Analele Ştiinţifice ale Universităţii „Al.I.Cuza” Iaşi, s. Biologie animală, Tom L, 2004

VARIATION OF THE SPECIES DIVERSITY OF CARABIDAE (COLEOPTERA, CARABIDAE) IN TWO VEGETAL ASSOCIATIONS IN THE BÂRNOVA FOREST, IAŞI (EAST OF ROMANIA)

BY

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Key words: forest ecosystems, vegetal associations, carabids , taxonomic structure, relative abundance,structure of dominance, Shannon index, Sorrensen,s coefficient, ecological preferences of species.

The paper is a synthesis of the results of knowledge of species variation and the number of individuals in the Querco-petreae-Tilio-Carpinetum and Carpino-Tilio-Făgetum vegetal associations from the Bârnova forest during the years 1983,1992, 2000. The material was collected from eight sites,using 10 - 12 pitfalls in each site. The number of species, the number of specimens afferent to species , the dominance structure of species , the Shannon index values and equitability present local and annual variations depending on the interaction of ec ological factors, mainly humidity. The paper includes tables with quantitative data and ecological characteristics of species.

Introduction

Moldova is a territorial area in eastern part of Romania and represents 10 % of its surface. Its main relief forms are: mountains,plateau, hills, plain.The hills are included in the geographical unity ,the Moldavian Plateau. The hills and the mountains are covered by forests.Depending on the altitude of relief and climate (solar radiation, temperature, precipitations) mixed (deciduous) forests, beech forests, mixed forests (beech and coniferous), coniferous forests are differentiated. Between the average altitude limits of 300 and 600 m the deciduous forest is developed. Within the framework of the deciduous forest, depending on altitude, the exposures of biotope (particularly southern and northern) associations of trees are differentiated. The main trees associations are: Querco- Tilio-Carpinetum şi Carpino-Tilio-Făgetum

The Bârnova forest massif belongs to the county of Iaşi which occupies a central-eastern position in Moldova. The Iaşi county has a surface of 5441 square kilometres representing 2.3 % of the country surface.

The territory of the Iaşi county includes two main forms of mesorelief: Plateau and plain. The west-northen part of the county is ocupied by the Suceava Plateau

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and the south part is occupied by the Moldavian Central Plateau.Each plateau represents 25 % of the county surface. The average altitude of the Suceava Plateau is 400 m and of the Moldavian Central Plateau is 350 m.

The second relief form is the Moldova Plain (The Jijia – Bahlui Depression) which occupies the central eastern part of the county , representing a fourth of the county surface. The average altitude is 150 m

Bârnova is a mixed, deciduous forest located in the northern –east part of the Moldavian Central Plateau , at 15 km away south of the town of Iaşi.From geographical point of view , the forestry massif is located in the transition geographical zone, the Moldova Plain geographical unity and the Moldavian Central Plateau called the „Coasta Iaşului. (structural abrupt). The altitude of the Moldavian Central Plateau ranges from 200 to 400 m.

The main trees associations in the Bârnova forerst are: Querco petreae–Tilio-Carpinetum şi Carpino-Tilio-Făgetum.Quercus petreae is a mesoxerophilous tree.Fagus silvatica is a mesophilous tree. In the Bârnova massif the Carpino-Tilio-Făgetum associations predominates. Within the associations, the proportion of trees are variable in unity with the concrete ensemble of main abiotic factors (temperature, humidity, slope) .For example, the participation proportion of the evergreen oak (Quercus petraea) within the association is from 12 % (north-east exposure, altitude 220 m) to 44 % (northern exposure, altitude 220 m).The participation proportion of the hornbeam (Carpenus betulus ranged from 36 % (northern exposure, altitude 220 m) to 73 % (north-west exposure, altitude 230 m) (Table no 1).

In general , the flora from these two associations is made up of 56.9 % (mesophytous plants), 24.9 % (mesoxerophytous plants),16.6 % (mesohygrophytous plants).

The annual average temperature is variable.Thus, the average temperature for five years (1978-1982) was 9.5 C degrees, 1983, 10.4 C degrees, l992, 8.5 C and in the year 2000, 11.8 C

The total annual amount of precipitations is also variable. The annual average for five years (l978-l982) was 618.3 litres per square metre but in the year 1983 (a droughty and warm year) only 456 litres per square metre were registered, in 1992, 550 litres per square metre.

In the Bârnova forest , the structure of the carabid coenosis (subfamilies, genera, species, structure of dominance, Shannon index in those two tree associations) was investigated by Varvara M. and Varvara V. (1991).

Taking into account the variation of the amount of precipitations and temperature, the present paper has as main objective to present a synthesis of results of the collected material in the years: 1983 (Sites I,VI,VII), 1992 (Sites II,III,IV,V) and 2000 (Site VIII) because the repetition of a scientific research in the same ecosystem and in the same locality or different localities has the value of an experiment to find the similitudes and differences as to diversity of carabids.

Material and method

To find the influence of habitat conditions on the fauna of carabids, for the collecting of material eight sites were chosen (different as to altitude, exposure, etc) in those two associations. The first five sites (stationaries) were placed in the Querco-petreae-Tilio-Carpinetum association (l983,l992) and the last three sites werre placed in the Carpino-Tilio-Făgetum association which predominates in the Bârnova forest.

The main characteristics of the sites referring to associations, altitude, exposure, soil, annual average temperature ,annual precipitations , of which the material was collected and the years of collecting, are given in table no 1.

Table no. 1. Ecological characteristics of the sites

		I	II	III	IV	V	VI	VII	VIII
1	Years	1983	1992	1992	1992	1992	1983	1983	2000
2	Phytocoenosis	1	1	1	1	2	3	3	3
3	Altitude	200	220	220	170	230	340	380	380
4	Slope	18-20	15	20	10	5	10-20	5-8	5-8
5	Exposure	S.V.S.E	N	N.E	N.E	N.V	V.S.V	S	N
6	Av.Temp.year	10.4	8.4	8.5	8.8	8.4	10.4	10.4	9
	Precipitation year	456	550	550	550	550	456	456	600
7	Soil	brown	brown	Argilo-iluvial pseudog.	brown	brown	brown	brown	brown
8	Age of trees (years)	111	121	120	120	121	111	111	128

1= Querco-Petreae-Tilio-Carpinetum; 2 = Querco-Petreae-Carpinetum;3 = Carpino-Tilio-Făgetum

S = south; V = west ; N = north; E = east

The material was collected using the method of soil pitfalls with preserving liquid (3 % formol solution). This method is widely used in faunal and ecological researches of epigeic carabids.

