MUZEUL JUDEȚEAN ARGEŞ, PITEŞTI, ROMÂNIA
ARGESIS *- STUDII ŞI COMUNICĂRI - seria ŞTIINŢELE NATURII,* **TOM XXV**, 2017

SOME OBSERVATIONS ON THE DIVERSITY, ABUNDANCE AND DOMINANCE OF THE EPIGEIC ARTHROPODS IN THREE BIOCOENOSES OF URSULUI VALLEY - GIURGENI FOREST, NEAMȚ COUNTY, MOLDAVIA, ROMANIA, 1990

MIRCEA VARVARA
59 Ion Creangă Street, block L3, scale A, floor 4, apartment 1, Iași, Iași County,
e-mail: mvarvara@uaic.ro
NICULINA ARDELEAN

ABSTRACT. The paper is a statistic synthesis of the original collecting data on the epigeic arthropods in three biocoenoses: oak grove, beech forest and grassy association. The aim of the work is to present the variation of the relative abundance and dominance of the epigeic arthropods (classes, orders of insects, families of Coleoptera, species of Carabidae) from three biocoenoses mentioned above to show the concrete influence of the type of biocoenoses on the taxonomic structure of epigeic arthropods in conformity with the principle of unity and interaction of biotope and biocoenosis. The material was collected from Ursului Valley, Giurgeni forest, Neamț County, 1990, Central Moldavian Plateau, using Barber pitfalls with preservative liquid, formalin solution 4%, protected against rainfalls, 30 pitfalls in each biotope. In total, there were collected 2,559 specimens of epigeic arthropods of which 487 (19.03%) from oak grove; 470 (18.37%) beech forest and 1,602 (62.60%) grassy association. In oak grove, there were collected four classes of arthropods; insects are eudominant, 322 individuals (66.12%); five orders of insects were recorded, of which 260 specimens of the order Coleoptera (80.75%); seven families of coleopterans, family Carabidae with 197 specimens (76.05%) of 17 species was the best represented; most specimens belonged to the species *Carabus glabratus* Paykull, 1790, with 49 specimens (24.50%) and *Carabus cancellatus* Illiger, 1798, with 29 specimens (14.50%). In beech forest, there were collected also four classes of arthropods; insects 398 specimens (84.68%), six orders of insects, Coleoptera 227 specimens (57.04%), eight families of coleopterans, Carabidae, 106 specimens (46.46%) from 16 species; most specimens belonged to the species *Aptinus bombarda* (Illiger, 1800), 36 specimens (34.29%) and *Abax parallelus* (Duftschmid, 1812), 15 specimens (14.29%). For the grassy association, there was the following situation: insects 1,463 specimens (91.32%); 8 orders of insects, Coleoptera 303 specimens (20.71%); 10 families of Coleoptera; family Carabidae, 223 specimens (86.14 %), from 14 species; most specimens belonged to the species *Pseudophonus rufipes* (Degeer, 1774), 90 specimens (34.48%) and *Poecilus coerulescens* (Linnaeus, 1758), 34 specimens (13.03%). The presence of taxa in all the biocoenoses is the following: four classes (Crustacea, Order Isopoda), Arachnida, Myriapoda, Insecta; five orders of insects (Collembola, Dermaptera, Coleoptera, Hymenoptera, Diptera; five families of Coleoptera (Carabidae, Scarabaeidae, Silphidae, Staphylinidae, Chrysomelidae); five species of Carabidae: *Bembidion lampros* (Herbst, 1784), *Carabus cancellatus* Illiger, 1798, *Abax parallelus* (Duftschmid, 1812), *Abax. carinatus*, (Duftschmid, 1812), *Pterostichus melas* (Creutzer, 1799).

Keywords: epigeic arthropods, abundance, dominance, oak grove, beech forest, grassy association.

