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SPECIES COMPOSITION AND ECOLOGICAL STRUCTURE OF THE CARABIDAE FAUNA IDENTIFIED IN A MIXED TREE FOREST FROM BUILA-VÂNTURARIȚA NATIONAL PARK

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Abstract

The Carabidae fauna was collected during April - October 2007 period in two sites from a mixed trees (beech and spruce) located in Bistrița Gorges (Buila-Vânturarița National Park) using a quantitative sampling method. In the two sites (A1and A2) were identified 17 carabid species, 10 of them occurring in both of them. To characterize the carabid populations, were discussed the structure of numerical dominance, constancy classes, species richness, Shannon-Wiener index of diversity, the structure of the carabid populations according to the species ecological and biological characteristics.

Keywords: Carabidae, mixed trees forest, diversity index, Buila-Vânturarița.

1. INTRODUCTION

The beetles (including carabids) are very important cenotic elements in all types of terrestrial ecosystems, and are used in the ecological researches [3]. The studies on the carabid fauna provide information on the ecosystems degree of preservation or deterioration and support the climate change assessment [1], [5], [7], [8] [13]. Carabids are excellent subject for studies of the effects of fragmentation on species with different dispersal abilities and habitat requirements [2], [6].
The Buila-Vânturarița National Park is located in the Buila-Vânturarița limestone massif and covers an area of 4500 ha. The landscape is varied, characteristic to the calcareous mountains. The minimum altitude is of 600 meters, in Bistrița Gorges and the maximum one is of 1885 meters, in the Vânturarița Mare peak. Bistrița Gorges are one of the four key sectors of the park.
The present study represents a contribution to the knowledge of the carabid populations identified in a mixed forest located in Bistrița Gorges.

2. MATERIAL AND METHOD

The carabids were collected in two sites from a mixed tree forest. The mixed forest is mainly formed of *Fagus sylvatica* and *Picea abies,* with rare exemplars of *Abies alba*. The herbaceous layer is poorly represented (*Dentaria glandulosa* and *Salvia glutinosa* species). The mixed forest was planted and it has 40 years. The A1 site is situated at the border of the mixed tree forest.
The carabid fauna was collected monthly from April to October 2007, using Barber traps (450 ml plastic cups with 10 cm diameter) filled with 4% formalin solution). The distance between two such traps was of three meters. In each studied site were placed 9 traps, meaning 81 traps in each studied site, throughout the period of the study. The locations where the traps were set are situated at 650 m altitude.
The collected carabid fauna was determined up to the species level using the identification keys [9], [10], [11], [12], [14], [15]. For each sampling site I have calculated the relative abundance, the frequency (in order to establish the species numerical dominance and the structure of constancy classes).
The diversity of the carabid populations was evaluated using the Shannon-Wiener index of diversity.

3. RESULTS AND DISCUSSIONS

3.1 Numerical abundance, relative abundance and the carabid species frequency

During the study, the captured carabids represented 17 species, 10 of them were common species. The collected carabid fauna counted 268 individuals (109 individuals were captured in A1 site and 159 in A2 location). In A1 sampling area, there were identified 11 carabid species, and in A2 16 species (Table 1).

Table 1: The numerical abundance (No.), relative abundance (Rel. ab. - %), frequency (F - %) of the carabid species from the from the mixed tree forest

SPECIES	A1			A2		
	No	Rel ab. %	F%	No	Rel ab. %	F%
Abax ater (Abax parallelepipedus) (Piller & Mitterpacher 1783)	12	11.01	13.58	25	15.72	22.22
Abax parallelus (Duftschmid 1812)	9	8.26	9.87	8	5.03	8.64
Calosoma (Acalosoma) inquisitor (Linnaeus 1758)				1	0.63	1.23
Carabus (Eucarabus) arvensis (C. arcensis) Herbst 1784	2	1.83	2.46	11	6.92	9.87
Carabus (Tomocarabus) convexus Fabricius 1775	2	1.83	2.47	4	2.52	4.93
Carabus (Procrustes) coriaceus Linnaeus 1758	21	19.27	19.76	18	11.32	17.28