The capacity of pitfalls was 800-1000 cm 3 , the height 11 cm and the diameter 7 cm .The pitfalls were protected from rainfalls by special lids. Between the lid and the opening of the pitfall there was a distance of five cm In each year and each site 10- 12 pitfalls were used, a number considered optim for the collecting of all categories of species both with small numbers (subrecedent, recedent species) and also with large numbers (eudominant, dominant species).

In sites, the pitfalls were set on three rows, each row having four pitfalls. The distance between rows and pitfalls was 5-6 m.

The pitfalls were placed in the month of April and functioned in ecosystems from April to September inclusive. Thus, a permanent operation was realized for 153 days. Table no 2.

Table no 2. Number of pitfalls, limits of functioning and number of collectings

Associationa	Site	Pitfalls	Functioning data	Total days	Collectings
Querco-petreae-Tilio-Carpinetum					
1983	I	12	18 April-15 Sept	151	14
1992	II	10	20 April-21 Sept.	155	10
1992	III	10	20 April-21 Sept	155	10
1992	IV	10	20 Aril-21 Sept	155	10
Querco-Petreae-Carpinetum					
1992	V	10	20 April-21 Sept	155	10
Carpinino-Tilio-Fagetum					
1983	VI	12	18 April-15 Sept.	151	14
1983	VII	12	18 April-15 Sept	151	14
2000	VIII	12	18 April-15 Sept.	151	9

The collecting of the material was made decadally and bimonthly of each pitfall.

For the characterization of the carabid coenoses (carabid communities) we have used the following parametres: relative abundance, dominance, Shannon diversity index,evenness, Sorensen,s similitude coefficient .

Nomenclature of species according to Freude,Harde , Lohse (1974).

Results obtained

Diversity and structure of the carabid coenosis

In general, from those two vegetal associations 50 species of carabids were collected (gama diversity) with a variation between 24 and 30 species. (alfa diversity) Table no 3.

In total, in the Querco-petreae –Tilio-Carpinetum association, 44 species were collected with local variation between 25 –28 species . In Carpino-Tilio-Fagetum , 37 species were collected with a variation between years from 24 to 30 species.

13 species (26 %) were collected in all the researching years:*Carabus coriaceus, C. glabratus, C. cancellatus, C.ullrichi, C. arvensis ,C. excellens , Cychrus semigranosus, Pterostichus oblongopunctatus, Abax parallelus, Abax parallelepipedus, Abax carinatus, Molops piceus, Aptinus bombarda*. These species are eudominant, dominant or subdominant . Their total number of specimens represents 90.8 % of the total collected individuals of Carabidae . They are forest,mesophilous or mesohygrophilous species. (Carabus arvensis,Cychrus semigranosus, Pterostichus oblongopunctatus).

11 species (22 %) were collected only in the Querco-petreae-Tilio-Carpinetum association. These are: *Carabus variolosus, Ophonus nitidulus, Harpalus signaticornis,Harpalus distinguendus ,Pterostichus anthracinus, Anchomenus dorsalis ,Amara similata, A. convexior, Panagaeus crux major, Brachinus explodens, Brachinus crepitans*. All these are subrecedent species. Their total number of individuals represents just 1.26 %.

Seven species (14 %) were collected only in the Carpino- Tilio-Făgetum association. These species are: *Carabus violaceus, Leistus piceus, Nebria brevicollis, Harpalus tardus, Chlaenius nitidulus, Badister bipustulatus , Cymindis humeral*is. Also these species are subrecedent. Their total number of individual represents 0.45 % . In this association ,the soil humidity degree is higher, indicated by the occurrence of mesohygrophilous species*: Leistus piceus, Nebria brevicollis,Chlaenius nitidulus* . Table no 9.

In the Querco – petreae – Tilio - Carpinetum association (1983,1992) , 17 species were common (38.6 % in comparison with the total number of species found only in this association) with four species more to the common species in those two associations. These species are. *Calosoma inquisitor, Notiophilus biguttatus, Harpalus latus, Harpalus atratus.* The total number of individuals of the common species in this association represents 94.4 %.

In the Carpino-Tilio-Făgetum association (1983, 2000) , 18 species were common (48.6 %) with five species more in comparison with the common species in both associations.These species are: *Carabus convexus, Leistus piceus, Pterostichus niger, P.melanarius, Platynus assimilis*. The species are meso and mesohygrophilous (Leistus piceus, Pterostichus niger, Platynus assimilis). The total number percentage of individuals of those 18 common species is 95.4 % , a percentage practically equal to that from the Querco-petreae-Tilio-Carpinetum association.

The species, their relative abundance is shown in table no 3.

Table no 3. The species of Carabidae and their realative abundance in those eight sites in the Bârnova deciduous forest

	Species /sites	1	II	III	IV	V	VI	VII	VIII	T
1	Calosoma inquisitor	2	4	6	7	5	-	3	-	27
2	Carabus coriaceus	39	93	85	56	68	80	25	109	555
3	C. convexus	-	-	14	29	2	4	2	50	101
4	C. glabratus	3	6	1	2	5	138	10	10	175
5	C. violaceus	-	-	-	-	-	-	3	-	3
6	C. variolosus	-	-	1	2	1	-	-	-	4
7	C. cancellatus	95	499	309	249	110	24	66	44	1396
8	C. ullrichi	16	185	251	7	30	55	8	60	612
9	C. arvensis	31	3	1	7	64	5	197	35	343
10	C. scabriusculus	-	-	-	-	1	-	-	-	1
11	C. excellens	99	121	96	37	94	168	17	95	729
12	C. intricatus	4	-	1	4	-	4	-	-	13
13	Cychrus semigranosus	1	1	12	10	12	40	28	92	196
14	Leistus piceus	-	-	-	-	-	1	7	1	9
15	L. rufomarginatus	-	-	1	2	-	-	3	5	11
16	Nebria brevicollis	-	-	-	-		2	-	1	3
17	Notiophilus bigutattus	2	10	1	2	2	-	-	1	18
18	Bembidion lampros	-	1	-	-	-	-	-	1	2
19	Ophonus nitidulus	2	46	6	1	-	-	-	-	55
20	Harpalus signaticornis	-	-	1	1	-	-	-	-	2
21	H. rufipes	-	8	-	-	-	-	-	1	9
22	H. griseus	-	-	1	1	-	-	-	-	2
23	H. latus	1	36	5	13	17	1	-	18	91
24	H. rubripes	1	-	-	-	-	4	-	-	5
25	H. atratus	2	15	6	2	1	-	-	22	48
26	H. tardus	-	-	-	-	-	-	2	-	2
27	H. distinguendus	-	-	-	-	1	-	-	-	1
28	Pterostichus melas	-	21	67	21	1	4	-	9	123
29	Pt. niger	2	2	-	-	2	5	5	2	18
30	Pt.nigrita	1	-	-	-	-	-	1	-	2
31	Pt. anthracinus	-	-	1	1	-	-	-	-	2
32	Pt. oblongopunctatus	10	3	18	17	5	46	78	11	188
33	Pt.melanarius	7	-	-	-	-	4	30	5	46
34	Stomis pumicatus	-	-	-	-	3	-	-	1	4