REZUMAT. Unele observații asupra diversității, abundenței și dominanței artropodelor epigee din trei biocenoze ale pădurii Valea Ursului - Giurgeni, județul Neamț, Moldova, România, 1990. Lucrarea este o sinteză statistică a datelor originale de colectare a artropodelor epigee din trei biocenoze: pădurea de stejar, pădurea de fag și asociație de ierburi. Scopul lucrării este de a prezenta variația abundenței relative și a dominanței artropodelor epigee (clase, ordine de insecte, familii de coleoptere, specii de carabide) din trei biocenoze, menționate mai sus, pentru a arăta influența concretă a tipului de biocenoză asupra structurii taxonomice a artropodelor epigee în conformitate cu principiul unității și interacțiunii biotopului și a biocenozei. Materialul a fost colectat din Valea Ursului, pădurea Giurgeni, județul Neamț, 1990, Podișul Central Moldovenesc, folosind capcane Barber cu lichid de conservare, soluție de formalină 4%, protejată împotriva precipitațiilor; 30 de capcane în fiecare biotop. În total au fost colectate 2.559 de exemplare de artropode epigee, din care 487 (19,03%) din pădurea de stejar, 470 (18,37%) din pădurea de fag și 1.602 (62,60%) din asociația de ierburi. În pădurea de stejar au fost colectate patru clase de artropode; insectele au fost eudominante, 322 de exemplare (66,12%); au fost înregistrate cinci ordine de insecte, dintre care 260 de exemplare din ordinul Coleoptera (80,75%); șapte familii de coleoptere, familia Carabidae cu 197 de exemplare (76,05%) din 17 specii a fost cea mai bine reprezentată; cele mai multe exemplare au aparținut speciilor *Carabus glabratus* Paykull, 1790, cu 49 de exemplare (24.50%) și *Carabus cancellatus* Illiger, 1798, cu 29 de exemplare (14.50%). În pădurea de fag, au fost, de asemenea colectate patru clase de artropode; insecte 398 de exemplare (84,68%), șase ordine de insecte, Coleoptera 227 de exemplare (57,04%), opt familii de coleoptere, Carabidae, 106 exemplare (46,46%) cu 16 specii; cele mai multe exemplare au aparținut speciilor *Aptinus bombarda* (Illiger, 1800) și *Abax paralelus* (Duftschmid, 1812), 15 (14,29%). Pentru asociația de ierburi, situație a fost următoarea: insecte 1.463 exemplare (91.32%); 8 ordine de insecte, Coleoptera 303 exemplare (20,71%); 10 familii de coleoptere; familia Carabidae, 223 exemplare (86,14%), din 14 specii; cele mai multe exemplare au aparținut speciilor *Pseudophonus rufipes* (Degeer, 1774), 90 de exemplare (34,48%) și *Poecilus coerulescens* (Linnaeus, 1758), 34 de exemplare (13,03%). Prezența taxonilor în toate biocenozele este următoarea: patru clase (clasa Crustacea, ordinul Isopoda), Arachnida, Myriapoda, Insecta; 5 ordine de insecte (Collembola, Dermaptera, Coleoptera, Hymenoptera, Diptera; 5 familii de coleoptere (Carabidae, Scarabaeidae, Silphidae, Staphylinidae, Chrysomelidae); 5 specii carabide: *Bembidion lampros* (Herbst, 1784), *Carabus cancellatus* (Illiger, 1798), *Abax paralelus* (Duftschmid, 1812), *Abax carinatus* (Duftschmid, 1812), *Pterostichus melas* (Creutzer, 1799).

Cuvinte cheie: artropode epigee, abundența, dominanță, pădure de stejar, pădure de fag, asociație de ierburi.

INTRODUCTION

The aim of the work is to present the variation of the relative abundance and dominance of the epigeic arthropods (classes, orders of insects, families of Coleoptera, species of Carabidae) from oak grove, beech forest, grassy association of Giurgeni Forest, Neamț County, 1990, to show the concrete influence of the type of biocoenosis on the taxonomic structure of epigeic arthropods in conformity with the principle of unity and interaction of biotope and biocoenosis. The paper includes ecological data.

The objectives of the work are:

1. Documentation;
2. Collecting and conservation of the collected material;
3. Taxonomic determination and processing of the material;

4. Knowledge of the taxonomic, numerical and percentage biodiversity of the epigeic arthropods from three ecosystems;

5. Expression of the results in specific tables and graphs;

6. Discussions of the results.

Geographically, Neamț County belongs to the Moldavian Central Plateau with hilly continental climate.

The annual average temperature varies between 2.0 and 6.5 Celsius degrees depending on the altitude and relief. The average amount of precipitations of Neamț County is 550 mm.

