Zbornik gozdarstva in lesarstva 74, s. 141 - 164

GDK: 451.4 (497.12*06)--01(045)=20

Prispelo / *Recieved:* 23. 8. 2004
Sprejeto / *Accepted:* 9. 9. 2004

Izvirni znanstveni članek
Original scientific paper

ANALYSIS OF THE INFLUENCE OF UNGULATES ON THE REGENERATION OF DINARIC FIR-BEECH FORESTS IN THE RESEARCH SITE TRNOVEC IN THE KOČEVJE FOREST MANAGEMENT REGION

Kristjan Jarni,* Dušan Robič,** Andrej Bončina***

Abstract:
In the period 1970-2000, 152 fenced-in areas were built in the Kočevje Forest Management Region with an aim to protect tree seedlings and saplings from ungulates' activity and to monitor the influence of roe and red deer on natural regeneration. The average surface area of fenced areas is 0.71 ha. Using the pair comparison technique (fenced vs. unfenced areas), the structure and the composition of the natural regeneration of tree species as well as complete shrub and herb vegetation were analysed in the research site Trnovec. Furthermore, the vegetation was investigated using the Braun-Blanquet method. The research results show significant differences between fenced and unfenced areas, both in tree species composition and in the height structure of the sapling community. In fenced areas the total number of saplings taller than 50 cm is higher and an increase is also evident in the number of saplings of silver fir *Abies alba*, sycamore *Acer pseudoplatanus*, elm *Ulmus glabra* and other minor tree species. There are also significant differences in species composition and in the abundance of plant species in the herb layer. The results show that natural regeneration of Dinaric fir-beech forests is successful, provided the influence of ungulates is excluded.

Key words: natural forest regeneration, fir-beech forest, *Abies alba*, *Fagus sylvatica*, red deer, roe deer, fenced area, seedling browsing, Kočevje forest region, research site Trnovec

ANALIZA VPLIVA PARKLJASTE DIVJADI NA POMLAJEVANJE DINARSKEGA JELOVO-BUKOVEGA GOZDA NA RAZISKOVALNI PLOSKVI TRNOVEC V KOČEVSKEM GOZDNOGOSPODARSKEM OBMOČJU

Izvleček:
V gozdnogospodarskem območju Kočevje so v obdobju 1970-2000 zgradili 152 gozdnih ograj, ki so namenjene zaščiti pomladka in mladovja pred velikimi rastlinojedi in preučevanju vpliva populacij jelenjadi in srnjadi na razvoj rastlinja. Poprečna velikost ograjene površine je 0,71 ha. Z vzorčenjem na transektu (N=42 ploskev, 4x4 m) v raziskovalnem objektu Trnovec smo podrobno raziskali sestavo in strukturo pomladka in drugega rastlinja v zeliščni in grmovni plasti na ograjeni in neograjeni površini. Analizo rastlinja smo dopolnili s tremi fitocenološkimi popisi. Pri parni primerjavi smo ugotovili značilne razlike v višinski strukturi in sestavi pomladka. Na ograjeni površini smo evidentirali več mladic, ki so višje od 50 cm, in znatno večje število mladic jelke (*Abies alba*), javorja (*Acer pseudoplatanus*), bresta (*Ulmus glabra*) in drugih minoritetnih drevesih vrst. Značilne so tudi razlike v sestavi in obilju zelnatih rastlin. Ob izključitvi vpliva jelenjadi in srnjadi poteka naravna obnova povsem nemoteno.

Ključne besede: naravna obnova gozdov, jelovo-bukovi gozdovi, jelka, bukev, jelenjad, srnjad, ograjena površina, objedanje pomladka, gozdnodospodarsko območje Kočevje, raziskovalni objekt Trnovec

* univ. dipl. inž. gozd., Srednja gozdarska in lesarska šola Postojna, Tržaška 36, 6230 Postojna, SLO
** mag, Pugljeva 27, 1000 Ljubljana, SLO
*** prof. dr., Oddelek za gozdarstvo in obnovljive gozdne vire BF, Večna pot 83, 1000 Ljubljana, SLO

CONTENTS

VSEBINA

1 INTRODUCTION AND PROBLEM DEFINITION UVOD IN OPREDELITEV PROBLEMA

Roe deer (*Capreolus capreolus* L.) and red deer (*Cervus elaphus* L.) populations can significantly influence the processes of natural regeneration in forest stands. During the last hundred years the population density of deer in Slovenia has been fluctuating although in general, the process has been one of a marked increase (PERKO 1977, ADAMIČ 1989a, JERINA 2003). In the last few decades, the natural regeneration of forest stands was rendered more difficult and somewhere even made impossible due to the increased density of the roe and red deer populations. In some forest regions, e.g. Postojna and Kočevje, ungulate browsing was declared the main problem of sustainable forest management (Gozdnogospodarski načrt … 2001) and it still remains one of the most important issues in the majority of Slovene forests (DIACI / GRECS 2003). When ungulates disturb the spontaneous forest regeneration or render it difficult, fencing of certain forest areas has to be considered as an alternative. Forest fence is a measure of "collective protection" of young forest stands or/and areas prepared for natural regeneration. Forest experts and researchers do not seem to agree on the level of significance of forest fencing. Their approaches can be divided into two main groups:

- The forest fence can be understood as a special research object enabling us to study quantitative and qualitative influences of ungulates on the natural regeneration, especially when comparing the data obtained inside the fence to those from an unfenced forest area (KINDLER 1953, RAJIČ 1955, PERKO 1977, VESELIČ 1981, ADAMIČ 1982, 1989b, REIMOSER / SUCHANT 1992, GREINER 1994, ODERMATT 1996, BONČINA 1996, 1997, KOREN 1997, LUTHARDT / BEYER 1998, NESSING / ZERBE 2002, OHEIMB / KRIEBITZSCH / ELLENBERG 2003). The approach enables us to obtain some information about the feeding habits of ungulates.
- According to some other experts, fences present an efficient way of ensuring collective protection of tree saplings against browsing (PRELESNIK 1974, ARETIN 1977). As regards intensive browsing, there are two main methods to promote natural regeneration of forest stands. First, there is artificial regeneration with spruce - a technology that is well known (preparation, planting, repeated protection of spruce saplings with coatings etc.) and effective. The second method is collective protection of natural regeneration, which can be enriched by some artificial saplings**.** The reasons for fencing in such conditions are numerous: provision of natural saplings, preservation of ungulates-endangered tree species,

at least in small areas. Such areas will play an important role in the preservation of certain tree species in the following decades and centuries. Economic reasons for fencing to protect natural regeneration if compared to spruce plantations and individual protection of saplings may not be underestimated. The costs of natural regeneration protected by fences were found to be lower than the costs of artificial regeneration with repeated individual sapling protection (ARETIN 1977, BENTZ 1977, MIKLAŠIČ / AREH 2001).

In the Kočevje Forest Management Region (FMR), the issue of over-dense ungulate population has been hot for a few decades. In the last thirty years numerous fences have been built to protect regeneration stands. The development of vegetation has already been analysed in several fenced areas (ROBIČ / BONČINA 1990, BONČINA 1996, 1997, INDIHAR 1997).

The aim of our study was to analyse the range and number of forest fences present in the Kočevje FMR, and to analyse detailed natural regeneration in the Trnovec fenced area compared to a nearby unfenced area.

2 WORKING METHODS AND RESEARCH SITE
METODE DELA IN OPIS OBJEKTA

2.1 FOREST FENCES IN KOČEVJE FOREST MANAGEMENT REGION
OGRAJENE POVRŠINE V GOZDNOGOSPODARSKEM OBMOČJU KOČEVJE

Kočevje FMR lies in the south of Slovenia. The area encompasses 118,000 ha, 91,000 ha of which are covered with forest (78% forest density). Approximately 59% of forests are state owned and 41% are privately owned. Parent material is mainly composed of carbonates, with a wide range of soils from the post-carbonate series. Well-preserved Dinaric mountain fir-beech forests (37%) and submountain beech forests (30%) prevail, whereas other forest types are rather limited and restricted to special ecological conditions (Gozdnogospodarski načrt ... 2001). Preserved habitats offer favourable living conditions to numerous animal populations. Wolf and brown bear populations are well preserved, and since 1973, after it was reintroduced to the area, lynx can also be traced. Ungulates are widespread and red deer populations are particularly dense; in 2002, the average harvest of roe and red deer was 1.39 and 1.20 per 100 ha of hunting area, respectively (BARTOL 2003).

