

ASPECTS OF TAXONOMIC AND ECOLOGICAL STRUCTURE OF THE COENOSES OF CARABIDAE (COLEOPTERA) IN FIVE ALFALFA CROPS, MOLDOVA (ROMANIA)

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Abstract. The paper is based on quantitative collectings of the individuals belonging to the epigeic species of Carabidae from five crops of alfalfa, Moldova (1977, 1978, 1981, 1983). For unitary collectings of the carabidological material, there were used 12 Barber pit-falls in every crops and year. In total, there were made 75 collectings, analysed 900 samples and collected 11,618 specimens of Carabidae belonging to 13 subfamilies, 20 genera and 45 species. In total, the Harpalinae subfamily is represented by four genera (20%), 11 species (24.44%) and 1,486 individuals (12.79%). The Pterostichinae subfamily is represented by five genera (25.00%), 10 species (22.22%) and 9,651 (83.06%). The average number of species present in the alfalfa crops was 9, with a variation between 7 species (Hemeiuș, 1981, Bacău County) and 25 (Suceava, 1978, Suceava County). The mean number of the individuals present in crops was 2,323, with a large variation between 636 (Pogonești, 1983) and 5,399 (Suceava, 1978). Three species had special relative abundances: *Harpalus (Pseudophonus) rufipes* 1,051 individuals (9.05% of total), *Poecilus cupreus* 3,585 (30.86%) and *Pterostichus melanarius* 5,969 (51.38%). The average value of the Shannon diversity index was 1.66 with a variation between 0.92 (Suceava, 1977) and 3.24 (Suceava, 1978) and evenness 42%, with a variation between 29% (Suceava, 1978) and 71% (Căbești, 1983).

Keywords: Alfalfa crop, carabids, species, taxonomic structure, abundance, dominance, ecological requirements, Shannon index, evenness.

Rezumat. Aspecte ale structurii taxonomice și ecologice ale cenozelor de Carabidae (Coleoptera) în cinci culturi de lucernă, Moldova (România). Lucrarea se bazează pe colectările cantitative ale indivizilor speciilor epigeice de Carabidae din cinci culturi de lucernă, Moldova (1977, 1978, 1981, 1983). Pentru colectarea unitară a materialului carabidologic s-au folosit câte 12 capcane Barber în fiecare cultură și an. În total, s-au efectuat 75 colectări, analizat 900 probe și colectat 11.618 exemplare de Carabidae care aparțin la 13 subfamilii, 20 genuri și 45 specii. În total, subfamilia Harpalinae este reprezentată prin 4 genuri (20%), 11 specii (24,44%) și 1486 indivizi (12,79%). Subfamilia Pterostichinae este reprezentată prin 5 genuri (25%), 10 specii (22,22%) și 9651 (83,06%). Numărul mediu de specii prezente în culturi de lucernă a fost 9, cu o variație între 7 specii (Hemeiuș, 1981, județul Bacău) și 25 (Suceava, 1978, județul Suceava). Valoarea medie a numărului de indivizi prezenți în culturi a fost de 2323, cu o amplă variație, între 636 (Pogonești, 1983) și 53.99 (Suceava, 1978). Trei specii au avut abundențe relative deosebite: *Harpalus (Pseudophonus) rufipes* 1051 indivizi (9,05% din total), *Poecilus cupreus* 3585 (30,86%) și *Pterostichus melanarius* 5969 (51,38%). Valoarea medie a Indicelui de diversitate Shannon a fost 1,66, cu o variație între 0,92 (Suceava, 1977) și 3,24 (Suceava, 1978), iar echitabilitatea, 42%, cu o variație între 29% (Suceava, 1978) și 71% (Căbești, 1983).

Cuvinte cheie: cultura de lucernă, carabide, specii, structură taxonomică, abundență, dominanță, cerințe ecologice, indice de diversitate Shannon, echitabilitate.

INTRODUCTION

Coenosis structure and especially the density and dominance (relative abundance) of carabids populations in the agroecosystems (wheat, potatoes, sugar beet, maize, alfalfa, clover, etc.) are influenced by many synergically acting factors, like pedological and hydrological conditions, microclimatic conditions specific for each crops, stand duration and timing of crop presence on the field, agro technical measures, and chemical pest control (VARVARA & SUSTEK, 2011).

Moldova is a zoogeographical region of Romania (KIS, 1970) characterized by a temperate continental climate, with the annual average temperature between 7.0 and 9.0°C and annual average precipitations of 450-650 mm. Within Moldova, (Romania) three climatic districts are distinguished: (1) The northern one with the southern limit southerly of Iași city (annual precipitations 500-600 mm, average annual temperature 9.4°C; (2) the central one with the southern limit south of Huși town (annual precipitations 400- 500 mm, average annual temperature 9.5°C and (3) the southern one (annual precipitations 400-500 mm, average annual temperature 10.5°C) (according to www.meteoromania.ro).

