

**DISTRIBUTION AND RELATIVE ABUNDANCE OF THE SPECIES
Poecilus cupreus LINAEUS 1758 (COLEOPTERA: CARABIDAE)
IN SOME WHEAT AND POTATO CROPS FROM ROMANIA, 1977-2002**

VARVARA Mircea, ŠUSTEK Zbyšek

Abstract. The paper is a synthesis of huge data on the occurrence of *Poecilus cupreus* L. in some wheat fields from 16 localities, 8 counties (1977-2002) and potato fields from 14 localities, 8 counties (1984-1999) in Romania. The material was pitfall-trapped, installing mostly 12 traps in each locality, a luxuriously sufficient number to characterize the dominance structure of a community. The traps were exposed in the wheat fields for 35 – 138 days (average 79 days) from 10 April to 1 August, while in potato fields they were exposed for 21 – 154 days (average 100 days) from 16 April to 30 September. The abundance and dominance of *Poecilus cupreus* showed a wide variability in the wheat fields: from 2 individuals (0.78% in the locality Brăila, Terasă, 1982, Brăila county) to 3,210 individuals (89.66%, Brăila, Lacul Sărat, 1983). In the potato fields, the abundance and relative abundance ranged from 1 individual (2.44% locality Târgu Jiu, 1994, Gorj county) to 742 (63.58 %, locality Zvoriștea, 1993, Suceava county). In the wheat fields *P. cupreus* was eudominant in 72% of the studied localities, with the dominance ranging from 10.42% in Căbești in 1983 (Bacău county) to 89.66% in Lacul Sărat in 1983 (Brăila county). In the potato fields it was eudominant in 42% of localities, where its dominance ranged from 12.04%, Brașov in 1985 (Brașov county) to 63.58%, Zvoriștea in 1993 (Suceava county). *Poecilus cupreus* is an Eurosiberian, spring breeding (May, June), mesophilous to moderately hydrophilous, panthophagous species, occurring in arable land and meadows.

Keywords: Romania, wheat and potato crops, Carabidae, *Poecilus cupreus*, communities.

Rezumat. Răspândirea și abundența relativă a speciei *Poecilus cupreus* (LINAEUS 1758) (Coleoptera: Carabidae) în unele culturi de grâu și cartofi din România, 1977-2002. Lucrarea este o amplă sinteză a colectării indivizilor speciei *Poecilus cupreus* din culturile de grâu din opt județe, 16 localități (1977-2002) și culturile de cartofi din opt județe, 14 localități (1984-1999), din România. Pentru colectarea materialului de carabide epigeice, în marea majoritate a localităților, au fost folosite câte 12 capcane Barber în fiecare cultură, număr de capcane suficient pentru a se colecta toate grupele de dominanță ale speciei. Capcanele Barber au funcționat continuu în culturi, între 35 și 138 zile, în medie, 79 de zile, de la 10 aprilie până la 1 august, în culturile de grâu și între 21 și 154 zile, în medie, 100 de zile, de la 16 aprilie până la 30 septembrie, în culturile de cartofi. Abundența și dominanța speciei *P. cupreus*, în culturile de grâu, a prezentat o amplă variație: doi indivizi (0,78%, Brăila, Terasă, 1982, Județul Brăila) și 3 210 indivizi (89,66%, Brăila, Lacul Sărat, 1983). În culturile de cartofi, dominanța a variat între un individ (2,44%, Târgu Jiu, 1994 Județul Gorj) și 742 (63,58 %, Zvoriștea, 1993, Județul Suceava). În culturile de grâu, *Poecilus cupreus* este eudominant în 72 % din localitățile cercetate (procentele dominanței variind de la 10,42 % Căbești, 1983 (județul Bacău) și până la 89,66%, Lacul Sărat, 1983, (județul Brăila). În culturile de cartofi, *Poecilus cupreus* este eudominant în 42 % din localitățile de unde s-a colectat materialul, procentele variind între 12,04%, Brașov, 1985 (județul Brașov) și 63,58%, Zvoriștea, 1993, (județul Suceava). *Poecilus cupreus* se reproduce în primăvară, mai, iunie, specia fiind mezofilă până la moderat hidrofila, răspândită în agroecosisteme, pășuni și fânețe, pantofagă, eurosiberiană.

Cuvinte cheie: România, culturi de grâu și cartofi, Carabidae, *Poecilus cupreus*, cenoze.

INTRODUCTION

Community structure and especially their population density and dominance (=relative abundance) of Carabids 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, agrotechnical measures, and chemical pest control. Knowledge of trends in structural changes of carabid communities in all types of ecosystems is of essential importance for the assessment of their state and for understanding of processes running in the nature in conditions of changing climate characterized first of all by the more frequent incidence of extreme climatic phenomena. The main goals of the present paper are (1) to specify the variation in the relative abundance of *Poecilus cupreus* LINNAEUS, 1758, one of the most abundant carabids in wheat and potato fields in some climatically different regions of Romania, viz Târgu Jiu basin (Oltenia), Brașov (Transylvania, Țara Bârsei region), Muntenia (Brăila region) and Moldova in dependence on different habitat conditions in regional and local scales and (2) to present some observations on its sex ratio and seasonal dynamics. Similarly as earlier papers (VARVARA 2011 and in press) referring to *Pseudophonus rufipes* (DE GEER 1774) and *Pterostichus melanarius* (ILLIGER 1798) in the wheat and potato fields, this paper synthesizes extensive original quantitative data originating from a long-termed (10-12 years) collecting of beetles in the same crop. Such a collecting was possible only thanks to collaboration at the scientific contracts with the Potato Protection Station of Brașov and due to the opportunity to lead works of licensing for students and theses for obtaining the first degree for the secondary school teaching. Thus, the entire entomological material obtained during these works was collected by the students and identified by the senior author.

The general data on the distribution and autecology of field Carabids were taken from the works by DUSHENKOV (1984); KABACIK-WASÍLIK (1970); KARPOVA (1984); LINDROTH (1949); PORHAJAŠOVÁ et al. (2008) and TIETZE (2003). The data on the occurrence of Carabids in fields in Romania come from BANIȚĂ et al. (1994); BICA (2005); CHIRECEANU (2009); DONESCU & ENIOU (1995); POPESCU & ZAMFIRESCU (2004); TEODOREANU (1970); VARVARA (2001, 2003, 2005, 2011a, 2001b) and VARVARA et al. (1990, 1993, 1999, 2003).