In the spring of 2001, a survey was carried out among 28 district foresters[1] of the Slovenian

[1] Thanks to: Bojan Knavs, Stanko Pelc, Alojz Novak, Srečko Namlih, Branko Janeš, Drago Vereš, Tomaž Černe, Stanko Poje, Marko Lavrič, Brane Miletič, Zdravko Vesel, Janez Šubic, Matjaž Pajnič, Franc Oražem, Brane Indihar, Emil Turk, Anton Vukelič, David Šterbenc, Cveto Štimac, Franc Glavič, Jože Škufca, Branko Stošič, Dušan Henigman, Branko Oberstar, Jernej Škrajnar, Stanko Anzeljc, Brane Brinc, Zlatko Malnar

Forest Service in the Kočevje region. The survey provided the main data concerning forest fences, e.g. locations of fences, year of fencing, size, maintenance (regular, occasional, an abandoned fence) and the purpose of fencing in the period 1970-2000.

2.2 RESEARCH SITE TRNOVEC
RAZISKOVALNI OBJEKT TRNOVEC

Kočevski Rog is located in the south-east part of the Kočevje FMR. Dinaric fir-beech-forests prevail. Many fences for collective protection of forest saplings have been built in this part of the forest region, among them the forest fence Trnovec in 1989. It is located in the forest management unit (FMU) Rog, compartments 19a and 19b. The size of the fenced area is 1.3 ha; and the fence has been regularly maintained. The forest stand is timber-producing, formed of mature fir and beech trees with a growing stock of 600 m^3/ha. The crown density of upper-layer trees is 0.8. The forest plant community is classified as *Abieti-Fagetum dinaricum galietosum odorati*[2]. The parent material is limestone, and the soil group is classified as eutric cambisol. The terrain is convex, stony (15%) and slightly sloped (≈10°) towards the south-west. The elevation of the site is 740 m above sea level. Beech *Fagus sylvatica* (52%) and fir *Abies alba* (40%) dominate in the tree composition; sycamore *Acer pseudoplatanus* (2%) and wych elm *Ulmus glabra* (5%) are also present (Gozdnogojitveni načrt ... 1998).

In the research site, a sampling transect was determined in order to analyse vegetation in detail**.** The transect crosses the fenced-in area, whereas both of its outermost parts lie in the unfenced area. The total size of the sampling area along the transect is 168 × 4 m. It is divided into 42 plots of size 4 × 4 m, 21 of which are fenced and 21 unfenced. Sampling plots (4 x 4 m) are positioned so that the ending side of one plot is the beginning side of the next one. Conditions (e.g. coverage of the ground by tree layer, exposition, inclination and stoniness) along the transect are practically uniform in the fenced and the unfenced area. Therefore it was presumed that all the distinctions in floristic composition, structure and composition of saplings between the fenced and the unfenced area may be attributed to the influence of ungulates. A similar method has already been tested (ROBIČ / BONČINA 1990, BONČINA 1997).

The following parameters were evaluated on every plot (4 x 4 m):

- coverage of ground by vegetation layers:
  - D1 upper tree layer (20-40 m)
  - D2 lower tree layer (5-20 m)
  - G1 upper shrub layer (1,3-5 m)

[2] *Abieti-Fagetum dinaricum* (TREG.57) emed. PUNC.79 *galietosum odorati* (SYN *Omphalodo-Fagetum* (TREG.57 corr.PUNC.80)MAR *et al.*93 var geogr. *Calamintha grandiflora* SURIN (2001)2002)

G2 lower shrub layer (0,5-1,3 m)
Z herb layer (up to 0,5 m), further divided into woody plants (Z_{les}) and herbaceous plants (Z_{zel})
M moss layer

- exposition
- slope (in degrees)
- form of ground surface (flat, convex, concave)
- stoniness (in % of surface area)
- coverage of ground by trunks and stumps (in % of surface area)
- coverage of ground by leaf litter

The vegetation was inventoried twice. In September 1999, all woody plants on 42 sampling plots were inventoried; species, height and browsing were determined for each sapling. The saplings were classified into height classes using a measuring stick: H1 (less than 10 cm), H2 (11 – 20 cm), H5 (21 – 50 cm), H9 (51 – 90 cm), H13 (91 – 130 cm), H20 (131 – 200 cm), H50 (201 – 500 cm). Germs (KL) were registered separately. Fresh, previous year's and older browsing was distinguished when estimating the intensity of browsing. On saplings damaged more than once the latest damage was registered.

In June 2000, plant composition of herbaceous and shrub layers was analysed, the plants being classified in the following layers: G1, G2, Z and M. The germs of tree species were involved as well and were classified in the moss layer.

The coverage of a single species was estimated by a 5% degree scale; in case of lower coverage (1–5%), the coverage was estimated by a 1% degree scale. The covering of less than 1% of ground was given the value of 1%. EXCEL was used for data management**.** The differences in abundance of plant species on fenced and unfenced sample plots were tested with non-parametrical Wilcox test across the normal deviation/deviant "z" (standardised value) (BLEJEC *et al*. 1977).

In September 1999, the vegetation in the research site Trnovec was additionally analysed using the standard Central European phytosociological method (BRAUN-BLANQUET 1964). Three phytosociological relevés were recorded, one being located inside the fenced area and two outside. This enabled us to compare the results of vegetation analysis on sampling plots to the results of the phytosociological relevés.

3 RESULTS
REZULTATI

3.1 FOREST FENCES IN THE KOČEVJE FOREST MANAGEMENT REGION
OGRAJENE POVRŠINE V GOZDNOGOSPODARSKEM OBMOČJU KOČEVJE

The total number of forest fences in the Kočevje FMR is 152; their total surface is 108.2 ha which represents 0.119% of the total forest surface of the region. Kočevje FMR is divided into 26 forest management units (FMU). The number of fences in individual FMUs differs, which indicates various degrees of browsing pressure on the natural regeneration. The highest number of fenced areas is found in the FMUs Kolpa (22), Struge (17), Draga (14) and Briga (13) where state owned forests prevail. No fences have been set up in FMUs Velika gora, Loški potok, Sodražica, Ortnek, and Dobrepolje where privately owned forests predominate.

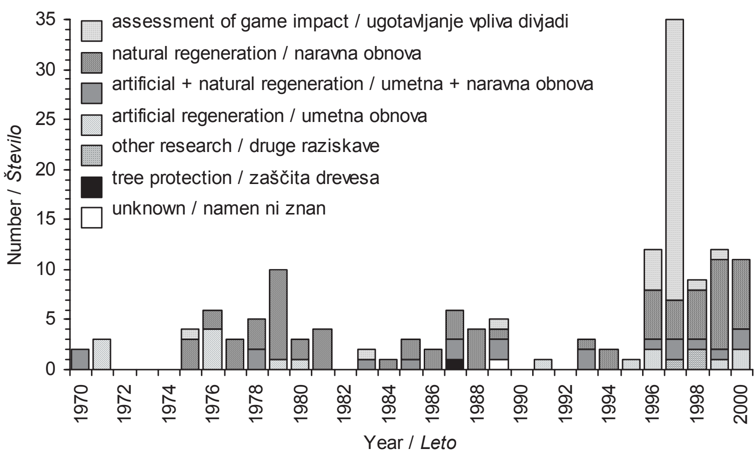

Figure 1: Time dynamics of fencing in the period 1970-2000
Slika 1: Letna dinamika postavljanja ograj v obdobju 1970-2000

The number of fences built per year has been changing in the analysed period. Generally, the period between 1970 and 1995 can be regarded as moderate with an average of three fences set up per year. The size of these fences varied from 0.05 ha to 3 ha and was 1.10 ha on average. The main goal was the protection of natural and/or artificial saplings. The period after 1995 shows a considerable increase in the number of newly built fences per year (Figure 1). Organisational changes of Slovenian forestry may be one of the reasons for that; in 1993, Slovenian Forest Service was made responsible for wildlife management planning according to the Forest Act. However, the average size of fenced areas dating from this period was substantially smaller than before. The main purpose for fencing was research, as the comparison of vegetation in fenced and unfenced areas presented a constituent part in assessing the appropriate density of ungulate populations in forest ecosystems.