Alfalfa (*Medicago sativa*) is a perennial plant that normally lives 4-8 years. It is a valuable forage legume plant for cows, cattle, beef cattle, sheep, goats, horses, rabbits, pigs because it is rich in proteins, calcium, minerals and vitamins (B group, C, D, K). Also, *Medicago sativa* is important for agriculture. It prevents erosion, enriches the soil with nitrogen due to symbiotic bacteria, provides food for pollinators, offers shelter for predators and parasitoids.

In Moldova, in some agricultural crops, ecological research were made by VARVARA & BRUDEA (1983); TURCULEȚ & VARVARA (2006) (clover); VARVARA et al. (1999) (potatoes), VARVARA & BULIMAR (2003); VARVARA (2005) (wheat); VARVARA (2001), VARVARA et al. (2001) (potatoes); VARVARA & GĂLUȘCĂ (2007); VARVARA (2008) (sugar beet); VARVARA & APOSTOL (2008) (sun flower).

MATERIAL AND METHODS

The carabidological material for this paper is original. The material was collected from alfalfa crops, from three counties, five localities (Moldova) in the interval 1977-1983: Suceava, 1977, 1978 (Suceava County), North of Moldova, Hemeiuș, 1981, Căbești, 1983 (Bacău County), Pogonești, 1983 (Vaslui County).

For collecting, there was used the Barber pit-falls method, a statistic, unitary, objective standard method that permits the continuous qualitative and quantitative collecting and dynamics of the epigeic arthro-fauna. In every crop and season of

collecting, there were used 12 pit-falls to collect all kinds of species in the structure of dominance (subprecedent-eudominant). The canisters contained a 4% formalin solution for preserving of the entomological material; the pit-falls were protected from precipitations. Each pit-fall had a capacity of 385 cubic centimetres, 7 centimetres in diameter, 10 centimetres in height. The pit-falls were set on three rows, each row having four pit-falls. The distance among rows and pit-falls was five meters.

The collecting was conducted for five months, from May to September. In crops, there were carried out between 12 and 15 calendar dates of collectings. The individuals collected from a pitfall constituted a sample (Table 1).

The paper presents the coenosis taxonomic structure of Carabidae and the variation of several ecological parameters: relative abundance, dominance, the main ecological requirements of the species of Carabidae in the ecological conditions of the alfalfa crop in the years 1977, 1978, 1981, 1983. The material collecting in the field and in the respective localities were made by BRUDEA (1983), PROCA (1984), MĂRCUȚĂ (1984), the last two being biology teachers in the general education in the localities mentioned for obtaining the first didactic degree in the preuniversity education. All the methodical instructions for collecting the material were given by me, Varvara Mircea, the advisor of the works for obtaining the first degree in the preuniversity teaching. The determination of the species of Carabidae was made in accordance with determination books in Romanian, Russian, German, English languages.

The objectives of the paper concern the knowledge of the numerical taxonomic structure (subfamilies, genera, species, specimens of the coenosis of Carabidae; specific diversity, the Index of diversity, the structure and variation of dominance), and the characterization of the species and the coenosis of Carabidae as reproduction of species, preferences for moisture, biotope, food regime and geographical distribution. Data for ecological characterization of the species were taken from different papers (NECULISEANU, 2003; PETRUSENKO, 1970; PETRUSENKO & PETRUSENKO, 1972; SUSTEK, 2000; VARVARA, (2005a, 2008); VARVARA & BRUDEA, 2012).

RESULTS

In those four years of collecting, there were used 60 Barber's pit-falls in crops for 723 days, were performed 75 collectings, analysed 900 samples in which there were numbered 11,618 individuals belonging to 13 subfamilies, 20 genera and 45 species (Carabidae) (Table 1).

Table 1. General information on the collectings in the alfalfa crops, Moldova, (Romania).

	Localities	County	Collecting limits	Days	Collectings	Samples	Individuals
1	Suceava, 1977	Suceava	April 28 – Sept. 30	156	15	180	2711
2	Suceava, 1978	Suceava	April 29-Sept. 30 .	155	15	180	5399
3	Hemeiuș, 1981	Bacău	May 11 – Oct. 18	142	17	204	2350
4	Pogonești, 1983	Vaslui	April 25 –August 20	117	12	144	636
5	Căbești, 1983	Bacău	May 1 – Sept. 30	153	16	192	522
			Total	723	75	900	11.618

Numerical variation of taxa is given in Table 2. Subfamilies, variation between 3 and 9; genera, 5-13; species, 7-25; individuals, 636-5,399 (Table 2).

Table 2. Taxonomic and numerical structure of the coenosis of Carabidae in five alfalfa crops from Moldova (1977, 1978, 1981, 1983).