Carabus granulatus Linnaeus 1758				2	1.26	2.46
Carabus (Orinocarabus) linnei Panzer 1813				2	1.26	2.46
Carabus (Eucarabus) ullrichi Germar, 1824	1	0.92	1.23	1	0.63	1.23
Carabus (Megodontus) violaceus Linnaeus, 1758	34	31.19	29.63	35	22.01	34.56
Cychrus caraboides (Linnaeus 1758)	10	9.17	8.65	26	16.35	23.45
Cychrus semigranosus Palliardi 1825	13	11.93	12.34	12	7.55	13.58
Harpalus laevipes Zetterstedt 1828				4	2.52	3.7
Pseudoophonus rufipes (De Geer 1774)				1	0.63	1.23
Pterostichus (Parahaptoderus) brevis (Duftschmid 1812)				1	0.63	1.23
Pterostichus (Platysma) niger (Schaller 1783)	4	3.67	4.94	8	5.03	9.87
Pterostichus (Bothriopterus) oblongopunctatus (Fabricius, 1787)	1	0.92	1.23			

The 268 individuals captured in the two studied sites belonged to 17 species and 7 genera respectively.

3.2 The numerical dominance

The carabid populations identified in A1 and A2 sampling locations were characterized by the presence of 4 eudominant carabid species and 1 dominant in A1 site, 4 eudominant and 2 dominant in A2 site.

In A1 sampling site, I have identified 11 carabid species, among which *Abax parallelepipedus Carabus violaceus, Carabus coriaceus* and *Cychrus semigranosus* were eudominant species, and *Abax parallelus* and *Cychrus caraboides* were dominant.

In A2, of the 16 identified species, 4 were eudominant (*Abax parallelepipedus*, *Carabus coriaceus*, *Carabus violaceus*, *Cychrus caraboides*) and 2 dominant (*Carabus arvensis*, *Cychrus semigranosus*) (Table 1).

The euritopic forest species *Abax parallelepipedus, Carabus coriaceus, Carabus violaceus, Cychrus semigranosus* and *Cychrus caraboides,* were common species for both studied carabid populations.

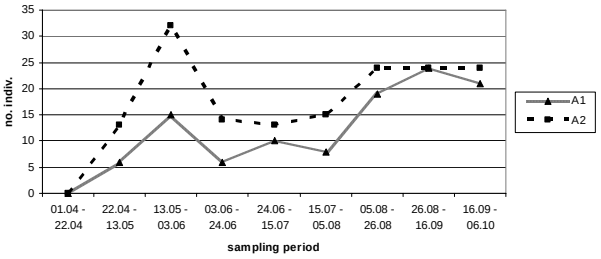

Figure 1. The dynamics of the carabids numerical abundance in A1 and A2 sites

Analyzing the variation of the numerical abundance within the carabid populations captured in A1 and A2 sites from the mixed tree forest, I have noticed that the highest number of individuals, for the carabid population identified in A1, was captured during the April-June period. In the case of the carabids identified in A2 site, the highest value for the numerical abundance was observed during autumn (from August to mid September).

The numerical abundance of carabids identified in A2 site was higher then the one of carabids captured in A1 site throughout the sampling period (Figure 1). This is probably due to the rich food resource present in A2 location.

During summer, the values of the numerical abundance were low and that can be explained by the variations of the abiotic factors (temperature increase and humidity decrease). It is known that the moisture of the soil surface modifies the carabids activity substantially [4].

I have noticed that, in both studied sites, most of the carabid species had low frequency values in samples, which puts them in the accidental species class.

Table 2: The structure of the numerical dominance and the constancy classes for the carabid species from the mixed tree forest

Studied sites	Numerical dominance					Constancy classes			
	SR	R	SD	D	ED	ACC	ACS	CT	ECT
A1 – 11 species	2	2	1	2	4	10	1	-	
A2 – 16 species	4	2	4	2	4	15	1	-	-

Abbreviations: SR-subrecedent; R-recedent; SD-subdominant; D-dominant; ED-eudominant;
ACC-accidental; ACS-accessory; CT-constant; ECT-euconstant.

Considering that most of these species are characteristic to the studied habitats, we can come to the conclusion that it is rather the case of reduced occurrence in samples, than the case of accidental species. This situation can indicate the species dispersion degree, determined by some microclimatic preferences (mainly for temperature and humidity) and food resource needs (Table 2).