In positive correlation with the altitude of the relief, temperature and precipitations, most part of the territory of Nemț County is covered by deciduous forests.

For the knowledge of the fauna of Neamț County, we mention the contributions brought by: Mândru and collaborators (Mândru et al., 1979), Varvara and Popescu (Varvara & Popescu, 1999), Varvara and Zugravu (Varvara & Zugravu, 2004), Serafim and Apetrei (Serafim & Apetrei, 1996).

MATERIAL AND METHODS

The entomological material of the work is completely original. It was collected by Ardelean Niculina, 1990.

To show the influence of the vegetation on the taxonomic structure of the epigeic arthropods, there were chosen three sites: oak grove, beech forest and grassy association in the same locality.

1. Characteristics of the oak grove stationary: waved slope, south west exposure, inclination 16 degrees, altitude, 260-320 m, podzol, pseudogleid, forest brown soil, 70% oak grove.

2. Beech forest: medium waved slope, southwest exposure, inclination 15 grade, altitude 340-400 m, forest brown soil, weakly podzol, moderately acidic (Ph = 6). Prevalence of the beech.

3. Grassy association: the stationary was chosen at the edge of the forest, oak grove moderate slope, inclination of the slope 20 degrees, southern exposure, altitude 180-200 m. The phytocoenosis is characterized by the predominance of gramineae.

For the quantitative and qualitative collecting of the material, the Barber pitfalls method was used, thirty in each stationary. The pitfalls were placed on three rows. Each row had 10 pitfalls. The distance between rows was 10 meters and also between pitfalls. As traps, glass jars of 800 ml capacity with preservative liquid, 4% formic aldehyde were used.

The pitfalls were introduced into the ground up to the opening of the trap. For special reasons, the pitfalls worked four days, each month and stationary (June, July and August), collecting being made on the fourth day, from four in four hours.

In the oak grove stationary, the collectings from each pitfall were made on June 15, July 15, August 12, 1990.

In the beech forest stationary, the collectings from each pitfalls were made on June 18, July 14, August 12, 1990.

In the grassy association stationary, the collectings from each pitfall were made on June 21, July 10, August 17, 1990.

The determination and the nomenclature of the Carabidae species was according to Freude, Harde and Lohse (Freude et al., 1974).

RESULTS

Results of the work are shown in four tables and 6 histograms.

In presenting the results, discussions and conclusions, we followed and respected the natural, logical and psychological principle from general to particular. Taxa exist through individuals having specific morphological characters from kingdom to the species.

The main characteristic of each taxon is the number of individuals.

The total number of collected individuals from the three biocoenoses was 2,561, of which 490 individuals (19.13%) were collected from the oak grove biocoenosis; 469 (18.31%) from the beech forest and 1,602 (62.55%) from the grassy association (Tab. 1, Fig. 10).

Table 1 - The taxonomic structure, abundance and dominance of the epigeic arthropods from three biocoenoses, Ursului Valley - Giurgeni forest, Neamț County, 1990, Moldova, Romania.

No.	Name of classes	Oak grove		Beech forest		Grassy association	
		A	D %	A	D%	A	D %
1	Insecta	325	66.33	397	84.63	1,463	91.32
2	Arachnomorpha	129	26.33	39	8.21	106	6.62
3	Miriapoda	28	5.71	29	6.11	13	0.81
4	Crustacea (Ord. Isopoda)	8	1.63	4	0.84	20	1.25
5	Gasteropoda	-	-	1	0.21	-	-
	Total classes	**4**		**5**		**4**	
	Total individuals :	**490**	**100**	**470**	**100**	**1,602**	**100**
	% of total :	**19.13**		**18.35**		**62.53**	

The total number of collected insects was 2,185, i. e. 85.32% of the total, of which 325 (14.87%) there were collected from the oak grove stationary; 397 (18.17%) from the beech forest and 1,463 (66.96%) from the grassy association. (Tab. 2, Fig. 2).

The main order was Coleoptera in the entomological collected material. In total, 792 individuals (36.25%) were collected from the total collected insects. The numerical and percentage distribution on biocenoses was: 263 individuals (80.92%), oak grove, 226 (56.93%), in beech forest and 303 (20.71%), grassy association (Tab. 3, Fig. 3).

