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COMPARATIVE DATA CONCERNING THE CARABID POPULATIONS DYNAMICS IN A MIXED TREE FOREST (BUILA-VÂNTURARIȚA NATIONAL PARK)

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ABSTRACT. The paper presents the dynamics of the carabid populations identified in a mixed tree forest on a period of 2 years (2006-2007), from April till October. The mixed tree forest is located in Bistriţa Gorges, in the western part of the Buila-Vânturariţa National Park. Within the forest I have identified 19 carabid species belonging to 6 genera, 12 species were common, being captured in 2006 and 2007. The studied populations were characterized by a small number of eudominant species: 4 eudominant carabid species and 2 dominant ones in 2006 and 4 eudominant carabid species and 3 dominant ones in 2007. The majority of the identified species belonged to the accidentally class specie, having low frequency values in samplings. The species diversity of the carabid populations from the mixed tree forest varied widely throughout the years, influenced by the abiotic factors. The quantitative and qualitative composition of the carabid populations was determined: number, seasonal dynamics, mean individual biomass, Shannon-Wiener index of diversity.

Keywords: diversity, carabid population, mixed forest

INTRODUCTION

The Buila-Vânturariţa National Park, found in 2004, is also a site of the European Ecologic Network Nature 2000 was. The Buila-Vânturariţa Massif is located in the central-northern part of Valcea County.

The Buila-Vânturariţa Massif lies from the western corner of Bistriţa Gorges to the eastern corner of Olăneşti Gorges. Bistriţa Gorges are one of the four gorges sectors from the park, located in the south-eastern part of the park.

The National Park is configured as a line in length, 14 km long and 0.5 to 2.5 km wide, (due to the expansion of Jurassic limestone).

There are only few ecological studies of carabids in forest ecosystems in Buila-Vânturariţa National Park.

Carabids are all known as extremely sensitive to abiotic and biotic factors; they respond quickly to habitat alteration and can be easily collected using pitfall traps (Avgin&Luff, 2010).

The ground beetles are use as boindicators in studies of the habitats conservation or deterioration status and for environmental predictions concerning the ecosystems tendency (Nitu, 2007).

Carabids are excellent subject for studies of the effects of fragmentation on species with different dispersal abilities and habitat requirements (den Boer 1990, Niemelä et al. 1993).

The breeding period is an important factor affecting the survival of carabid populations, especially in the forests from the temperate zones. Species that breed during the time when the forest management practices are very intense (spring), are affected more that the ones that breed during periods of less anthropic disturbance (autumn) (Magura et al. 1999).

Although forest management affects specialized forest species, the dominance structure does not necessarily change.

The present study represents a contribution to the knowledge of the carabid populations dynamics in a mixed tree forest located in Bistriţa Gorges.

MATERIALS AND METHODS

The fauna material was taken on a monthly base during April-October 2006 and 2007 in a mixed tree forest from Bistriţa Gorges (Buila-Vânturariţa National Park).

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.

In order to collect the ground beetle fauna, I used pitfall traps (plastic cups of 450 ml and with a 10 cm diameter) filled with a 4% formalin solution. The captured fauna was placed in tubes with 70% alcohol.

In order to be weighed, the fauna was partly dried out with filter paper.

In the studied habitat were placed 9 traps (meaning 81 traps for each study period). The distance between two traps was about three meters.

The collected carabid fauna was determined up to the species level using the identification keys (Jeannel, 1941, 1942; Trautner, 1986; Hůrka, 1996; Panin, 1955).

To characterize the dynamics of the carabid populations throughout 2006-2007 period, I have determined the number on individual for each identified species, the relative abundance, (in order to establish the numerical dominance), the Shannon-Wiener index of diversity. Every species was weighed separately. I also determined the mean individual biomass (MIB) by dividing the total biomass of a species to the number of individuals of that species.

For the studied area, the temperature varied from the monthly mean value of 10.6 ^{0}C to 18.88^{0}C in 2006 and from 10.9^{0}C to 23.27^{0}C in 2007. Also, the monthly mean values for humidity varied form 90 mm to 94 mm in 2006 and from 80.75 mm to 94.25 mm in 2007.

Knowing that the carabids distribution depends on several abiotic factors such as temperature, humidity, food resources presence and distribution of competitors (Lövei and Sunderland 1996, Hristovski et. Al 2005), the correlation coefficient "r" was calculated between carabids numerical abundance the values registered for temperature and humidity. The obtained values were tested for significance using Student Test ($\alpha = 0.05$).