	Taxa	1	2	3	4	5	Total
1	Subfamilies	6	7	3	5	9	13
	%	46.15	53.84	23.07	38.46	69.23	
2	Genera	7	11	5	6	13	20
	%	35.0	55.0	25.0	30	65.0	
3	Species	9	23	7	17	25	45
	^%	20.0	51.11	15.55	37.77	55.55	
4	Individuals	636	522	2350	2711	5399	11.618
	%	5.47	4.49	20.23	23.33	46.47	99.99

Legend = 1. Pogonești, 1983; 2. Căbești, 1983; 3. Hemeiuș, 1981; 4. Suceava, 1977; 5. Suceava, 1978.

Subfamilies, number of localities in which they were found and the numerical and percentage of individuals capturers are given in Table 3.

Table 3. The subfamilies of Carabidae present in alfalfa crops, Moldova.

No	Subfamilies	Localities	Individuals	%
1	Cicindelinae	1	9	0.07
2	Carabinae	5	243	2.09
3	Loricarinae	1	8	0.06
4	Scaritinae	1	46	0.39
5	Broscinae	1	2	0.01
6	Anisodactilinae	2	42	0.36
7	Harpalinae	4	1,486	12.79
8	Stenolophinae	2	4	0.03
9	Pterostichinae	5	9,651	83.06
10	Callistinae	1	2	0.01

11	Zabrinae	4	117	10.07
12	Dromiinae	2	3	0.02
13	Brachiniinae	1	5	0.04
	Total		11,618	

The subfamilies Harpalinae and Pterostichinae are eudominant as number of individuals and percentages. The numerical land percentage variation of the species collected, on localities, is detailed in Table 4.

Table 4. The species of carabids found in alfalfa crops from Moldova, their relative abundance and dominance.

No	Species	Pogonești	Căbești	Hemeiuș	Suceava -77	Suceava-78	Total
1	<i>Cicindela germanica</i>	-	-	-	-	9	9
	%	-	-	-	-	0.17	0.08
2	<i>Calosoma auro-punctatum</i>	20	11	-	-	-	31
	%	3.14	2.11	-	-	-	0.27
3	<i>Carabus violaceus</i>	-	-	35	51	19	105
	%	-	-	1.49	1.88	0.35	0.90
4	<i>C. cancellatus</i>	-	-	3	-	-	3
	%	-	-	0.13	-	-	0.03
5	<i>C. granulatus</i>	-	-	10	1	6	17
	%	-	-	0.43	0.04	0.11	0.15
6	<i>C. scabriusculus</i>	-	1	-	2	-	3
	%	-	0.19	-	0.07	-	0.03
7	<i>C. excellens</i>	-	-	-	5	16	21
	%	-	-	-	0.18	0.30	0.18
8	<i>C. besseri</i>	-	63	-	-	-	63
	%	-	12.07	-	-	-	0.54
9	<i>Loricera pilicornis</i>	-	-	-	-	8	8
	%	-	-	-	-	0.15	0.07
10	<i>Clivina fossor</i>	-	-	46	-	-	46
	%	-	-	1.96	-	-	0.40
11	<i>Brosicus cephalotes</i>	-	-	-	-	2	2
	%	-	-	-	-	0.04	0.02
12	<i>Anisodactylus poeciloides</i>	-	-	-	-	2	2
	%	-	-	-	-	0.04	0.02
13	<i>A. signatus</i>	-	-	-	11	15	26
	%	-	-	-	0.41	-	0.22
14	<i>A. binotatus</i>	-	-	-	6	8	14
	%	-	-	-	0.22	0.15	0.12
15	<i>Ophonus sabulicola</i>	-	1	-	-	-	1
	%	-	0.19	-	-	-	0.01
16	<i>O. diffinis</i>	-	1	-	-	-	1
	%	-	0.19	-	-	-	0.01
17	<i>Metoponus azureus</i>	-	28	-	-	-	28
	%	-	5.36	-	-	-	0.24
18	<i>Harpalus rufipes</i>	417	57	-	332	245	1051
	%	65.57	10.92	-	12.25	4.54	9.05
19	<i>H. griseus</i>	-	-	-	3	14	17
	%	-	-	-	0.11	0.26	0.15
20	<i>H. aeneus</i>	-	3	-	9	4	16
	%	-	0.57	-	0.33	0.07	0.14
21	<i>H. rubripes</i>	-	9	-	-	2	11
	%	-	1.72	-	-	0.04	0.09
22	<i>H. distinguendus</i>	120	171	-	3	2	296
	%	18.87	32.76	-	0.11	0.04	2.55
23	<i>H. latus</i>	9	5	-	2	-	16
	%	1.42	0.96	-	0.07	-	0.14
24	<i>H. calceatus</i>	-	-	-	-	2	2
	%	-	-	-	-	0.04	0.02
25	<i>H. tardus</i>	-	47	-	-	-	47
	%	-	9.0	-	-	-	0.40
26	<i>Acupalpus meridianus</i>	2	2	-	-	-	4
	%	0.31	0.38	-	-	-	0.03
27	<i>Poecilus cupreus</i>	-	10	1539	461	1575	3585
	%	-	1.92	65.49	17.00	29.17	30.86
28	<i>Pterostichus melanarius</i>	-	1	713	1817	3438	5969
	%	-	0.19	30.34	67.02	63.689	51.37
29	<i>Pt. ovoideus</i>	-	-	-	2	7	9
	%	-	-	-	0.07	0.13	0.08
30	<i>Pt. melas</i>	-	4	-	-	-	4
	%	-	0.77	-	-	-	0.03
31	<i>Pt. nigrita</i>	-	-	-	2	-	2