	Species /sites	1	II	III	IV	V	VI	VII	VIII	T
35	Anchomenus dorsalis	-	1	-	-	-	-	-	-	1
36	Platynus assimilis	3	-	2	2	1	14	18	11	51
37	Abax parallelus	45	68	267	121	105	31	35	26	698
38	A. parallelepipedus	17	89	204	40	272	115	11	134	882
39	A. carinatus	16	5	5	5	12	3	19	2	67
40	Molops piceus	25	34	43	100	10	33	31	19	295
41	Amara similata	1	-	-	-	-	-	-	-	1
42	A. convexior		4	-	-	1	-	-	-	5
43	A. ovata	-	-	1	1	-	-	-	2	4
44	Panageus crux major	-	2	-	-	-	-	-	-	2
45	Chlaenius nitidulus	-	-	-	-	-	-	-	2	2
46	Badister bipustulatus	-	-	-	-	-	1	1	-	2
47	Cymindis humeralis	-	-	-	-	2	6	-	6	14
48	Brachinus explodens	-	24	-	-	-	-	-	-	24
49	B. crepitans	-	1	-	-	-	-	-	-	1
50	Aptinus bombarda	140	153	426	80	10	12	3	69	893
	Total species	25	27	28	28	27	25	24	30	50
	Total individuals	565	1435	1832	820	837	800	603	844	7736

1.Querco-petreae-Tilio-Carpinetum,1983 ; II.Querco-petreae-Tilio-Carpinetum,1992 ; III. Querco-petreae-Tilio-Carpinetum,1992 ; IV. Querco-petreae-Tilio-Carpinetum,1992 ; V. Querco-petreae-Carpinetum, 1992 ; VI. Carpino-Tilio-Făgetum,1983 ; VII. Carpino-Tilio-Făgetum,1983 ; VIII. Carpino-Tilio-Făgetum, 2000.

Variation in number of the individuals

Any species occurrs by population or populations and that or these by individuals.

The total number of individuals of Carabidae collected in different biocoenoses (forests, agricultural crops ,fruit trees orchards etc.) as well as the total number of afferent individuals to each species ranges locally and annualy as an expression of concrete ecological determinism: abiotic factors (soil humidity,temperature etc) and biotic ones. (competition, food, pradation).

Thus , within the Querco- petreae –Tilio- Carpinetum vegetal association, the total number of individuals of Carabidae (1983,1992) collected was 5489, with a local and annual variation (among sites) of 565 (first site ,1983, 10.3 % of the total collected material in the association, south – west-south-east , altitude , 200 m, brown soil) and 1832 (site III, 1992, 33.4 %, north – east exposure ,altitude 220, argilo-iluvial- pseudogley soil).

In the Carpino –Tilio - Făgetum vegetal association 2247 individuals of Carabidae were collected with a variation between 603 (site VII, 1992, 26.8 %, southern exposure, altitude 380 m, brown soil) and 844 (site VIII, 2000 ,37.6 %, northern exposure, altitude 380 m, brown soil).

In coenoses , depending on relative abundance and structure of dominance, the species collected are grouped in eudominant species with percentages over 10 % of the total individuals collected, dominant species (5.1-10 %), subdominant species (2. 1 – 5 %), recedent species (1.1 – 2 %), subrecedent species (0.1- 1 %). In associations within each dominance class , limits of variation are registered. In the case of Bârnova forest, in the Querco-petreae-Tilio-Carpinetum association on average, the majority of species about 63 % are subrecedent and recedent species with limits between 13 and 19 and respectively between 1- 4 , species with very low relative abundance , but which expresse the alfa specific diversity . The eudominant, dominant and subdominant species represent 37 % with limits between 3 - 5 (eudominant), 1- 3 (dominant), 2-5 (subdominant).The eudominant , dominant and subdominant species are species with big relative abundance (table no 3).

Table no 4. Numerical variation of structure spectrum of dominance in the Querco – petreae -Tilio-Carpinetum vegetal association, Bârnova

Querco-petreae-Tilio-Carpinetum	1	2	3	4	5	T
1983	13	2	4	3	3	25
1992	14	3	4	3	3	27
1992	19	0	3	1	5	28
1992	17	1	5	2	3	28
1992	15	4	2	2	4	27
Mean	**15. 6**	**2. 5**	**3. 6**	**2. 2**	**3.6**	**27**
Limits	**13-19**	**1-4**	**2-5**	**1-3**	**3-5**	
No individuals	253	131	644	782	3679	5489
% of total	4.61	2.39	11.73	14.25	67.02	100.00

1 = Subrecedent ; 2 = Recedent; 3 = Sudominant; 4 = Dominant = Eudominant

Table no 5. Numerical variation of structure spectrum of dominance in the Carpino-Tilio-Făgetum vegetal association, Bârnova

Carpino-Tilio-Fagetum	1	2	3	4	5	T
1983	13	2	4	3	3	25
1983	9	4	6	2	3	24
2000	13	4	5	4	4	30
Mean	**11. 6**	**3. 3**	**5**	**3**	**3. 33**	**26. 3**

Carpino-Tilio-Fagetum	1	2	3	4	5	T
Limits	9-13	2-4	4-6	2-4	3-4	24-30
No.individuals	97	103	385	470	1192	2247
%	4.32	4.58	17.13	20.92	53.05	100.00

1= Subrecedent; 2 = Recedent ; 3 = Sudominant ; 4 = Dominant ; 5 = Eudominant

The situation of each species from point of view of dominance in the ecological context of the associations and years of collecting of material from the Bârnova forest is shown in table no 9.

Because the eudominant, dominant and subdominant species by their individuals have an important role in the trophic function of coenosis of Carabidae within the epigeic invertebrates in the associations of Bârnova forest,these species are named in table no 6.