RESULTS AND DISCUTIONS

Numerical abundance, frequency and species relative abundance

Of the total 19 captured species throughout the studied period, 12 of them were common species identified in both studied period. The collected carabid fauna counted 263 individuals in 2006 and 128 individual in 2007 (Table 1). In 2006 were identified 18 species and during 2007 were captured only 14 species. The highest number of individual and majority of the species were captured during 2006. This can be explained by the higher humidity value and low temperature registered during 2006 in contrast with to the abiotic factors values noticed in 2007.

Table 1

The numeric abundances (no.ind.), frequency and relative abundances values during 2006 and 2007

SPECIES	No. Ind.		Frequency values (%)		Relative abundance values (%)	
	2006	2007	2006	2007	2006	2007
Abax ater (Abax parallelepipedus) (Piller & Mitterpacher 1783)	52	24	38.3	23.5	19.77	18.75
Abax parallelus (Duftschmid 1812)	23	16	21	17.3	8.74	12.5
Carabus (Eucarabus) arvensis (C. arcensis) Herbst 1784	29	7	22.2	7.4	11.02	5.47
Carabus (Autocarabus) cancellatus Illiger 1798	2	1	2.46	1.23	0.76	0.78
Carabus (Tomocarabus) convexus Fabricius 1775	3	4	3.7	4.94	0.76	3.13
Carabus (Procrustes) coriaceus Linnaeus 1758	4	9	4.93	9.88	1.52	7.03
Carabus granulatus Linnaeus 1758	1		1.23		0.38	
Carabus (Chaetocarabus) intricatus Linnaeus 1761	2		2.46		0.76	
Carabus (Oreocarabus) glabratus Paykull 1790	9	2	6.17		3.42	
Carabus (Orinocarabus) linnei Panzer 1813	8		8.64	2.47	3.04	1.56
Carabus (Eucarabus) ullrichi Germar, 1824	5	1	3.7	1.23	1.9	0.78
Carabus (Megodontus) violaceus Linnaeus, 1758	52	34	37	27.2	19.11	26.56
Cychrus caraboides (Linnaeus 1758)	24	10	21	9.88	9.12	7.81
Cychrus semigranosus Palliardi 1825	39	13	21	13.6	14.82	10.16
Harpalus affinis (H. aeneus) (Schrank 1781)		1		1.23		0.78
Harpalus tardus (Panzer 1796)	1		1.23		0.38	
Molops piceus (Panzer 1793)	1	2	1.23	2.46	0.38	1.56
Pterostichus (Parahaptoderus) brevis (Duftschmid 1812)	1		1.23		0.38	
Pterostichus (Platysma) niger (Schaller 1783)	7	4	6.17	4.94	2.66	3.13

The studied populations were characterized by a small number of eudominant species: 4 eudominant carabid species (*Abax parallelepipedus*, *Carabus violaceus*, *Carabus arvensis*, *Cychrus semigranosus*) and 2 dominant (*Abax parallelus*, *Cychrus caraboides*) in 2006, 4 eudominant carabid species (*Abax parallelepipedus*, *Carabus violaceus*, *Abax parallelus*, *Cychrus semigranosus*) and 3 dominant ones (*Carabus arvensis*, *Carabus coriaceus*, *Cychrus caraboides*) in 2007. The majority of the identified species belonged to the accidentally class species (88.8% of the carabids identified in 2006 and 93.75% of the carabids captured in 2007), having low frequency values in samplings. 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

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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.

The presence of 6 (eu)dominant carabid species in 2006 site and 7 (eu)dominant species in 2007, leads to the assumption that those species are less sensitive to variations of abiotic factors (Table 1).

