MONITORING OF THE SAPROXYLIC BEETLE *ROSALIA ALPINA* (LINNAEUS, 1758) (COLEOPTERA: CERAMBYCIDAE) USING VISUAL METHODS IN THE MĂCIN MOUNTAINS NATIONAL PARK (ROMANIA)

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A monitoring programme was developed for *Rosalia alpina* (Linnaeus, 1758) in the Măcin Mountains National Park (MMNP), using visual methods. Three transects were monitored for two years (2014 and 2015). To make a correlation between numerical abundance and environmental variables, ten abiotic factors were analysed: altitude (A), exposition (Ex.), slope (S.a), forest coverage (F.c.), air temperature (A.t.), soil temperature (S.t.), air relative humidity (A.h.), cloud cover (Nb.), wind speed (W.s.) and wind direction (W.d.). In two years of study, 37 specimens of *Rosalia alpina* were identified. The main environmental variables that influenced the beetle population dynamics were: the type of habitat, exposition, air temperature and air relative humidity. The most favourable habitats for this species were Pannonian-Balkanic Turkey oak-sessile oak forests (91M0) and Moesian silver lime woods (91Z0). *Rosalia alpina* preferred slopes smaller than 45°, with South-West exposition, with warmer climate (27°C–31°C), and correlated with relative air humidity of 50%–70%. *Rosalia alpina* preferred habitats where recorded values for relative humidity were between 50%–70%. The main threats and protection measures for *Rosalia alpina* are provided to aid conservation.

Keywords: *Rosalia alpina*, abundance, climate, habitat, monitoring, transect, Măcin Mountains, Romania.

INTRODUCTION

Forest ecosystems provide diverse environmental services: regulation of water regimes; maintenance of soil quality and provision of organic materials; limiting erosion and protection of soil from the direct impact of rainfall; modulating regional climate; nutrient cycling; carbon sequestration; and maintenance of species and habitats biodiversity (Nadrowski *et al*., 2010). Dead wood is an important component for forest biodiversity (Jonsson *et al*., 2005). The high quantity of organic matter, in different stages of decomposition, provides a large number of ecological niches for many invertebrates, e.g. saproxylic beetles (Muller & Butler, 2010; Walentowski *et al*., 2013). According to Walentowski *et al*. (2013), due to their

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high degree of specialisation and to specific colonisation sequences, saproxylic beetles contribute significantly to the complex ecological interrelationships of deadwood-rich forests. Characteristic beetle communities for forest ecosystems could be used to investigate the ecological equilibrium, its maturity and the anthropic impact (Bussler *et al*., 2005; Vrezec *et al*., 2012). In order to protect these beetles and their habitats through nature conservation legislation, the European Union include 22 saproxylic beetles in the lists of Annex II and IV of the Habitats Directive 92/43 EEC. One of these protected species is *Rosalia alpina* (Linnaeus, 1758). This beetle was identified in one of the Natura 2000 protected areas of Romania, Măcin Mountains National Park (ROSCI0123). Studies of management practices and biodiversity assessment of the invertebrate fauna, developed in the period June 2006 – December 2007, revealed the presence of these saproxylic beetles and demonstrated that their presence was affected by forestry cutting (UNDP/GEF, 2006–2007).

For the saproxylic beetle *Rosalia alpina*, the present research attempts to establish: a) its presence and abundance in the established areas; and b) its population dynamics at the local level (small scale), taking into account the environmental influences and responses of populations to conservation management/measures. We focus only on reliable relative comparisons between sites and periods.

MATERIAL AND METHODS

The study area

The Măcin Mountains National Park (MMNP) has an area of 11151.82 hectares and it is located in the South-East of Romania, in Dobrogea region, Tulcea county (45º8´49” N and 28º19´51”E). The climate is continental, with sub-Mediterranean influences in higher areas and with steppic characteristics in the south. Average annual temperatures are 10–11°C and average precipitation is 500 mm, which are extreme values within Romania, where the Măcin Mountains are the most arid mountains in Romania (http://www.parcmacin.ro/plan-management).

The management plan for the Măcin Mountains National Park describes the following Natura 2000 habitats: Eastern white oak forests (91AA); Euro-Siberian steppic woods with *Quercus* spp. (91I0*); Pannonian-Balkanic Turkey oak – sessile oak forests (91M0); Dacian oak and hornbeam forests (91Y0); Dobrogean beech forests (91X0); Ponto-Sarmatian deciduous thickets (40C0*); Ponto-sarmatic steppes (62C0*); Pannonic salt steppes and salt marshes (1530); Siliceous rock with pioneer vegetation of the *Sedo-Scleranthion* or *Sedo albi-Veronicion dillenii* (8230); Caves not open to the public (8310); Moesian silver lime woods (91Z0); and Siliceous rocky slopes with chasmophytic vegetation (3220) (Gafta & Mountford, 2008) (Fig. 1).