Table no 6. Eudominant, dominant and subdominant species in those two associations of the Bârnova forest

	Species	I	II
1	Carabus coriaceus	D	D
2	C.glabratus	-	D
3	C.cancellatus	ED	D
4	C.ullrichi	D	D
5	C.arvensis	-	ED
6	C.excellens	D	D
7	Cychrus semigranosus	-	D
8	Pterostichus oblongopunctatus	-	D
9	Abax parallelus	-	SD
10	A.parallelepipedus	ED	ED
11	Molops piceus	SD	SD
12	Aptinus bombarda	ED	SD
	Total	7	12

I = Querco-petreae-Tilio-Carpinetum association ; II = Carpino - Tilio-Fagetum association ; SD = Sudominant ; D = Dominant ; ED = Eudominant

In the Querco-petreae-Tilio-Carpinetum association 7 species were found which have functioned as eudominant, dominant and subdominante species and in the Carpino-Tilio-Făgetum associations 12 species were found.

The tolerance law of ecological factors (humidity , temperature, light etc) is manifested by three zones , depending on the variation of the respective factor , from minum values to maximum values, in which the individuals of the respective species can occur: Zone of minimum stress,optimum zone and zone of minimum stress In the

zones of minimum and maximum stress , the species have few individuals, in the optimum zone , the species have many individuals because it is a prefered zone . The mesoxerophilous species have more individuals in the Querco-petreae-Tilio-Carpinetum association.For example, *Carabus cancellatus, Aptinus bombarda*. These two species are eudominant in the Querco-petreae-Tilio-Carpinetum association and dominant and subdominant in the Carpino-Tilio-Făgetum association respectively. The meso and mesohygrophilous species have more individuals in the Carpino-Tilio-Făgetum association.For example, *Carabus glabratus, Cychrus semigranosus.* The species Carabus glabratus was eudominant in 1983 and recedent in the year 2000, an year with precipitations under multiannual average.*Carabus glabratus* is an Euro-Siberian species.

Variation of the specific diversity index and evenness

For general characterization and comparisons we have used the Shannon index in the paper. The Shannon index is a statistico-informative index because it uses in calculation also the subrecedent species which have very few individuals. It is the most utilized diversity index in the appreciation of organization state, stability, characterization and comparisons of coenoses. Numerical values of the diversity index are influenced by the number of pitfalls utilized, duration of collecting and equitability of species. We remind that in the years of collecting (1983,1992, 2000) 10 – 12 pitfalls were used that have functioned 151 days in each site. The results of calculation of diversity index have been obtained using the Multi-variate Statistical Package Programme and are expressed in log 2.Table no 7.

Table no 7. Values of the Shannon index and equitability in the sites of those two forest associations in the Bârnova forest

Association	Site	H	S	E %	Association	Site	H	S	E.%
1					2				
1983	I	3.33	25	71	1983	VI	3.50	25	75
1992	II	3.24	27	68	1983	VII	**3.43**	24	75
1992	III	**3.16**	28	65	2000	VIII	**3.85**	30	75
1992	IV	**3.34**	28	69					
1992	V	3.16	27	66					

1 = Querco-petreae-Carpinetum; 2 = Carpino-Tilio-Făgetum

It is admited that the normal variation limits of the Shannon index in real coenoses is between 1.50 and 3.50 Our general data as well as those from two vegetal associations are given in table no 8.

Table no 8. Average values and the diversity index limits of species and equitability in the Bârnova forest

	H	limits	S	limits	E %	limits
Forest, mean	3.38	3.16 -3 .85	26.7	25 - 30	70.9	65 - 78
Assoc. 1 mean	3.25	3.16 – 3.34	27	25 - 28	67.8	66 - 71
Assoc.2 mean	3.59	3.43 – 3.85	26.3	24 - 30	76	75 - 78

H = Shannon index ; S = Number of species ; E = Equitability; Assoc.1 = Querco-petreae-Tilio –Carpinetum ; Assoc. 2 = Carpino-Tilio-Fagetum

It results from the table that in the Querco-petreae-Tilio-Carpinetum association the mean of the Shannon index and equitability are a little lower (H = 3.25, E = 67.8 %) in comparison with the general mean (H = 3.38 , E = 70.9 %) and higher in the Carpino- Tilio-Fagetum (H = 3.59, E = 76 %), but these values are included in the limits of normal variation.(1.50 – 3.50). In the same association (1) ,but in the Fundătura forest (material collected in 1982, using 12 pitfalls, April - September, the Shannon index had the value of 3.96 and equitability 83 %. (Varvara and Alice, 2004, in press An.St.Univ. Iasi).

In the Querco-petreae-Tilio-Carpinetum association from the Durleşti forest, the Republic of Moldova on the basis of a material collected three years running (1993-1995) (Dănilă and Varvara, 1999), the Shannon index ranged between 2.71 and 3.45, number of species between 19 and 25 , and equitability between 62 and 81 %. On the other hand, on the basis of collecting of a material from 11 deciduous forest sites in the Vaslui, Iasi,Bacău,Botosani, Suceava, counties in the period 1975 –1998, (Varvara, 2002), the Shannon index had variation limits between 2.38 and 3.77, and equitability between 54 and 80 %, in comparison with H = 3.16- 3.85 and E = 65 - 78 % found in the Bârnova deciduous forest.

Similarity between associations and years

Concretely,biotope of an ecosystem is made up of micro- biotopes because of variation of relief elements, vegetation and microclimate (pedo-climate, phyto-climate). Similitude percentages among sites may be expressed by calculation of the Sörensen's coefficient.Among sites may exist three similitude classes: low (percentages between 1 and 25 %), medium (26 –50 %) and high (51-100 %). Dendrogram shows firstly two groups corresponding to those two associations: Querco- petreae-Tilio-Carpinetum and Carpino-Tilio-Fagetum, between which the similitude percentage is 68 % (high similitude).