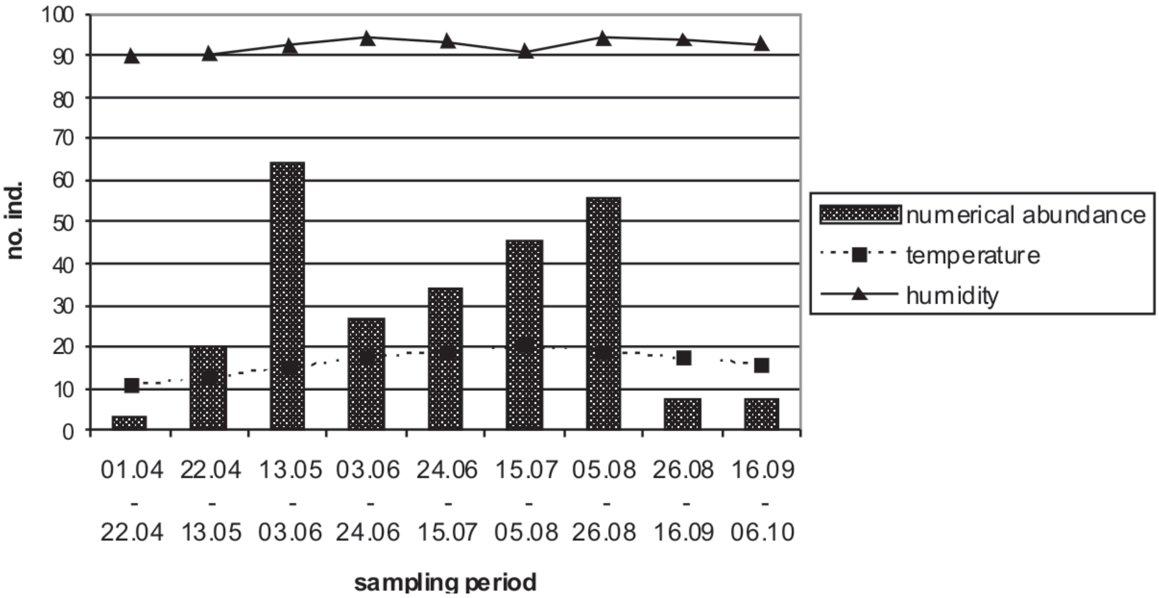

Fig. 1 The dynamics of the carabids numerical abundance during 2006

The dynamics of the species numerical abundance was similar in 2006 and 2007. The abiotic factors influences were obvious during the studied periods. In 2006, the numerical abundance had maximum values during spring and at the end of the summer when the temperature registered a decrease and the humidity an increase (Figure 1).

A similar situation was observed also during 2007, except that, during spring, the carabids numerical abundance was very low compared to the one registered in 2006 (Figure 2).

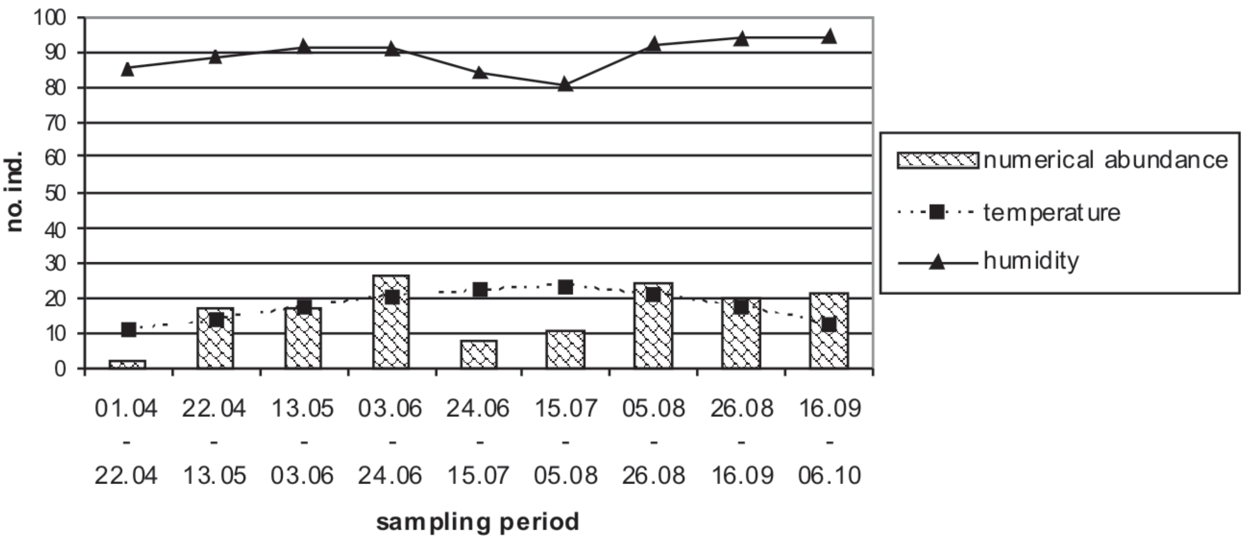

Fig. 2 The dynamics of the carabids numerical abundance during 2007

Among the (eu)dominant species identified in the carabid populations structure during 2006 and 2007, three of them were common: *Cychrus semigranosus, Carabus violaceus, Abax parallelepipedus*.