MATERIAL AND METHODS

In the period 1977-2002, an extensive material of Carabids was collected in potato and wheat fields in Transylvania (counties Brașov and Covasna), Moldavia (counties: Bacău, Iași, Neamț, Botoșani, and Suceava), Muntenia (Argeș County), Oltenia (Dolj and Gorj Counties), Dobroudja (Tulcea County) and wheat fields in Muntenia (Brăila County) and Moldavia (counties: Galați, Vrancea, Bacău, Vaslui, Iași, Suceava, Botoșani). In most sites 12 pitfalls were installed. This number proved to be sufficient to record reliably about 80% of occurring species and to exactly characterize quantitative proportion in of all dominant species (OBRTTEL, 1971).

The basin of Țara Bârsei region has an area of 2,406 km². Its altitude varies between 504 m (Feldioara area) and 723 m (Brașov area). Due to its geographical position within Romania, the climate of Țara Bârsei region is temperate continental, mesophilous, with annual average temperature of 7.8°C; the annual average rainfall varies between 548-782 mm, reaching a maximum in Brașov area. In this region, summers are cool because of the mountain influence. The warmest months are July and August, when the temperature rises to 25°C.

Târgu Jiu basin comprises floodplain meadows and river terraces. 80% of the basin's area has a temperate continental climate. The annual average air temperature is 10.2°C at Târgu Jiu. Annual average rainfall is 753.0 mm. In Târgu Jiu basin, the brown alluvial soils predominate on the extensive Jiu river floodplain. The cereals, potatoes and vegetables occupy large surfaces in the centre and south of the county. The average yields are below the Romanian average.

Moldavia is a zoogeographical district (KIS, 1970) characterized by a continental climate, with the annual average temperature between 7.0 and 9.0°C, annual average precipitations of 450-650 mm. The climate of Moldavia is temperate continental. Correlatively with the rising of the altitude, two zones are evident here. The cooler western zone of Moldavia with an annual average temperature of 8.5°C and precipitations of 600-700 mm, and the eastern zone with the annual average temperature of 9.5°C and precipitations of 450-550 mm. Within the western zone three climatic districts are distinguished: (1) the northern one with the southern limit southerly of Iași city (annual precipitation 500-600 mm, average annual temperature 9.4°C); (2) the central one with the southern limit southerly of Huși town (annual precipitation 400-500 mm, average annual temperature 9.5°C) and (3) the southern one (annual precipitation 400-500 mm, average annual temperature 10.5°C). (according to www.meteoromania.ro).

The collecting effort is generally characterized in Table 1 and in details in Tables 2 and 3 (localities, period of the pitfalls exposition, length of their operation, total number of pitfalls used, total number of catches and samples examined, locality and year. To describe the occurrence of *Poecilus cupreus* in the wheat and potato fields, the variation of its dominance, dynamics and sex ratio are given. The material was collected at Brașov for 12 years (1984-1998), near Târgu Jiu for 10 years (1987-1998), in Mârșani for three years (1987-1989), in Muntenia, Brăila County, for five years (1981-1985) and in Moldova for 10 years (1978-2002).

For simplicity, the absolute number of individuals is called as "abundance" and the relative abundance as "dominance".

Table 1. General characteristic of the collecting of Carabids in wheat and potato fields 1977-2002. / Tabel 1. Caracteristica generală a efortului de colectarea carabidelor în culturile de grâu și cartofi, 1977-2002.

Parameter	Wheat	Potato
Period of sampling	1977 – 2002	1984 - 1999
Years of sampling	14	15
Total number of pitfalls used	329	430
Average of pitfalls per site	12	11
Range of number of pitfalls used	6 – 35	5 - 17
Total number of effective days of pitfalls exposition	2098	3994
Average length of pitfalls exposition per site	81	105
Range of pitfalls exposition per site	35 – 138	21 - 154
Total number of analysed samples	2218	8542
Average per locality	85	224
Range of number of analysed samples	24 – 210	24 - 520

RESULTS

Numerical and percentage variations of abundance and dominance of *Poecilus cupreus* in wheat and potato fields are given in Table 4.

Poecilus cupreus was collected in 26 wheat fields in eight counties, in alphabetical order: Bacău, Botoșani, Brăila, Galați, Iași, Suceava, Vaslui, and Vrancea and 38 potato fields (1984-1999), in 11 counties: Argeș, Bacău, Botoșani, Brașov, Covasna, Dolj, Gorj, Iași, Neamț, Suceava, and Tulcea. During 14 years (1977 – 2002) 329 pitfalls functioned (average 12, range 6-35, 2,098 days in total, average 81, range 35-138) here. Altogether 177 catches were obtained from them and 2,218 samples were analysed, on average 85, with a range 24 - 210 (Tables 1 and 2).

During 15 years (1978 – 1999), in potato fields, 430 pitfalls functioned (average 11, range 5-17) 3,994 days in total, average 105 per field, range 21-154. A total of 741 catches were effectuated (average 19, range 2-32, and 8,542 samples were analysed, on average 224 per field, with a range 24 - 520 (Tables 1 and 3).

Table 2. Detailed data (collecting sites, traps exposition, total number of days, number of traps, catches number, total number of samples) on the collecting of *Poecilus cupreus* from different wheat fields, 1977-2002. / Tabel 2. Date detaliate (locuri de colectare; durata de expunere a capcanelor; total zile; număr de capcane; număr de capturi, total probe) asupra colectării speciei *Poecilus cupreus* din diferite culturi de grâu, 1977-2002.