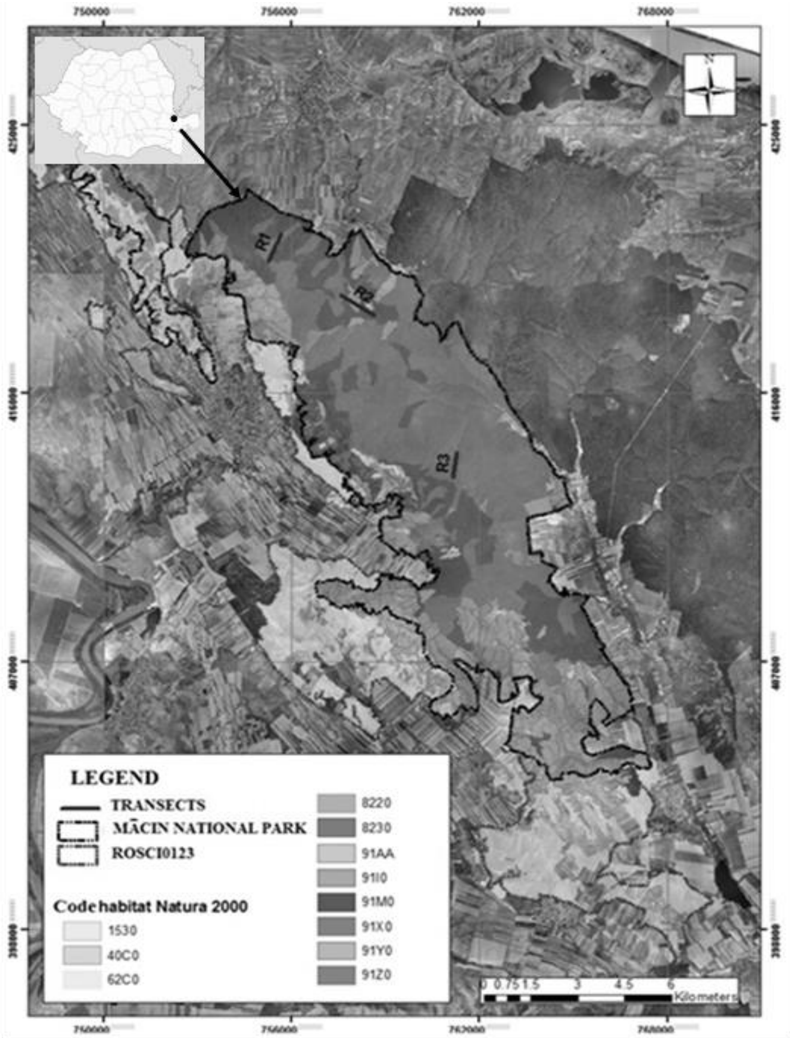

Fig. 1. Monitoring transects for *Rosalia alpina* in MMNP.

Biological material

Daytime visual longitudinal transects were recorded to identify the distribution and abundance of *Rosalia alpina* during June–August of 2014 and 2015 (the period of maximum activity of the species). However, the start and end of this period vary with altitude and annual climatic factors (Russo *et al*., 2011; Lachat *et al*., 2013). Three transects were chosen (of length 1000 metres and width 50 metres), mainly in areas covered by the following habitats: Pannonian-Balkanic Turkey oak – sessile oak forests (91M0); Moesian silver lime woods (91Z0); Eastern white oak forests (91AA); and Dacian oak and hornbeam forests (91Y0) (Fig. 1). These three transects were monitored four times/year for two years, during daylight between 9:00 a.m. and 18:00 p.m. The position of transects was recorded with a Magellan Professional Mobile Mapper or/and Garmin 76CSx, in order to avoid repetition.

Our investigation mainly targeted large trees, both alive and decomposing (standing dead and fallen trunks), as the most favourable woody material to host individuals of the investigated species (Jurc *et al*., 2008; Cizek *et al*., 2009; Russo *et al*., 2011; Castro *et al*., 2012; Vrezec *et al*., 2012) (Fig. 2).

Chiţău forest (R1) Habitat 91M0+91Z0 — Seaca valley (R2) Habitat 91Z0+91M0+91AA+91Y — Teica hill (R3) Habitat 91Z0

Fig. 2. Favourable habitats for *Rosalia alpina* in MMNP.

Climate data

The following abiotic factors were analysed: altitude (A), exposition (Ex.), slope (S.a), forest coverage (F.c.), air temperature (A.t.), soil temperature (S.t.), air relative humidity (A.h.), cloud-cover (Nb.), wind speed (W.s.) and wind direction (W.d.) (Table 1). Air temperature and relative humidity were measured with a wireless thermo-hygrometer HTS55 Irox. Soil temperature was recorded with a Step System thermometer. Wind speed was quantified using the Beaufort scale (the numbers 0 to 12 indicating the strength of the wind from force 0 (calm) to force 12 (hurricane)). The percentage of sky covered by clouds was also taken into consideration (Wikstrom *et al*., 2009). Climate data were recorded each time, at the starting point of each monitored transect.

Statistical analysis

Nine population parameters were calculated: numerical abundance (Ab. – the total number of individuals); average number of individuals (x); numerical density per hectare (x/ha); variance (S^2); standard deviation (S); standard error (S'); dominance (D %); constancy (C %); and the Morisita overlap index (IM) measure of dispersion (Tables 1 and 2).