Analyzing the annual dynamics of *Abax parallelepipedus* for 2006 and 2007, it can be noticed a higher numerical abundance in 2006. In 2006 there were two peaks of numerical abundance, one during May-June period and one, higher, during summer. In 2007 the highest numerical abundance was observed during May-June (Figure 3).

If in 2006, during summer, the numerical abundance registered a maximum value, in 2007, in the same period, the numerical abundance was very low. It must be emphasize that during 2007 the temperature was higher and the humidity was lower comparing to the abiotic factors values noticed in 2006. In view of these facts it can be concluded that the abiotic factors are very important in the carabids dynamics, influencing (directly or by influencing the food resources) their development. It is well known that the carabids activity is influences by the variation of the climatic factors (Honěk, 1997).

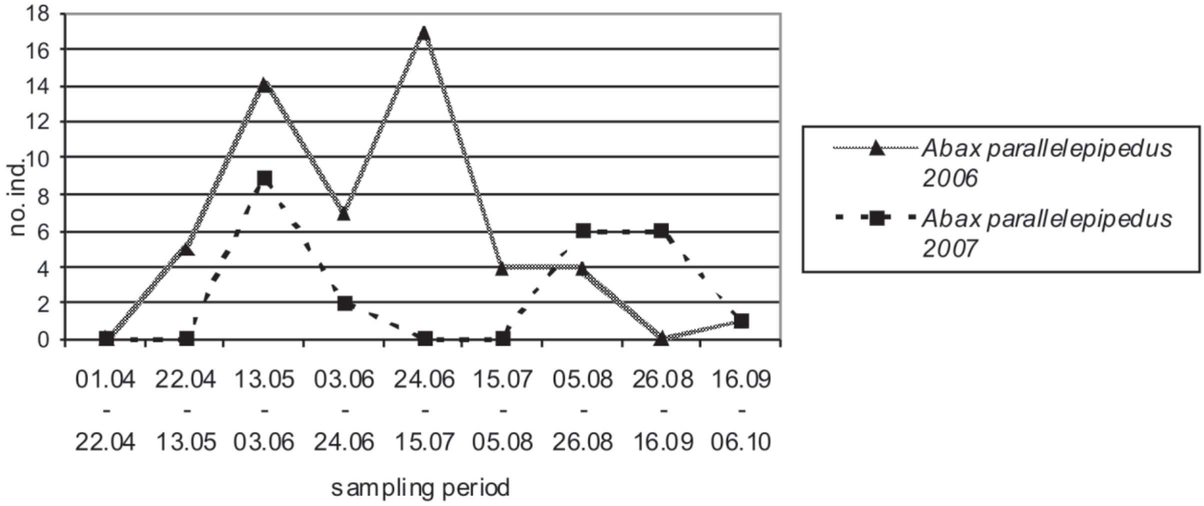

Fig. 3 The dynamics of the numerical abundance of *Abax parallelepipedus* during 2006 and 2007

In the case of *Cychrus semigranosus*, the variation pattern was similar for 2006 and 2007, with a small increase of numerical abundance during May-June period and a maximum point registered in August. (Figure 4).