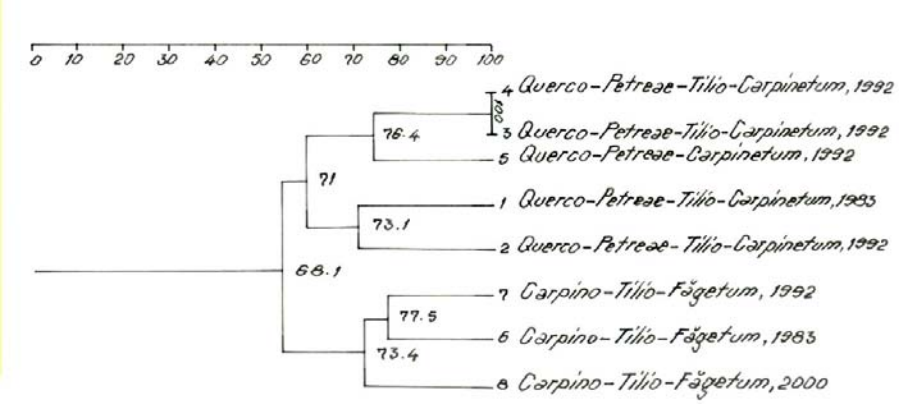

Fig. 1. Similarity hierarhical dendrogram of the sites

Within the first group, between site III (altitude 220 m, north-east exposure, argilo-iluvial-pseudogley soil) and site 4 (altitude 170 m, north-east -exposure, brown soil) the similitude percentage was maximum (100 %).Between sites III and IV, on one hand, and site V (Querco –petreae-Carpinetm, altitude 230 m, north –east exposure) the similitude percentage was 76. Between site I (altitude 200, south-west and south-east exposure, 10.4 annual average temperature brown soil) and site II (altitude 220, north exposure, 8.4 annual average temperature, brown soil) the similitude percentage was 73 % .

In the second group, between site VI (altitude 340 m, west – south - west exposure, 10.4 annual average temperature, brown soil) and site VII (altitude 380 m, south exposure, 10.4 annual average temperature, brown soil) the similitude percentage was 77.5 %). Between the sites VI and VII, on one hand, and site VIII (altitude 380 m, northern exposure, brown soil), on the other hand, the similitude percentage is very close , 73.4 %.

From the faunal point of view, between the Querco-petreae-Tilio-Carpinetum association (Bârnova,1983) and the same vegetal association in the Durleşti forest , the Republic of Moldova ,the similitude percentage was 42 % (medium similitude). Deciduous forests in the Republic of Moldova are at the eastern limit for this type of forest in Europe (Neculiseanu, 2003).The comparative occurrence of the species of Carabidae in the mentioned association in those two forests is given in table no.11.

Alfa diversity of carabids in the Querco-petreae- Tilio-Carpinetum association in the Durleşti forest is composed of 37 species and that in the same association in the Bârnova forest is composed of 43 species. 17 species (27 %) were found in both associations.

Ecological preferences of the species of Carabidae in the Bârnova forest, Iasi

To characterize the coenoses of carabids from those two associations, from point of view of adaptations and stability referring to reproduction, preferences for humidity, biotops, food, geographyical distribution I have made table no10. This table is prepared on the basis of information from literature. Petrusenko,C.B.,1970, Petrusenko,C.B. and Petrusenko,O,A, 1972, Turin and colab. 1991, 2003, Neculiseanu,1991, Neculiseanu, 2003, Šustek, 2000 and some information and verifications received from Dr. Šustek and Neculiseanu, 2003, as well as on the basis of personal observations during the years of collecting the material.

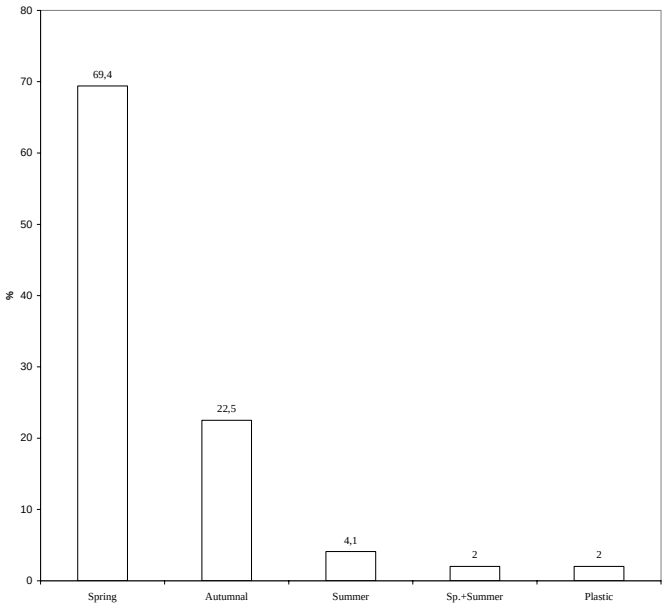

Fig. 2. Percentage structure of the types of reproduction of the species of Carabidae in the Bârnova forest, Iasi

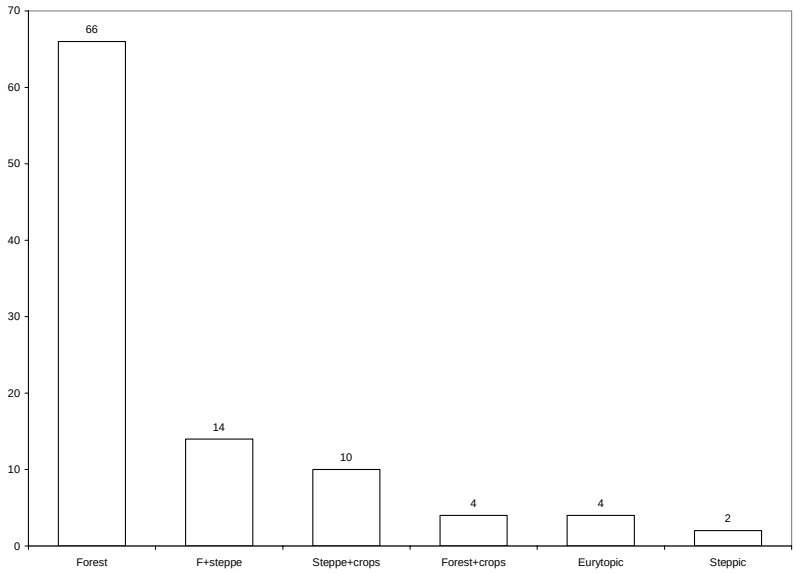

Fig. 3. Percentage structure of the habitat preferences of the species of Carabidae in the Bârnova forest, Iaşi

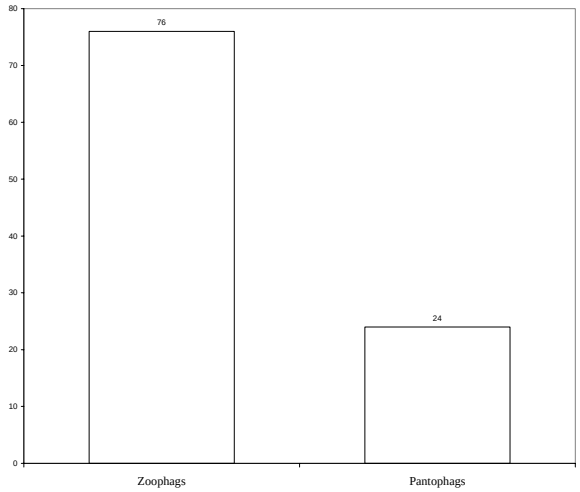

Fig. 4. Percentage structure of the food regime of species of Carabidae in theBârnova forest, Iaşi