Sites and year	Traps exposition	Days	Traps number	Catches number	Samples total
Brăila, Terasă 1981, (Brăila County)	May 24 – Sept. 3	102	12	6	72
Brăila, Terasă 1982	May 28 – Aug. 30	95	12	9	84
Brăila, Terasă 1983	May 10 – July 20	71	12	7	84
Brăila, Terasă 1984	May 10 – July 11	63	12	6	72
Brăila, Terasă 1985	April 10 – July 10	92	12	7	84
Brăila, Trăian 1985	April 29 – July 10	72	12	7	84
Uzlina 1986	June 1 – July 5	35	12	2	24
Brăila, Lacul Sărat 1981	May 25 – July 15	51	12	3	36
Brăila, Lacul Sărat 1982	May 28 – Aug. 30	95	12	7	84
Brăila, Lacul Sărat 1983	May 28 – Aug. 30	95	12	7	84
Brăila, Lacul Sărat 1984	May 8 – July 17	70	12	6	72
Corod, 1983 (Galați County)	April 25 – July 10	78	12	7	84
Vaslui 1977 (Vaslui County)	May 1 – July 20	81	12	7	84
Perieni 1989	April 24 – July 28	96	12	8	96
Pogonești 1983	April 15 – Aug. 30	137	12	12	144
Căbești 1983, (Bacău County)	April 25 – June 25	61	12	6	72
Hemeiuși 1980	May 1 – Aug. 29	121	12	12	144
Letea Veche 1996	May 1 – July 15	76	12	6	76
Adjud 1978, (Vrancea County)	April 15 – July 30	106	12	8	96
Lețcani 1981, (Iași County)	May 10 – July 17	68	12	7	84
Lețcani 1982	May 10 – July 16	67	12	7	84
Miroslava 1981	April 20 – July 15	86	12	8	96
Chirița 1999	May 1 – July 15	76	35	6	210
Zvoriștea 1993, (Suceava County)	May 1 – Aug. 1	93	12	9	108
Sârbi 1999 (Botoșani County)	June 1 – July 30	60	6	4	24
Santa Mare 2002	May 10 – June 30	51	12	3	36
Total		2,098	329	177	2,218

Table 3. Detailed data (collecting sites, traps exposition, total number of days, number of traps, catches number, total number of samples) on collecting of *Poecilus cupreus* from different potato fields, 1978-1999. / Tabel 3. Date detaliate asupra colectării (locuri de colectare; durata de expunere a capcanelor; total zile; număr de capcane; număr de capturi, total probe) a speciei *Poecilus cupreus* din diferite culturi de cartofi, 1978-1999.

Sites	Traps exposition	Total days	Pitfalls number	Catches number	Samples total
Brașov 1984 (Brașov County)	May 29 – Sept. 12	107	13	20	260
Brașov, 1985	April 16 – Sept. 4	142	13	31	403
Brașov, 1986	May 29 – Sept. 12	107	13	30	390
Brașov, 1987	May 29 – Sept. 12	107	13	30	390
Brașov, 1988	May 29 – Sept. 12	107	13	29	377
Brașov, 1989	May 29 – Sept. 12	107	8	27	216
Brașov, 1991	June 10 – Aug. 14	66	17	12	204
Brașov, 1992	June 1 – Sept. 15	107	12	20	240
Brașov, 1993	June 1 – Sept. 15	107	12	20	240
Brașov, 1996	June 1 – Sept. 20	112	12	20	240
Brașov, 1997	May 24 – June 13	21	12	2	24
Brașov, 1998	June 30 – Sept. 18	80	12	15	180
Târgu Secuiesc, 1987 (Covasna County)	May 15 – Aug. 24	101	7	23	161
Mârșani, 1987 (Dolj County)	May 1 – Aug. 30	122	13	40	520
Mârșani, 1988	April 15 – Aug. 27	137	13	22	286
Mârșani, 1989	April 15 – June 29	66	10	6	78
Târgu Jiu, 1987 (Gorj County)	May 5 – Sept. 13	131	13	21	273
Târgu Jiu, 1988	June 1 – Sept. 13	105	13	37	481
Târgu Jiu, 1989	May 10 – Aug. 26	108	13	32	416
Târgu Jiu, 1991	July 1 – Aug. 30	61	10	10	100
Târgu Jiu, 1993	May 25 – Aug. 30	97	12	18	216
Târgu Jiu, 1994	May 3 – Aug. 19	108	12	18	216
Târgu Jiu, 1995	May 1 – Aug. 16	108	12	32	384
Târgu Jiu, 1996	May 1 – Sept 1	124	12	28	336
Târgu Jiu, 1997	May 25 – July 19	55	12	21	252
Târgu Jiu, 1998	May 1 – Aug. 30	122	12	32	420
Tulcea, 1987 (Tulcea County)	May 12 – Sept. 9	121	5	31	155
Podul Dâmboviței, 1988 (Arges County)	April 1 – Sept. 30	183	5	24	120
Dofteana, 1978 (Bacău County)	May 1 – Sept. 15	138	12	18	216
Secuieni, 1997 (Bacău County)	May 11 – July 30	81	12	8	96
Vânători, 1999 (Iași County)	May 20 – Sept. 15	118	12	7	84
Zvoriștea, 1993 (Suceava County)	April 26 – July 25	91	12	8	96
Zvoriștea, 1995	May 15 – Aug. 25	102	12	10	120
Zvoriștea, 1998	May 15 – Sept. 15	123	6	9	54
Dorna Arini, 1993	May 10 – July 30	81	10	7	70
Dragomirna, 1995	May 1 – Aug. 20	112	12	8	96

Vicovu de Jos, 1998	May 15 – Aug. 30	107	12	7	84
Sârbi, 1999 (Botoşani County)	June 1 – Sept. 30	122	6	8	48
Total		3,994	430	741	8,542

Among 25 wheat fields (Table 4) *Poecilus cupreus* was found in 24 localities, where 9,124 individuals of *Poecilus cupreus* were collected, i. e. 365 individuals per locality (380 ind. per the positive locality), with an ample variation of dominance and abundance in the positive catches, ranging from 0.78% (2 individuals, Brăila, at the point called Terasă, Brăila County, 1982) to 89.66% (3,210 individuals, Brăila, Lacul Sărat, 1983). It was eudominant in 20 localities (80%), dominant, subdominant, recedent or subrecedent in one locality. Only in one wheat field, at Vaslui, 1977 (Table 4), it was not found at all.