	%	-	-	-	0.07	-	0.02
32	<i>Calathus fuscipes</i>	-	52	-	2	-	54
	%	-	9.96	-	0.07	-	0.46
33	<i>C. ambiguus</i>	10	7	-	-	-	17
	%	1.57	1.34	-	-	-	0.15
34	<i>C. melanocephalus</i>	-	-	-	-	2	2
	%	-	-	-	-	0.04	0.02
35	<i>Dolichus halensis</i>	-	-	4	-	3	7
	%	-	-	0.17	-	0.06	0.06
36	<i>Agonum sexpunctatum</i>	-	-	-	-	2	2
	%	-	-	-	-	0.04	0.02
37	<i>Amara equestris</i>	-	-	-	2	-	2
	%	-	-	-	0.07	-	0.02
38	<i>A.ovata</i>	52	1	-	-	2	55
	%	8.18	0.19	-	-	0.04	0.47
39	<i>A.similata</i>	-	8	-	-	12	20
	%	-	1.53	-	-	0.22	0.17
40	<i>A.familiaris</i>	-	-	-	-	2	2
	%	-	-	-	-	0.04	0.02
41	<i>A.aenea</i>	-	33	-	-	-	33
	%	-	6.32	-	-	-	0.28
42	<i>Chlaenius vestitus</i>	-	-	-	-	2	2
	%	-	-	-	-	0.04	0.02
43	<i>Zabrus tenebrioides</i>	5	-	-	-	-	5
	%	0.79	-	-	-	-	0.04
44	<i>Brachinus crepitans</i>	-	5	-	-	-	5
	%	-	0.96	-	-	-	0.04
45	<i>Microlestes maurus</i>	1	2	-	-	-	3
	%	0.16	0.38	-	-	-	0.03
	Total species	9	23	7	17	25	45
	%	20.0	51.11	15.55	37.77	55.56	
	Total individuals	636	522	2350	2711	5399	11.618
	%	5.47	4.49	20.23	23.33	46.47	99.99
	No. of eudominant species	2	3	2	3	2	
	H' (Shannon index of diversity)	1.18	1.58	3.24	0.92	1.38	
	E (Evenness index)	0.42	0.49	0.71	0.23	0.29	

The main ecological requirements of the species found are presented in Table 10. The main synthetic ecological requirements of the coenosis of Carabidae referring to types of reproduction, preferences for moisture, biotopes, food and geographical distribution are presented in Tables 5-9 and Figs. 1-5.

Table 5. Numerical and percentage variation of the types of reproduction in the species of Carabidae from five alfalfa crops, Moldova, (Romania).

No.	Seasons	No of species	%
1	Spring	26	57.77
2	Spring, Summer	1	2.22
3	Summer	1	2.22
4	Autumn	15	33.38
5	Autumn, Spring	1	2.22
6	Plastic	1	2.22
	Total	45	100

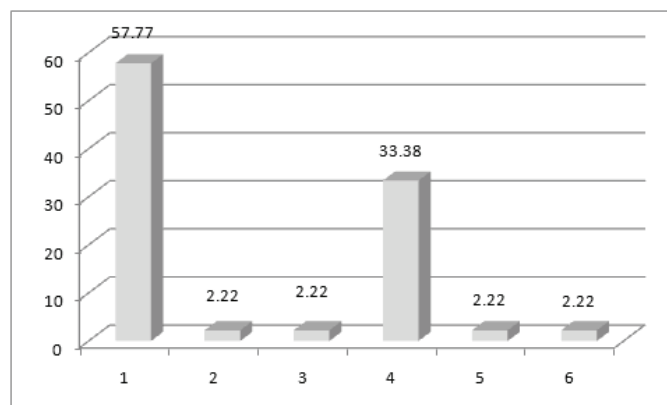


Figure 1. Percentage ratios of the types of reproduction of Carabidae in five alfalfa crops, Moldova.

Legend: 1-6 in Table 5.

The spectrum of moisture preferences of the species of Carabids from five alfalfa crops, Moldova (Romania) are presented in Table 6 and Figure 2.

Table 6. The spectrum of moisture preferences of the species of Carabids from five alfalfa crops, Moldova (Romania).