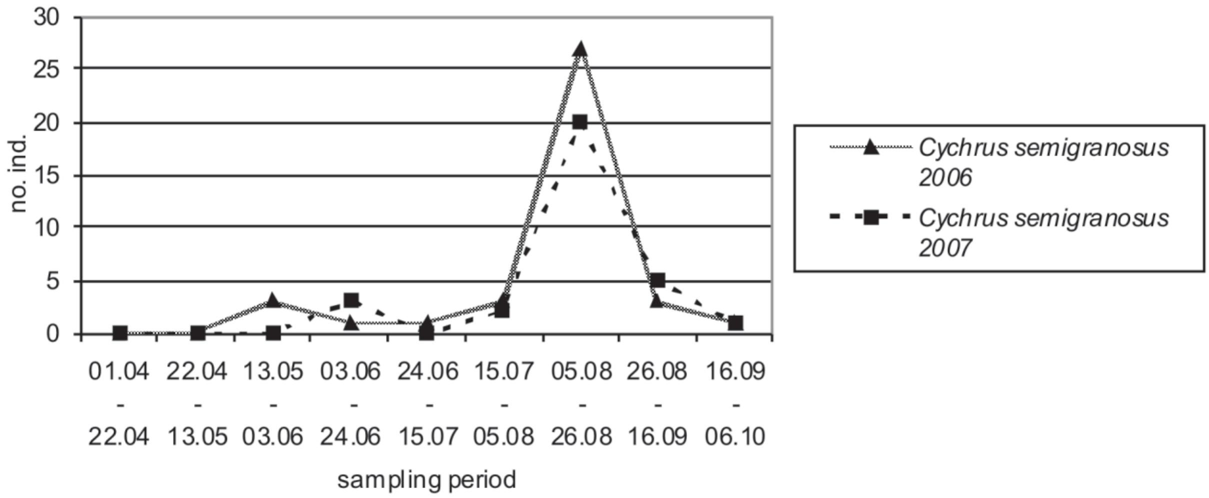

Fig. 4 The dynamics of the numerical abundance of *Cychrus semigranosus* during 2006 and 2007

A similar situation was noticed also for *Carabus violaceus* (Figure 5). The high numerical abundance registered during August can be explained by the species breeding period, both species being autumn breeders.

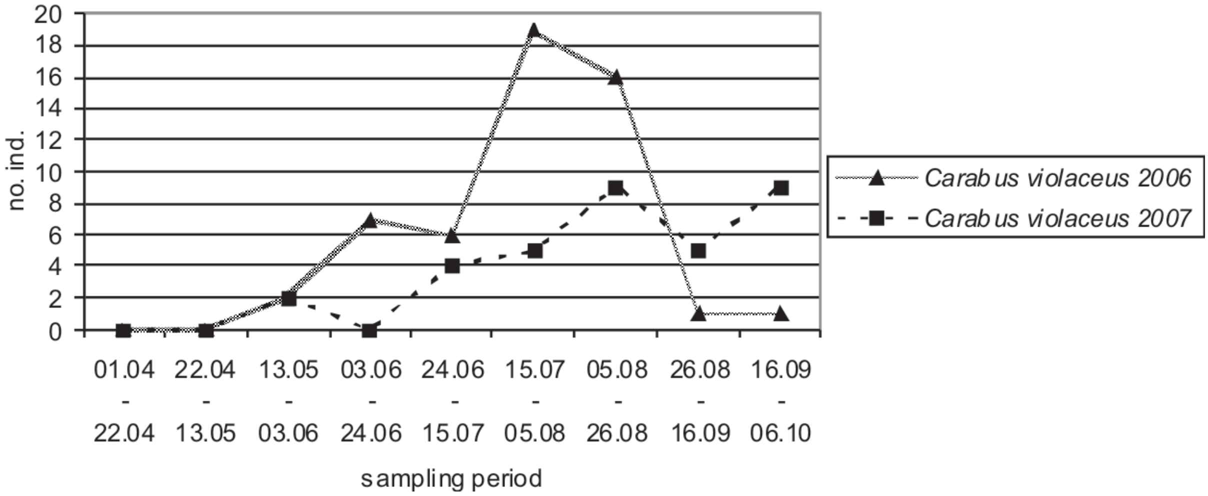

Fig. 5 The dynamics of the numerical abundance of *Carabus violaceus* during 2006 and 2007

Analyzing the values of the correlation coefficient calculated between the abiotic factors (humidity and temperature) and the numerical abundance of the carabids identified in the mixed tree forest during 2006, it can be noticed that there was a positive correlations for temperature, the values of these climatic factor encouraging the ground beetles development (the correlation was statistically significant, r = 0.487, α = 0.05). In the case of the abiotic factors values registered in 2007 and the carabids numerical abundance, the correlation was positive for humidity (the correlation was statistically significant, r = 0.694, α = 0.05).

According to the species ecological characteristics in both studied periods (2006 and 2007), the majority of the species were euritop forest species, with preference for moderate values of temperature and humidity. Most of the carabids were spring breeding predacious species.

Dynamics of the carabids mean individual biomass (MIB)

Analyzing the variations of the MIB during sampling period, it was noticed that, in 2006, the highest value was registered during spring and early summer (May-June). In the case of the carabid populations identified during 2007, unlike the ones captured in 2006, I noticed a maximum value for MIB during August. The MIB dynamics was similar to the one of the numeric abundance of the species: a peak observed in May-June and during August and a slow decrease during summer (Figure 6). This is due to the abiotic factors influence. The climate factors exert a direct influence on carabid development, and an indirect one, on their food resources (Thiele, 1977).