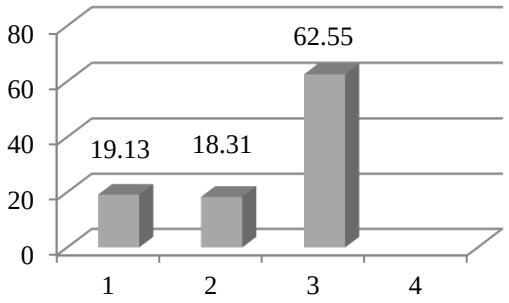

Figure 1 - The percentage variation of the total number of individuals, collected from three biocoenoses, Giurgeni forest, 1990 (1 - oak grove, 2 - beech forest, 3 - grassy association).

Table 2 - The taxonomic structure, abundance and dominance of orders of the epigeic insects from three biocoenoses, Ursului Valley - Giurgeni, forest, Neamț County, 1990, Moldova, Romania.

No.	Insecta Name of orders	Oak grove		Beech forest		Grassy association	
		A	D %	A	D %	A	D %
1	Coleoptera	263	80.92	226	56.93	303	20.71
2	Hymenoptera	30	9.23	155	39.04	1145	78.26
3	Diptera	4	1.23	9	2.27	1	0.07
4	Collembola	26	8.00	4	1.01	1	0.07
5	Dermaptera	2	0.62	2	0.50	1	0.07
6	Heteroptera	-	-	1	0.25	7	0.48
7	Lepidoptera	-	-	-	-	3	0.21
8	Homoptera	-	-	-	-	2	0.14
	Total orders	**5**		**6**		**8**	
	Total individuals:	**325**	**100**	**397**	**100**	**1,463**	**100**
	% of total:	**14.87**		**18.17**		**66.96**	

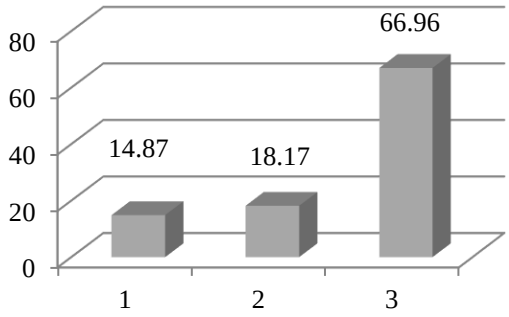

Figure 2 - The percentage variation of the total number of individuals (orders, insects) collected from three biocoenoses, Giurgeni forest, 1990
(1 - oak grove, 2 - beech forest, 3 - grassy association).

Table 3 - The taxonomic structure, abundance and dominance of the epigeic families of Coleoptera from three biocoenoses, Ursului Valley - Giurgeni, forest, Neamț County, 1990, Moldova, Romania.

No.	Coleoptera Name of families	Oak grove		Beech forest		Grassy association	
		A	**D %**	**A**	**D %**	**A**	**D %**
1	Carabidae	200	76.05	105	46.46	259	86.05
2	Scarabaeidae	28	10.65	46	20.35	1	0.33
3	Silphidae	8	3.04	11	4.86	1	0.33
4	Staphylinidae	22	8.37	60	26.55	10	3.32
5	Elateridae	-	-	1	0.44	-	-
6	Byrrhidae	-	-	-	-	1	0.33
7	Dermestidae	3	1.14	-	-	20	6.64
8	Coccinellidae	1	0.38	-	-	1	0.33
9	Tenebrionidae	-	-	1	0.44	5	1.66
10	Cerambycidae	-	-	1	0.44	-	-
11	Chrysomelidae	1	0.38	1	0.44	1	0.33
12	Curculionidae	-	-	-	-	2	0.66
	Total families:	**7**		**8**		**10**	
	Total individuals:	263	100	226	99.98	301	99.98
	% of total.	**33.29**		**28.61**		**38.10**	

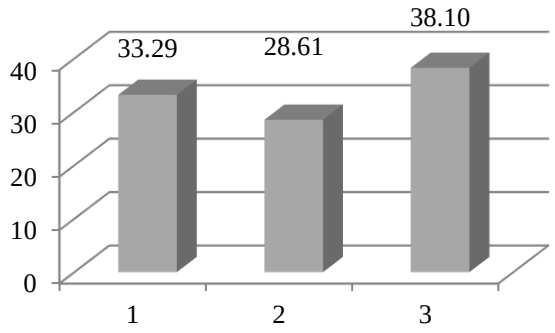

Figure 3 - The percentage variation of the total number of individuals (Coleoptera) collected from three biocoenoses, Giurgeni, forest, 1990 (1 - oak grove, 2 - beech forest, 3 - grassy association).