No.	Preference for moisture	No of species	%
1	Hygrophilous	3	6.66
2	Hygro-mesophilous	2	4.44
3	Mesophilous	28	62.22
4	Meso-xerophilous	10	22.22
5	Xerophilous	2	4.44
	Total species	45	99.98

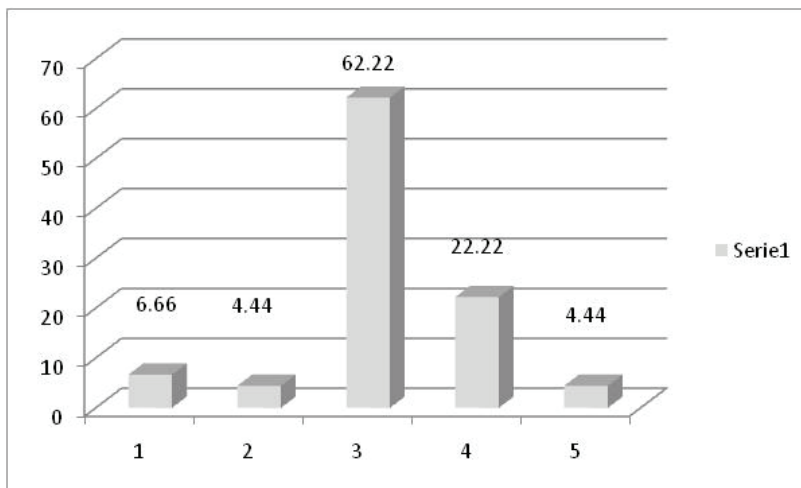


Figure 2. Percentage ratios of preferences for moisture of Carabidae from five alfalfa crops, Moldova.

Table 7. The spectrum of biotope preferences of the species of Carabidae from five alfalfa crops, Moldova (Romania).

No.	Biotopes	No of species	%
1	Forest	6	13.33
2	Forest, steppe	3	6.67
3	Forest, crops	3	6.67
4	Steppe	1	2.22
5	Steppe, crops	11	24.44
6	Crops	15	33.33
7	Open land	3	6.67
8	Riparian	1	2.22
9	Eurytopic	2	4.44
	Total	45	99.99

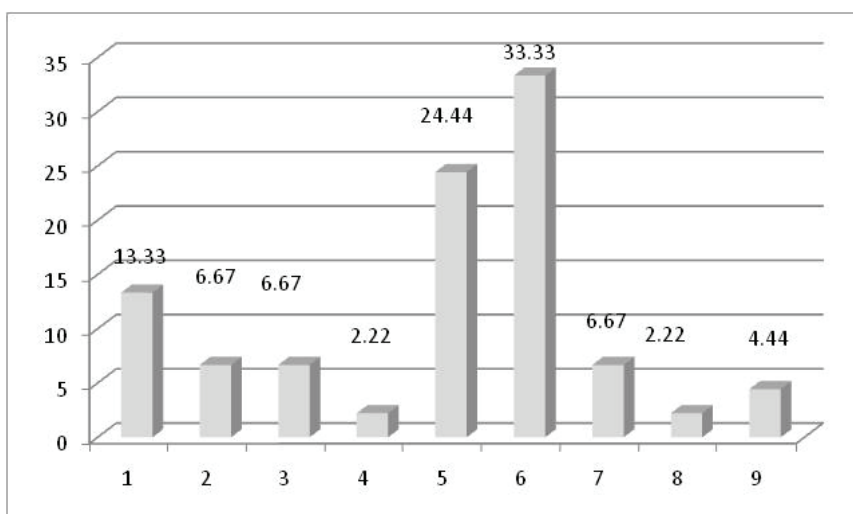


Figure 3. Percentage ratios of the preferences for biotopes of Carabidae from five alfalfa crops, Moldova (Romania).

Legend: 1-9 in Table 7.

Table 8. The spectrum of food regime of the species of Carabidae from five alfalfa crops, Moldova.

No.	Food regime	No of species	%
1	Zoophagous	20	44.44
2	Mixophagous	1	2.22
3	Phytophagous	7	15.56
4	Pantophagous	17	37.78
	Total	45	100

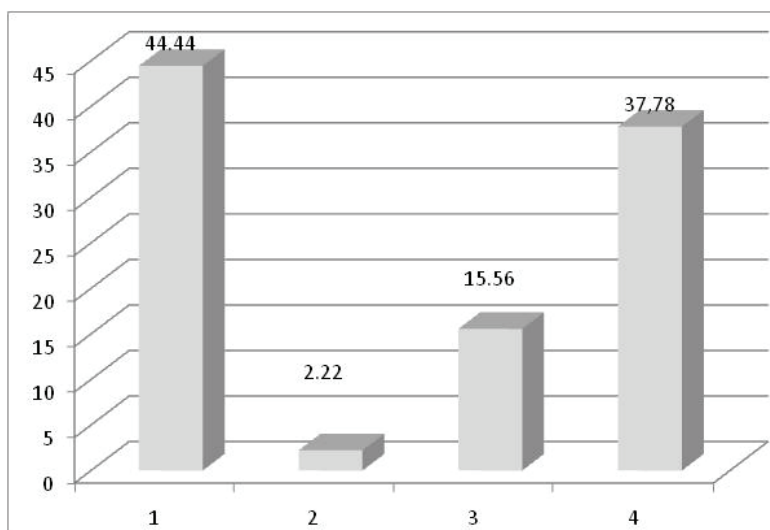


Figure 4. Percentage ratios of the trophic spectrum of the Carabidae from five alfalfa crops , Moldova.

