

**SOME MORPHOLOGICAL CHARACTERISTICS AND  
DISTRIBUTION OF *LUCANUS CERVUS* (LINNAEUS, 1758),  
(INSECTA: COLEOPTERA, LUCANIDAE) IN BOSNIA AND  
HERZEGOVINA**

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This paper gives an overview of previous research on the stag beetle *Lucanus cervus* (Linnaeus, 1758) in Bosnia and Herzegovina. It covers the analysis undertaken of 11 exomorphological characteristics of 65 individuals (34 males and 31 females) of the Bosnian metapopulation which are examined and discussed. The final part of the paper provides a map of the distribution of this species in Bosnia and Herzegovina and reviews the threat status of this species in Bosnia and Herzegovina.

**Key words:** Stag beetles, *Lucanus, cervus*, Bosnia and Herzegovina, variation, taxonomy, ecology.

## INTRODUCTION

Research on Bosnian beetles, or more generally on the entomofauna, has a very long tradition. The first written record dates back to the Ottoman period, i.e. the first half of the 19<sup>th</sup> century, and deals with research done by

French entomologist Count Dejean (Drovenik & Tabaković-Tošić 1989). However, detailed data specific to the morphology and the distribution of the stag beetle in Bosnia and Herzegovina are very scarce and *Lucanus cervus* is most often simply listed as present in the country (for example, Mikšić 1970).

The only paper that provides detailed information concerning Bosnian Lucanidae (Bartolozzi 2010) is one by Mikšić (Mikšić 1955). In Bosnia and Herzegovina, *Lucanus cervus* is the only representative of the genus *Lucanus* Scopoli, 1763. In Bosnian fauna the family is represented by three subfamilies and seven species: (Mikšić, 1955, 1970; Lelo, 2004, 2006, 2009; Lelo & Kašić-Lelo, 2009; Table 1).

Table 1. - Review of stag beetle fauna in Bosnia and Herzegovina (Lelo & Kašić-Lelo 2009).

Family	Subfamily	Genus	Species	
Lucanidae Leach, 1815	Sinodendrinae Mulsant, 1842	<i>Sinodendron</i> Hellwig, 1792	<i>S. cylindricum</i> (Linnaeus, 1758)	
	Aesalinae Mac Leay, 1819	<i>Platycerus</i> Geoffroy, 1762	<i>P. caraboides</i> (Linnaeus, 1758)	
			<i>P. caprea</i> (De Geer, 1758)	
			<i>Ceruchus</i> MacLeay, 1819	<i>C. chysomelinus</i> (Hochenwarth, 1758)
	Dorcinae Parry, 1864	<i>Dorcus</i> MacLeay, 1819	<i>Aesalus</i> Fabricius, 1801	<i>Ae. scarabaeoides</i> (Panzer, 1794)
			<i>D. parallelopipedus</i> (Linnaeus, 1758)	
	Lucaninae Latreille, 1804	<i>Lucanus</i> Scopoli, 1763	<i>L. cervus</i> (Linnaeus, 1758)	

*Lucanus cervus* areal encompasses the entire Palaearctic and all of Europe except for islands and island countries (for example Ireland). It also does not inhabit northern Africa.

*Lucanus cervus* is an extremely thermophilic species and therefore it most commonly inhabits thermophilic oak forests. It can, however, be found both in other types of deciduous forests and in secondary habitats such as parks, gardens, yards, i.e. areas containing logs which females use for laying eggs.

The mating season starts in May but depending on the geographical latitude can be postponed even to the beginning of August. Males are the

first to emerge as adults and immediately start looking for females. In general, stag beetles are active at dusk and throughout the night, but can occasionally be seen during the day. After mating, females search for a suitable location to lay their eggs (dead oak trees or some other decaying deciduous species). The female dies soon after the eggs have been laid.

The larvae which hatch from the eggs are fat, soft, and cream-white to transparent; the larval body surface is covered in numerous folds and creases. The larvae feed on decaying wood and take several years to develop fully. They are “C” shaped and blind. During their development they go through phases characterised by different larval weights and lengths. A fully developed larva is approximately 8 cm long and 2 cm thick.

Stag beetle larvae have a stridulatory organ consisting of pars stridens (formed out of elongated ribs and lower functioning ridges on both sides if the ribs are distributed over the lateral side and face their hind legs) on the coxa of the middle legs and plectrum (a series of ridges) on the trochanter of the hind legs. Rubbing of these two parts against each other briefly produces a sound. The function of this stridulation has not yet been fully explained but is thought to serve as a means of intragroup communication and to define communal space.