Among 38 potato fields (Table 4) it was found in 28 fields, where 2,945 individuals was collected, with an average of 77 individuals per locality (105 ind. per positive locality) and a variation of abundance in the positive catches from one individual (Târgu Jiu, 1994 and 1998, Dolj County) to 742 individuals (Zvoriştea, 1993, Suceava County). In these fields its dominance ranged between 0.35%, (Sârbi, 1999) and 63.58% (Zvoriştea, 1993) (Table 4). During 1984-1999 it was eudominant in 17 localities (44.74%, Table 4) and in further five localities dominant (13.15%) in six localities (15.79%) subrecedent to subdominant. Its absence or very low abundance was recorded first of all in the fields near Târgu Jiu (Table 5, Fig. 1). When excluding the localities and years without any individual recorded, the numbers of individuals in potato fields are lower than in wheat, but much more stable (coefficient of variance 142% in potato, but 185% in wheat).

Table 4. Abundance (A) and dominance (D in %) of *Poecilus cupreus* in the wheat and potato fields from individual years and localities of Romania. /
Tabel 4. Abundența (A) și dominanța (D %) speciei *P. cupreus* în culturile de grâu și cartofi din unele localități ale României.

Locality and year	Wheat		Potato		
	A	D	Locality and year	A	D
Brăila, Terasă 1981	125	45.78	Braşov 1984	53	4.36
Brăila, Terasă 1982	2	0.78	Braşov 1985	109	12.04
Brăila, Terasă 1983	235	68.51	Braşov 1986	129	19.79
Brăila, Terasă 1984	60	30.61	Braşov 1987	127	19.66
Brăila, Terasă 1985	101	61.59	Braşov 1988	92	17.59
Uzlina, 1986	82	32.41	Braşov 1989	61	34.27
Brăila, Lacul Sărat 1981	147	54.65	Braşov 1991	112	54.63
Brăila, Lacul Sărat 1982	178	48.77	Braşov 1992	210	60.87
Brăila, Lacul Sărat 1983	3,210	89.66	Braşov 1993	170	30.25
Brăila, Lacul Sărat 1984	29	26.01	Braşov 1996	25	5.59
Corod 1983	94	28.75	Braşov 1997	4	20.00
Vaslui 1977			Braşov 1998	31	28.44
Perieni 1989	99	40.08	Mârşani 1987		
Pogoneşti 1983	7	1.51	Mârşani 1988		
Căbeşti 1983	5	10.42	Mârşani 1989	61	34.27
Hemeiuşi 1980	889	79.23	Târgu Jiu 1987	3	6.98
Letea –Veche 1996	657	37.33	Târgu Jiu 1988	19	21.59
Adjud 1978	61	23.83	Târgu Jiu 1989		
Leţcani 1981	547	52.39	Târgu Jiu 1991		
Leţcani 1982	800	65.36	Târgu Jiu 1993		
Mirolava 1981	188	51.37	Târgu Jiu 1994	1	2.44
Chiriţa (Iaşi) 1999	87	29.49	Târgu Jiu 1995		
Zvoriştea 1993	1,474	78.07	Târgu Jiu 1996	5	6.41
Sârbi 1999	9	2.20	Târgu Jiu 1997		
Santa Mare 2002	38	7.85	Târgu Jiu 1998	1	2.44
			Podul Dâmboviţei 1988		
			Tulcea 1987		
			Târgu Secuiesc 1986	120	29.34
			Dofteana 1978	30	5.21
			Secuieni 1997	201	25.38
			Zvoriştea 1993	742	63.58
			Zvoriştea 1995	108	8.37
			Zvoriştea 1998	156	27.23
			Dorna Arini 1993	1	0.40
			Dragomirna 1995	358	43.77
			Vicovu de Jos 1998	14	2.16
			Vânători 1999		
			Sârbi 1999	2	0.35
Total	9,124			2,945	
Average ¹	364.96	38.67		77.50	15.46
Standard deviation ¹	692.83	26.41		136.89	18.19
Average ²	380.17	40.28		105.18	20.98
Standard deviation ²¹	703.46	25.70		150.53	18.25

Explanations: Average¹ and Standard deviation¹ include all localities
Average² and Standard deviation² include only localities, where *Poecilus cupreus* occurred

Distribution of dominance of *Poecilus cupreus* within the whole material is shown in Table 6. In altogether 57.90% of one-year catches it was eudominant or dominant, in 26.32% of catches (as matter of fact in those from Târgu Jiu) it was absent in the localities studied, but only in a small portion of localities it had a low dominance, not exceeding 5%.

Table 5. Potato fields. *Poecilus cupreus*, regional variation of the number of collected individuals. / Tabel 5. Culturi de cartofi *Poecilus cupreus*, variația regională a numărului de indivizi colectați.

Locality	Period	Years	Samples	Individuals	Average %	Range of %
Brașov	1984-1998	12	3,164	1,123	39.75	4.36 – 60.87
Târgu Jiu	1987-1998	10	3,214	90	3.19	0.00 – 21.59
Moldova	1978-1999	10	964	1,612	57.06	0.00 – 63.58
Total			7,342	2,825	100.00	



Figure 1. The regional variation of average dominance of *Poecilus cupreus* in potato fields.
 Figura 1. Variația regională a dominanței medii de *Poecilus cupreus* colectat din culturile de cartofi.