The Carabidae family (Coleoptera Order) was represented by 566 individuals, i. e. 71.46% of the collected coleopterans, the total number of collected individuals and the percentages on the biotopes being: 200 (76.05%), oak grove, 105 (46.46%), beech forest) and 261 (86.14%), grassy association (Tab. 4, Fig. 4).

Table 4 - Abundance and dominance of the species of Carabidae from three biocoenoses of Ursului Valley - Giurgeni, forest, Neamț County, 1990, Moldova, Romania.

No.	Carabidae Name of species	Oak grove		Beech forest		Grassy association	
		A	D %	A	D %	A	D %
1	*Bembidion lampros* Herbst, 1784	1	0.50	1	0.95	19	7.34
2	*Notiophilus biguttatus* Fabricius, 1779	1	0.50	-	-	-	-
3	***Carabus glabratus*** Paykull, 1790	**49**	**24,50**	**13**	**12.38**	**2**	**0.77**
4	*C. coriaceus* Linne, 1758	2	1.00	6	5.71	-	-
5	*C. violaceus* Linne, 1758	1	0.50	-	-	-	-
6	*C. cancellatus* Illiger, 1798	29	14.50	3	2.86	4	1.54
7	*C. convexus* Fabricius, 1776	2	1.00	-	-	-	-
8	*C. excellens* Fabricius, 1798	3	-	2	1.90	3	1.16
9	*Calosoma inquisitor* Linne, 1758	1	0.50	-	-	-	-
10	*Cychrus semigranosus* Palliardi, 1825	5	2.50	-	-	-	-
11	*Clivina fossor* Linne, 1758	-	-	-	-	8	3.09
12	*Abax parallelopipedus* Piller & Mitterpacher, 1783	15	7.50	1	0.95	-	-
13	*Abax parallelus* (Duftschmid, 1812)	17	8.50	15	14.29	1	0.39
14	*Abax carinatus* Duftschmid, 1812	2	1.00	4	3.81	4	1.54
15	***Pterostichus melas*** Creutzer, 1799	**25**	**12.50**	**13**	**12.38**	**26**	**10.04**
16	*Pt. oblongopunctatus* Fabricius, 1787	21	10.50	5	4.76	-	-
17	*Pt. anthracinus* Illiger, 1798	-	-	-	-	1	0.39
18	*Poecilus coerulescens* Linne, 1758	-	-	2	1.90	34	13.13
19	*Poecilus cupreus* Linne, 1758	-	-	-	-	12	4.63
20	*Calathus fuscipes* Goeze,1777	-	-	-	-	19	7.34
21	*Amara consularis* Duftschmid, 1812	-	-	-	-	1	0.39
22	*Molops piceus* Panzer, 1793	4	2.00	2	1.90	-	-
23	*Pseudoophonus rufipes* De Geer, 1774	1	0.50	-	-	90	34.75
24	*Metophonus punctatulus* Duftschmid, 1812	-	-	-	-	5	1.93
25	*Anisodactylus binotatus* Fabricius, 1787	-	-	-	-	24	9.27
26	*Harpalus aeneus* Fabricius, 1792	-	-	-	-	3	1.16
27	*Harpalus latus* Linne, 1758	-	-	1	0.95	-	-
28	*Harpalus distinguendus* Duftschmid, 1812	-	-	-	-	2	0.77
29	*Acupalpus meridianus* Linne, 1767	-	-	1	0.95	-	-
30	*Aptinus bombarda* Illiger, 1800	21	10.50	36	34.29	-	-
31	*Brachinus psophia* Serville, 1821	-	-	-	-	1	0.39
	Total species:	**18**		**15**		**19**	
	Total individuals:	**200**		**105**		**259**	
	% of total:	**35.46**		**18.62**		**45.92**	

Two species of the Carabidae family had the following number of individuals: 1. ***Carabus glabratus***, 64 specimens (11.31%) of the total individuals; oak grove, 49 (24.50%), beech forest 13 (12.38%) and 2 (0.77%), grassy association (Fig. 5).