In the period from 1970 to 2000, the average size of fenced areas built for protection of natural and artificial regeneration was 0.93 ha. The average size of forest fences built for monitoring the influence of ungulates on vegetation development was only 0.12 ha.

The majority of the fences (76%) built in the period 1970-2000 is still regularly maintained; however, 7% of them are completely abandoned.

3.2 RESULTS OF VEGETATION ANALYSIS IN RESEARCH SITE TRNOVEC
REZULTATI ANALIZE VEGETACIJE V RAZISKOVALNEM OBJEKTU TRNOVEC

3.2.1 Structure, density and height structure of saplings
Sestava, gostota in višinska struktura pomladka

All the saplings (up to the height of 5 m) and germs of woody species were analysed on 42 sampling plots. Altogether 5,022 stems (N/ar = 747) were evidenced, 97.9% of which were saplings of tree species; and 502 stems (N/ar =75) of the total number were silver fir saplings.

The total density of saplings does not differ much between the fenced and unfenced area (Table 1). A slightly greater number of saplings was registered in the unfenced area (N/100 m^2 = 771) compared to the fenced area (N/100 m^2 = 721). However, noticeable differences in density and tree composition by height classes of saplings between fenced and unfenced area have been observed:

- In the unfenced area the number of germs and saplings in lower height 3 classes (under 50 cm) is higher than in the fenced area. In higher height classes the relation is reversed; the number of saplings is higher in fenced areas, and the difference would be even more evident if the analysed site had been set up earlier. In case of unhindered development of saplings, the competition between them is more evident. Higher saplings that managed to grow quickly create unfavourable light conditions for the lower ones. In unfenced areas, constant browsing severely reduces the intensity of overgrowing of young growth into higher height classes.

Thus, constant "favourable" conditions for initial growth are maintained.

- There is an evident difference in tree species composition by height classes between the fenced and unfenced areas (Table 3). The most evident example of this is silver fir *Abies alba*; in the unfenced area the number of fir is already lower in the height class up to 10 cm, whereas this species is completely absent from higher classes. In fenced areas, silver fir successfully regenerates and overgrows; however, it has not yet reached the height of more than 50 cm due to its extremely slow growth. The fence was set up only 11 years prior to the time of the analysis, and only during this time the influence of ungulates on natural regeneration was excluded. Sycamore *Acer pseudoplatanus* and wych elm *Ulmus glabra* are also numerous outside the fence, but only in the lowest height classes (under 20 cm), whereas in the fenced area they successfully grow in height despite very high growing stock and dense stand canopy (Table 3). It is interesting that the sapling number of sycamore and elm to the height of 20 cm is higher in the unfenced area. This could be explained by the fact that these tree species regenerate constantly and even survive browsing but are not able to grow to higher height classes.

- The density of beech saplings is much higher in the unfenced area than in the fenced one, which may probably be attributed to selective browsing of tree species. Another reason may be the height structure of saplings, which is lower in the unfenced area, thus producing higher sapling density.

Table 1: Density and height structure of saplings of woody species (N/100 m^2) in fenced and unfenced plots
Preglednica 1: Gostota mladic grmovnih in drevesnih vrst (število/ar) na ograjeni in neograjeni površini po višinskih razredih

		Height class (cm) / Višinski razred (cm)							Total / Skupaj
	Germ / Klice	-10	11-20	21-50	51-90	91-130	131-200	201-500	
Fenced / Ograjeno	46	112	244	256	72	26	9	2	721
Unfenced / Neograjeno	108	147	287	270	55	11	1	0	771

Table 2: Mean number of woody species per height class and significant difference between fenced and unfenced plots (pair comparison method, N=42, plot size 16 m^2)
Preglednica 2: Srednje vrednosti števila različnih lesnatih vrst po višinskih razredih na ograjeni in neograjeni površini ter značilnost razlik med njimi (metoda parnih primerjav, N=42, velikost ploskev 16 m^2)

Height class / Višinski razred	Fenced / Ograjeno		Unfenced / Neograjeno		Significance / Tveganje
	Mean / Povprečje	Standard deviation / Standardni odklon	Mean / Povprečje	Standard deviation / Standardni odklon	
H1 (-10 cm)	2.33	0.89	3.95	1.21	***
H2 (11-20cm)	3.24	1.11	3.76	0.92	
H5 (21-50cm)	3.71	1.20	2.14	0.71	***
H9 (51-90cm)	2.05	1.40	1.24	0.68	
H13 (91-130cm)	1.62	1.29	0.67	0.64	*
H20 (131-200cm)	0.81	0.85	0.24	0.43	*
H50 (201-500cm)	0.33	0.56	0.00	0.00	*

There are significant differences in the richness of woody species in particular height classes (Table 2). Up to the height of 10 cm, species richness is significantly higher on sampling plots in the unfenced area. In the next height class (11 – 20 cm), the number of species is higher in the unfenced area as well, but this difference is statistically insignificant. However, in higher classes this relation is reversed; the number of different species on sampling plots in fenced area is much higher. The results indicate selective influence of ungulates on the species diversity of woody plants – by selective browsing they diminish species diversity of saplings in higher height classes, which importantly influences the (future) tree composition of forest stands.

During the periods when the influence of ungulates was excluded from regeneration stands, differences in the dynamics of height overgrowth among the saplings of individual tree species can be recorded on the basis of composition and height structure of saplings. Fir saplings overgrow slowly and no fir higher than 50 cm was found, although the influence of ungulates has been absent for 11 years. On the other hand, height growth dynamics is clearly evident in elm and sycamore. High number of sycamore and elm trees in higher classes shows fast growth in the early stages. The growth dynamics of beech saplings is moderate. The slow height growth of the fir in youth and its ability to “patiently wait” and survive in unfavourable light conditions during the regenerating processes are the main typical characteristic of fir regeneration. It can be concluded that in the case of high density of ungulate populations these area disadvantage rather than an advantage for the regeneration of fir (ROBIČ / BONČINA 1990).

Table 3: Number of tree saplings (number/100 m^2) according to height classes in fenced and unfenced plots
Preglednica 3: Število mladic (število/ar) drevesnih vrst po višinskih razredih na ograjeni in neograjeni površini

Species / Vrsta		Germ / Klice	Height class / Višinski razred H1	H2	H5	H9	H13	H20	H50	Total / Skupaj H1-H50
Beech / bukev	Fenced / Ograjeno	0	14	139	197	58	11	1	0	420
	Unfenced / Neograjeno	0	43	249	261	53	11	1	0	618
Silver fir / jelka	Fenced / Ograjeno	46	92	93	36	0	0	0	0	221
	Unfenced / Neograjeno	108	73	3	0	0	0	0	0	76
Sycamore / gorski javor	Fenced / Ograjeno	0	3	8	11	4	10	6	0	42
	Unfenced / Neograjeno	0	11	16	1	0	0	0	0	28
Whych elm / gorski brest	Fenced / Ograjeno	0	0	2	7	7	4	2	2	24
	Unfenced / Neograjeno	0	13	15	1	0	0	0	0	29
Other tree sp. / Druge drev. v.	Fenced / Ograjeno	0	0	0	1	0	0	0	0	1
	Unfenced / Neograjeno	0	1	0	1	0	0	0	0	2
Shrub species / Grmovne v.	Fenced / Ograjeno	0	3	2	4	3	1	0	0	13
	Unfenced / Neograjeno	0	6	4	6	2	0	0	0	18

3.2.2 Browsing damage
Poškodovanost

Every sapling with signs of browsing was counted as a browsed subject, regardless of the age of damage. In general, the share of browsed saplings increases with the their height or age (Table 4). Browsing intensity by height class differs for the same tree species. The browsing of sycamore and elm is outstandingly high already in the lowest height class (under 10 cm). The data from the table indicate that the average value of browsing intensity is not reliable; actually, it is misguiding. The fir browsing intensity, for instance, amounts to only 5% of the total browsed saplings, although every single sapling above 20 cm of height is browsed.