Table 9. The numerical and percentage spectrum of the geographical distribution of the species of Carabidae from five alfalfa crops of Modova (Romania).

No	Geographical distribution	Species	%
1	Palaeartic	14	31.11
2	West palaeartic	15	33.33
3	Holarctic	1	2.22
4	European	4	8.89
5	Euro-Mediterranean	2	4.44
6	Euro-Siberian	5	11.11
7	Euro-Caucasian	3	6.67
8	East-European	1	2.22
	Total	45	99.99

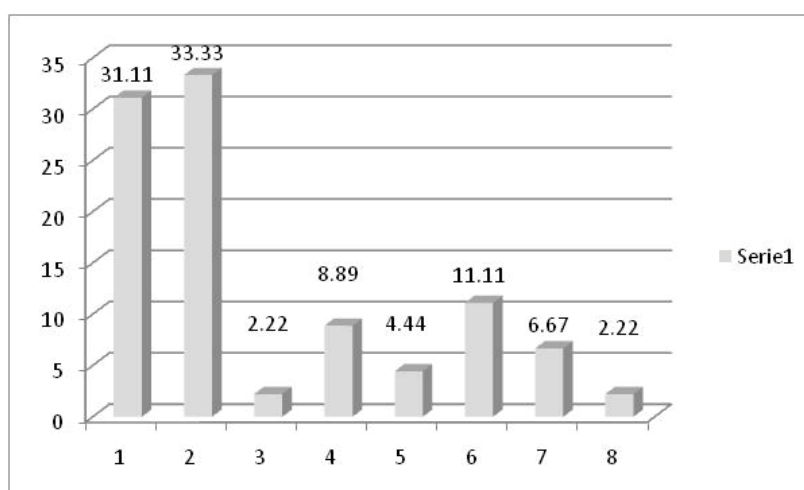


Figure 5. The percentage spectrum of the geographical distribution of Carabidae in five alfalfa crops from Moldova (Romania).

The main ecological requirements, numerical and percentage of the species are presented in Table no. 10.

Table 10. General ecological requirements of the species found in the alfalfa crops of Moldova.

No.	Species	1	2	3	4	5
1	<i>Cicindela germanica</i> Linne 1758	Sp	M	St,Cr	Z	Wp
2	<i>Calosoma auronotum</i> Herbst 1784	Sp	M	St,Cr	Z	Wp
3	<i>Carabus violaceus</i> Linne 1758	A	M-X	F,Cr	Z	Es
4	<i>C. cancellatus</i> Illiger 1798	Sp	M	F	Z	Pl
5	<i>C. granulatus</i> Linne 1758	A	H-M	Cr	Z	Pl
6	<i>C. scabriusculus</i> Oliver 1795	Sp	M-X	St,Cr	Z	E
7	<i>C. excellens</i> Fabricius 1798	Sp	M	F	Z	E
8	<i>C. besseri</i> Fischer Von Waldheim 1822	A	M	St,Cr	Z	EstE
9	<i>Loricera pilicornis</i> Fabricius 1775	Sp	H	F,Cr	Z	Hol
10	<i>Clivina fossor</i> Linne 1758	Sp	M	Rip.	Z	PL
11	<i>Broscus cephalotes</i> Linne 1758	Sp	X	St,Cr	Z	E
12	<i>Anisodactylus poeciloides</i> Stephens 1828	Sp	M	Cr	Mixofit	Em
13	<i>A. signatus</i> Panzer 1797	Sp	M	Cr	P	Pl
14	<i>A. binotatus</i> Fabricius 1787	A	M	St,Cr	Fit	Es
15	<i>Ophonus sabulicola</i> Panzer 1796	A	M	St, Cr	Fit.	Es
16	<i>O. diffinis</i> Dejean 1829	A	M	St,Cr	Fit.	Em
17	<i>Metophonus azureus</i> Fabricius 1775	A	M	St,Cr	Fit.	Wp
18	<i>Harpalus rufipes</i> De Geer 1774	A	M-X	OLS	P	Wp
19	<i>H. griseus</i> Panzer 1767	A	M-X	OLS	P	Pl
20	<i>H. aeneus</i> Fabricius 1775	Sp	M-X	Cr	P	Pl
21	<i>H. rubripes</i> Duftschmid 1812	A	M	F	P	Wp
22	<i>H. distinguendus</i> Duftschmid 1812	Sp,S	M	OLS	P	PL
23	<i>H. latus</i> Linne 1758	A	M	F,St	P	PL
24	<i>H. calceatus</i> Duftschmid 1812	Sp	M-X	Cr	P	PL
25	<i>H. tardus</i> Panzer 1797	Sp	M-X	St	P	Es
26	<i>Acupalpus meridianus</i> Linne 1767	Sp	M	Cr	P	E
27	<i>Poecilus cupreus</i> Linne 1758	Sp	M	Cr	Z	Wp
28	<i>Pterostichus melanarius</i> Illiger 1798	Sp	M	F,Cr	Z	Wp
29	<i>Pt. ovoideus</i> Sturm 1824	Sp	M	F	Z	Ec
30	<i>Pt. melas</i> Creutzer 1799	Sp	M-X	F	Z	Ec
31	<i>Pt. nigrita</i> Paykull 1790	S	H	F,St	Z	PL
32	<i>Calathus fuscipes</i> Goeze 1777	A	M	Eu	P	Wp
33	<i>C. ambiguus</i> Paykull 1790	A	M-X	St,Cr	P	Wp
34	<i>C. melanocephalu</i> Linne 1758	A,Sp	M	Eu	P	Pl
35	<i>Dolichus halensis</i> Schaller 1783	A	M	Cr	P	PL
36	<i>Agonum sexpunctatum</i> Linne 1758	Sp	H-M	Cr	Z	Pl
37	<i>Amara equestris</i> Duftschmid 1812	Sp	M	Cr	P	Es
38	<i>A. ovata</i> Fabricius 1792	Sp	M	F	P	Pl
39	<i>A. similata</i> Gyllenhal 1812	Sp	M	F,St	P	Wp
40	<i>A. familiaris</i> Duftschmid 1812	Sp	M	Cr	Fit	Wp
41	<i>A. aenea</i> De Geer 1774	Sp	M	Cr	Fit	Wp
42	<i>Chlaenius vestitus</i> Paykull 1790	Sp	H	Cr	Z	Wp
43	<i>Zabrus tenebrioides</i> Goeze 1777	A	M	Cr	Fit	Ec
44	<i>Brachinus crepitans</i> Linne 1758	Sp	M-X	St,Cr	Z	Wp
45	<i>Microlestes maurus</i> Sturm 1827	Plastic	X	Cr	Z	Wp