The Dominance Index (%) was calculated using the formula:

D = 100% * n/N, where: n = number of individuals of one species in all samples; N = total number of individuals of all species in all samples. Dominance classes for the beetles identified were: eudominants with D > 10.0% (D5); dominants with D of 5.1–10.0% (D4); sub-dominants with D of 2.1–5.0% (D3); recedents with D of 1.1–2.0% (D2), and sub-recedents with D < 1.1% (D1).

The Constancy Index (%) was obtained using the formula:

C = 100% * pA/P, where: pA = number of samples with species A; P = total number of samples. The beetle species were divided in four constancy classes: euconstant species with C of 75.1–100% (C4); constant species with C of 50.1–75% (C3); accessory species with C of 25.1–50% (C2); and accidental species with C of 1–25% (C1).

RESULTS AND DISCUSSION

In the two years of study, 37 specimens of *Rosalia alpina* were recorded, 19 individuals in 2014 and 18 in 2015 (Fig. 3). The highest numbers of individuals were recorded in July, although it should be noted that two observations were made during this month (Fig. 4). In MMNP, this beetle species was recorded from June until the end of August, in both years (Table 1).

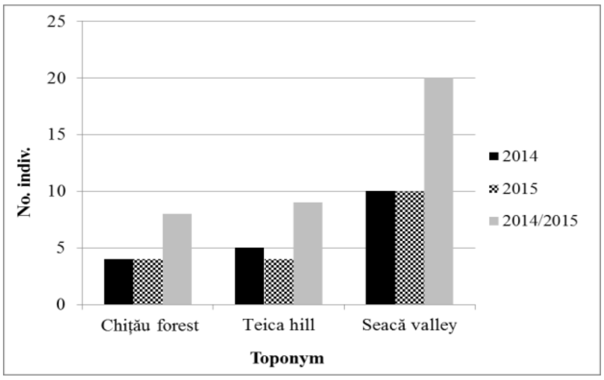

Fig. 3. Distribution of the number of individuals of *Rosalia alpina* from MMNP.

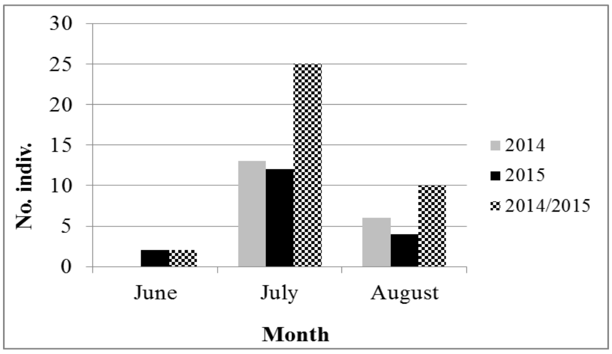

Fig. 4. The monthly number of individuals of *Rosalia alpina* from MMNP.

Table 1

Population parameters of *Rosalia alpina* and environmental variables, recorded in MMNP (2014–2015)

T	Ab.	P	A (m)	Ex	Sa (°)	Fc. (%)	At (T°)	S.t (T°)	Ah (%)	Nb. (%)	Ws	Wd
		2014										
R1	0	EJ	212	SW/NE	28	50	27	22	69	90	1	SE
R2	0	EJ	173	SW	35	30	18	16	59	60	1	NE
R3	0	EJ	181	SW	25	60	27.3	22	63	60	3	NE
R1	1♂	EJy	183	SW/NE	28	60	28.3	24	62	5	1	SE
R2	2♂+1♀	EJy	211	SW	25	60	28.1	25.8	63	5	1	NE
R3	2♂	EJy	220	SW	30	65	30.5	25	60	15	0	–
R1	1♂	EdJy	220	SW	28	60	27.8	23.5	69	20	1	SE
R2	3♂+1♀	EdJy	211	SW	35	30	27	22	62	5	0	–
R3	2♂	EdJy	183	SW/NE	25	60	29.6	26.2	80	35	1	NE
R1	1♂	EA	183	SW/NE	28	30	28.6	26.1	60	80	0	–
R2	2♂+1♀	EA	304	SW	25	60	25.6	20.8	64	10	0	–
R3	2♂	EA	220	SW	30	60	24.8	21.7	68	95	0	–
		2015										
R1	0	EdJ	183	SW/NE	28	60	27.2	21.5	34	80	0	–
R2	1♀	EdJ	211	SW	23	60	22.6	18.5	72	85	2	SE
R3	1♂	EdJ	220	SW	20	55	23.5	18.9	65	5	2	SE
R1	1♂	MJ	183	SW/NE	28	60	29.5	23.3	49.4	0	0	–
R2	3♂+2♀	MJ	211	SW	23	60	25.9	20.5	58	0	1	SE
R3	1♂+1♀	MJ	220	SW	20	55	22.8	17.9	75	0	0	–
R1	1♂+1♀	EdJy	183	SW/NE	28	60	21.3	18.6	59.1	0	1	SE
R2	1♂	EdJy	211	SW	23	60	25.6	20.5	46	0	1	SE
R3	1♂+1♀	EdJy	220	SW	20	55	24.6	18.7	43.8	0	1	SW
R1	1♀	EA	183	SW/NE	28	60	28.3	24.7	38.5	0	2	SW
R2	2♀	EA	211	SW	23	60	28.8	24.1	37	0	2	SE
R3	1♀	EA	220	SW	20	55	21.6	19.5	56	0	1	SE

Legend: A = altitude; Ab = numerical abundance; A.h.= air relative humidity; A.T.= air temperature; E = East; N = North; W= West; EJ= early June; EJy= early July; EdJ= end of June; EdJy= end of July; EA= early August; Ex = exposition; F.c.= forest coverage; MJ = middle July; Nb = cloud cover; P= period; S.a= average slope; S.T. = soil temperature; S = South; Y = year; T = transect; Ws = wind speed; W.d= wind direction.