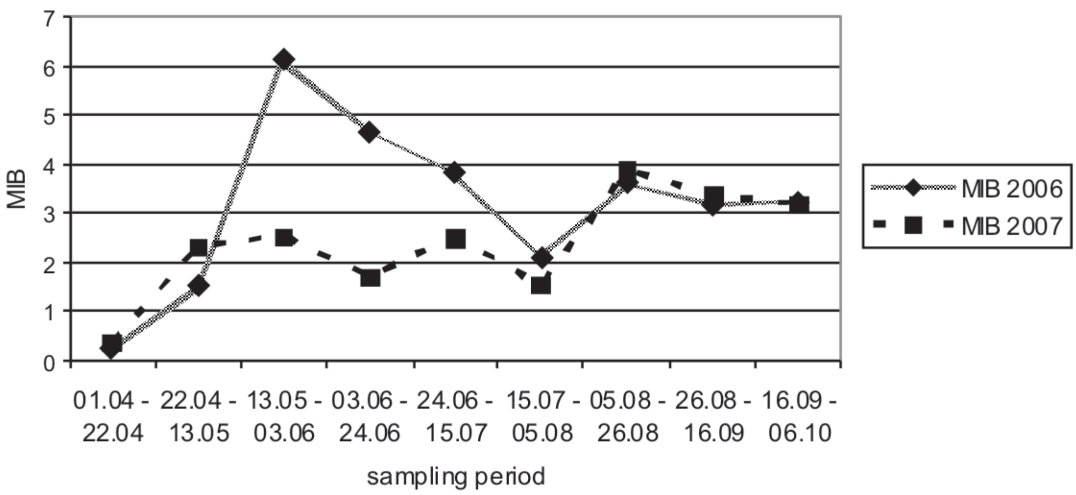

Fig. 6 The dynamics of the MIB of the carabid populations during sampling period in 2006 and 2007

The total MIB value calculated in the case of the carabids captured in 2006 were higher then the total MIB value of the ground beetles identified in 2007. This can be explained by the higher number of species and the higher numerical abundance observed during 2006 in the mixed tree forest, and also by the plentiful food resource found in 2006.

The highest contribution to the total MIB of the carabids captured during 2006 was brought by the eudominant species *Carabus violaceus*. For the next year, the highest contribution belonged to *Carabus coriaceus*.

Analyzing the annual dynamics for the common (eu)dominant carabid species, in the case of *Abax parallelepipedus* it was noticed a peak registered during August in 2007. The highest value observed in 2006 was registered in September-October period, when the MIB values for 2007 registered a decrease (Figure 7).

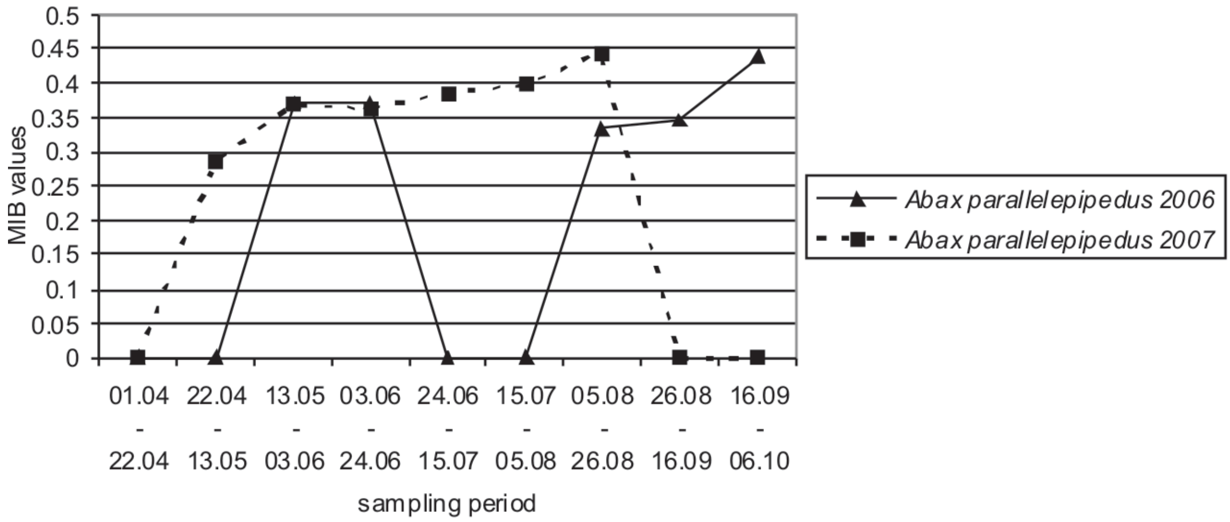

Fig. 7 The dynamics of *Abax parallelepipedus* MIB during sampling period in 2006 and 2007

For *Cychrus semigranosus,* during 2006, the MIB values registered a peak in August-September. High values were noticed also during spring. The lowest values were noticed in July-August (Figure 8). In 2007, the maximum value was observed during July-August period.