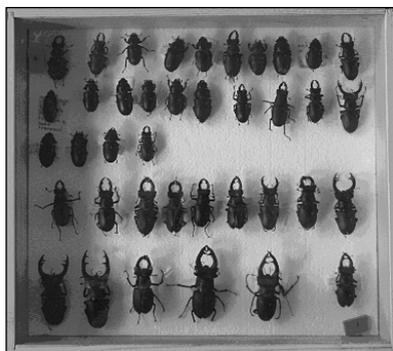


Fig. 1. - One of the entomological boxes (Lelo collection) containing specimens of *Lucanus cervus* (Linnaeus, 1758) from Bosnia and Herzegovina.

A fully grown larva makes a cocoon of soil with a peculiar “larval secretion” which makes the inside of the cocoon smooth. The larva protected by the cocoon becomes a pupa. Pupation occurs during winter and early spring, so although adults are fully formed as early as autumn, they wait for suitable conditions of the following spring to fly out for mating. The pupae have developed mandibles and males can be distinguished from females. Adults feed primarily on plant juices (Klausnitzer & Krell 1996).

It has long been known that the life cycle of a stag beetle lasts 3 to 7 years. Most of this time is spent in the larval form; in fact, they live for approximately 90 days as sexually mature adults and only in extreme cases

significantly longer than that. During the mating season agonistic mating competition is expressed among the males.

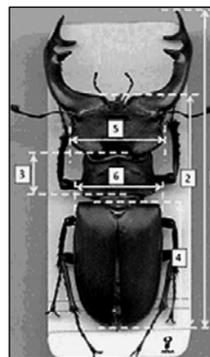
The stag beetle is a completely harmless insect that has a whole range of predators; the most common include cats, foxes, bats, hedgehogs, boars, and woodpeckers. Crows are the most important predator and take the lead in the number of individuals they catch (Fremlin 2007).

## MATERIAL AND METHODS

The examined material included 47 specimens of *Lucanus cervus* from the private collection “Lelo” and 18 specimens from the entomological collection of The National Museum of Bosnia and Herzegovina in Sarajevo. Specimens were collected by different researchers in different localities across Bosnia and Herzegovina (Fig. 1). The total number of specimens used for the analysis is 65.

Analysis of 11 characters in accordance with Kašić-Lelo (2005) was undertaken (nine quantitative and meristic and two qualitative; Fig. 2).

Fig. 2. - Measurements used on the sample of *Lucanus cervus* from Bosnia and Herzegovina: 1. total body length, 2. body length excluding mandibles, 3. thorax length, 4. right elytron length, 5. head width, 6. shoulder calluses width (Husein-spahić 2006).



### Quantitative and meristic characteristics reflect:

- total body length (TBL),
- body length excluding mandibles (BL),
- thorax length (TL),
- right elytron length (REL),
- scapus length (SL),
- head width (HW),
- shoulder calluses width (SCW),
- number of articles of the antennal club (NLAC),
- number of teeth on the mandibles (NPM).

### Qualitative characteristics:

- pubescence of the ventral side of the body (HVB):  
Less hairy (phenotype 1) and distinctly hairy (phenotype 2),

- body colour (BC):  
pale chestnut (phenotype 1), dark chestnut (phenotype 2),  
pale maroon (phenotype 3) and dark maroon (phenotype 4).

Graph paper, handheld magnifier (4x, 8x), binocular stereo microscope were used in the analysis. Basic statistical data was obtained by employing methods of Marinković *et al.* (1982) and Petz (1964): mean ( $\bar{x}$ ), variance ( $s^2$ ), standard deviation (S), standard error of the mean (Sx), variability coefficient (V%).

A map of the distribution of *Lucanus cervus*, a subspecies in the studied area, was made using ArcView software.

## RESULTS AND DISCUSSION

After the morphological analysis of 65 specimens from a Bosnian metapopulation of *Lucanus cervus* (Linnaeus, 1758), a preliminary description of the characters of the population was obtained. (Appendices I and II).