Table 4: Percentage (%) of browsed saplings in unfenced plots by tree species and height class
Preglednica 4: Delež (%) poškodovanih mladic na neograjeni površini po drevesnih vrstah in višinskih razredih

Species / Vrsta	Height class (cm) / Višinski razred (cm)						Total / Skupaj
	-10	11-20	21-50	51-90	91-130	131-200	
Beech / bukev	16	24	35	58	75	60	32
Silver fir / jelka	4	27	100	100	-	-	5
Sycamore / gorski javor	66	87	100	-	-	-	79
Whych elm / gorski brest	91	92	100	-	-	-	92
Other tree sp. / Druge dr. v.	0	100	100	-		-	50
Shrub species / Grmovne v.	20	73	45	50	100	-	45
Total / Skupaj	20	32	36	58	76	60	34

3.2.3 Abundance and species composition of herbaceous and shrub layers
Obilje ter vrstna sestava zeliščne in grmovne plasti

There are significant differences in species richness in shrub layers (G1 and G2) and in total abundance of species in the upper shrub layer (Table 5). In the fenced area, there is a higher number of different plant species (species richness) and their total abundance is higher. The situation in the herbaceous layer reveals the opposite; species richness and total abundance are higher in the unfenced area.

The analysis on the level of individual plant species (pair comparison method, significance < 0,05) between fenced and unfenced areas shows that the average abundance of the following plant species is significantly higher in the fenced area:

Layer G1: *Acer pseudoplatanus*, *Ulmus glabra,*
Layer G2: *Acer pseudoplatanus, Ulmus glabra,*
Layer Z: *Abies alba, Omphalodes verna, Rubus hirtus, Scopolia carniolica, Ulmus glabra.*

In the unfenced area the average abundance of the following plant species was significantly higher:

Herbaceous layer (Z): *Anemone nemorosa, Aremonia agrimonioides, Cyclamen purpurascens, Daphne laureola, Euphorbia amygdaloides, Fagus sylvatica, Galeobdolon flavidum, Lycopus europaeus, Oxalis acetosella, Sanicula europaea, Senecio fuchsii.*

Table 5: Mean values of attributes and statistically significant differences between plots in fenced and unfenced areas (pair comparison method, N=42, plot size = 4 x 4 m)
Preglednica 5: Srednje vrednosti primerjanih parametrov za ograjene in neograjene ploskve ter signifikantnost razlik med njimi (metoda parnih primerjav, N=42, velikost ploskve = 4 x 4 m)

Attribute / Analizirani znaki	Fenced / Ograjeno		Unfenced / Neograjeno		Significant / Tveganje
	Mean / Povprečje	Standard deviation / Standardni odklon	Mean / Povprečje	Standard deviation / Standardni odklon	
Total abundance in upper shrub layer / Obilje v G1	4.8	7.6	0.8	1.4	*
Total abundance in lower shrub layer / Obilje v G2	18.6	15.9	11.3	11.6	
Total abundance in herb layer / Obilje v Z	34.7	18.9	36.6	14.3	
Number of species in herbaceous layer / Število vrst v Z	19.1	4.5	20.9	3.0	
Number of species in upper shrub layer / Št. vrst v G1	0.8	0.9	0.2	0.4	*
Number of species in lower shrub layer / Št. vrst v G2	2.8	1.8	1.5	0.7	*

There are several reasons for the differences in abundance of particular plant species. One reason is selective browsing; ungulates, which prefer some plant species to others for their feeding, directly decrease their abundance and thus indirectly increase the abundance of other otherwise less competitive plant species. The second reason lies in the stand conditions which have been changed through ungulate browsing. They hinder the growth of plant species in height, this resulting in lower abundance of shrub layer. They simply slow down the development of a young stand. In this way ungulates directly influence light conditions in particular, primarily in the herb layer, which may be the reason for higher species richness and abundance of some plant species in this layer. It can be concluded that significantly higher abundance of some plant species in the unfenced area is a result of selective browsing as well as of preserving favourable light conditions for development of these species (BONČINA 1997).

3.3 ANALYSIS OF VEGETATION IN FENCED AND UNFENCED AREAS BY BRAUN-BLANQUET METHOD
ANALIZA RASTLINJA NA OGRAJENI IN NEOGRAJENI POVRŠINI PO METODI BRAUN-BLANQUET

Regardless of the early autumn aspect of the described vegetation, which was classified as Dinaric fir-beech forest with sweet woodruff (*Abieti-Fagetum dinaricum galietosum odorati*, SYN.: *Omphalodo-Fagetum galietosum odorati*), the analysis showed relevant differences among the described sites.

Numerical comparisons of phytosociological relevés indicate important differences between the relevé of the fenced site (P1) and the two relevés of the neighbouring unfenced areas (P2, P3). The dendrogram (Figure 2a) shows that the floristic similarity between the relevés P2 and P3 is higher (84 – 88%) than between these two and the relevé P1 (72%). Similar differentiation, which can be attributed to the effect of the fence, may also be observed in the presentation of a two-dimensional ordination of relevés (Figure 2b).

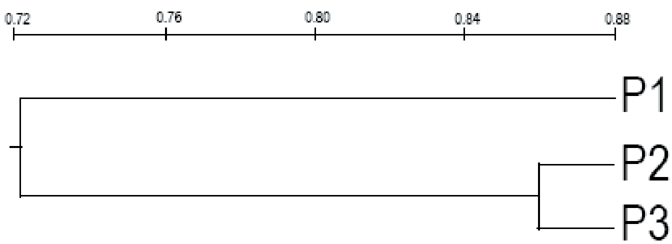

Figure 2a: Dendrogram of relevés from the research site Trnovec in the Kočevje Forest Management Region. They are ranked into syntaxon Omphalodo-Fagetum galietosum odorati; relevé P1 originates from the fenced area and relevés P2 and P3 are located nearby, outside the fence
Slika 2a: Dendrogram fitocenoloških popisov iz raziskovalnega objekta Trnovec na Kočevskem. Uvrščamo jih v sintakson Omphalodo-Fagetum galietosum odorati, popis P1 je v ograjeni površini, P2 in P3 pa v neposredni bližini zunaj ograje

In the relevé table (Table 6), species composition, species richness and layer structure are presented. In the fenced area more plant species were found. Additionally, the total cover of vegetation layers is considerably higher because of more developed lower shrub and herbaceous layers. As the fence obviously prevents the ungulates from browsing, there are more silver firs *Abies alba*, sycamores *Acer pseudoplatanus*, common rowans *Sorbus aucuparia* and elm-trees *Ulmus glabra* in the shrub layer than outside the fence. Following the exclusion of browsing, *Rubus hirtus* spreads abundantly.