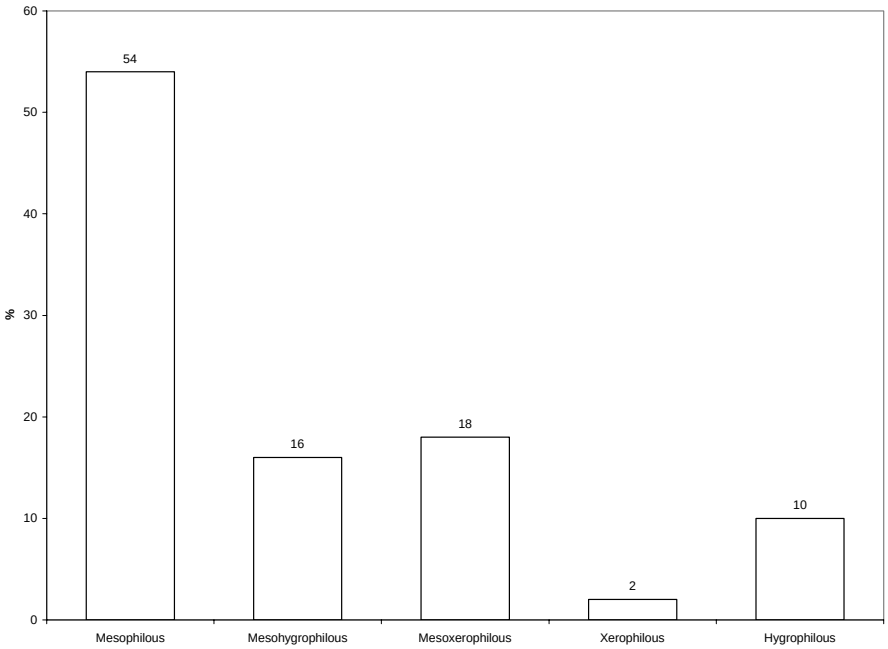

Fig. 5. Percentage structure of hygric preferences of species of Carabidae in the Bârnova forest, Iaşi

Discussions

Within the associations , the participation proportions of the trees are variable in unity with the concrete ensemble of main abiotic factors (temperature , humidity, slope). For example, within the Querco-petreae -Tilio-Carpinetum vegetal association , the participation proportion of the oak tree (*Quercus petreaea*) is from 12 % (north-east exposure, altitude 220 m) to 44 % (northern exposure , altitude 220 m).

Our observations show that, both on local level , between the associations of trees, the exposures from which the material was collected and in the deciduous forests from the counties of Moldova , the number of species, the number of specimens , the Shannon diversity index , echitability present local variations as a result of the concrete ecological determinism.. Annual and local variations of the number of species (alfa diversity) in the Bârnova forest was between 25 and 28 species (Querco-petreae-Tilio-Carpinetum) and between 24 and 30 (Carpino-Tilio-Fagetum))and in the other deciduous forests from Moldova was between 13 and 30 (Varvara , 2002, p.37),but annual and local variation of the number of individuals of some species was very big. For example, the species *Carabus cancellatu*s (in the Querco-petreae-Tilio-Carpinetum)

had a variation between 95 individuals (1983, south-east,south-west) and 499 individuals (1992, northern exposure), but in the second association (more humid) between 24 individuals (west-south-west exposure) and 66 individuals (southern exposure). These significant differences within the first association we interprete them as being due to climatic differences between those two years .In 1983, annual average temperature was 10, 5 C, with precipitations under annual average; in 1992, annual averaged temperature was 8.5 C with precipitations between 520-550. " Within a deciduous forest, in May –October months, the patterns of distribution of euritopic and forest species are strong dependent on humidity which is influenced by the terrain relief and vegetation (Šustek, 2001).

In open habitats ,specific diversity is higher than in forests , but number of individuals and their fluctuation is higher in forests (Mousson and Lebrun ,1996, p 85). These variations are a synthetic result of action of abiotic factors which have effect in the ecological context in unity with ecological valences of species: Soil type, the content in humus, temperature and soil humidity variation , the pH , vegetation character and the shade degree of soil (Hůrca, Šustek , 1995, p 350, Šustek ,2000, p.2), (Šustek, 2001), (Neculiseanu, 1995, p 48), (Holland and Luff, 2000, p 112), Varvara and Soare, 2003).

The preference of species of carabidae for habitat is expressed by the number of individuals (Turin and colab , 1991, p.283). Mesohygrophilous species as for example, *Carabus arvensis*, *Cychrus semigranosus*, *Leistus piceus*, *Pterostichus oblongopunctatus*, *Platynus assimilis* had a higher number of individuals in the Carpino-Tilio-Făgetum association.

As for the reproduction seasons of carabids in the Bârnova forest in those two associations, 34 species (69.4 %) are spring species, 11 species (22. 5 %) are autumnal species) Fig no 2.

As to humidity, 29 species (58.0 %) are mesophylous , 9 species (18.0 %) are mesoxerophilous and 6 species are mesohygrophilous species (Fig. No 5).

Referring to preferred habitat, 33 (66 %) species are forest species, 7 (14 %) species are forest and steppe species, and 5 (10 %) are open landscape species .Fig no. 2.

Food regime of the species of carabids in the Bârnova forest is predominantly zoophagous, that is 38 (76 %) species and only 12 species (24. 0 %) are pantophagous . Fig. no 4.

Geographical distribution, 24 (48 %) species are Transpalearctic and European, 14 species (28 %) are west-Palearctic and Euro-Siberian species.

Comparing the results obtained in the Querco – petreae – Tilio - Carpinetum association from the Bârnova forest with those from the same association in the Durleşti forest , the Republic of Moldova (three years (1993-1995), 10 pitfalls in each year were used , in total, there were collected 63 species (gama diversity), 37 species in the Durlesti forest (alfa diversity) and 46 species (Bârnova ,alfa diversity). 17 species were in common (table no.11) Sörrensen similitude index was 42. 5 % (medium

similitude). The common species are deciduous forest , subdominant, dominant and eudominant, mesophilous and mesohygrophilous species, indicators of forest brown soil. (Neculiseanu, 1995, p 48).

