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THE PROTECTED SAPROXYLIC BEETLES (INSECTA: COLEOPTERA) IN *NORDUL GORJULUI DE EST,* SITE OF COMMUNITY INTEREST FROM ROMANIA

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Abstract
Observations carried out in May-August 2015 in Nordul Gorjului de Est, a Natura 2000 site located in the South-Western part of Romania, highlight four species of protected saproxylic beetles: Lucanus cervus, Morimus asper funereus, Rosalia alpina and Cerambyx cerdo. The mountain relief and local climatic conditions influence the abundance and distribution of the species in the site. L. cervus and C. cerdo are present in small areas on the lower level of the site with oak forests, being situated at the limit of their distribution area. The beech forests, dominant in this site and abundant in veteran trees, ensure optimal living conditions for R. alpina and M. asper funereus. Even if the species seem to have important effectives in the area, without strong forest management policies, in the absence of adequate legislative measures, and due the fact that most part of the area is private property it is expected for the populations of these species to decrease in the near future.

Keywords: distribution , Natura 2000 area, protected Coleoptera, records.

1. INTRODUCTION

The dependency of the saproxylic beetles, as well for the other saproxylic insects, on the dead or dying wood (Speight, 1989) makes it mandatory for the protection measures to be taken in order to ensure their suitable habitats considering the reduction of forest areas at European level and the decline of veteran trees. According to Geiser (1998), 60% of saproxylic beetle species in Central Europe are currently threatened by extinction as a consequence of the damage to their habitats.

In this context, Nieto & Alexander (2010) selected 436 species of saproxylic beetles from all Europe on The European Red List in order to stimulate research, monitoring and conservation of saproxylic beetles at local and global level.

At the moment, in European countries where the system Natura 2000 activates, specialists have high preoccupations regarding the elaboration of efficient methods for monitoring and evaluating populations of these saproxylic coleopteran species which will ensure their long-term viability (Campanaro et al., 2011; Campanaro et al., 2017; Leonarduzzi et al., 2017; Hardersen et al., 2017; Redolfi De Zan et al., 2017).

The purpose of this study was to identify the protected saproxilic coleopteran species and to emphasize their biological and ecological particularities in a mountain area of the South-Western part of the country, Nordul Gorjului de Est, characterised by an outstanding diversity of flora and fauna. As well, the study represents a starting point for further research which will evaluate the size

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of the populations of the species in the area, will determine the perspectives of the species in the conditions specific to the area and the adequate measures of management, considering at the same time the pressures and threats in this area, parts of which were identified in this study.

2. MATERIALS AND METHODS

Area description

The site Natura 2000 ROSCI0128 Nordul Gorjului de Est, with a surface of 49,160 hectares, was designated in 2007, natural area protected by community interest. In this site there were already eight areas with the status of protected areas, covering a surface of 755 hectares. The site is located in the Meridional Carpathians, over the Southern part of Parâng Mountains, and in the Western part of Căpățânii Mountains (Fig.1); it is situated in the alpine (88.97 %) and the continental biogeographic regions (11.03 %). The coordinates of the area are N 45º 15' 17" lat. and E 23º 37' 22" long. and its altitude ranges between 348 m and 2.314 m a.s.l. The community importance of this site consists of 25 habitats, 4 species of plants, 16 species of vertebrates and 2 species of invertebrates, meaning the *L. cervus* coleopteran and the *Callimorpha quadripunctaria* lepidopteran.