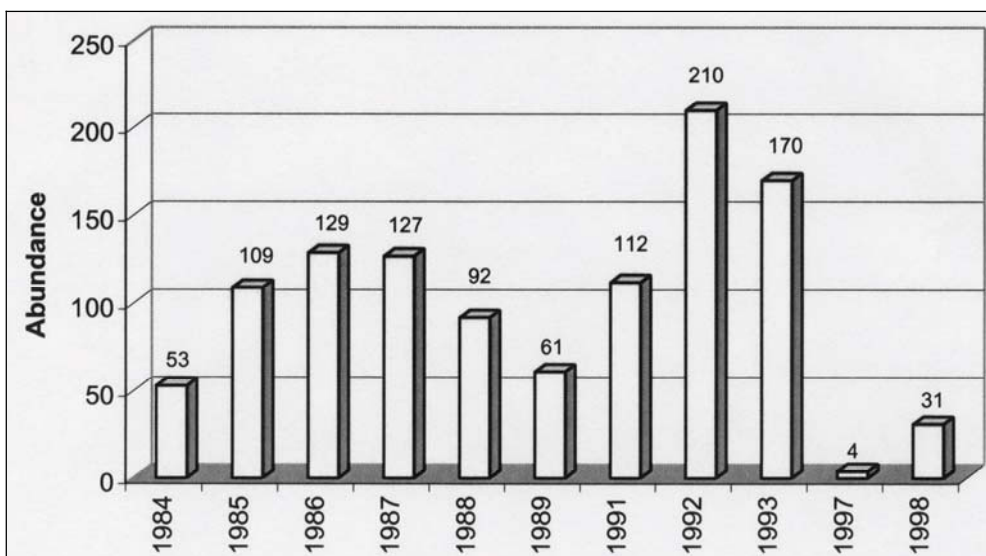
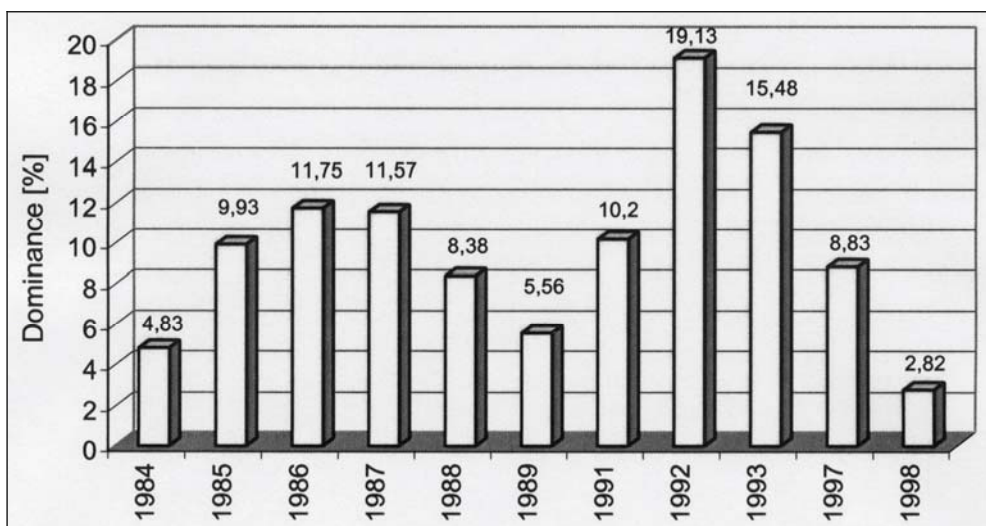


Figure 2a – 2b. Annual variation in abundance and dominance of *Poecilus cupreus* in potato fields near Brașov (Țara Bârsei region).
 Figura 2a – 2b. Variația anuală a abundenței și dominanței a speciei *Poecilus cupreus* în culturile de cartofi lângă Brașov (Țara Bârsei).

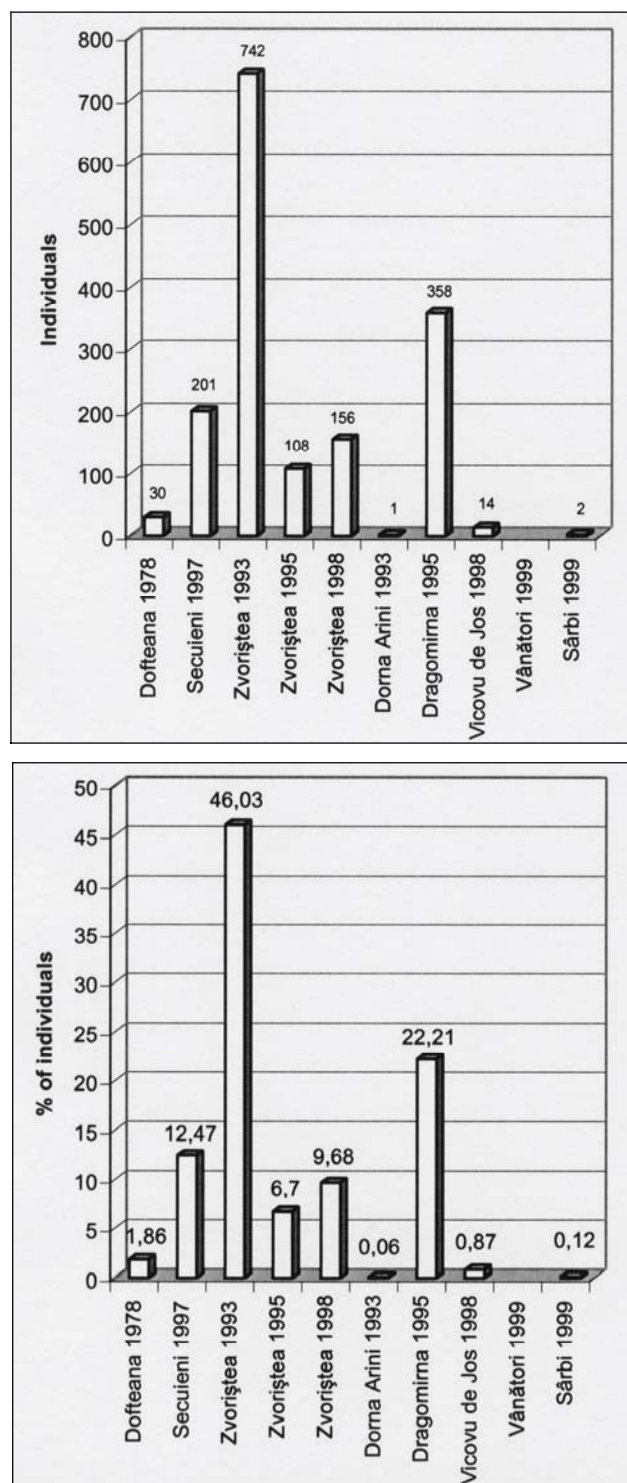


Figure 3a – 3b. Variation of abundance and dominance of *Poecilus cupreus* collected from potato fields of Moldavia.
 Figura 3a – 3b. Variația abundenței și dominanței speciei *Poecilus cupreus* din diferite culturi de cartofi ale Moldovei.

Table 6. Variation in dominance of *Poecilus cupreus* in wheat and potato fields. / Tabel 6. Variația dominanței speciei *Poecilus cupreus* în culturile de grâu și cartofi.