Some other ecological parameters were established based on the numerical abundance of the beetles (Table 2). To make a comparison with other taxa from the biocoenosis, other beetle species were recorded that have similar ecological requirements to *Rosalia alpina*: *Morimus funereus*, *Lucanus cervus*, *Cerambyx cerdo*, *Dorcus parallelipipedus*, *Protaetia aeruginosa* and *Cetonia aurata*.

When compared with other studies, the number of individuals recorded per year of *Rosalia alpina* from MMNP is similar to that obtained in Poland (11–12 individuals), Serbia (2–18 individuals), but higher than in Slovenia, Austria, Spain, Italy, Hungary, Czech Republic, Macedonia, Croatia, Bulgaria, Greece, Ukraine, France and other protected areas from Romania (Mitter, 2001; Bussler *et al*., 2005; Jurc *et al.*, 2008; Cizek *et al*., 2009; Michalcewicz *et al*., 2011; Zamoroka & Panin, 2011; Betard & Gerbaud, 2011; Michalcewicz & Ciach, 2012; Castro *et al*., 2012; Mazzei *et al*., 2013; Ilić & Ćurčić, 2013; Ilić *et al.*, 2013; Prunar *et al*., 2013; Di Santo & Biscaccianti, 2014; Keszthely, 2015; Drag *et al*., 2015; Radosław Plewa *et al*., 2015; Drag *et al*., 2015).

Table 2

Ecological parameters for *Rosalia alpina* and accompanying species identified in MMNP (2014–2015)

Species	Ab. (no. ind.)	x	x/ha	S^2	S	S'	D (Ar%)	C (F%)	IM 2014/2015
Rosalia alpina (Linnaeus, 1758)	37	3.08	0.62	3.72	1.93	0.16	7.09	83.33	1.66/1.67
Morimus funereus Mulsant, 1863	114	9.50	1.90	9.18	3.03	0.25	21.84	100.00	1.10/1.39
Lucanus cervus (Linnaeus, 1758)	251	20.92	4.18	220.63	14.85	1.24	48.08	100.00	1.81/1.51
Cerambyx cerdo Linnaeus, 1758	26	2.17	0.43	7.24	2.69	0.22	4.98	50.00	2.15/6.76
Dorcus parallelipipedus Linnaeus, 1758	67	5.58	1.12	4.63	2.15	0.18	12.84	91.67	2.19/1.12
Protaetia aeruginosa (Linnaeus, 1767)	6	0.50	0.10	0.27	0.52	0.04	1.15	41.67	3.67/11
Cetonia aurata (Linnaeus, 1761)	21	1.75	0.35	3.84	1.96	0.16	4.02	54.17	2.71/3.91

Legend: A = numerical abundance (the total number of individuals); x = average number of individuals; x/ha = numerical density reported for one hectare; S2= variance; S= standard deviation; S'=standard error; D (%) = dominance; C (F%) = constancy (frequency%); IM = Morisita overlap index (IM).

The population density, calculated for one and ten hectares, varied with the size of the population, being 0.32 individuals/hectare (3.2 individuals/10 hectares), in 2014; and 0.30 individual/hectare (3 individuals/10 hectares) in 2015. Thus for the two years, the combined value was 0.62 individuals/hectare, with an average of 0.31 individuals/hectare. Lower densities of *Rosalia alpina* than those recorded for the MMNP were obtained in the Austrian Alps (0.01 – 0.005 individuals/hectare) (Friess *et al*., 2014). In the Czech Republic the opposite situation was recorded, with the favourable environment leading to a density of 42–84 individuals/hectare (Drag *et al*., 2011).

If we consider the numerical abundances recorded in both years of the study, we observed that the values for *Rosalia alpina* are similar, even if the climate conditions differed considerably (especially air relative humidity). The period June–August 2015 was characterised by a severe drought. The values of the air relative humidity decreased to 34%, and influenced the activity of *Rosalia alpina* negatively, especially on males. This situation is reflected in modification of the sex ratio from 5.33 (2014) to 0.8 (2015). Combining the data for the two years of the study, of the 37 identified individuals, 65% were males and 35% females, with a sex ratio of 1.84, reflecting male dominance (Fig. 5). Due to their higher mobility, in normal conditions males are easier to observe, as noted in 2014. In the drought conditions of 2015, the sex ratio tends to be more balanced due to decreased activity of males in early autumn, when female activity is more intense (Drag *et al*., 2011).

Because the immature stages of *Rosalia alpina* are difficult to find and identify, only the adults were recorded and analysed during this study.