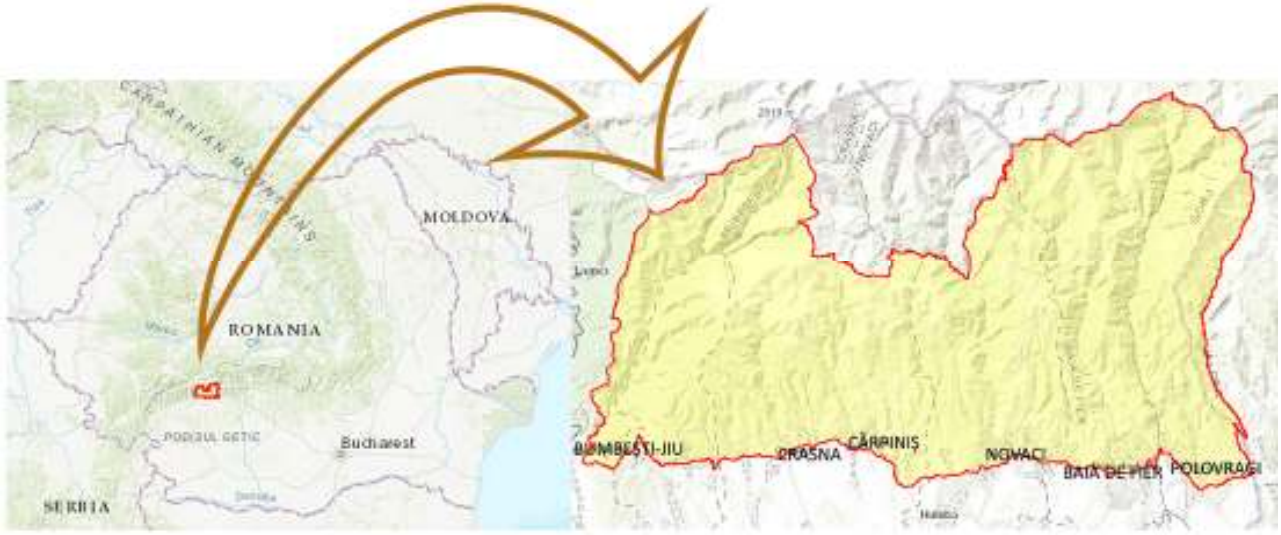

Figure 1. General map of the area
(processed after http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=ROSCI0128)

Altitudinal amplitude determined by the diversity of relief forms and the clime, leads to the presence of several vegetation levels. Reaching altitudes of 600/700 m a.s.l., it is found the sessile oak level, dominated by *Quercus* species and hornbeam (*Carpinus betulus*) in the lower part. In the rest of this level, the strongly fragmented relief creates microclimates propitious for beech growth (*Fagus sylvatica*). Typical to this level is the phytocenosis mosaic with a high diversity of herbaceous and woody species.

The beech level covers the areas between 600 (700) m and 1300 (1400) m a.s.l., and consists of forests mainly out of beech, but with encounters of birch (*Betula verrucosa*), lime (*Tilia cordata*), ash (*Fraxinus excelsior*), and spruce on the upper limit (*Picea abies*) etc. Representative for this site is the presence of secular beech trees on this level.

The spruce level is located in the upper mountain region up to 1600 (1700) m a.s.l., followed by juniper level up to 2000 (2200) m a.s.l., and the alpine grassland level (Popescu et al., 2001).

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The area presents a rich hydrographical system, being crossed by several valleys of rivers and streams which create optimal life conditions for a high variety of vegetal and animal species: Olteț, Galbenu, Gilort, Arinişul, Ciocăzeaua, Ghia, Ciocadia, Blahnița, Larga, Amaradia, Prislopului, Sădişoru, Sadu (Fig. 2).

Methods

The studies were carried out during May – August 2015. Considering the wideness of the area and the diversity of the relief forms, research was carried out mainly in suitable habitats of protected saproxilic coleopteran species. Mountainous relief and steep slopes hinder the access in habitats which led for the observations to be made on forest roads, across the mentioned river and stream valleys, up to altitudes of 1070 m. For *Morimus asper funereus* species the observations were made also in Rânca, resort located at around 1600 m a.s.l., where spruce forests alternate with juniper and alpine grasslands, and the medium annual temperature is approximately 3.2 ° C.