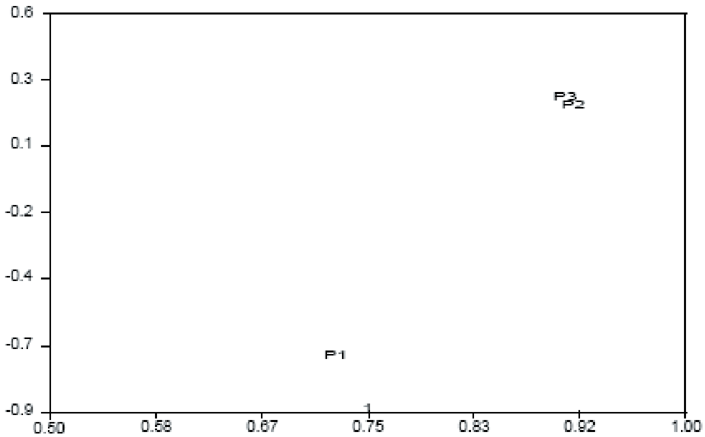

Figure 2b: Two dimensional ordination of relevés from the research site Trnovec in the Kočevje region. They are ranked into syntaxon *Omphalodo-Fagetum galietosum odorati*; relevé P1 originates from the fenced area and relevés P2 and P3 are located nearby, outside the fence
Slika 2b: Dvorazsežna ordinacija fitocenoloških popisov iz raziskovalnega objekta Trnovec na Kočevskem. Uvrščamo jih v sintakson *Omphalodo-Fagetum galietosum odorati*, popis P1 je v ograjeni površini, P2 in P3 pa v neposredni bližini zunaj ograje

3.4 COMPARISON OF THE RESULTS OBTAINED BY TRANSECT AND BRAUN-BLANQUET SAMPLING METHOD
PRIMERJAVA IZSLEDKOV, UGOTOVLJENIH S TRANSEKTNO IN SREDNJEEVROPSKO METODO ANALIZE VEGETACIJE

The number of plant species registered with both sampling methods is similar (Table 7). Minor deviations appear because all the inventories were not made at the same time of year. Inventories along the transect were carried out in the first half of June, whereas the inventories by Braun - Blanquet method were carried out at the end of September. In the meantime (June – September) season species composition as well as the abundance of species partly change. The second reason for deviations is in the method of work itself as the size of the analysed area varied. When the transect method is used the sampling plot is defined beforehand and quite precisely. On the other hand, when the Braun – Blanquet method is used the sampling plot is generally bigger and not precisely defined in advance.

Table 6: Relevés from the research site Trnovec in the Kočevje region.
They are ranked into syntaxon *Omphalodo-Fagetum galietosum odorati*; relevé P1 was made in the fenced area and relevés P2 and P3 outside the fence.
Preglednica 6: Fitocenološki popisi iz raziskovalnega objekta Trnovec na Kočevskem.
Uvrščamo jih v sintakson *Omphalodo-Fagetum galietosum odorati*, popis P1 je na ograjeni površini, P2 in P3 pa v neposredni bližini zunaj ograje.

Number of relevé *(Številka popisa)*		1	2	3
Characterization of relevé in text *(Označitev popisa v besedilu)*		P1	P2	P3
Altitude in metres a.s.l. *(Nadmorska višina v metrih)*		720	720	720
Aspect *(Lega)*		SW	S	SW
Slope in degrees *(Strmina v stopinjah)*		10	10	5
Stoniness in % *(Kamnitost v %)*		10	20	15
Cover in % *(Zastiranje v %)*; (Summ D1+D2+…+M) (*Vsota)*		205	135	126
Upper tree layer *(Zgornja drevesna plast)* - D1		80	75	55
Lower tree layer *(Spodnja drevesna plast)* - D2		5	10	10
Upper shrub layer *(Zgornja grmovna plast)* - G1		5	2	1
Lower shrub layer *(Spodnja grmovna plast)* - G2		60	20	15
Herb layer *(Zeliščna plast)* - Z2		50	20	35
Moss layer *(Zeliščna plast)* - M		5	8	10
Relevé area in sq m *(Velikost popisne ploskve v m^2)*		~400	~400	~400
Month of taking relevé *(Mesec popisovanja)*		9	9	9
Number of species per relevé *(Število vrst v popisu)*		56	36	45
Abies alba - bela jelka, navadna jelka, hoja	D1	3.3	2.3	1.1
Abies alba - bela jelka, navadna jelka, hoja	D2	1.1	2.2	1.1
Abies alba - bela jelka, navadna jelka, hoja	G1	+.1	.	.
Abies alba - bela jelka, navadna jelka, hoja	G2	2.2	.	.
Abies alba - bela jelka, navadna jelka, hoja	Z2	1.1	+.1	1.1
Abies alba - bela jelka, navadna jelka, hoja	M	1.1	1.1	2.2
Acer obtusatum - topolistni javor, topokrpi javor	D2	(+.1)	.	.
Acer pseudoplatanus - gorski javor, beli javor	G1	+.1	.	.
Acer pseudoplatanus - gorski javor, beli javor	G2	2.2	.	.
Acer pseudoplatanus - gorski javor, beli javor	Z2	.	1.1	1.1
Acer pseudoplatanus - gorski javor, beli javor	M	.	+.1	.
Aconitum vulparia - navadna preobjeda	Z2	(+.1)	.	.
Anemone nemorosa - podlesna vetrnica	Z2	.	+.1	.
Aremonia agrimonioides - navadni strček, redkocvetna oskorica	Z2	+.2	+.2	+.2
Athyrium filix-femina - navadna podborka	Z2	+.2	+.2	+.2
Atropa belladonna - volčja češnja, norica	Z2	+.1	+.2	+.1
Brachypodium sylvaticum - gozdna glota	Z2	+.2	1.2	1.2
Calamintha grandiflora - velecvetni čober, velecvetni šetraj	Z2	.	.	+.1
Cardamine trifolia - trilistna penuša	Z2	+.2	+.2	+.2
Carex digitata - prstasti šaš	Z2	+.2	+.2	+.2
Carex pendula - previsni šaš	Z2	+.2	+.2	+.2
Carex sylvatica - gozdni šaš	Z2	1.3	2.2	2.2
Cirsium sp. - osat	Z2	.	.	r
Clematis vitalba - navadni srobot	Z2	+.2	.	.
Corylus avellana - navadna leska	G2	+.2	.	.
Ctenidium molluscum - apnenčevo sedje	M	2.4	2.4	2.4
Cyclamen purpurascens - navadna ciklama, navadni kokorik, korček	Z2	+.2	+.2	+.1
Daphne laureola - lovorolistni volčin	G2	1.1	1.1	1.1
Daphne laureola - lovorolistni volčin	Z2	.	+.1	+.1
Daphne mezereum - navadni volčin	G2	1.1	+.1	+.1
Deschampsia caespitosa - rušnata masnica	Z2	r	.	.
Dicranum scoparium - metličasti krivčevec	M	.	+.3	+.3

Table 6: (continuation)
Tabela 6: (nadaljevanje)