Legend: 1 = Reproduction type; 2 = Moisture preference; 3 = Biotope preference; 4 = Food regime; 5 = Zoogeographical distribution; Sp. = Spring; A = Autumn; S = Summer; H = Hygrophilous; H-M = Hygro-mesophilous; M = Mesophilous; M-X = Meso-Xerophilous; Cr = Crops; F = Forest; OLS = Open landscape; St = Steppe; Eu = Eurytopic; Rip. = Riparian; Fit = Phytophagous; Mixofit = Myxo-phytophagous; P = Pantophagous; Z = Zoophagous; E = European; Ea = Euro-Asiatic Ec = Euro-Caucasian; East E. = East European; Em = Euro-Mediterranean; Es = Euro-Siberian; Hol = Holarctic; Pl = Palaearctic; Wp = West palaearctic; Pla = Plastic.

DISCUSSIONS

In the ecological conditions of the alfalfa crop (1977, 1978, 1981, 1983) from Moldova, the coenosis structure of Carabidae was characterized by the variation of the taxon number, number of specimens, the structure of dominance, the values of the two ecological indexes, due to the type of ecosystem and pedoclimatic conditions. There were collected 11,618 specimens belonging to 13 subfamilies of Carabidae, 20 genera and 45 species. The concrete variations on localities and years are shown in Table no 2. The year 1978 was the most favourable when there were collected 5,399 individuals (46.47% of total), that is 8-10 times more than in the alfalfa crops from Căbești (Bacău County) and Pogonești (Vaslui County). Soil moisture favoured the increase of the number of individuals, an ecological fact indicated by the presence of the specimens of *Loricera pilicornis* and *Chlaenius vestitus*, hygrophilous species, only in 1978. These two species were not collected in the other four localities (Table 4). *Pterostichus melanarius* (a mesophilous species) was collected two times more in 1978 than in 1977 (Suceava), four times than in the locality Hemeiuș, 1981 (Bacău County). The species was not collected in Căbești locality (1983) and only one individual in Pogonești (1983). Sure, it was because of the variation of soil moisture determined by the geographical position of those two localities. *Poecilus cupreus* (mesophilous to moderately hygrophilous) was collected three times more in 1978 than 1977 in the same locality, Suceava, in the same crop (alfalfa). It was not collected in Căbești locality and only 10 specimens in Pogonești locality. Comparing our data with those from the Republic of Moldova,

there were collected in total 98 species of which: 45 (45.91%) (VARVARA, 2014) – (in the present paper); Republic of Moldova, 48 (48.97 %), (NECULISEANU, 2003); 57 (58.16%), DĂNILĂ, 2005); 3 (3.06%), (BUȘMACHIU & BACAL, 2012). Out of the total number of 98 species, 13 species (13.26 %) are common in Moldova and the Republic of Moldova; 20 species (20.40 %) were common within the Republic of Moldova; 13 species (13.26%) were found only in Moldova (Romania); 29 species (29.59 %) were found only in the Republic of Moldova; 24 species were found only by NECULISEANU (2003); 34 species (34.69%) were collected only by DĂNILĂ (2005).