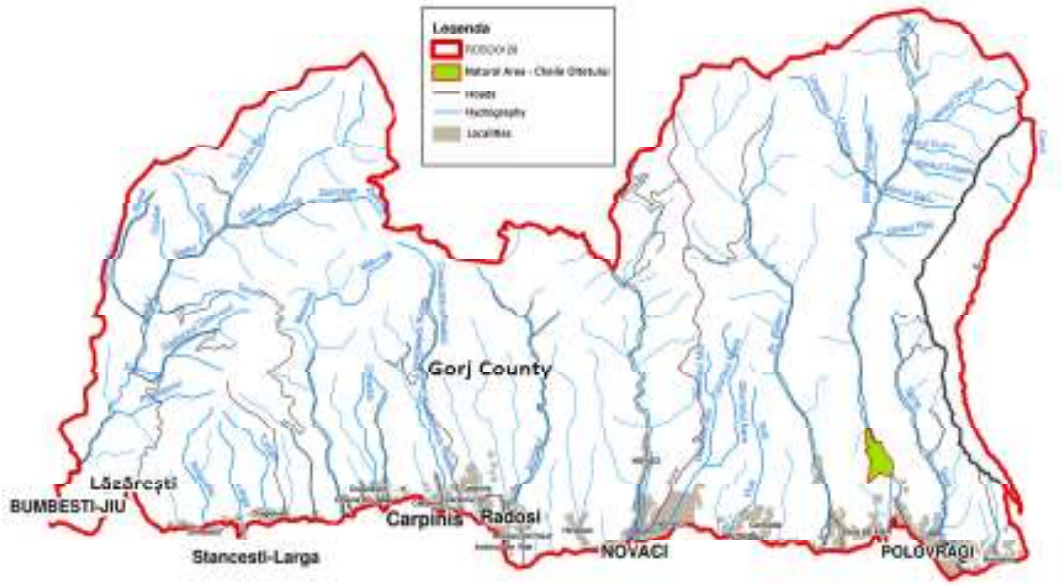

Figure 2. Location of the forest road and river valleys in Nordul Gorjului de Est area

In the targeted habitats, there were inspected veteran trees of the species *Quercus*, *F. sylvatica*, *C. betulus*, *Prunus avium*, birch etc., trunks, dry trees, stacks of wood, litter, forest roads. There were delimited transects with a surface of S = 2000 mp, with 100 m length and 20 m width, and were counted the individuals observed on trunks and on litter, and after the end of the flight period, their exoskeletons. We mention that the exoskeletons are found among the species *L. cervus*, *R. alpina* and *C. cerdo*, while for *M. asper funereus* they are very rare and thus cannot be used for inventory. The emerging galleries of these species were also under observation.

Geographic coordinates were measured with a Garmin GPSmap 60 CSx.

3. RESULTS AND DISCUSSIONS

In the protected area Nordul Gorjului de Est, were identified four species of coleopterans of community interest: *L. cervus, M. asper funereus, R. alpina* and *C. cerdo.*

a. *Lucanus cervus* (Linnaeus 1758) (Coleoptera: Lucanidae)

Status: Habitats Directive 92/43/CEE, Annex II; in Romania - OUG 57/2007 Annex 3

Romanian common name: rădaşca, răgăoace, caradaşcă

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In the site, in locality Langa, the species is known under the name "garace".
Marcu (1928) mentions the species in Tismana (Gorj County), locality situated only 50 km far from the West side of the protected area. According to Cuzepan & Tăuşan (2013), this is the first record of *L. cervus* in Romania.
In the area, the species is recorded by Chimişliu (2007) on Galbenului Valley, close to Baia de Fier.
The data about the recorded specimens has been presented in the following order: date of observation/ specimens (♀ and ♂; exoscheleton/altitude/ locality.
30.05.2015/ 1♀, exoscheleton remains from 7 spec. / 571 m a.s.l./ Amaradia Valley (Stănceşti); 31.05.2015/ exoscheleton remains from 3 spec. / 452 m a.s.l./Crasna; 17.06.2015/ 1♀, 3♂♂, exoscheleton remains from 7 spec. /467-481 m a.s.l./ Bârcului Forest; 18.06.2015/ 1♂ /723 m a.s.l./Drăgoieşti Forest; 1♀, 1♂, exoscheleton remains from 6 spec./701 m a.s.l./ Novaci Forest
19.06.2015/ 8♂♂, 2♂♂, exoscheleton remains from 4 spec. /613-696 m a.s.l./Lăzăreşti Forest
23.06.2015/2♂♂, 1♀, 1 exoscheleton remains/548 m a.s.l./ Polovragi; 25.06.2015/1♂, 2♀♀, 1 exoscheleton remains/632 m a.s.l./ Olteţului Valley; 14.07.2015/ 2♂♂, exoscheleton remains from 3 spec. /669-719 m a.s.l./ Aninişului Valley (Radoşi); 15.07.2015/1♀ /476 m a.s.l./Novaci town; exoscheleton remains from 1♀, 1♂/702 m a.s.l./ Transalpina highway; 17.07.2015/ exoskeleton 2♂♂ /706 m a.s.l./Prislop Point (Lăzăreşti); 18.07.2015/ exoskeleton 1♂; 1♀ /695 m a.s.l./Ciocăzeaua Valley (Radoşi); 26.07.2015/ exoskeleton 1♂; 1♀ /601 m a.s.l./Cerna Valley; 24.08.2015/ exoscheleton 1♂; 1♀ /679-682 m a.s.l./Sădişorului Valley; 25.08.2015/1 exoscheleton remains/674 m a.s.l./Plaiului Valley (Cărpiniş).