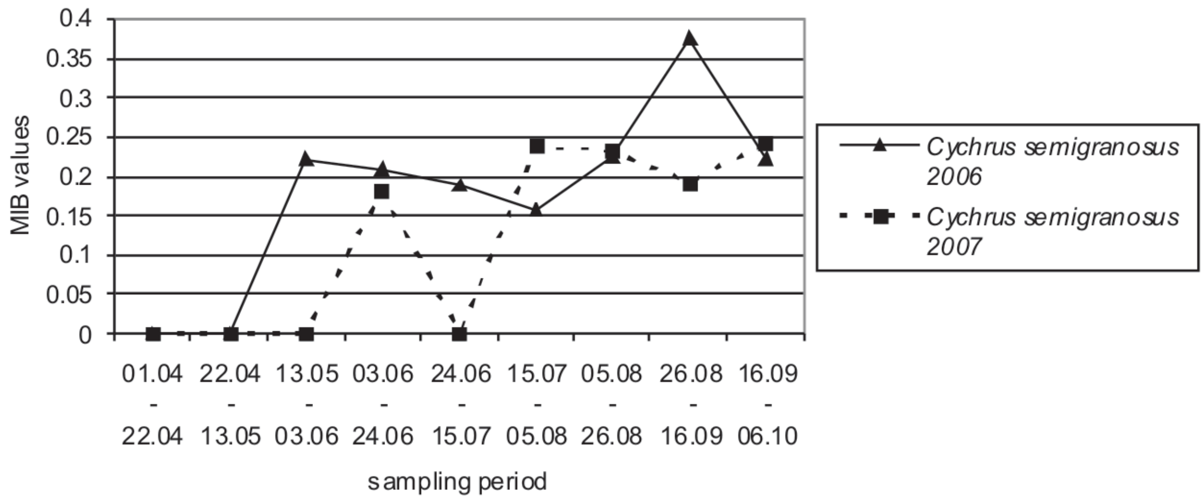

Fig. 8 The dynamics of *Cychrus semigranosus* MIB during sampling period in 2006 and 2007

In the case of *Carabus violaceus*, the annual dynamics of MIB in 2006 indicated a peak in September-October period, while the highest value registered in 2007 was observed during August (Figure 9).

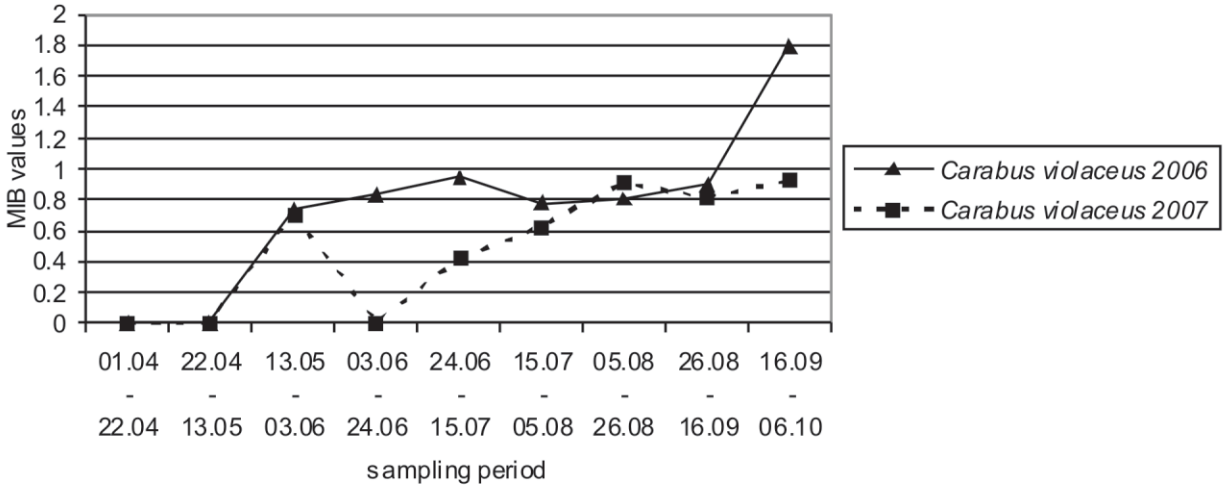

Fig. 9 The dynamics of *Carabus violaceus* MIB during sampling period in 2006 and 2007

Dynamics of the Shannon Wiener index of 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 population captured during 2006, the difference was statistically insignificant (t=0.188, α=0.05). The higher species diversity observed in the case of the carabid populations identified during 2006, could be explained by the higher number of species and high numerical abundance registered in 2006, compared to the ones from 2007.