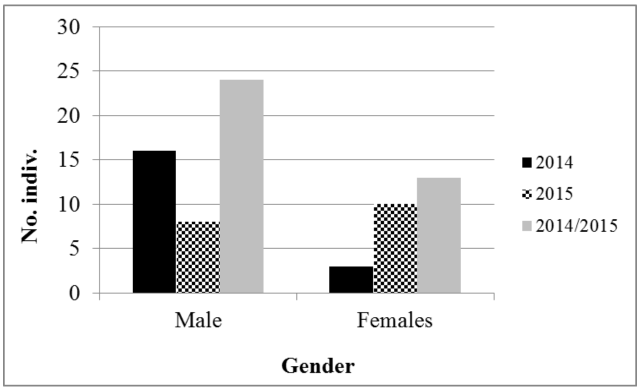

Fig. 5. The numerical abundance by gender for *Rosalia alpina* in MMNP.

The most important ecological parameters were dominance and constancy, which are indexes that reveal the status of the *Rosalia alpina* population in the biocoenosis. In 2014 and in 2015, *R. alpina* was a dominant species (D4 over 5.1%), (Table 1, Fig. 6). The higher value from 2015 (D = 8.96%) can be explained by the decrease in the number of specimens of the accompanying species, while the number of *Rosalia alpina* specimens declines very little (mainly in drought conditions). The situation recorded for constancy was similar. In 2014 and 2015, *Rosalia alpina* was a euconstant invertebrate (C1 over 75.1%), i.e. one of the characteristic species of beetle in the habitats investigated.

Evaluation of dispersion was carried out by the Morisita overlap index, the preferred measure because it is independent of the sample and the arithmetic average of the number of specimens. Values of this index for 2014 (1.66) and 2015 (1.67) were greater than 1, showing a grouped distribution of *Rosalia alpina* specimens. The slight increase in the degree of aggregation in 2015 may be due to the unfavourable weather conditions (dryness) in that year leading to grouping of *Rosalia alpina* specimens in the more humid and shady habitats.

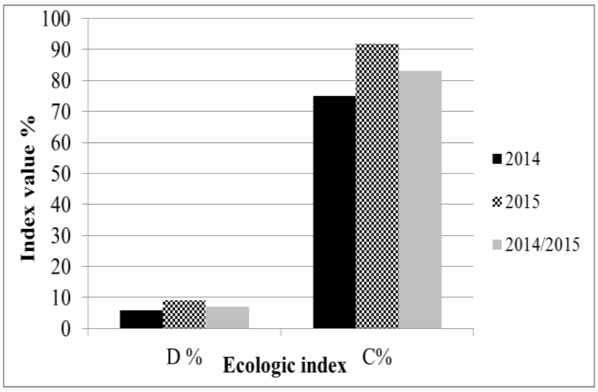

Fig. 6. Dominance (D%) and econstance (C%) of *Rosalia alpina* in MMNP.

Analysing the habitat preference of *Rosalia alpina*, 54.05% of the individuals recorded came from the Seaca Valley, an area characterised by four habitats: Pannonian-Balkanic Turkey oak – sessile oak forests (91M0); Moesian silver lime woods (91Z0); Eastern white oak forests (91AA); and Dacian oak and hornbeam forests (91Y0). The most favourable habitat was Moesian silver lime woods (91Z0), where 24.34% of the *Rosalia alpina* were recorded. In habitat mosaics of Pannonian-Balkanic Turkey oak – sessile oak forests (91M0) and Moesian silver lime woods (91Z0), 21.62% of the total individuals were recorded, this value remaining unchanged during the two years of monitoring (Fig. 7).

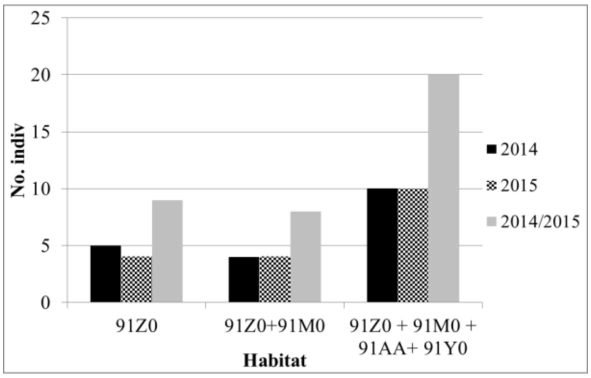

Fig. 7. Distribution of the number of individuals of *Rosalia alpina* considering the habitat, in MMNP.

In 2015, a drought year, the most favourable habitat was the combination of Pannonian-Balkanic Turkey oak – sessile oak forests (91M0) and Moesian silver lime woods (91Z0). Preference for Moesian silver lime woods (91Z0) reduced by 5%, due to beetle migration to more humid and shady habitats near the valleys, with higher cover of Pannonian-Balkanic Turkey oak – sessile oak forests (91M0).

Examining the morphology and exposition of the Măcin Mountains, the habitats described above are normally dominant on slopes with a SW or NE/SW orientation. Over 78% of *Rosalia alpina* individuals recorded during the monitoring programme preferred habitats with a SW exposition (Fig. 8). These preferences for sunny and warmer areas, with moderate air relative humidity, are maintained even if the analysis is made separately for both years of the study.