### Description of the Bosnian metapopulation

In Bosnia and Herzegovina the individuals of the species are characterised by total body lengths from 26 to 89 mm, with males being slightly longer than females (males: 36-89 mm; females: 26-45 mm), and being clearly distinguishable from females (sexual dimorphism) as they have strongly developed mandibles and differ in other metric traits (Fig. 3-5). Thus body length excluding the mandible ranges from 22 to 56 mm, and body length of males is larger than of females (males: 28-56 mm; females: 22-42 mm).

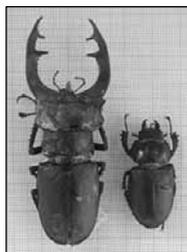


Fig. 3. - Sexual dimorphism of *Lucanus cervus* shown on a sample from Bosnia and Herzegovina: male, 18<sup>th</sup> August 2005, Zavidovići, coll. A. Halilović (left) and female, 8<sup>th</sup> July 2005, Kotor Varoš, coll. L. Mahmutović (right).

All specimens that were analysed have the same number of articles on the antennal club last segment of triple segmented antenna.

In males, the number of mandibular teeth could numerically be represented in the form 2+4+2+1. However, specimens from Bosnia and

Herzegovina have a number of models of distribution of these teeth ranging from 2+2+1+1, including 2+5+1+4, and ending in 2+9+4+1. It could be said that the number of teeth of the mandible is dependent on the degree of development of a specimen, i.e. larger males have more developed mandibles and a higher number of teeth (a male 38 mm in length has six prongs represented as 2+2+1+1 and a male of 89 mm has fifteen prongs in the form of 2+8+1+4).

Head width ranges from 6 to 25 mm, and the range and mean for this value are slightly higher in males: males – 6-25 mm, females – 7-12 mm. The range of scapus length is from 3 to 11 mm and along with the mean it is also slightly higher in males than in females (males: 4-11 mm; females: 3-5 mm).



Fig. 4. - Variation of body size in males of the *Lucanus cervus* specimens shown on a sample from Bosnia and Herzegovina; from left to right: 18<sup>th</sup> August 2005, Zavidovići, coll. A. Halilović (1); 18<sup>th</sup> August 2005, Goražde, coll. S. Bajrović (2); July 2005, Vogošća, coll. D. Pušina (3); 25<sup>th</sup> July 2005, Doborovci - Gračanica, coll. H. Džananović (4); and 4<sup>th</sup> August 2004, Vareš, coll. A. Vesnić (5).

The length of the right elytron varies between 17 and 32 mm, with the range being larger in males than in females (males: 18-32 mm; females 17-25 mm). Thorax length range is 6-10 mm and is identical in both sexes. The span of the shoulder calluses ranges from 12 to 20 mm, and it was noted that the width of the shoulder calluses is usually larger than the width of the head in females and that these two values are usually pretty even in males (males – 10-19 mm; females – 12-20 mm).

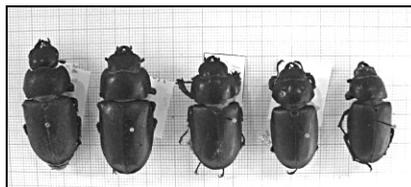


Fig. 5. - Variation of body size in females of the *Lucanus cervus* specimens from Bosnia and Herzegovina; from left to right: 8<sup>th</sup> July 2005, Kotor Varoš, coll. L. Mahmutović (1); 15<sup>th</sup> July 2006, Zavidovići, coll. A. Subašić (2); 18<sup>th</sup> August 2006, Plitki Do - Popovo polje, coll. S. Lelo (3); 8<sup>th</sup> August 2005, Vareš, coll. A. Vesnić (4); and 15<sup>th</sup> June 2004, Banovići, coll. S. Rahmanović (5).

The base body colour ranges from a pale chestnut colour, through dark chestnut (colour more typical of males), to pale or dark maroon shades (colours more typical of females). Females are never in pale shades while males can be found in all the colours of the range.

All Bosnian specimens have a hairy abdomen but males are more distinctly hairy (phenotype 2) and females are less so (phenotype 1). Pubescence can be described in the following terms: soft, pale hairs unevenly distributed across the ventral side, with tufts of hair present along the lines between the head and the thorax and different thoracic segments as well as around the coxae, while the thorax itself is evenly covered in hairs. There are no hairs on the head and abdomen.

An overview of basic statistical data for all analysed characteristics is given in Table 2.

Table 2. - Comparative view of basic statistical data for morphological characteristic of male and female *Lucanus cervus* (Linnaeus, 1758) chosen for this study (N = 75; males - 34, females - 31).