We appreciate that in the Durleşti forest a more pronounced soil aridity degree occurs. Mesohygrophilous species such as *: Carabus arvensis, Cychrus semigranosus, Platynus assimilis* were not captured in the years of collecting in the Durleşti forest (1993 - 1995) which might explain smaller values of Sörrensen's coefficient..

Table 9. Structure of the dominance of the species of Carabidae in the Bârnova forest, Iaşi

	Name of species	1	2	3	4	5	6	7	8
1	Calosoma inquisitor	SR	SR	SR	SR	SR	-	SR	-
2	Carabus coriaceus	D	D	SD	D	D	D	SD	ED
3	C. convexus	-	-	SR	SD	SR	SR	SR	D
4	C. glabratus	SR	SR	SR	SR	SR	ED	R	R
5	C. violaceus	-	-	-	-	-	-	SR	-
6	C. variolosus	-	-	SR	SR	SR	-	-	-
7	C. cancellatus	ED	ED	ED	ED	ED	SD	ED	D
8	C. ullrichi	SD	ED	ED	SR	SD	D	R	D
9	C. arvensis	D	SR	SR	SR	D	SR	ED	SD
10	C. scabriusculus	-	-	-	-	SR	-	-	-
11	C. excellens	ED	D	D	SD	ED	ED	SD	ED
12	C. intricatus	SR	-	SR	SR	-	SR	-	-
13	Cychrus semigranosus	SR	SR	SR	R	R	SD	SD	ED
14	Leistus piceus	-	-	-	-	-	SR	R	SR
15	L. rufomarginatus	-	-	SR	SR	-	-	SR	SR
16	Nebria brevicollis	-	-	-	-	-	SR	-	SR
17	Notiophilus bigutattus	SR	SR	SR	SR	SR	-	-	SR
18	Bembidion lampros	-	SR	-	-	-	-	-	SR
19	Ophonus nitidulus	SR	SD	SR	SR	-	-	-	-
20	Harpalus signaticornis	-	-	SR	SR	-	-	-	-
21	H. rufipes	-	SR	-	-	-	-	-	SR
22	H. griseus	-	-	SR	SR	-	-	-	-
23	H. latus	SR	SD	SR	SR	SD	SR	-	SD
24	H. rubripes	SR	-	-	-	-	SR	-	-

	Name of species	1	2	3	4	5	6	7	8
25	H. atratus	SR	R	SR	SR	SR	-	-	SD
26	H. tardus	-	-	-	-	-	-	SR	-
27	H. distinguendus	-	-	-	-	SR	-	-	-
28	Pterostichus melas	-	R	SD	SD	SR	SR	-	R
29	Pt. niger	SR	SR	-	-	SR	SR	SR	SR
30	Pt.nigrita	SR	-	-	-	-	-	SR	-
31	Pt. anthracinus	-	-	SR	SR	-	-	-	-
32	Pt.oblongopunctatus	R	SR	SR	SD	SR	D	ED	R
33	Pt.melanarius	R	-	-	-	-	SR	SD	SR
34	Stomis pumicatus	-	-	-	-	SR	-	-	SR
35	Anchomenus dorsalis	-	SR	-	-	-	-	-	-
36	Platynus assimilis	SR	-	SR	SR	SR	R	SD	R
37	Abax parallelus	D	SD	ED	ED	ED	SD	D	SD
38	A. parallelepipedus	SD	D	ED	SD	ED	ED	R	ED
39	A. carinatus	SD	SD	SR	SR	R	SR	SD	SR
40	Molops piceus	SD	SD	SD	ED	R	SD	D	SD
41	Amara similata	SR	-	-	-	-	-	-	-
42	A. convexior	-	SR	-	-	SR	-	-	-
43	A. ovata	-	-	SR	SR	-	-	-	SR
44	Panageus crux major	-	SR	-	-	-	-	-	-
45	Chlaenius nitidulus	-	-	-	-	-	-	-	SR
46	Badister bipustulatus	-	-	-	-	-	SR	SR	-
47	Cymindis humeralis	-	-	-	-	SR	SR	-	SR
48	Brachinus explodens	-	R	-	-	-	-	-	-
49	B. crepitans	-	SR	-	-	-	-	-	-
50	Aptinus bombarda	ED	ED	ED	D	R	R	SR	D
	Total species	25	27	28	28	27	25	24	30

1.Querco – petreae – Tilio - Carpinetum,1983;2.Querco – petreae – Tilio - Carpinetum,1992;3.Querco – petreae - Tilio-Carpinetum,1992;4.Querco – petreae - Tilio-Carpinetum,1992;5.Querco – petreae - Carpinetum,1992; 6.Carpino - Tilio-Făgetum,1983; 7. Carpino – Tilio - Făgetum,1983 ,8.Carpino – Tilio - Făgetum,2000.

SR = subrecedent; R = recedent; SD = subdominant; D = dominant ; ED = eudominant

Table nr. 10. Main ecological characteristics of the species of Carabidae in the Bârnova forest

	Name of species	1	2	3	4	5
1	Calosoma inquisitor	Sp	M	F	Z	CE
2	Carabus coriaceus	A	M	F	Z	E
3	C. convexus	Sp	M	F	Z	Es
4	C. glabratus	A	Mh	F	Z	Es
5	C. violaceus	A	Mx	F	Z	Wp
6	C. variolosus	Sp	H	F	Z	E
7	C. cancellatus	Sp.	M	F	Z	T
8	C. ullrichi	Sp	M	F	Z	CE
9	C. arvensis	Sp	Mh	F	Z	T
10	C.scabriusculus	Sp	M	Ols	Z	E.
11	C. excellens	Sp	Mx	F	Z	EstE
12	C. intricatus	Sp	M	F	Z	E
13	Cychrus semigranosus	A	Mh	F	Z	SestE
14	Leistus piceus	A	Mh	F	Z	E
15	L. rufomarginatus	A	Mh	F	Z	Ec
16	Nebria brevicollis	A	Mh	F	Z	Ec
17	Notiophilus bigutattus	Sp	M	F	Z	Es
18	Bembidion lampros	Sp	M	FOls	Z	T
19	Ophonus nitidulus	Sp	M	F	P	Wp
20	Harpalus signaticornis	Sp	M	F	P	Ec
21	H. rufipes	A	Mx	Ols	P	Wp
22	H. griseus	A	Mx	Ols	P	T
23	Harpalus latus	A	M	F+St	P	T
24	H. rubripes	A	X	F	P	Wp
25	H. atratus	Sp	Mx	F	P	Ec
26	H. tardus	Sp	M	S	P	Es
27	H. distinguendus	Sp +S	M	Ols	P	T
28	Pterostichus melas	Sp	Mx	F	Z	Ec
29	Pt. niger	Pl	M	Eu	Z	T
30	Pt.nigrita	S	H	F+St	Z	T
31	Pt. anthracinus	Sp	H	F+St	Z	Es
32	Pt.oblongopunctatus	Sp	Mh	F	Z	T
33	Pt.melanarius	A	M	Eu	Z	Es
34	Stomis pumicatus	Sp	M	F	Z	E
35	Anchomenus dorsalis	Sp	M	Ols	Z	Wp