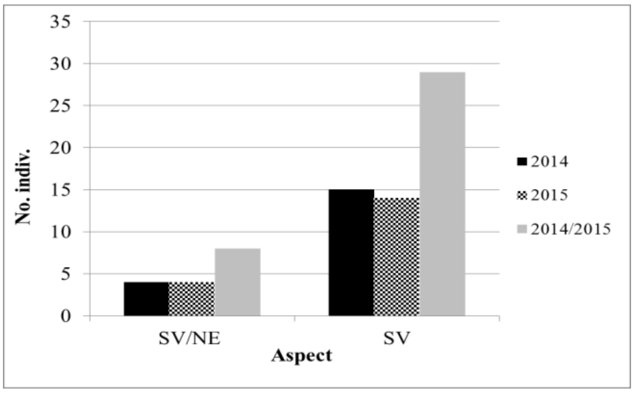

Fig. 8. Distribution of the number of specimens of *Rosalia alpina* in terms of exposition in MMNP.

Studying the results for air and soil temperature, most individuals of *Rosalia alpina* apparently preferred situations where the air temperature exceeds 26°C and the soil temperature 20°C, confirming that this is a thermophilous species, as other researchers have mentioned (Cizek *et al*., 2009; Vrezec *et al.*, 2012). An exception was recorded in 2015 when, due to drought, *Rosalia alpina* preferred a range of air temperatures of 22°C–26°C. The relationship between air temperature and the number of individuals is not a positive linear correlation, since at temperatures over 33°C, the numerical abundance decreases and activity is drastically affected.

The correlation between soil temperature and numerical abundance was not so obvious, its influence being probably indirect, mediated by the relative air humidity. Most individuals (43.24%) were recorded when soil temperature varied between 20°C and 23°C, while 40.54% preferred the interval 24°C ↔ 27°C (Fig. 9). Comparing the two years of study: in 2014, 63% of the total number of individuals were identified when the soil temperature varied between 24°C and 27°C, whilst in 2015, over 50% of individuals preferred the range 20°C ↔ 23°C and only 16.67% the range of 24°C ↔ 27°C.

The relative air humidity was another factor that influenced the dynamics of the *Rosalia alpina* population. The combined data for both years of study revealed that the optimal values of relative air humidity were between 50% and 70% on 64.86% from all beetle individuals (Fig. 10). Examining the two years of data separately, in 2014 the situation was similar to that described above, i.e. 63.16% of the total individuals preferred air relative humidity of 61–70%. In 2015, when the air relative humidity decreased to under 35%, most individuals (45%) were recorded when this climatic parameter had values of 30–50%. In this period, we observed a migration of individuals to more humid habitats, close to the valleys.

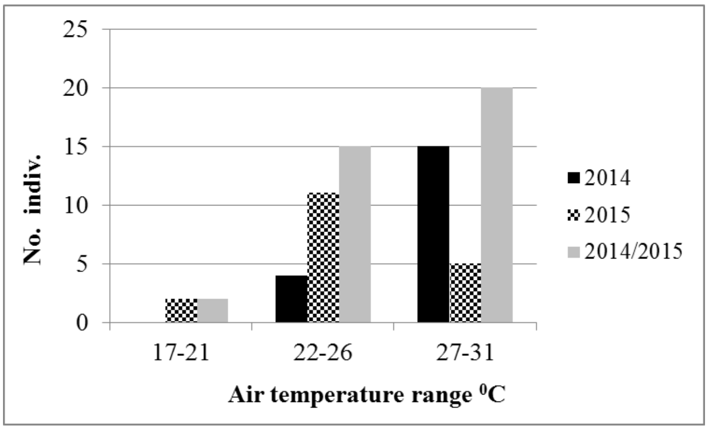

Fig. 9. Distribution of the number of specimens of *Rosalia alpina* relative to air temperature (°C) in MMNP.

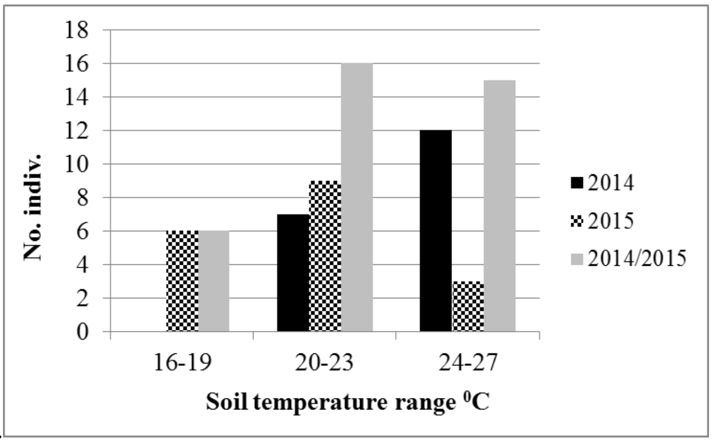

Fig. 10. Distribution of the number of individuals of *Rosalia alpina* relative to soil temperature (°C) in MMNP.