Statistical analysis	Sex	Chosen characteristic										
		TBL (mm)	BL (mm)	TL (mm)	REL (mm)	SL (mm)	HW (mm)	SCW (mm)	NLA	NPM	HVB	BC
Minimum	♂♂	36	28	6	18	4	6	10	4	6	2	1
	♀♀	26	22	6	17	3	7	12	4	2	1	2
Maximum	♂♂	89	56	10	32	11	25	19	4	17	2	4
	♀♀	45	42	10	25	5	12	20	4	2	1	4
$\bar{x}$	♂♂	51.7	40.2	7.9	24.2	6.8	14.4	15.3	4	9.8	2	2.8
	♀♀	37.9	35.2	8.3	22.4	3.8	9.7	16.3	4	2	1	3.4
S <sub>x</sub>	♂♂	1.93	1.21	0.15	0.59	0.30	0.69	0.34	0	0.5	0	0.17
	♀♀	0.69	0.70	0.18	0.36	0.11	0.22	0.33	0	0	0	0.16
Variance	♂♂	126.9	49.6	0.8	11.6	3.1	16.4	4.0	0	9.07	0	1.0
	♀♀	14.8	15.1	1.0	4.0	0.4	1.5	3.4	0	0	0	0.8
V%	♂♂	21.8	17.4	11.4	14.0	25.8	27.8	13.1	0	30.9	0	37.0
	♀♀	10.0	11.1	12.5	8.9	15.8	12.4	11.2	0	0	0	26.5

### Distribution in Bosnia and Herzegovina

The areal of the stag beetle definitely encompasses the whole of Bosnia and Herzegovina, and although rare, representatives of this species are distributed throughout Bosnia and Herzegovina. Specimens of the species have been recorded from a range of Bosnian locations: Cazin, Mt Kozara,

Kotor Varoš<sup>#</sup>, Brčko<sup>#</sup>, Novi Šeher<sup>#</sup>, Gradačac<sup>#</sup>, Zavidovići<sup>#</sup>, Banovići<sup>#</sup>, Gračanica<sup>#</sup>, Tuzla<sup>#</sup>, Jajce<sup>#</sup>, MT Vranica<sup>#</sup>, Fojnica (Malkoč), Prusac<sup>#</sup>, Kakanj<sup>#</sup>, Zenica<sup>#</sup>, Nemila, Vareš<sup>#</sup>, Travnik<sup>#</sup>, Kreševo<sup>#</sup>, Vogošća<sup>#</sup>, Olovo<sup>#</sup>, Ilijaš<sup>#</sup>, Sarajevo<sup>#</sup>, Pale (Bistrica), Mt Romanija<sup>#</sup>, Višegrad, Han Begov, Gorazde<sup>#</sup>, Tjentište, Ilidža, Mt Igman (Hrasnički stan), Mt Ivan, Mt Prenj, Nevesinje, Nevesinjsko polje - Sopilji<sup>#</sup>, Stolac, Bileća, Trebinje (Zupci), Popovo polje<sup>#</sup> (Mikšić, 1955, 1970; Georgijević, 1974; Huseinović, 2007; present study) (Fig. 6).