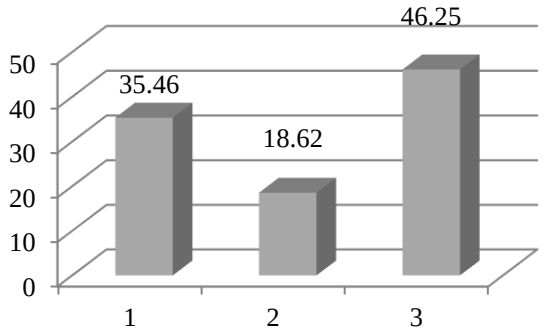

Figure 4 - The percentage variation of the total number of individuals (Carabidae) collected from three biocoenoses, Giurgeni, forest, 1990
(1 - oak grove, 2 - beech forest, 3 - grassy association).

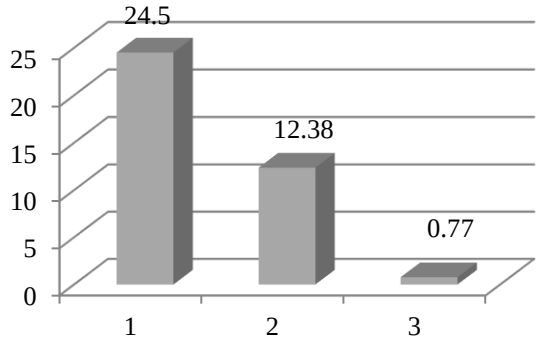

Figure 5 - The percentage variation of the total number of the species *Carabus glabratus* Paykull 1790, collected from three biocoenoses, Giurgeni, forest, 1990
(1 - oak grove, 2 - beech forest, 3 - grassy association).

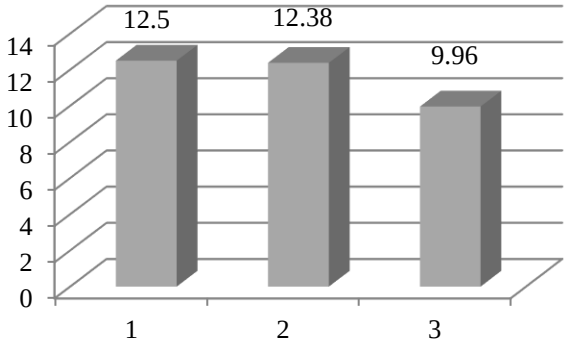

Figure 6 - The percentage variation of the total number of individuals of the species *Pterostichus melas* Creutzer 1799, collected from three biocoenoses, Giurgeni, forest, 1990
(1 - oak grove, 2 - beech forest, 3 - gassy association).

DISCUSSIONS

On the whole, discussions should include syntheses, comparisons, and interpretations. The main objective of the paper was to show the influence of vegetation (relief, altitude, temperature, humidity) on the taxonomic structure of epigeic arthropods (classes, orders, families, genera and especially species) in the particular conditions from the Ursului Valley, Giurgeni forest, Neamț County, 1990. Everything in objective nature, in living nature, in ecosystems is in unity, connection, action, interaction. Nothing without a cause and effect.

Taking into account the altitude of the relief, 260-320 m, 340-400 m, most territory of the Neamț County is covered with deciduous forests.

In the oak grove and beech forest stationaries, the total number of taxa, the total number of collected individuals, related to these taxa (classes, orders) are close. For example, 4 classes in the oak grove stationary and 5 classes in the beech forest stationary, with the percentage of collected individuals, 19.13% (oak grove) and 18.35% (beech forest).

The habitat influences due to the main ecological factors (soil, vegetation, temperature, humidity, food) are predominant on the individuals of the species with the ecological characteristics of the species, especially the Carabidae family (preference for habitat, preference for humidity, preference for food).

For example, the species *Pseudophonus rufipes* (Degeer, 1774), that prefers open habitats (crops), meso-xerophilous, its presence in the three stationary was the following: in the beech forest no individual was collected, in the oak grove one specimen was collected, but in the grassy association 90 individuals were collected (34.75%).