In both studied populations, there was no constant species. The accidental species represented 90.90% (10 species) from the total number of carabid species identified in A1. In A2 studied site, the accidental species represented 93.75%, the rest of them being included in the accessory species class (Table 2)

Table 3. The structure of the carabid populations (%) from the mixed tree forest (A1, A2) according to the ecological and biological characteristics of the species

Species characteristics	Sites	
	A1	A2
	%	%
Habitat affinity		
Euritopic forest species	81.81	71.42
Stenotopic forest species	9.09	7.14
Euritopic of open areas species		7.14

Euritopic species	9.09	7.14
Rocky soil species		7.14
Breeding period		
Autumn breeders	45.45	50
Spring breeders	45.45	37.5
Variable	9.09	6.25
Estivating species		6.25
Humidity preferences		
Hygrophilous		6.66
Mesoxerophilous	9.09	20
Mesohygrophilous	90.90	73.33
Temperature preferences		
Mesothermic	37.5	25
Thermophilous	25	25
Low temperature preferences	37.5	50

Analyzing the structure of the carabids according to the species ecological and biological characteristics it can be concluded that the majority of the species were mesohygrophilous euritopic forest species, which preferred low or moderate values of temperature. For the carabid populations captured in A2 site, the predominant species were the autumn breeders, fact suggested also by the high numerical abundance registered during autumn (Figure 1). In the case of the carabids identified in A1, the number of autumn breed species was equal to the one of the spring breeders (Table 3).
High proportions of carabids with preference for low temperature were noticed in A2 site. Analyzing the trophic structure it can be noticed that all captured species were predators.

3.3 The species diversity

The diversity of the carabid populations was evaluated using Shannon-Wiener index of diversity. Although the Shannon-Wiener index of diversity has indicated a higher diversity value for the carabid populations identified in A2 site, the difference was statistically insignificant ($t=0.216$, $\alpha=0.05$). The higher species diversity observed in the case of the carabid populations identified in A2, could be explained by the richer nutritional sources, compared to the one from A1 sampling site (Table 4).
The difference between the theoretical and the observed value for the diversity index was bigger in the case of the carabids identified in A2 site.

Table 4. The Shannon-Wiener index of diversity in the mixed tree forest

Site	A1	A2
Number of species	11	16
Shannon-Wiener index of diversity	1.956	2.270
H max.	2.397	2.772
t ($\alpha = 0.05$)	0.216	

The diversity index values varied from one collecting period to another, for each carabid population (Figure 2). For the carabid population identified in A2, the highest species diversity value was noticed during spring (April-May period). For the carabids from A1 site, the highest value for Shannon-Wiener index of diversity was registered during autumn (August-September), when a decrease of temperature was observed.
During summer (June-July), I have noticed a decrease of the diversity index for both studied carabid populations, due to the climate modifications observed during this period (the high temperature and the low humidity are limiting factors for the ground beetles development), and also due to the estival diapauses.

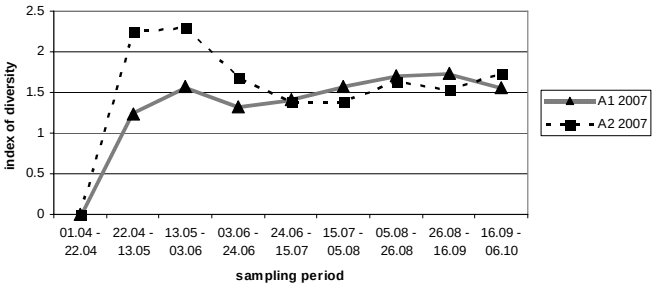

Figure 2. The dynamics of the Shannon-Wiener index of diversity during sampling period, in A1 and A2 sites

The highest contribution to the Shannon-Wiener index of diversity value was brought by *Carabus violaceus* (17.37%) for the carabid populations identified in A1 site. For the carabids captured in A2 sampling area, the highest contribution belonged to *Carabus coriaceus* (33.49%).
With small differences, the variation pattern for the Shannon-Wiener index of diversity was similar for both studied carabid populations.

4. CONCLUSION

In the mixed tree forest (A1 and A2 site) located in Bistrița Gorges there were identified 17 carabid species belonging to 7 genera.
The low numerical abundance observed for *Pterostichus oblongopunctatus* (a species present mainly in forests with high anthropic influences) indicated a high degree of conservation for the mixed forest.
Among the characteristic species used for the ecological monitoring for mixed and coniferous forests, there were identified *Carabus violaceus, Carabus arvensis.*
Both studied carabid populations were characterized by the presence of a small number of (eu)dominant species (4 eudominant carabid species, 2 dominant), and a high proportion of accidental ones. *Abax parallelepipedus Carabus violaceus, Carabus coriaceus* were common eudominat species (sylvicolous species).
The mesohygrophilous euritope forest species with preference for the low or moderate values of temperature were predominant in the mixed tree forest.
Analyzing the trophic structure it can be noticed that all captured species in the mixed tree forest were predators.
For both carabid populations it can be noticed a similar patterns of variation in time for carabids numerical abundance and also for index of diversity values.
The Shannon-Wienner index of diversity values indicated higher species diversity for the carabid populations captured in A2 site.

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