Dominance classes	Wheat fields		Potato fields	
	Number	%	Number	%
Absent	1	4.0	10	26.32
Subrecent < 1%	1	4.0	2	5.26
Recent 1.1-2%	1	4.0	0	0.00
Subdominant 2.1-5%	1	4.0	4	10.53
Dominant 5.1-10%	1	4.0	5	13.16
Eudominant > 10.1%	20	80.0	17	44.74
Total	25	100.0	38	100.0

Table 7. The monthly changes in sexual ratio of *Poecilus cupreus* and its seasonal dynamics in wheat field at Zvoriștea in 1993 and potato field at Târgu Secuiesc in 1986. / Tabel 7. Raportul lunar numeric și procentual între masculi și femele la *Poecilus cupreus* și dinamica lui sezonieră în cultura de grâu la Zvoriștea în 1993 și cultura de cartofi, Târgu Secuiesc în 1986.

Localities	Month	Sex ratio				Dynamics	
		Males		Females		ind.	%
		ind.	%	ind.	%		
Zvoriștea	May	289	37.53	481	62.47	770	53.44
	June	141	29.62	335	70.38	476	33.03
	July	63	32.31	132	67.69	195	13.53
Târgu Secuiesc	May	16	22.54	55	77.6	71	59.17
	June	10	25.64	29	74.36	39	32.50
	July	3	60.00	2	40.00	5	4.17
	August	3	60.00	2	40.00	5	4.17

Reproduction. *Poecilus cupreus* is a spring-breeding species, copulating in May and having a single generation per year (BURMEISTER, 1939; LINDROTH, 1949). It winters as adult and is found in agricultural ecosystems from April to September (our observations). In the wheat fields in Moldavia, the species was eudominant in 80% of the cases, and in the potato fields from Brașov in 45% of the fields. Adults are more active in May and June (wheat, Moldavia) and June, July (potato, Brașov and north Moldavia). At Iași, in the wheat field, Lețcani, many females with eggs were found between May 26 and June 6. According to our observations, *Poecilus cupreus* lays eggs intensely in the second half of May and in June.

According to NECULISEANU (2003), in the Republic of Moldova, *Poecilus cupreus* lays eggs in May-August, and young adults appear from June until October. According to BURMEISTER (1939) *Poecilus cupreus* is active from March to September. It lays eggs in May and June and new generation appears in August and September. These data are in accordance with our observations.

Preference for moisture. *Poecilus cupreus* is a mesophilous to moderately hydrophilous species. Conformable to our observations, *Poecilus cupreus* is much more abundant in crops with increased soil humidity (potato, sugar beet, clover, wheat). Similarly it prefers meadows in floodplains or also penetrates into disintegrated floodplain forests, where it indicates their deterioration (ȘUSTEK, 2001).

Preference for habitat. *Poecilus cupreus* is distributed in Europe and Siberia up to the Lena river (LINDROTH, 1949). According to our observations, the species lives in wet habitats from deteriorated floodplain forests, meadows, pastures, places with loamy or clay soils, agricultural crops (wheat, potato, sugar beet, sunflower, clover, apple orchards, sorghum). The species is mesohydrophilous to moderately hydrophilous and prefers habitats without closed woody vegetation. In places with sandy or gravelly soils it is usually replaced by *Poecilus lepidus* (LESKE, 1785), while at higher altitudes by *Poecilus coeruleus* (LINNAEUS 1758).

In Moldova, *Poecilus cupreus* occurs in agrocoenoses, especially in those of wheat, potato, sugar beet, clover, where it was eudominant.

Food. The larvae and adults are zoophagous, according to (BASEDOW et al., 1976) an adult can eat up to 200 eggs of *Leptinotarsa decemlineata*; it also eats larvae of Tenthredinidae and aphids.

Sex ratio. In the wheat field at Zvoriștea in 1993, Moldova, and the potato field at Târgu Secuiesc in 1986, all individuals were sexed (Table 7). According to our data, the number of females is higher than that of males.

In the wheat field at Zvoriștea in 1993, among 1,441 individuals 493 were males (34.21%) and 948 were females (65.79%), thus, the females predominated 2.72 times.

In the potato field at Târgu Secuiesc in 1986, among 120 individuals, 32 were males (26.66%) and 88 were females (73.34 %), thus, the females predominated 2.75 times. Predominance of females was very stable in both crops during the whole collecting period, fluctuating within narrow limits of about 63 – 70 % in potato and in wider limits of 44 – 77 % in wheat, irrespectively of the decline of the total number of individuals in the subsequent months (Table 9). A striking predominance of females of the most abundant species was also observed in other Carabid communities living in ecosystems exposed to a moderate continuous stress, like agrocoenoses (NOVÁK, 1967; PETRUȘKA, 1971) or periurban ecosystems (ȘUSTEK, 1984). It seems that the predominance of females in the most abundant species represents a competitive advantage of these species allowing them to survive successfully in ecosystems exposed to cyclical stress factors, in the agroecosystems first of all to ploughing and harvesting. The enormous abundance of some Carabid species in such ecosystem indicates that they find in them, in spite of a strong cyclical stress, optimal conditions. This corresponds with the generally known fact that females, being responsible for the offspring, use to search the optimum conditions, while the males tend to prevail in pessimal conditions, being more moveable or explorative. In Carabids this was observed along different continuous ecological gradients (MÜLLER-MOTZFELD, 1970) or very centres of large cities ȘUSTEK (1984).

Dynamics. The numerical and percentage dynamics of the individuals of *Poecilus cupreus* in some potato fields are rendered in Fig 4. The dynamics was studied in two geographical regions – Țara Bârsei region (Brașov in 1985 and 1986) and Târgu Secuiesc in 1986) and Moldova: Zvoriștea (1993, 1995), Dragomirna 1995. In the localities,

Brașov, 1986, Târgu Secuiesc 1986, Zvoriștea, 1993, and Dragomirna, 1995, the big majority of individuals was captured in May and June, 76.18% (Zvoriștea, 1993) and 93.85% (Dragomirna, 1995). In Brașov, 1985 and Zvoriștea, 1995, the majority of individuals of *Poecilus cupreus* was captured in June and July: 64.81% (Zvoriștea, 1995) and 75.23% (Brașov, 1985). This corresponds with the spring reproduction of this species.