Biology and ecology

The observations made in the area during the period May-August, emphasised 24 individuals, active males and females, and exoskeletons and fragmented exoskeletons.
During the conditions of 2015 year, the high temperatures in May favours the emergence of adults, thus on 30 May 2015 on Amaradia Valley it is observed a female, and on 17 June in Bârcului Forest are already observed the first dead males. The species is active as well in the second decade of July when a female was observed in oviposition.
The presence of the perforated elytra, broken mandibles, exoskeleton fragments, indicate the existence of predators, mostly known in the area being the boar, the badger and the fox.
Apart from the *Quercus, Fagus, Castanea, Alnus* species the observations in the area emphasize another wood species inhabited by the larvae: the birch.
The suitable habitat, represented by oak forests with a rarefied layer of trees, it is found in the lower level of the area in small surfaces, which leads to low populations of the species in the site. Transects did not emphasize more than 2 spec./2000 sqm, while in the hilly area at the edge of oak forests, were found up to 23 spec. /2,000 square meters (Bărbuceanu et al., 2015).

Distribution

The species was identified mainly in oak habitats that occupy small surfaces in the site. Such forests were observed next to the localities Baia de Fier, Polovragi, Novaci, Hiriseşti, Radoşi, Cărpiniş, Crasna, Drăgoieşti, Stănceşti, Lăzăreşti. As well there were seen males and females, whole exoskeletons or fragmented, galleries of emergence, at the edge of some oak forests mixed with beech, in birch forests with old trees and at the borders of the beech forests on the Aninişului Valley, on the left side of the Transalpina highway, on the Cernei Valley.
The species is present in oak enclaves from beech forests. Thus, observations on Prislopului Valley through secular beech forests highlighted at the Prislop Point a sessile oak trees enclave of around 5 hectares with exoskeletons belonging to robust individuals, and galleries of emergence. The enclave is situated at an altitude of 696 - 706 m a.s.l.

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The species was also observed in different habitats: alder forests on Olteţului Valley, a plantation of *Castanea sativa* in the yard of the Forest District Polovragi.
In the beech forests disposed on plateau or on slopes, the species was not observed. The species has also been seen in urban areas, a crushed female being spotted on 15 of July 2015, in the centre of Novaci city. Besides, the presence of *L. cervus* individuals is mentions in gardens, parks, or other areas close to forests (Hawes, 2008; Thomaes et al., 2008). The preference for oak forests from hilly areas (Nieto et al., 2010) with sun exposed slopes causes the presence of the species only on the lower level of the area and up to 723m a.s.l. In Romania, based on his personal observations during 1977-2007, Ruicănescu mentions the presence of the species on altitudes from 150 m up to 550 m (http://www.crayfish.ro/anexe/SpeciesFactSheetsFeb08.pdf). Literature mentions the species on altitudes up to 1,000 m (Campanaro et al. 2011) and even 1,700 m, in Bulgaria (Harvey et al., 2011), but in Romania at such altitudes the climatic conditions are not optimal for the species.