The effect of forest coverage was also analysed. *Rosalia alpina* preferred habitats with 50–60% forest coverage (almost 78% from the total number of individuals in both years) (Fig. 11). In 2015, no individuals were found in habitats with forest coverage less than 50%. This species prefers semi-shade and semi-open areas, characteristic of mature and old forests (Fig. 12).

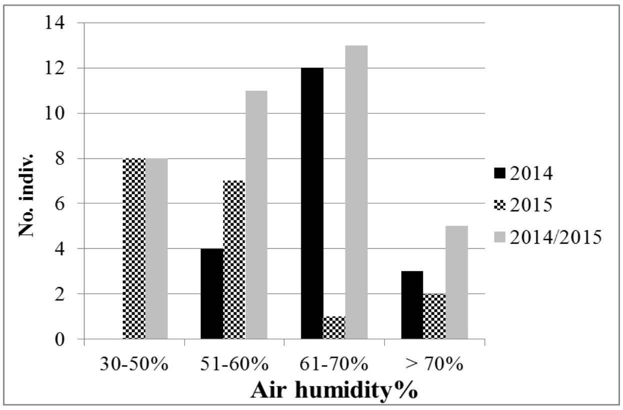

Fig. 11. Distribution of the number of individuals of *Rosalia alpina* in relation to air relative humidity (%) in MMNP.

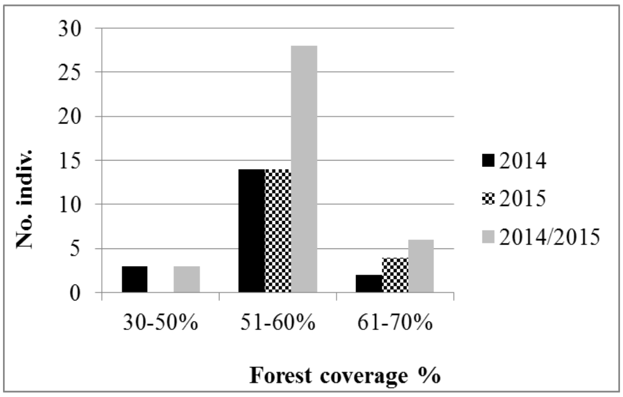

Fig. 12. Distribution of the number of individuals of *Rosalia alpina* relative to forest coverage (%) in MMNP.

Cloud cover was another factor that had a low influence on the dynamics of this species. 83.78% of adult beetles were recorded when the cloud cover was 0–50%. Where values of this parameter were higher, the number of individuals decreased in both years (Fig. 13).

The speed and direction of the wind had no significant impact on the population dynamics of *Rosalia alpina*, given that during the monitoring period, wind speed did not exceed force 2 (3.3 m/s) on the Beaufort scale.

Analysing the annual population dynamics of *Rosalia alpina*, in every year the number of individuals increased from the end of June until the middle of July. After this period, the abundance decreased at different rates in each year (Fig. 14). The decline was more obvious in 2015, probably due to the drought that characterised the monitoring period that year, after which the trend remained constant until early

August, when the study finished. Examination of combined data for the two years revealed a similar situation to that mentioned above.

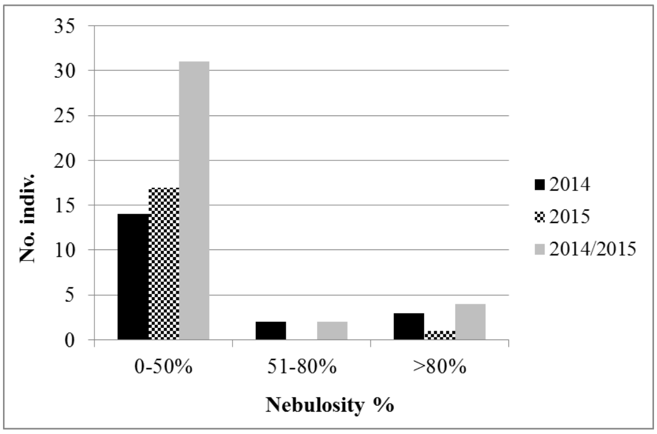

Fig. 13. Distribution of the number of individuals of *Rosalia alpina* relative to cloud cover (%) in MMNP.

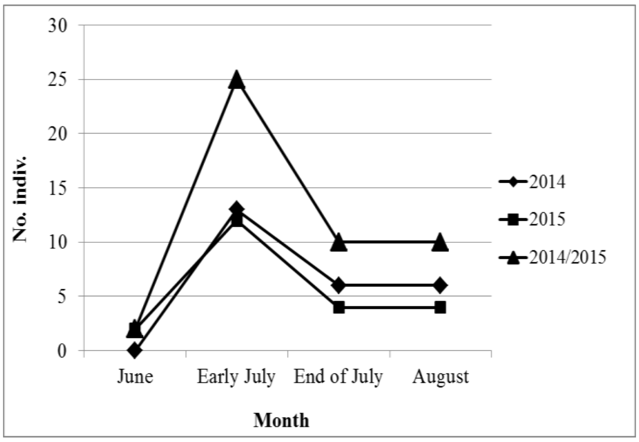

Fig. 14. Monthly dynamics of the number of specimens of *Rosalia alpina* in MMNP.