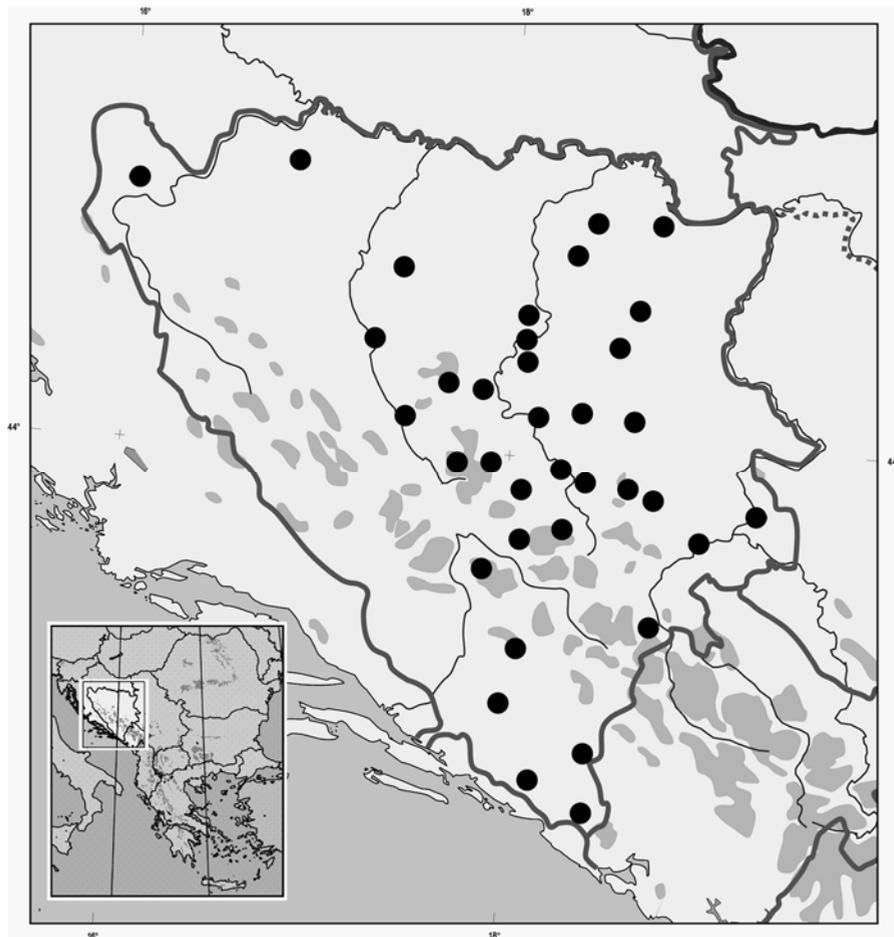


Fig. 6. - Distribution of *Lucanus cervus* subspecies on the outline map of Bosnia and Herzegovina (Lelo & Kašić-Lelo 2009).

An overview of the locations as parts of Bosnian geographic regions (Nurković & Mirić 1998) would look like this:

- 1<sub>1</sub>: Cazin, Mt Kozara, Kotor Varoš;
- 1<sub>2</sub>: Brčko, Novi Šeher, Gradačac;

- 1<sub>3</sub>: Zavidovići, Banovići, Gračanica;
- 2<sub>4</sub>: Jajce, Mt Vranica, Fojnica, Prusac;
- 2<sub>5</sub>: Kakanj, Zenica, Nemila, Vareš, Travnik, Kreševo, Vogošća, Olovo, Ilijaš, Sarajevo, Pale, Mt Romanija, Ilidža, Mt Igman;
- 2<sub>6</sub>: Višegrad, Han Begov, Goražde;
- 3<sub>8</sub>: Tjentište, Mt Ivan, Mt Prenj, Bileća;
- 4<sub>11</sub>: Stolac, Nevesinje, Nevesinjsko polje, Popovo polje, Trebinje.

### **Evaluation of the endangerment metapopulation in Bosnia and Herzegovina in accordance with IUCN categories**

*Lucanus cervus*, is regionally extinct (RE, or more specifically EX) in some countries of northern Europe, while in other European countries it is still in the low risk category (LR, specifically lc as in Spain, for example). After a review of IUCN's criteria for categorisation of the threat level for any given species, we conclude that local populations of *Lucanus cervus* in Bosnia and Herzegovina are in a unique position.

From dusk through midnight of 13<sup>th</sup> and 14<sup>th</sup> July 2001, one of the authors (S. Lelo) roamed the town of Olovo and its surrounding areas (the area of investigation was 10x10 km) and counted more than 500 individuals (no specimens were collected) with the highest abundance of individuals in the vicinity of street lamps. The same researcher collected similar data over a three-year period of investigation in the village of Ilijaš during late July 2004 - 2006 (21<sup>st</sup> July 2004, 22<sup>nd</sup> July 2005, 21<sup>st</sup> July 2006). These investigations were conducted from sunset to about one hour after dusk (roughly 6:30 PM to 8:30 PM) in the area of search, which was 2x2 km. In each investigation more than 50 specimens were counted (for counting purposes specimens were not marked and the numbers presented here, which constitute preliminary data, have been rounded up). On 18<sup>th</sup> August 2008 while conducting field research in Popovo polje S. L. counted only two females, but it must be pointed out that in Popovo polje there are no habitats suitable for stag beetles (even in 2007 and 2008 no stag beetles were recorded in this area). Furthermore, S. L. did not collect live samples from areas for which he already had specimens or photographs of a given species.