b. *Morimus asper funereus* Mulsant 1862 (Coleoptera: Cerambycidae)
Status: Habitats Directive 92/43/CEE, Annex II; in Romania - OUG 57/2007 Annex 3.
Romanian common name: croitorul cenuşiu, croitorul de piatră.
Panin and Săvulescu (1961) consider the species to be common in Romania and mention it in deciduous forests, rarely in coniferous ones, lower attraction for the coniferous wood being recorded as well by other authors (Vrezec et al., 2010; Leonarduzzi et al., 2017).
The species was also signalled in the area in Bumbeşti, Novaci, Rânca (Bobîrnac et al, 1999; Serafim et al., 2004) and Galbenului Valley (Chimişliu, 2007).
The data about the recorded specimens has been presented in the following order: date of observation/ specimens (♀ and ♂; exoscheleton/altitude/ locality.
30.05.2015/ 3♂♂, 2♀♀/ 525-526 m a.s.l./ Amaradia Valley (Stănceşti); 31.05.2015/ 1♂, 1♀ / 452 m/Crasna; 1♂ / 767 m a.s.l./Ciocăzeaua Valley; 17.06.2015/ 3♀♀, 7♂♂ /467- 481 m a.s.l./ Bârcului Forest; 18.06.2015/ 2♂♂,1♀ /701 m a.s.l./ Novaci Forest; 1♂/ 723 m a.s.l. / Sunătoarea Valley (Drăgoieşti); 19.06.2015/1♂, 1♀/637 m a.s.l./Lăzăreşti Forest; 25.06.2015/1♂,1♀ /623 m a.s.l./ Olteţului Valley; 16.07.2015/ 1 exoscheleton /669 m a.s.l./ Sunătoarea Valley (Drăgoieşti); 19.07.2015/1 exoscheleton ♀/637 m a.s.l./ Amaradia Valley (Stănceşti); 25.08.2015/1 exoscheleton without head/676 m a.s.l./Plaiului Valley (Cărpiniş).
Biology and ecology
This species, active since the month of April in South-Eastern areas of Europe (Vrezec et al., 2010; Dojnov et al., 2012; Bărbuceanu et al., 2015), is observed in the area since the end of May, either as solitary individuals or while mating. Because the flightless of adults has peak activity in the first half of May, and in the second half of June (Vrezec et al. 2010), from the last half of July and in August, no more active individuals were observed, even if in some areas the species could still be active.
37 adults were seen on dry stems, on stacks of wood deposited along forest roads, and on freshly cut logs of hornbeam, *Quercus* sp, beech, wild cherry, poplar. Attraction for freshly cut wood led to observations of several adults on such trunks of poplar wood, in 17 June in Bârcului Forest. Besides, this behaviour recommends freshly cut log piles as monitoring tool (Hardersen et al., 2017; Leonarduzzi et al., 2017). There were observed more males than females (23 ♂♂/14♀♀), situation mentioned as well by other authors (Leonarduzzi et al., 2017), a possible cause being the fact that they are more active while searching females for mating, which makes them more visible, while the females hide and are more discrete.
Distribution

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M. asper funereus was observed in oak forests at the base of the area, in the beech forests investigated up to 767 m a.s.l., however the data obtained on the field is insufficient to compose a complete distribution of the species for the area level. Many observations in the area were made in the last half of July and in August when the species is less active and could not be emphasized. Discussions with the forestry personnel and locals indicate the species as being common in the lower level and the beech one, while on the coniferous level it was seen occasionally. Serafim et al. (2004) signals it in Ranca, at 1600 m a.s.l., where it is brought a high amount of wood from lower levels, and it is possible for the species to have been brought together with the stacks of wood. Observations made during the study period in this locality did not highlight the species.