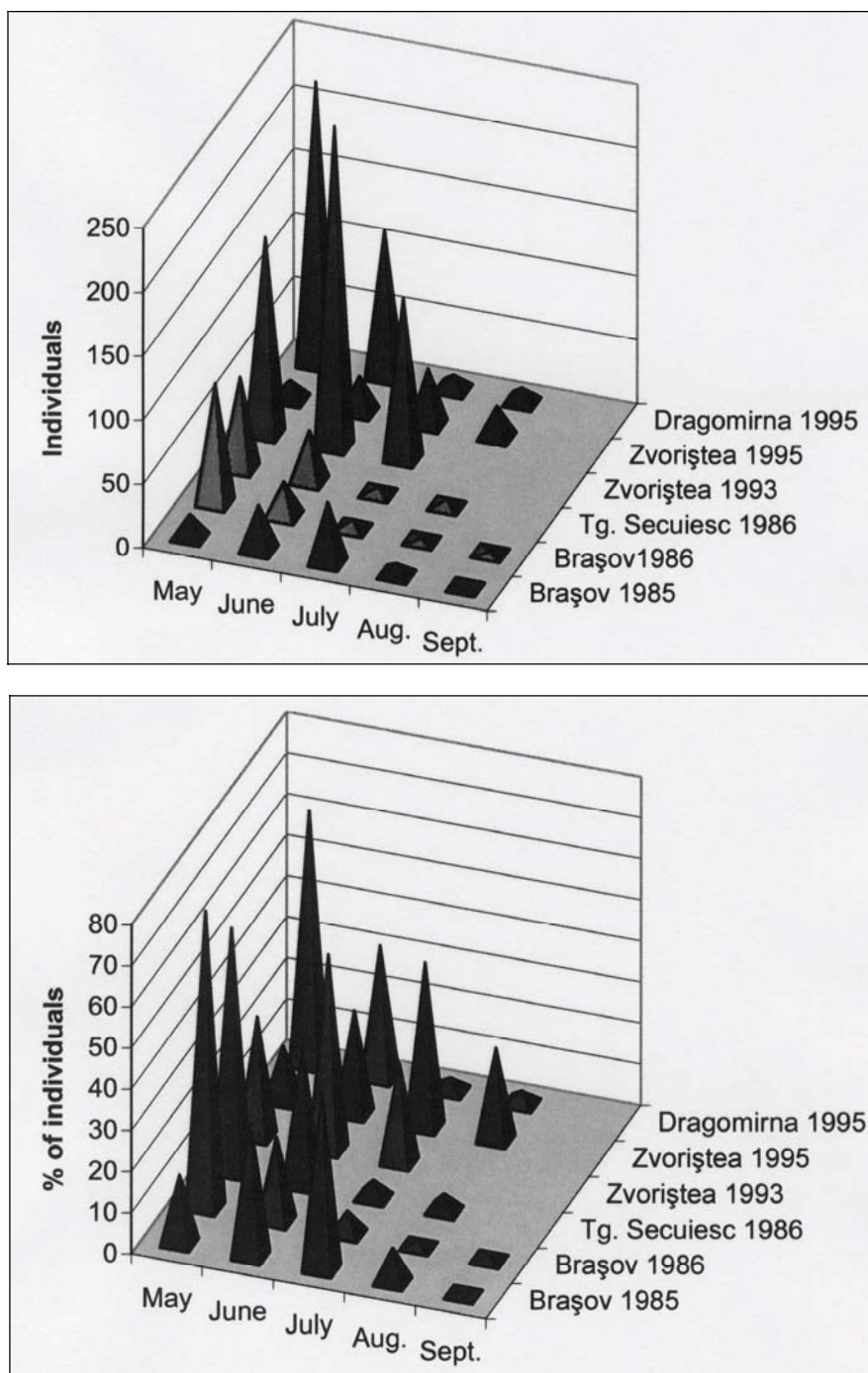


Figure 4. The seasonal dynamics of abundance and dominance of *Poecilus cupreus* in some potato fields.
 Figura 4. Dinamica sezonieră a abundenței și dominanței speciei *Poecilus cupreus* în unele culturi de cartofi.

Distribution. *Poecilus cupreus* is distributed in the whole Europe and Siberia easterly up the Lena river (LINDROTH, 1949). In Romania, according to TEODOREANU (1970), the species was recorded in Muntenia, (Valea Prahovei), Transylvania (nine localities), Banat (one locality). During our systematic long-termed collecting in Moldova (VARVARA & BRUDEA, 1999; VARVARA, 2008; VARVARA & APOSTOL, 2008), this species was also observed in large quantities in maize (12 localities, from 1984 to 2000), sunflower (five localities 1982-1999), sugar beet (8 localities, 1987-2001), clover (3 localities 1977-1978, 2005).

In the Republic of Moldova (NECULISEANU, 2003), the species was recorded in seven crops (alfalfa, wheat, maize, soybeans, barley, sunflower, peas).

DISCUSSIONS

The considerable differences of climate in the compared zones, the dominance of *Poecilus cupreus* in wheat and potato fields strongly varies in regional, local, and between-year scale. In the wheat crop from Brăila County (Muntenia, south-east of Romania), *Poecilus cupreus* was collected only on one locality (Brăila), but in two pedologically different sites: Brăila, Terasă, with weakly salt soil (1981-1985, five years continuously) and Lacul Sărat with carbonated soil (1981-1984, four years continuously). The biggest number of *Poecilus cupreus* from these two sites was caught in 1983: Terasă, 235 (68.51% of all Carabids), Lacul Sărat, 3,210, (89.66% of all Carabids). The large quantity of individuals collected from Lacul Sărat had two causes, the carbonated chernozem and the increased soil humidity (the ground-water table was at the depth of 1.5 m (Table 4).

The three regions, Brașov, Moldova and Târgu Jiu basin, where the material was collected in potato fields, differ in average temperature and annual precipitations. At Brașov, annual average temperature is 7.8°C, Moldova 8.5°C, Târgu Jiu 10.2°C. The annual average precipitations are 548-782 mm (Brașov), 450-550 mm (Moldova) and 753 mm (Târgu Jiu).