Dryopteris filix-mas - navadna glistovnica	Z2	1.2	.	+.2
Epilobium montanum - gorski vrbovec	Z2	+.1	.	.
Euonymus latifolia - širokolistna trdoleska	G1	+.1	.	.
Euonymus latifolia - širokolistna trdoleska	G2	+.1	.	.
Eupatorium cannabinum - konjska griva	Z2	(+.1)	.	.
Euphorbia amygdaloides - mandljevolistni mleček, kolesnik	Z2	+.1	+.2	1.2
Fagus sylvatica - bukev	D1	3.3	3.3	3.3
Fagus sylvatica - bukev	D2	+.1	+.1	.
Fagus sylvatica - bukev	G1	.	+.1	+.2
Fagus sylvatica - bukev	G2	3.3	2.3	2.3
Fagus sylvatica - bukev	Z2	2.2	1.1	2.2
Fissidens taxifolius	M	+.2	+.3	.
Fragaria vesca - navadni jagodnjak	Z2	+.1	+.1	+.2
Galeobdolon flavidum - navadna rumenka, bleda rumenka	Z2	+.1	.	1.2
Galium odoratum - dišeča lakota, dišeča perla, prehlajenka, "valdmajster"	Z2	2.2	1.1	2.2
Hedera helix - navadni bršljan	D2	.	.	(+.1)
Hedera helix - navadni bršljan	Z2	+.1	.	.
Hordelymus europaeus - navadna ječmenka	Z2	+.2	1.2	+.2
Hypnum cupressiformae - štorovo sedje	M	.	.	+.3
Ilex aquifolium - navadna bodika, božji les, bodika	G1	(+.1)	.	.
Isothecium alopecuroides - navadni skalnik	M	.	+.3	+.3
Lamium orvala - velecvetna mrtva kopriva	Z2	+.1	.	.
Lonicera alpigena - planinsko kosteničevje	G2	+.2	.	.
Lonicera xylosteum - puhastolistno kosteničevje	G2	(+.2)	.	+.2
Mercurialis perennis - trpežni golšec	Z2	1.2	+.1	1.1
Mycelis muralis - navadni zajčji lapuh	Z2	+.1	+.1	+.2
Neckera crispa - zgrbljeni zavesar, zavesar, zaveščček	M	+.3	+.3	+.3
Omphalodes verna - spomladanska torilnica	Z2	2.2	1.2	2.2
Oxalis acetosella - navadna zajčja deteljica	Z2	1.3	2.2	2.3
Paris quadrifolia - volčja jagoda	Z2	+.2	.	.
Peltigera aphthosa - pasji lišaj	M	+.2	+.2	+.2
Picea abies - navadna smreka	G2	.	.	+.1
Picea abies - navadna smreka	Z2	+.1	.	+.1
Polystichum aculeatum - bodeča podlesnica	Z2	+.2	+.2	+.2
Polytrichum formosum - širokolistni pušnik	M	.	+.3	.
Prenanthes purpurea - škrlatnordeča zajčica	Z2	(+.1)	+.1	.
Prunella grandiflora - velecvetna črnoglavka	Z2	.	.	+.3
Prunus avium - češnja	D2	(+.1)	.	.
Prunus avium - češnja	G2	(+.1)	.	.
Prunus avium - češnja	Z2	+.1	.	+.1
Pyrus pyraster - drobnica	G2	(+.1)	.	.
Rubus hirtus - srhkostebelna robida	G2	2.2	.	.
Rubus hirtus - srhkostebelna robida	Z2	2.2	.	+.1
Rubus idaeus - malinjak	G2	+.2	.	.
Rubus idaeus - malinjak	Z2	.	.	+.1
Salvia glutinosa - lepljiva kadulja	Z2	+.2	.	+.2
Sambucus nigra - črni bezeg	G1	(+.2)	.	.
Sambucus nigra - črni bezeg	G2	.	+.1	.
Sanicula europaea - navadni ženikelj, lečuha	Z2	1.2	1.2	1.2
Senecio ovatus - fuchsov grint	Z2	+.1	+.1	+.1
Sorbus aucuparia - jerebika	G2	+.1	.	.
Ulmus glabra - goli brest, gorski brest	G1	1.1	.	.
Ulmus glabra - goli brest, gorski brest	G2	1.3	.	.
Ulmus glabra - goli brest, gorski brest	Z2	1.2	+.1	1.1
Veronica montana - gorski jetičnik	Z2	.	.	+.1
Veronica officinalis - zdravilni jetičnik	Z2	r	.	.

Note: Grey colour indicates significant differences in abundance of some plant species between the fenced and the unfenced areas.

Table 7: Comparison of the number of recorded plant species obtained by Braun-Blanquet method (method B-B) and transect method
Preglednica 7: Primerjava števila evidentiranih rastlinskih vrst po posameznih popisih po metodi Braun-Blanquet (metoda B-B) in transektni metodi

	Fenced site/ Ograjena površina		Unfenced site – east / Neograjena površina – vzhodno od ograje		Unfenced site – west / Neograjena površina – zahodno od ograje	
	B-B P1	Transect (21 plots) / Transekt	B-B P2	Transect (10 plots) / Transekt	B-B P3	Transect (11 plots) / Transekt
Number of plant species / Št. evidentiranih vrst	56	62	36	45	45	59
Number of phanerophytes per relevé / Št. fanerofitov v popisu	21	18	7	10	12	19
Percentage of phanerophytes per relevé (%) / Delež fanerofitov v popisu (%)	38	29	19	22	27	32

The comparison of the appearance and abundance of particular species inside and outside the fence by the B –B and the transect methods reveals several similarities. Both methods show nearly identically which species appear in higher or lower abundance in the fenced area and outside it.

4 DISCUSSION
RAZPRAVA

It was established that the process of natural regeneration of fir-beech forests is successful and undisturbed if roe and red deer are completely excluded. All native tree species regenerate and overgrow successfully – the dominant tree species of Dinaric fir-beech forests (silver fir, beech) and the less frequent ones (e.g. sycamore, elm). Similar results were attained by Robič and Bončina (1990) in the analysis of saplings in the fenced area in Rog (compartment 36b) and by other authors (PERKO 1977, VESELIČ 1981, INDIHAR 1997) in similar forest types. It is surprising that in spite of a relatively large growing stock (600 m^3/ha) of the forest stand (transition from timber to regeneration phase), sycamore and elm trees regenerate and overgrow successfully. The research confirms the results of some authors (LEIBUNDGUT 1974, PERKO 1977, VESELIČ 1981, 1991, KŐNIG / BAUMANN 1990, BONČINA 1996, 1997, INDIHAR 1997, LUTHARDT / BEYER 1998, NESSING / ZERBE 2002) that ungulates importantly or even decisively affect the composition and structure of forest stands and thus indirectly affect the whole forest community. The effect depends on the density of ungulate populations. It is clearly reflected in the composition and structure of saplings and in the composition and abundance of herbaceous and shrub layers of Dinaric fir-beech forest:

- The density of saplings above 50 cm is considerably lower due to constant browsing which prevents the overgrowing of saplings.
- Ungulates selectively influence the tree composition, as they prefer certain tree species (fir *Abies alba*, sycamore *Acer pseudoplatanus*, elm *Ulmus glabra*, minority species) to others, and thus indirectly accelerate the overgrowing of the distasteful and/or usually more abundant species, e.g. beech *Fagus sylvatica*. Browsing intensity differs; it depends mainly on the density of ungulate populations. In the analysed example ungulates entirely prevent the overgrowth of the tree species mentioned. If the ungulate population was smaller, it is presumed that the overgrowth of different tree species would be easier and faster. Numerous researches carried out in the Dinaric fir-beech forests state that the proportion of fir, sycamore and elm would dramatically increase if the influence of roe and red deer was excluded (PERKO 1977, BONČINA 1997, INDIHAR 1997). In case of bigger density even the browsing of beech would increase and its overgrowth in height would be hindered.
- By constant browsing of lower vegetation layers, ungulate populations actually maintain favourable feeding conditions for themselves.
- Ungulates selectively browse herb plants in the forest floor; which is in accordance with the findings by Adamič (1982, 1989b) and Čop (1989).

In the area outside the fence, every third sapling (34%) among woody species has been browsed. The extent of fresh browsing (current year) is smaller (18%). According to the data provided by the Slovenian Forest Service, the average browsing intensity in Slovenian forests was 27% in 2000 but came to 36% for saplings higher than 15 cm (JURC *et al*. 2003). Perko (1982) stated that the browsing index for main tree species must not exceed 35% of the total number, and the index of all regeneration should not exceed 30%. Similar values were also determined in Switzerland in the 1960s. Experiments on plantations established that the browsing intensity of terminal shoots of conifers should not exceed 38% of the total sapling number; it is reported that there is practically no damage for future stands if browsing intensity is lower than 27% (STANIČ 1966). The average values of browsing may be misleading since other data, e.g. tree composition and height structure as well as the density of saplings are also important. Browsing intensity varies for different tree species and also depends on the height of tree species. Roth (1996) believes that a damage of a level lower than 10% can sometimes be critical, and that it does present an important disturbance in the process of regeneration. On the other hand, sometimes even a browsing intensity larger than 40% does not disturb natural regeneration. Therefore it is necessary to take into account a combination of more parameters when assessing the influence of ungulates on forest regeneration. However, a distribution (number) of tree species by height class is one of the most useful parameters indicating the course of natural regeneration.

The comparison of vegetation in the fenced and unfenced areas shows the quantitative and qualitative influence of ungulate populations on the vegetation development. The disadvantage of the method lies in the fact that the influence of a particular ungulate population cannot be determined in the case when two or more ungulate populations are present. The next disadvantage is in the fact that the conditions in fenced area and outside are not comparable after a period of time due to faster and more abundant development of vegetation (saplings) in the fenced area. Nevertheless, fenced sites are a useful tool when researching relations between forests and ungulate populations. Besides, they present a useful way of "collective protection" of (natural) regeneration and young stands where ungulates prevent natural regeneration. The recommended fenced area for collective protection is between 1 and 3 ha. Klein and Backes (1993) established that the most appropriate size is 0.8 – 1.3 ha. However, the idea to regenerate forests with fences is controversial and unacceptable from several points of view. Nature based management of forest resources also includes nature based wildlife management. With collective protection of wide areas the living area of ungulates would become limited, such measures could be in disharmony with other forest functions, it can be technically demanding due to very long regeneration periods needed in some forests, and expensive.