These observations suggest that a large number of specimens of the species inhabit the mountainous part of Bosnia and Herzegovina and that their numbers diminish in areas northeast and southeast of this area. According to IUCN criteria, given current conditions populations of *Lucanus cervus* across Bosnia and Herzegovina can be classified as low

risk – LR - but on a smaller scale, populations of the central part of Bosnia and Herzegovina can be classified as least concern (lc), compared to northeast and southeast parts (nt). However, in accordance with the Bern convention (from 1979) and opinions and recommendations of several European Commissions for the protection of the environment (for example, Appendix 10 - Resolution No. 6, 1998, of the Standing Committee listing the species; The Standing Committee of the Convention on the Conservation of European Wildlife and Natural Habitats; having regard to its Recommendation No. 14, 1989 on species habitat conservation and on the conservation of endangered natural habitat types) *Lucanus cervus* has been classified as endangered and its habitats as protected areas. Thus the species must be included in the Red Book of endangered animals of Bosnia and Herzegovina.

### CONCLUSION

Based on a statistical sample of 65 individuals (34 males and 31 females) of the Bosnian *Lucanus cervus cervus* and on data from available literature, an original description of a Bosnian metapopulation has been obtained as well as an analysis of the degree of variation of selected morphological characters.

This metapopulation seems to be poorly studied. There are only a few papers dealing with the species in this area.

A map of the distribution of *Lucanus cervus* in Bosnia and Herzegovina has been made using data from existing literature, specimens stored in the scientific entomological collection of The National Museum in Sarajevo, and the private collection “Lelo”.

Lastly, the threat status of the species in Bosnia and Herzegovina has been evaluated and classified as stable throughout Bosnia and Herzegovina. However, on a smaller scale populations of the central part of Bosnia and Herzegovina can be classified differently (LR - lc) to those in the northeast and southeast parts (LR - nt).

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**НЕКЕ МОРФОЛОШКЕ КАРАКТЕРИСТИКЕ И ДИСТРИБУЦИЈА ВРСТЕ  
*LUCANUS CERVUS* (LINNAEUS, 1758) (INSECTA, COLEOPTERA,  
LUCANIDAE) У БОСНИ И ХЕРЦЕГОВИНИ**

СУВАД ЛЕЛО, МИРЗЕТА КАШИЋ-ЛЕЛО, АДИ ВЕСНИЋ

**РЕЗИМЕ**

Истраживања колеоптера у Босни и Херцеговини имају изузетно дугу традицију, али су подаци о налазима и реалном распрострањењу јеленка, *Lucanus cervus* (Linnaeus, 1758) на датом подручју тек спорадични, а једини пажње вриједан рад потиче из давне 1955. године (Mikšić 1955). Нажалост и у том раду су презентирани врло шутири подаци о појединим налазима па сам рад више представља фаунистички куриозитет него озбиљан научни допринос познавању јеленка у Босни и Херцеговини. Дакле, у задњих 50-так година није било ни једног значајнијег рада о поменутој врсти.

На основу елементарног статистичког узорка од 75 индивидуа (34 мужјака и 31 женке) (Fig. 3-5) подврсте *L. cervus cervus* са подручја Босне и Херцеговине, као и доступних литературних података, у овом раду је изведен оригинални опис босанскохерцеговачке метапопулације посматране врсте, као и анализа степена варијације одабраних морфолошких карактеристика у наведеном узорку (Tab. 1, Fig. 1-2).

Констатовано је да је дата метапопулација јако слабо истражена те да постоји тек неколико озбиљнијих радова о овој врсти на посматраном подручју.

На основу постојећих литературних података, похрањених индивидуа у Научној ентомолошкој колекцији Земаљског музеја Босне и Херцеговине те приватној Зоолошкој колекцији „Лело“ израђена је оригинална карта привременог распрострањења врсте *L. cervus* у Босни и Херцеговини (Lelo & Kašić-Lelo 2009) (сл. 6).

На крају извршена је процјена стања метапопулације посматране врсте на подручју Босне и Херцеговине оцјењена је као стабилна, у тренутним условима животне средине, на цијелом босанскохерцеговачком подручју. Сматрамо да тренутачно постоји ниска вјероватноћа опасности за цијелу метапопулацију (LR), која се различито може протумачити у средњем (LR - lc), у односу на сјевероисточно и југоисточно подручје (LR - nt).