The same general trend was observed for *Rosalia alpina* population dynamics when each transect is considered separately. In this case, it was easier to observe the influence of environmental factors, which determine variable size of population around lines indicating the trend (Fig. 15).

In 2014, those environmental variables that had the strongest influence on the *Rosalia alpina* population dynamics were air temperature and air relative humidity, but only correlated with other analysed factors.

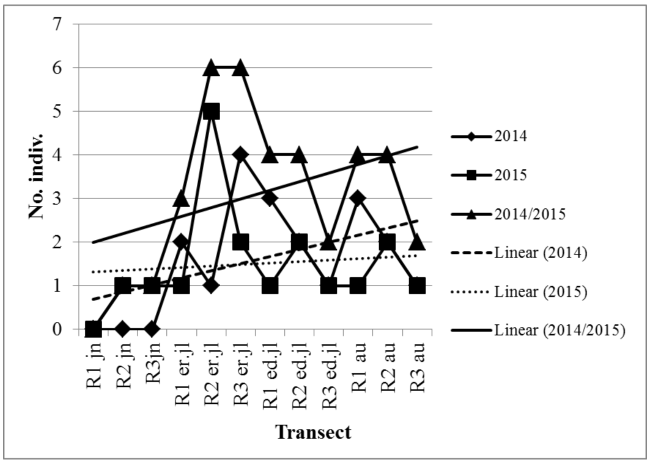

Fig. 15. Spatial dynamics (transect) of the number of individuals of *Rosalia alpina* in MMNP (jn= June; er.jl= early July; ed.jl= end of July; au.= August).

In 2015, the maximum numerical abundance (R2 er.jl) was correlated with an air temperature of 25°C and air relative humidity of 65–75%, in early July. The population decline from the end of July was correlated with temperatures from 25°C to 30°C and with humidity below 50%, values that coincided with the most intense drought. *Rosalia alpina* adapted to this drought by individuals moving to more humid and shaded habitats, close to the river valleys (e.g. in Seaca valley). Unlike the previous year, no specimen was observed in open areas in 2015.

From a conservation point of view, the following main threats were identified for *Rosalia alpina* in MMNP, together with suggested protection measures (Salafsky, 2008):

– the presence of forest roads, which fragment the habitats. It is necessary to decrease both the intensity of use of forest roads and to avoid building new ones. Access to the beetle’s habitat by tourists, domestic animals and vehicles or equipment of any kind must be limited and monitored. The intensity of this threat is low.

– thinning or removing old, dead trees, fallen or standing. As a protection measure we propose forbidding the extraction of any form of timber and the conservation of old, dead trees. Forest cutting should only be made in exceptional cases, and under rigorous control. The present intensity of this threat is medium.

– the presence of solid waste, requiring creation of special places for their collection and disposal, close to the camping areas. This waste must be removed monthly. All these actions must be checked and, when not accomplished, they must be enforced through the law. The present intensity of this threat is medium.

– the presence of a high number of bee-keepers and hives in MMNP is strongly connected with the local waste management. The intensity of this threat is low at present.

CONCLUSIONS

Monitoring the species *Rosalia alpina* in the Măcin Mountains protected area during the summer (June–August) period of 2014 and 2015, using three transects, revealed the presence of 37 individuals. The main environmental variables that influenced the population dynamics of this beetle were: the type of habitat, exposition, air temperature and relative air humidity. The most favourable habitats for this species were Pannonian-Balkanic Turkey oak – sessile oak forests (91M0) and Moesian silver lime woods (91Z0). *Rosalia alpina* preferred slopes gentler than 45°, with a South-west exposition, a warmer climate (27°C–31°C), and relative air humidity of 50–70%. *Rosalia alpina* preferred habitats with forest cover of 50–70%. It prefers the mosaic of semi-shade and semi-open areas that is characteristic of mature, old, deciduous forests that are rich in dead wood.

Ecological indices quantified for *Rosalia alpina* showed that, in the Măcin Mountains protected area, there is a viable population, with potential for future growth. Even in the drought conditions of 2015, the population parameters for *Rosalia alpina* did not drastically change, with the main modification being inversion of the sex ratio, following decreased male activity. Such modification of the sex ratio, arising from natural causes, is temporary and does not affect the long-term viability of the beetle. The annual and biannual dynamics of *Rosalia alpina* population showed a slightly increasing trend, with the exception of 2015, due to the natural drought. Consequently, we recommend a future monitoring programme for at least three years.

From the conservation point of view, the threats to *Rosalia alpina* are of low or medium intensity, and could easily be diminished or eliminated by application of proper management measures. Particular attention should be given to any type of forest cutting. Even where forest cutting has relative low intensity in the Măcin Mountains protected area, it remains a major threat to xylophagous, saproxylic beetles, a threat correlated with removal of old, dead trees, both fallen or standing.

Our main conclusion from the monitoring programme for *Rosalia alpina* (with its statistical analysis of beetle abundance in relation to environmental variables, especially habitat preferences) was that the Măcin Mountains National Park was in favourable condition to ensure the long-term viability of these beetle species of EU Community Interest.

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