betulus</i> L.	39	95	364	342	840
<i>Fraxinus excelsior</i> L.	7	10	18	21	56
<i>Acer pseudoplatanus</i> L.	1	-	-	1	2
<i>Acer platanoides</i> L.	-	1	-	-	1
<i>Acer campestre</i> L.	-	-	1	-	1
<i>Corylus colurna</i> L.	-	-	1	-	1
<i>Prunus avium</i> L.	-	2	-	-	2
<i>Picea abies</i> (L.) Karst	6	-	-	-	6
Total	53	108	387	364	912

Table 3 presents the incidence of bark stripping per tree species. The most frequent bark-stripped species were hornbeam (*Carpinus betulus* L.) and white ash (*Fraxinus excelsior* L.). Of the total number of damaged trees, hornbeam accounted for 92.1%, or 840 trees, and white ash accounted for 6.1%, or 56 trees.

Table 4 presents the diameter structure of damaged hornbeam trees by intensity of bark stripping (damage category). The incidence and intensity of bark stripping were the highest in the diameter classes 5.0-9.9 cm (252 trees) and 10.0-14.9 cm (303 trees). They accounted for 66.1% of the total number of damaged hornbeam trees, of which the bark was ringed on 229, which is 70.0% of the total number of very severely damaged trees. There was not a statistically significant difference ($t=1.775$, $p=0.08$) between the mean diameters ($\bar{x} \pm SE$) of severely damaged (11.7±4.3 cm; $n=291$) and very severely damaged (11.0±4.0 cm; $n=274$) hornbeam trees.

Table 4. Diameter class distribution of hornbeam (*Carpinus betulus* L.) damaged trees

DBH class (cm)	Stem damage category				Total stem (n)
	(1) Limited	(2) Moderate	(3) Severe	(4) Very severe	
≤ 4.9	-	-	73	68	141
5.0-9.9	8	36	89	119	252
10.0-14.9	12	36	145	110	303
15.0-19.9	9	14	41	33	97
≥ 20.0	10	9	16	12	47
Total	39	95	364	342	840

Previous research shows that the effect of red deer on forest flora differs significantly depending on the fenced rearing centre [3, 9]. The authors report that, in the rearing centre “Lomnička Reka“ (Veliki Jastrebac), red deer mainly caused bark stripping damage of beech, and in the rearing centre “Miloševa Voda“ (Sokolovica) there was no beech bark stripping at all. Moreover, the authors conclude that broadleaf forests at the locality “Miloševa Voda“ were potentially more endangered by red deer, because the beech percentage was much higher, especially that of middle-aged stands aged 41-60 years. This is also confirmed by our results (Table 3) which showed that red deer did not strip the beech bark in the rearing centre “Miloševa Voda“, despite the fact that their density increased significantly (52 individuals in 2008, i.e. 85 individuals in 2010). Damage by red deer in the rearing centre “Lomnička Reka“ was explained by the deficiency in pasture areas (2.5 ha or 0.7% of the total area) [3, 6, 9]. In contrast, pasture areas in the rearing centre “Miloševa Voda“ occupy 23.9 ha (5.2%) and they have a favourable plant community composition for red deer pasturage [19, 20].

Conclusion

Red deer density in the fenced rearing centre “Miloševa Voda“ (99 individuals in 2011) does not differ from the planned (optimal) density predicted by the reintroduction programme, whereas red deer density in the neighbouring hunting areas is about 40 individuals (hunting ground “Sokolovica“), which is significantly lower than the planned density (240 individuals). The incidence of red deer damage to forest flora is not high and there are no adverse effects on the structure and composition of the forest area. Red deer most often stripped the hornbeam bark (92.1% or 840 trees), which is explained by the sufficient percentage of good-quality pasture areas (23.9 ha). However, in the fenced rearing centre “Miloševa Voda“, the dominant forests are high even-aged beech forests aged 41-60 years, therefore there is a great risk of bark stripping damage. The following measures are proposed with the aim of protection of forest flora and harmonisation of hunting management and forest management: (1) to improve the quality of pasture areas and all forest clearings, and to establish new areas covered with green forage; (2) to remove

(fell) severely and very severely damaged trees; and (3) to ensure the complete red deer protection, especially from illegal hunting.

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