Studied period	No. Of species	Shannon-Wiener index of diversity (H')	H max	T (α=0.05)
2006	18	2.262	2.89	0.188
2007	14	2.163	2.639	

Table 2. The Shannon-Wiener index of diversity in the mixed tree forest during 2006 and 2007

The diversity index values varied a lot during sampling period (2006 and 2007) (Figure 10). The pattern of variation in 2006 and 2007 was similar, with high values of diversity registered during spring. During July, in both cases I have noticed a decrease of the diversity index for the captured carabid populations, due to the climate modifications from this period (the high temperature and the low humidity values). In July-August there was a slight increase of the diversity index values, followed by a decrease at the end of the study period.

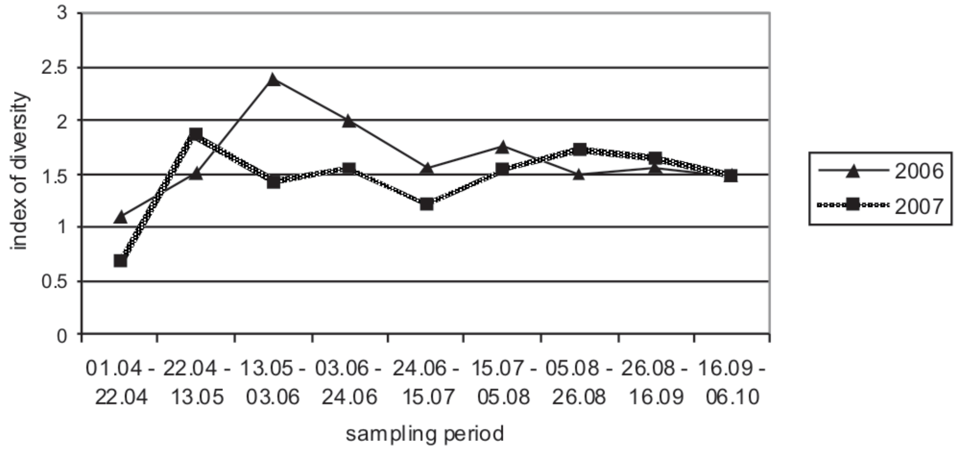

Fig. 10 The dynamics of the Shannon-Wiener index of diversity during 2006 and 2007

CONCLUSIONS

In the studied mixed tree forest located in Bistriţa Gorges, during the two years of study, there were identified 19 carabid species (18 species in 2006 and 14 species in 2007), 12 of them being common.

Both studied carabid populations (the one identified during 2006 and the one identified in 2007) were characterized by the presence of a small number of (eu)dominant species (4 eudominant species *(Abax parallelepipedus, Carabus violaceus, Carabus arvensis, Cychrus semigranosus)* and 2 dominant *(Abax parallelus, Cychrus caraboides)* in 2006, 4 eudominant carabid species *(Abax parallelepipedus, Carabus violaceus, Abax parallelus, Cychrus semigranosus)* and 3 dominant ones *(Carabus arvensis, Carabus coriaceus, Cychrus caraboides)* in 2007.

Most of the carabid species identified in the mixed tree forest during 2006 and 2007 were euritop forest species, with preference for moderate values of temperature and humidity. Most of the carabids were spring breeding species.

The majority of the identified species belonged to the accidentally class species having low frequency values in samplings.

In both cases a high numerical abundance was observed during spring and early summer. The numerical abundance of the carabid populations captured during 2006 was higher then the one of the carabids identified in 2007.

The highest contribution to the total MIB of the carabids captured during 2006 was brought by the eudominant species *Carabus violaceus*. For the next year, the highest contribution belonged to *Carabus coriaceus*. The (eu)dominant species had high contribution to the total MIB.

The species diversity of the carabid populations captured during 2007 was lower in the case of the ground beetle populations identified in 2006, but the differences were statistically insignificant.

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