Among common species in Moldova and the Republic of Moldova, we cite: *Anisodactylus signatus*, *Harpalus rufipes*, *H. riseus*, *H. rubripes*, *H. distinguendus*, *Poecilus cupreus*, *Pterostichus melanarius*, *Calathus ambiguus*, *Amara aenea* and *Brachinus crepitans*. Out of the total common species in Moldova and the Republic of Moldova, 69% are mesophilous and 31% meso-xerophilous. In Moldova, (Romania), the subfamilies Harpalinae and Pterostichinae are well represented as species and specimens. The specimens percentages of Harpalinae varied between 4.98% (1978) and 12.87% (1977), a difference of 7.89% between years, knowing the fact that within this subfamily mesoxerophilous species are comprised. The specimens percentages of Pterostichinae varied between 84.25% (1977) and 93.11% (1978), a difference of 8.86%. These differences are another proof that the year 1978 was more humid than the year 1977. Three species, *Pterostichus melanarius*, *Poecilus cupreus* and *Harpalus rufipes* are euconstant and eudominant in both years, except *Harpalus rufipes*, which was dominant in 1978. Normal variation values of the diversity index (Shannon-Wiever) are between 1.50 and 3.50. Our data show that this index had the value of 0.92 (Suceava, 1977) and 3.24 (Hemeiuș) and the value of evenness was 0.23 (Suceava, 1977) and 0.71 (Hemeiuș, 1981). The values were influenced by the exaggerated dominance of those three species. It meant that there were very good conditions for these species in the alfalfa crop.

Survival and reproduction are the two main features of species. All the adaptations converge towards these targets. Reproduction types and their percentages are given in Table 5 and illustrated in Fig. 1. Two reproduction types predominate. Spring species (26 species, 57.77%) and autumn species (15 species, 33.33). Based on our published results these two groups of species predominate in the coenosis of carabids in wheat crops, potato crops, clover crops, deciduous and coniferous ecosystems from Moldova (according to VARVARA, 2005, 2008; VARVARA & BRUDEA, 2012).

According to NECULISEANU (2003: 131-137) species breeding in the spring-summer winter as adults, their life cycle lasts one or two years. The egg-laying takes place in April-August and the appearance of the larvae, pupae and young adults in May-September. Species breeding in the autumn-summer winter as larvae or partly as adults present a life cycle that lasts one year, two years or three years.

The results referring to moisture preferences are given in Table 6 and illustrated in Fig 2. According to the law of tolerance most individuals of a species are found in the optimum preferendum. The mesophilous and meso-xerophilous species predominate: 62.22 % are mesophilous and 20.22 % are meso-xerophilous. According to our published results the mesophilous and mesoxerophilous species predominate in the ecosystems of winter wheat, potatoes, clover, sugar beet, deciduous forests in various proportions according to local conditions (VARVARA, 2008).

The coenosis of carabids in the alfalfa crop as concerns the preference for biotopes is formed of a mixture of species. There were found 9 classes of species (Table 7 and Fig. 3). The species which prefer crops are in proportion of 33% followed by species which live in steppe, crops (24.44%) and forest 13.33%. Referring to the food regime, the coenosis of carabids in the alfalfa crop is characterized by the predominance of zoophagous and pantophagous species (Table 8, Fig. 4), in total, 82.28%, like in sugar beet and clover crops (VARVARA & BRUDEA, 1983; TURCULEȚ & VARVARA, 2006). Zoogeographically, the species in the alfalfa crop belong to 8 geographical regions (Table 9, Fig. 5). The Palaearctic and West Palaearctic species (64.44%) characterize the coenosis of Carabidae.

CONCLUSIONS

In the local conditions of the alfalfa crops Moldova (1977, 1978, 1981, 1983), from North, Centre and South of Moldova, the coenosis of ground beetles comprised 13 subfamilies, 20 genera and 45 species with local and annual variations. The dominant subfamilies are: Harpalinae, Pterostichinae; the dominant species are: *Pterostichus melanarius*, *Poecilus cupreus* and *Harpalus rufipes*. Their specimens represented 91.28% (out of total). The majority of species are subrecent. The Shannon index had the value of 0.92 (Suceava, 1977) and 3.24 (Hemeiuș, 1981). Evenness was 0.23 (Suceava, 1977) and 0.71 (Hemeiuș, 1981).

Ecologically, the coenosis of Carabidae is dominated by the species with reproduction in Spring (57.77%) and Autumn (33.38 %), mesophilous (62.22 %) and meso-xerophilous (22.22%), pantophagous 37.78%, phytophagous 15.56%, distributed in crops (33.33%), steppe, crops 24.44%, forest 13.33, zoophagous (44.44%), pantophagous 37.78%, phytophagous 15.56% spread in West Palaearctic 33.33% and Palaearctic (31.11%).

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