The conditions in the fenced area are not completely "natural" as the influence of ungulates is totally excluded. The density of roe and red population has been changing during the past, therefore their influence (the size and frequency of the disturbances) on forest regeneration has varied as well. This fact has to be considered when trying to understand forest development; only too often our judgement about "natural" conditions, natural state etc. is too static. An evident example of the varying effect of ungulates on the natural regeneration of Dinaric fir-beech forests may be observed in the fluctuation of roe deer populations – from total extinction in the middle of the 19th century (ADAMIČ 1989a) to reintroduction a few decades later and the "explosion" of population density in the second half of the 20th century. Dinaric fir-beech forests are a sensible forest ecosystem (BONČINA / DIACI / GAŠPERŠIČ 2003). Undisturbed natural regeneration is one of the conditions for their stable functioning. We should be aware of the fact that through the regulation of roe and red deer populations, the structure and composition of forest ecosystems in the next century is indirectly created.

5 POVZETEK

Velika rastlinojeda divjad pomembno vpliva na strukturo in naravno pomlajevanje gozdnih sestojev. Ograje so način kolektivne zaščite pomladka in mladovja. Z anketiranjem revirnih gozdarjev smo poskušali ugotoviti, koliko je ograjenih površin v Kočevskem gozdnogospodarskem območju (GGO Kočevje), določiti njihove lokacije, ugotoviti velikost ograjenih površin, čas in namen postavitve ograj ter stopnjo njihove vzdrževanosti. Na izbranem primeru – ograji Trnovec smo poskušali prikazati uporabno vrednost ograjenih površin za spremljanje vpliva parkljaste rastlinojede divjadi na razvoj vegetacije, še posebej pa pomladka lesnatih vrst. S parno primerjavo vegetacije na ograjeni in neograjeni površino smo analizirali sestavo in obilje rastlinskih vrst ter višinsko strukturo in objedenost lesnatih vrst v zeliščni in grmovni plasti. Na podlagi rezultatov smo sklepali o jakosti vpliva rastlinojede parkljaste divjadi (jelenjadi, srnjadi) na razvoj gozdne vegetacije.

Skupno število evidentiranih ograj v GGO Kočevje je 152. Število ograj in tudi skupna ograjena površina je različna znotraj območja; največ ograjenih površin je v v gospodarskih enotah (GE) Kolpa (22), Struge (17) in Draga (14). V enotah Velika gora, Loški potok, Sodražica, Ortnek, Dobrepolje ni ograjenih površin. Od leta 1970, ko so bile v območju postavljene prve danes še stoječe ograje, se je število letno zgrajenih spreminjalo. V obdobju 1970-1995 so v povprečju letno postavili približno tri ograje. Število postavljenih ograj po letu 1995 je opazno večje. Večino ograj (110) so postavili zaradi obnove sestojev. Veliko ograj je bilo postavljenih tudi zaradi spremljanja vpliva velikih rastlinojedov na vegetacijo (37). Velikost ograjenih površin je različna. V povprečju so ograjene površine namenjene obnovi gozdnih sestojev večje od onih za spremljanje vpliva divjadi na gozd. Vzdrževanje ograj je dobro, saj jih je kar 76% redno vzdrževanih.

S primerjanjem dvojic med ograjeno in neograjeno površino smo s transektno metodo analizirali vpliv rastlinojede parkljaste divjadi na vegetacijo. Skupno smo analizirali 42 ploskev velikosti 4×4 m. Raziskava je bila opravljena v GE Rog, oddelek 19a/b. Raziskovalni objekt smo poimenovali Trnovec. Analiza je pokazala, da rastlinojeda parkljasta divjad pomembno vpliva na strukturo in naravno pomlajevanje sestojev. Zaradi vpliva divjadi so spremenjene vrstna sestava, gostota ter višinska struktura pomladka. Gostota ter vrstna pestrost višjih višinskih razredov (od 20 cm naprej) je na ograjeni površini večja. V nižjih višinskih razredih (do 20 cm) pa je ravno obratno. Zaradi spremenjenih razmer se zunaj ograje do te višine pojavlja večje število mladic, večja pa je tudi vrstna pestrost. Analiza poškodovanosti osebkov na neograjeni površini je pokazala, da se delež poškodovanih osebkov z višino povečuje. Stopnja poškodovanosti po posameznih višinskih razredih se med vrstami razlikuje. Pri vseh vrstah, razen pri bukvi, pa je najvišja stopnja poškodovanosti 100% . Poškodovanost gorskega javorja in bresta je že v najnižjem višinskem razredu (do 10 cm) izredno visoka.

Analiza obilja ter vrstne sestave zeliščnega in grmovnega sloja je pokazala, da med ograjeno in neograjeno površino obstajajo značilne razlike v vrstnem bogastvu v obeh grmovnih plasteh in v skupnem obilju vrst v zgornji grmovni plasti. Vzrokov za različno obilje je več. Neposredni razlog je selektivna objedenost določenih vrst. Zaradi tega se poveča delež drugih, lahko tudi manj konkurenčnih vrst, ki za prehrano niso tako priljubljene. Posredni razlog pa je v spremenjenih sestojnih razmerah. Parkljasta divjad z objedanjem zmanjšuje zastiranje grmovne plasti in onemogoča preraščanje lesnatih rastlin v višino in razvoj grmovne plasti. Tako divjad posredno vpliva zlasti na svetlobne razmere, ki so ugodnejše za uspevanje nekaterih vrst. Domnevamo lahko, da je relativno večje obilje nekaterih rastlinskih vrst na neograjenih ploskvah deloma posledica selektivnega objedanja, kot tudi ohranjanja ugodnih svetlobnih razmer za uspevanje teh vrst.

Raziskave kažejo, da se neusklajenost jelenjadi in srnjadi z njunim okoljem zmanjšuje, zato lahko sklepamo, da v prihodnje najbrž ne bomo več postavljali novih ograj za obnavljanje gozdov v takšnem obsegu kot doslej. Še vedno pa bodo ograjene površine potrebne pri usmerjanju in gospodarjenju s populacijami jelenjadi in srnjadi. S primerjanjem dvojic vzorcev na ograjeni in neograjeni površini smo ugotovili, da z odstranitvijo vpliva velikih rastlinojedov (postavitev ograje) poteka naravno obnavljanje vseh drevesnih vrst v dinarskih jelovo-bukovih gozdovih uspešno.

6 REFERENCES
VIRI

ADAMIČ, M., 1982. Prehranske značilnosti jelenjadi in srnjadi v kočevskem, notranjskem in krimskem lovsko gojitvenem območju.- GozdV 40, 7-8: 295-314.

ADAMIČ, M., 1989a. Dinamika populacij parkljaste divjadi v Sloveniji.- V: Košir, B. (ur.), Gospodarjenje z gozdom ob upoštevanju potreb rastlinojede divjadi. Strokovna in znanstvena dela 101. Ljubljana, BF, VTOZD za gozdarstvo in Inštitut za gozdno in lesno gospodarstvo: 7-27.

ADAMIČ, M., 1989b. Pomen poznavanja prehranskih značilnosti parkljaste divjadi.- V: Košir, B. (ur.), Gospodarjenje z gozdom ob upoštevanju potreb rastlinojede divjadi. Strokovna in znanstvena dela 101. Ljubljana, BF, VTOZD za gozdarstvo in Inštitut za gozdno in lesno gospodarstvo: 29-69.

ARETIN, C. A., 1977. Auswirkungen der überhöhten Rehwildbestände auf den Waldertrag.- Der Forst- und Holzwirt 32, 4: 60-62.

BARTOL, M., 2003. ,'Shoot-off of roe and red deer in FMR Kočevje".- Kočevje, Zavod za gozdove, OE Kočevje (personal communication, 14.11.2003).

BENTZ, F., 1977. Der Kulturschutzzaun gegen Rehwild.- Allgemeine Forstzeitung 88, 2: 31-35.