c. *Rosalia alpina* (Linnaeus, 1758) (Coleoptera: Cerambycidae)
Status: Habitats Directive 92/43/CEE, Annex II, IV; in Romania - OUG 57/2007 Annex 3, 4A.
Romanian common name: croitorul alpin.
It was assessed as Least Concerned at European Level (Horák et al., 2010), while in our country Tatole et al. (2009) included it into VU (Vulnerable) category.
In Romania, according to Panin & Săvulescu (1961), the species is found among beech and coniferous levels, rarely among oak forests, up to the altitude of around 1500 m. Horák et al. (2010) considers the species to be spread in beech forests of the Romanian Carpathians region.
The species was signalled in the area in Bumbeşti (Bobîrnac et al, 1982; Serafim et al., 2004) and Galbenului Valley (Chimişliu, 2007).
The data about the recorded specimens has been presented in the following order: date of observation/ specimens (♀ and ♂; exoscheleton/altitude/ locality.
15.07.2015/ 2♂♂ /631 m a.s.l./ Blahnița Valley (Crasna); 16.07.2015/ 2♂♂; 1♀ /669 m a.s.l./ Sunătoarea Valley (Drăgoieşti); 17.07.2015/ 6♂♂; 4♀♀ / 715-755 m a.s.l./ Prislopului Valley; 18.07.2015/ 1♂; 1 ♀/820 m a.s.l./ Sădişorului Valley; 1♂/ 820 m a.s.l./Ciocăzeaua Valley; 19.07.2015/3♂♂, 2♀♀/ 737 m a.s.l./ Galbenului Valley; 24.08.2015/1 exoscheleton/679-682 m a.s.l./Sădişorului Valley; 1exoscheleton/780 m/Sadului Valley; 25.08.2015/1 exoscheleton ♂/763 m a.s.l./Valea Mare (Drăgoieşti); 26.08.2015/1 exoscheleton /624 m a.s.l./Langa Valley
Biology and ecology
The species was distinguished in the area during the investigations from the month of July, in beech forests with veteran trees, namely in the sunny areas around the edges of forest roads, in clearings, at the edge of the forest. 22 males and females were observed, solitary or while mating, usually on standing old beech trees with exfoliated bark and partially dried, on sun-exposed trees or on litter. On stems were also visible elongated emergence holes. The preference for habitats with standing dying beech trees is also recorded by other authors (Campanaro et al., 2017). Investigations made on 17 July, 14 p.m. on the forest road Prislopului, situated on the Western part of the area in a habitat favourable to the species, distinguish on a distance of around 300 m, eight individuals out of which 5 ♂♂ and 3 ♀♀, extremely active, one couple in the mating process.
Even if the species is associated with beech forests, its polyphagous behaviour allows it to colonize other wood species (Ciach et al., 2007; Bosso et al, 2013). Thus, also on the West side of the area were observed emergence holes on veteran lime, and on the litter, close to them, exoskeletons of the species. During the investigations from the second half of August no more active individuals were observed, only exoskeletons. Considering the local climatic conditions, the activity of the adults is intense during July and first half of August. Drag et al. (2011) and Campanaro et al. (2017) mention the period of maximum activity to be between July and August, fluctuating between the first and the last part of July depending on the local climatic conditions.

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Distribution

The species was observed in beech forests on Prislopului Valley, Sadului Valley, Sădişorului Valley, Blahnita Valley, Galbenului Valley. Even if the investigations are few, the local climate optimal for beech and the remarcable richness of the area with veteran trees, show the ideal conditions for the existence of rosalia longicorn. The beauty and colourfulness of the species makes it easy to spot in the area, and thus from the discussions with the forestry personnel and locals it is clear that *R. alpina* is often found in the site.

The importance of protecting and preserving the species in area also results from the fact that it is considered that the highest populations exist in the South-Western part of Romania (Horák et al., 2010).

d. *Cerambyx cerdo* Linnaeus 1758 (Coleoptera: Cerambycidae)

Status: Habitats Directive 92/43/CEE, Annex II, IV; in Romania - OUG 57/2007 Annex 3, 4A.

Romanian common name: croitorul mare al stejarului.

It was assessed as Vulnerable at European level (IUCN) and in our country (Tatole et al., 2009).

In the past, the forest ecosystem dominated by deciduous forests rich in veteran trees, was favourable to this species which was spread all around the country (Panin & Săvulescu, 1961).

At the moment, the species is in decline and survives in "islands" contained in the initial area (http://www.crayfish.ro/anexe/SpeciesFactSheetsFeb08.pdf).