	Name of species	1	2	3	4	5
36	Platynus assimilis	Sp	Mh	F	Z	T
37	Abax parallelus	Sp	M	F	Z	E
38	A. parallelepipedus	Sp	M	F	Z	E
39	A. carinatus	Sp	M	F	Z	E
40	Molops piceus	Sp	M	F	Z	E
41	Amara similata	Sp	M	F+St	P	T
42	A. convexior	Sp	M	F	P	Es
43	A. ovata	Sp	M	FOls	P	T
44	Panageus crux major	?	M	F	Z	Wp
45	Chlaenius nitidulus	Sp	H	F+St	Z	E
46	Badister bipustulatus	Sp	H	F	Z	Hl
47	Cymindis humeralis	Sp	M	F	Z	E
48	Brachinus explodens	Sp	Mx	F+St	Z	Em
49	B. crepitans	Sp	Mx	F+St	Z	Wp
50	Aptinus bombarda	Sp	Mx	F	Z	CE

1 = Reproduction type ; 2 = Humidity preference ; 3 = Habitat preference ; 4 = Food regime ; 5 = Zoogeographical distribution

Legend: Sp = Spring; A = Autumn ; S = Summer ; Pl = Plastic ; M = Mesophilous ; Mh = Mesohygrophilous ; Mx =Mesoxerophilous ; H = Hygrophilous; F = Forest ; St = Steppe ; Eu = Euritopic ; Ols = Open landscape; Z = Zoophagous ; P = Pantophagous ; Wp = West-palearctic ; T = Transpalearctic ; E = European ; Em = Euromediterranian ; Ec = Eurocaucasian ; Es= Eurosiberian ; CE = Central European ; EstE = East- European; SestE = South-east-European; Hl = Holarctic

Table 11. The species of Carabidae collected from the Bîrnova and Durleşti forests

	Name of species	1	2
1	Calosoma inquisitor	-	+
2	Carabus coriaceus	+	+
3	C.convexus	+	+
4	C.glabratus	+	+
5	C.variolosus	-	+
6	C.cancellatus	+	+
7	C.ullrichi	-	+
8	C. arvensis	-	+
9	C. scabriusculus	-	+
10	C. excellens	+	+
11	C. intricatus	-	+
12	Cychrus semigranosus	-	+
13	Leistus piceus	+	-

	Name of species	1	2
14	L. rufomarginatus	-	+
15	Clivina fossor	+	-
16	Ophonus brevicollis	+	-
17	Harpalus signaticornis	-	+
18	Ophonus nitidulus	+	+
19	Metophonus azureus	+	-
20	Harpalus rufipes	+	+
21	H. griseus	-	+
22	H. dimidiatus	+	-
23	H.s latus	-	+
24	H. rubripes	-	+
25	H. atratus	+	+
26	H.distinguendus	-	+
27	H.serripes	+	-
28	H. tardus	+	-
29	Acupalpus meridianus	+	-
30	Poecilus cupreus	+	-
31	Poecilus sericeus	+	-
32	Poecilus subcoeruleus	+	-
33	Pterostichus melas	-	+
34	Pt.macer	+	-
35	Pt. niger	-	+
36	Pt.nigrita	-	+
37	Pt. anthracinus	-	+
38	Pt.oblongopunctatus	+	+
39	Pt.melanarius	-	+
40	Stomis pumicatus	-	+
41	Anchomenus dorsalis	+	+
42	Platynus assimilis	-	+
43	Abax parallelus	+	+
44	A. parallelepipedus	+	+
45	A. carinatus	+	+
46	Molops piceus	+	+
47	Amara similata	-	+
48	A. convexior	-	+
49	A.montivaga	+	-
50	A.eurynota	+	-
51	A. ovata	+	+
52	A.familiaris	+	-

	Name of species	1	2
53	A.aenea	+	-
54	Panageus crux major	+	+
55	P.bipustulatus	+	-
56	Chlaenius nitidulus	-	+
57	Badister bipustulatus	+	-
58	Cymindis macularis	+	-
59	Cymindis humeralis	-	+
60	Microlestes minutulus	+	-
61	Brachinus explodens	-	+
62	B. crepitans	+	+
63	Aptinus bombarda	-	+
	Total species	37	43
	Common species	17	17
	Species only in Durleşti	20	
	Species only in Bârnova		26

1 = Durleşti Forest, 2 = Bârnova Forest

Conclusions

Under the conditions of the Bârnova forest (Querco – petreae – Tilio - Carpinetum, (QTC), Querco-petreae- Carpinetum, (QC), Carpino –Tilio - Fagetum associations (QTF), the fauna of Carabidae is composed of 50 species, of which 25 –28 (QTC), 27 (QC), 24- 30 (QTF).

Depending on the vegetal conditions that assure favourable ecological conditions, 13 species of carabidae are subdominant, dominant and eudominant, their number ranging from 7 (QTC) to 12 (QTF). Among these species are: *Carabus coriaceus, C. cancellatus, C. ullrichi, C. excellens, Pterostichus oblongopunctatus, Abax parallelepipedus, Molops piceus, Aptinus bombarda*.The vegetal associations by their ecological conditions influence the number of individuals of the species.

The minimum and maximum limits of the Shannon index and equitability are higher in the Bârnova forest (3.16-3.85, E = 65 - 78 %) in comparison with other deciduous forests from Moldova and the Republic of Moldova (2.38-3.77, E =54 – 80 %).

The similitude degree among years and associations are high ranging from 64 to 100 %, mostly between 71 –77 %.

The carabidae fauna in the Bârnova forest is composed predominantly of spring, mesophilous, forest, zoophagous,European and Palearctic species , the same as in the other deciduous forests from Moldova.(Romania).

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