BLEJEC, KENDALL, LIENERT, PRODAN, SNEDECOR, 1977. Statistične metode. Izbrana poglavja za študij gozdarstva. Drugi zvezek. (priredil Kotar). Ljubljana, BF, VTOZD:173-378.

BONČINA, A., 1996. Vpliv jelenjadi in srnjadi na potek gozdne sukcesije v gozdnem rezervatu Pugled-Žiben.- GozdV 54, 1: 57-65.

BONČINA, A., 1997. Naravne strukture gozda in njihove funkcije v sonaravnem gospodarjenju z gozdom. Doktorska disertacija.- Ljubljana, Univerza v Ljubljani, BF, Oddelek za gozdarstvo, 210 s.

BONČINA, A., DIACI, J., GAŠPERŠIČ, F., 2003. Long-term changes in tree species composition in the Dinaric mountain forests of Slovenia. The Forestry Chronicle, 79, 2: 227-232.

BRAUN-BLAUNQUET, J., 1964. Pflanzensoziologie. Grundzuege der Vegetationskunde.- Wien – New York, Springer Verlag, 865 s.

ČOP, J., 1989. Varstvo gozdov pred škodami po divjadi.- V: Košir, B. (ur.), Gospodarjenje z gozdom ob upoštevanju potreb rastlinojede divjadi. Strokovna in znanstvena dela 101. Ljubljana, BF, VTOZD za gozdarstvo in Inštitut za gozdno in lesno gospodarstvo: 109-129.

DIACI, J., GRECS, Z., 2003. Uspešnost gojenja gozdov v zadnjem desetletju in priložnosti za prihodnost.- V: Bončina, A. (ur.), Območni gozdnogospodarski načrti in razvojne perspektive slovenskega gozdarstva. XXI. gozdarski študijski dnevi, 27.-28. marec 2003. Ljubljana, BF, Oddelek za gozdarstvo in obnovljive gozdne vire: 81-102.

Gozdnogojitveni načrt za oddelek 19 v GE Rog. 1998.- Kočevje, Zavod za gozdove Slovenije, OE Kočevje.

Gozdnogospodarski načrt za gozdnogospodarsko enoto Rog 1997-2006. 2001.- Kočevje, Zavod za gozdove Slovenije, OE Kočevje.

Gozdnogospodarski načrt za V. gozdnogospodarsko območje Postojna 1991-2000. – Postojna, Zavod za gozdove Slovenije, OE Postojna.

Gozdnogospodarski načrt za VI. gozdnogospodarsko območje Kočevje 1991-2000. – Kočevje, Zavod za gozdove Slovenije, OE Kočevje.

GREINER, R., 1994. Verjüngungskontrolle durch permanente Stichproben.- AFZ 49, 12: 646-648.

INDIHAR, B., 1997. Uspešnost pomlajevanja v ograjenih površinah na rastiščih *Abieti-Fagetum dinaricum*. Diplomska naloga.- Ljubljana, Univerza v Ljubljani, BF, Oddelek za gozdarstvo in obnovljive gozdne vire, 112 s.

JERINA, K., 2003. Prostorska razporeditev in habitatne značilnosti jelenjadi (*Capreolus elaphus* L.) v dinarskih gozdovih jugozahodne Slovenije. Magistrsko delo.- Ljubljana, BF, Oddelek za gozdarstvo in obnovljive gozdne vire, 137 s.

JURC, D., JAKŠA, J., JURC, M., MAVSAR, R., MATIJAŠIČ, D., JONOZOVIČ, M., 2003. Zdravje gozdov – Slovenija 2002.- Ljubljana, Gozdarski inštitut Slovenije, 70 s.

KINDLER, V., 1953. Še o jelovem pomladku.- GozdV 11, 5: 143-145.

KLEIN, M., BACKES, U., 1993. Rentabilität des Zaunbaus.- AFZ 48, 14: 701-704.

KŐNIG, E., 1976. Wildschadenprobleme bei der Waldverjüngung.- Schweizerische Zeitschrift für Forstwesen 127, 1: 40-57.

KŐNIG, E., BAUMANN, B., 1990. Der Einfluß des Verbisses durch Rehwild auf die Naturverjüngung von Nadelwaldmischbeständen.- Allgemeine Forst und Jagdzeitung 161, 9: 170-176.

KOREN, I., 1997. Vpliv rastlinojede divjadi na pomladitveni potencial gozdov zahodnega visokega krasa.- GozdV 55, 2: 97-109.

LEIBUNDGUT, H., 1974. Erhebungen über den Rehwildverbiss im Albisriederberg.- Schweizerische Zeitschrift für Forstwesen 125, 5: 311-316.

LUTHARDT, M., BEYER, G., 1998. Einfluβ des Schalenwildes auf die Waldvegetation.- AFZ/Der Wald 53, 17: 890-894.

MIKLAŠIČ, Z., AREH, P., 2001. Zaščita pomladka pred divjadjo. Seminarska naloga.- Mislinja, 18 s. (tipkopis)

NESSING, G., ZERBE, S., 2002. Wild und Waldvegetation – Ergebnisse des Monitorings im Biosphärenreservat Schorfheide-Chorin (Brandenburg) nach 6 Jahren.- Allgemeine Forst und Jagdzeitung 173, 10: 177-185.

ODERMATT, O., 1996. Zur Bewertung von Wildverbiss. Die »Methode Eiberle«.- Schweizerische Zeitschrift für Forstwesen 147, 3: 177-199.

OHEIMB, G.V., KRIEBITZSCH, W.U., ELLENBERG, H., 2003. Dynamik von Artenvielfalt und Artenzusammensetzung krautiger Gefäßpflanzen in gezäunten und ugezäunten Vergleichsflächenpaaren.- Allgemeine Forst und Jagdzeitung 174, 1: 1-7.

PERKO, F., 1977. Vpliv divjadi na naravno obnovo jelovih in bukovih gozdov na visokem Krasu.- GozdV 35, 5: 191-204.

PERKO, F., 1982. Metode in prvi izsledki kvantificiranja vpliva divjadi na gozdno vegetacijo.- V: Acceto, M. (ur.), Gozd-Divjad. Gozdarski študijski dnevi v Ljubljani, 28. in 29. januar 1980. Ljubljana, BF, VTOZD za gozdarstvo: 121-160.

PRELESNIK, A., 1974. Divjad in premena grmišč na Kočevskem.- GozdV 32, 7-8: 291-292.

RAJIČ, S., 1955. Prispevek k vprašanju pomlajevanja jelke na Kočevskem Rogu.- GozdV 13: 225-235.

REIMOSER, F., SUCHANT, R., 1992. Systematische Kontrollzäune zur Festellung des Wildeinflusses auf die Waldvegetation.- Allgemeine Forst und Jagdzeitung 163, 2: 27-31.

ROBIČ, D., BONČINA, A., 1990. Sestava in struktura naravnega mladovja bukve in jelke v dinarskem jelovem bukovju ob izključitvi vpliva rastlinojede parkljaste divjadi.- ZbGL 36: 69-77.

ROTH, R., 1996. Der einfluβ des Rehwildes auf die Naturverjüngung von Mischwäldern.- Zeitschrift für Jagdwissenschaft 42, 2: 143-156.

STANIČ, B., 1966. Zaščita gozdnih nasadov pred poškodbami od velike divjadi.- GozdV 36, 3-4: 85-92.

VESELIČ, Ž., 1981. Vpliv divjadi na obnovo jelovo-bukovih gozdov v Postojnskem gozdnogospodarskem območju.- GozdV 39, 10: 435-450.

VESELIČ, Ž., 1991. Na postojnskem preštevilna rastlinojeda divjad še naprej hudo ogroža gozdno mladje.- GozdV 49, 3: 147-157.

Zakon o gozdovih.- Ur. l. RS št. 30-1299/93.

ACKNOWLEDGEMENTS
ZAHVALA

We would like to express our thanks to reviewers of this paper for their helpful and constructive comments. Our thanks go also to district foresters of the Slovenian Forest Service in the Kočevje region for their taking part in the survey, which provided the main data concerning forest fences.