The species is known in the area, being records in Bumbeşti and Novaci by Bobîrnac et al. (1982) and Serafim et al. (2004).

The data about the recorded specimens has been presented in the following order: date of observation/ specimens (♀ and ♂; exoscheleton/altitude/ locality.

17.06.2015/ fragment exoschelet /481 m a.s.l./ Bârcului Forest (Novaci); 18.06.2015/ 1♂, /626 m a.s.l./ Bârcului Forest; 19.06.2015/ 1♀ /613 m a.s.l./Lăzăreşti Forest.

Biology and ecology

Only two adults, one exoskeleton and a few emergence holes were observed in the month of June on veteran sessile oak trees from the lower level of the area up to 626 m a.s.l. This oligophagous saproxylic species prefers old forests of *Quercus* situated in open or semi-open landscapes (Buse et al. 2007; Redolfi De Zan et al., 2017), and in the area they are very limited.

Distribution

The species is present in the oak forests from Bârcului Forest, Stănceşti and Lăzăreşti, where also present veteran trees, but its population is extremely low. It is distinguished Bârcului Forest with many veteran sessile oaks which already has the status of natural reservation and a surface of 25 m^2, but which is not managed properly, and crossing it on the county road Bumbeşti-Jiu - Novaci leads to the fragmentation of the area.

The species tolerates extremely limited variations of temperature, thus the local climatic conditions do not meet the requirements of the species for its habitat. As in the case of *L. cervus*, *C. cerdo* is present at the limit of its distribution area.

e. Threats

According to Nieto & Alexander (2010), inappropriate logging and wood harvesting practices and the decline of veteran trees, are among the main threats to the protected saproxylic species.

Romania, country which in 2004 had 218,000 hectares of virgin forests, compared to 400,000 hectares in 1984 (Veen et al., 2010), has been experiencing for over two decades a severe forest

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degradation as a result of illegal deforestation. At the moment, forest legislation has many gaps which allow abuses leading to the loss and degradation of this national treasure.
In the current study, the observations in the area with the purpose of inventorying the protected coleopteran saproxylic species distinguished a number of pressures manifested upon them which could represent threats towards the viability of the species in the area:
a. illegal timber extraction is observed particularly in forests near localities, but local authorities are overwhelmed by this situation;
b. intense exploitation of wood, respectively beech trees with trunks of wide diameter in optimal areas for *R. alpina* (Sadului, Sadisorului Valley);
c. construction of roads on some of the mountain valleys (Galbenului, Oltețului, Gilortului Valleys) which allows easy access for the tourists who set fire to the trunks of old trees and cut firewood for campfires;
d. inadequate placement by local authorities of a tourist place in Bârcului Forest generates large amounts of garbage near the veteran trees;
e. indifference of local authorities and communities towards the norms of the protected area, the absence of measures regarding the management of forests at the moment this study was made.
An important aspect that must be taken into consideration is the fact that most part of the area is private property, situation which can interfere with the management of this site and the implementations of protection and preservation measures for the all protected species and habitats.

4. CONCLUSIONS

In the protected area Nordul Gorjului de Est four coleopteran species of community interest are present: *L. cervus, M. asper funereus, R. alpina,* and *C. cerdo*. Observations made in the site show that the species *L. cervus* and *C. cerdo* are at the limit of their distribution area, have small populations, and the habitat which is propitious for the growth of these two saproxylic species is reduced to the forests on the lower level of the area. *L. cervus* is noticed up to 723 m altitude in habitats with birch. *M. asper funereus* benefits of suitable habitats on the oak and beech levels. Even if in the area it as observed a small number of *R. alpina* individuals, beech forests typical to the area, rich in veteran trees, are able to sustain an important population of the species in this part of the country. We assess this species to be representative for the site Nordul Gorjului de Est., together with *M. asper funereus*.
Exploitation of timber, especially of veteran beech trees, construction of roads on many of the mountain valleys, the indifference of local authorities and communities towards the norms of the protected area, that most part of the area as private property, are factors which can damage dramatically the perspectives of protected saproxylic beetles populations, and in general, the biodiversity of the site.

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