Comparing the total number of collected Carabidae species in oak grove Giurgeni (1990), with the total number of carabid species of the same phytocoenosis, Gâdinți forest, Neamț County, 1991, (Varvara & Zugravu, 2004), 18 species were collected, and in the Gâdinti forest 23 species, common in both localities being only 12 species.

Doing the same operation with the total number of collected Carabidae species from the *Querco petreae - Carpinetum* association, the Fundătura forest, Răchitoasa, Bacău County, 1982 (Varvara & Pilat, 2004) 29 species were collected, 11 species being common in the two localities.

The number of individuals belonging to the species of Carabidae is most variable.

CONCLUSIONS.

In total, there were collected 2,561 specimens of epigeic arthropods of which 490 (19.13%) from oak grove), 469 (18.31%) from beech forest and 1,602 (62.55%) from grassy association.

In the oak grove, there were collected four classes of arthropods; insects are eudominant, 325 individuals (66.33%); five orders of insects, Coleoptera

263 individuals (80.92%); seven families of coleopterans, family Carabidae 200 individuals (76.05%) with 17 species. *Carabus glabratus* 49 specimens (24.50%) and *Carabus cancellatus* 29 specimens (14.50%).

In the beech forest, there were collected also four classes; insects 397 specimens (84.65%); six orders of insects, Coleoptera 226 specimens (56.93%); eight families of coleopterans, Carabidae, 105 specimens (46.46%) and 16 species; *Aptinus bombarda* 36 specimens (34.29%) and *Abax parallelus* 15 specimens (14.29%).

In the grassy association, insects 1,463 specimens (91.32%); 8 orders of insects, Coleoptera 303 specimens (20.71%); 10 families of Coleoptera, Carabidae, 261 specimens (86.14%); 14 species, *Pseudophonus rufipes* 90 specimens (34.48%) and *Poecilus coerulescens* 34 specimens (13.03 %).

The presence of taxa in all the biocoenoses is the following: four classes (Crustacea: Ord. Isopoda, Arachnida, Myriapoda, Insecta); five orders of insects (Collembola, Dermaptera, Coleoptera, Hymenoptera, Diptera); five families of Coleoptera (Carabidae, Scarabaeidae, Silphidae, Staphylinidae, Chrysomelidae); five species of Carabidae (*Bembidion lampros*, *Carabus cancellatus*, *Abax parallelus, A. carinatus*, *Pterostichus melas*).

ACNOWLEDGEMENTS

The authors of this paper address special thanks to Mestecaneanu Adrian, PhD from the Pitesti Museum for his kind and competent attitude and other persons who read attentively the text and made some concrete observations referring to the bibliography.

REFERENCES

FREUDE H., HARDE K. W., LOHSE A., 1974 - *Die Käfer Mitteleuropas. 2. Adephaga*. Goecke and Evers, Krefeld. 381 p.

MÂNDRU C., CONSTANTINEANU R., RĂIANU L., MIRONESCU I., GHEORGHIADE M., BORCEA M., VANCEA ȘT., SIMIONESCU V., VALENCIUC N., IORDACHE I., CONSTANTINEANU IR., LEHRER A., 1979 - *Aspecte din fauna Masivului Ceahlău*. Ocrotirea naturii nemțene. Piatra Neamț. 106-125.

SERAFIM R., APETREI M., 1996 - *Coleoptere Coccinellidae si Cerambycidae din colecția Muzeului de Științele Naturii din Piatra Neamț*. Muzeul de Științele Naturii Piatra Neamț. Studii și cercetări. Piatra Neamț. **8:** 431-453.

VARVARA M., ZUGRAVU F., 2004 - *Contributions to the study of carabids (Coleoptera, Carabidae) from the Gâdinți forest, Neamț County*. Analele Științifice ale Univ. "Al. I. Cuza" Iași, seria Biologie animală. Iași. **L:** 157-172.

VARVARA M., PILAT A., 2004 - *The knowledge of carabids (Coleoptera, Carabidae) from three sites of the Fundătura forest, Bacău County*. Analele Științifice ale Univ. "Al. I. Cuza" Iași, seria Biologie animală. Iași. **L:** 141-155.

VARVARA M., POPESCU I., 1999 - *Contributions to the knowledge of populations of Carabidae from the Ceahlău Massif*. Universitatea din Bacău, Studii și comunicări. Bacău. **4:** 85-94.