Comparing our general data from the potato fields, the dominance of *Poecilus cupreus* is positively correlated with precipitations in these regions, at Brașov and north of Moldova, in comparison with Târgu Jiu basin, (Table 5 and Fig. 1 are conclusive). At Brașov, 39.75% of individuals of *Poecilus cupreus* were collected, whereas, 57.43% in Moldavia) while only 3.19% in Târgu Jiu. The collecting lasted 12 years at Brașov and 10 years at Târgu Jiu, but in Brașov the total catch was twelve times higher than in Târgu Jiu; in Moldova, the collecting lasted 10 years as in Târgu Jiu, but the total catch was 18 times higher than in Târgu Jiu. The main factor influencing the abundance of *P. cupreus* was the humidity of the habitat correlated with the precipitations in the region. In an integrated form this relationship is greatly expressed by the climatic complexes defined basing on the de Martone's aridity index (SĂVULESCU in KNECHTEL & PANIN, 1944). According to it, the localities near Târgu Jiu belong to the climatic complex of forests steppes to oak forests (aridity index 24-35), while those from Brașov to the complexes of beech or coniferous forests (aridity index 35-45).

The long-termed fluctuations of the population of *Poecilus cupreus* in two regions, Brașov and Moldova, are shown in figures 2 and 3. The fluctuations of the population from Brașov (Fig. 2) are almost regular, with sudden declines in occurrence in about 4-5 years intervals. The lowest catches were here recorded in 1997 and 1998 (Fig. 2), but the extremely low abundance in 1997 was accompanied by a medium dominance, hence this year was unfavourable for all Carabids, not only for *Poecilus cupreus* lowest dominance. The year 1998 was the warmest year of the study period. In this year both abundance and dominance dropped below the average values (Fig. 2). In Moldova, the population fluctuations of *Poecilus cupreus* were much less regular (Fig. 3) and rather a local then temporal character. The largest catch was recorded at Zvoriștea, 1993, because of the alluvial soil and humidity in the study site. The abundance and dominance were closely correlated here, unlike the years 1997 and 1998 in Brașov (Fig. 2). In both areas a tendency to decrease of population in 1997 and 1998 is obvious.

According to our data, the relative abundance of the species is high in 80% of localities (eudominant, wheat crops) and 45% (potato crops). Numerically, *Poecilus cupreus* is the second most abundant species in the wheat and potato crops after *Pseudophonus rufipes*. Also, it abundantly occurs in the sugar beet fields, where it was eudominant in 12 localities, 63% (from 19 localities, 1978-2001) (VARVARA, 2001).

Comparing our data with the quantitative collecting (BICA, 2005) from wheat fields from Banat region, four localities (1999-2002), big differences are observed: in Banat, *Poecilus cupreus* is subrecedent and recedent in wheat fields (1-4 individuals), while at Brăila and localities from Moldova, the species was eudominant in 80% of the localities.

In the European and Central European zoogeographical regions with continental temperate climate, the dynamics of a species has a genetically fixed seasonal character. *Poecilus cupreus*, winters as larva, passes into pupal stage in spring. In the potato fields most individuals (Brașov, 1986, Târgu Secuiesc, 1986, Dragomirna, 1995) occurred in May, when 59-71% of all individuals collected were captured, while in the locality Zvoriștea 1993, most individuals occurred in June (47%) and at Brașov, 1985 in July (43%). In the Republic of Moldova, according to NECULISEANU (2003), *Poecilus cupreus* is an eudominant species in the wheat fields, where its activity culminates in the first half of June, while in the maize fields, in July. These shifts of activity culmination can, of course, result from different temperature, but also from temporal shifts of presence of individual crops on the fields studied and from their maturity, which is other significant factor influencing microclimate in the stand interior and the crop attractively for Carabid species, inclusively *Poecilus cupreus*. As the winter wheat creates a developed closed stand already in the very spring or the spring wheat emerge very soon, the maize forms a closed stand as late as in early July, but unlike wheat stays on field until late autumn. Thus it can serve as refuge for Carabids leaving the harvested wheat field.

The females predominated in *Poecilus cupreus* similarly as in *Carabus scabriusculus* and *Carabus cancellatus* also were present in potato crops. Their predominance is interpreted as favourable to maintain a high population density; they successfully survive even under unsuitable existence conditions of ecosystems exposed to cyclical anthropogenic stress. It is reflected by its dominant or subdominant position in a major part of communities studied.

Seasonal dynamics is an ecological attribute of the species, its limits and the peak of activity is the result of the evolution and natural selection, being directly influenced by temperature. In *Poecilus cupreus*, in most cases, the peak of activity of the species, when most of individuals were captured, was in May and June, and in rare cases in June and July.

CONCLUSIONS

In spite that the field ecosystems are not the original natural habitat characteristic to *Poecilus cupreus*, it can successfully develop in post of them (wheat, potatoes, sugar beet, maize, sun flower, clover, sorghum, orchards), depending on their ecological conditions.

In wheat fields *Poecilus cupreus* appeared more frequent and its representation was less variable. It was recorded in the counties: Tulcea, Brăila, Bacău, Vrancea, Iași, Suceava, and Botoșani. Its dominance (within each community and years) varied between 1.21% (Perieni, 1989, Vaslui County) and 89.24% (Sârbi, 1999, Botoșani County). The species was eudominant in 20 localities (80.00%).

In the potato fields, *Poecilus cupreus* is less frequent and its representation was more variable. It was present in the counties: Argeș, Bacău, Botoșani, Brașov, Covasna, Dolj, Iași, Suceava, Tulcea. Its dominance varied between 1.46% (Brașov, 1991, Brașov County) and 68.52% (Vicovu de Jos, 1992, Suceava County). The species was eudominant in 33 localities (94.29%). The populations were strongly female dominated. The ratio between females and males was 1.92: 1 (wheat, Zvoriștea, 1993) and 2.75: 1 (potato, Târgu Secuiesc, 1986).

In most cases the seasonal activity dynamics culminated in May and June and in rarely in June and July.

ACKNOWLEDGEMENTS

The material used in this paper was collected by a number of persons. It is a special pleasure for us to thank for it to Dr. Donescu Daniela from the Institute of Potato Crop Protection, Brașov, who assured the collecting of the material from the localities Brașov, Târgu Jiu, Mârșani and Tulcea; the former students of the Faculty of Biology: Budeanu Gabriela, Herghelegiu Simona, Mititiuc Mihaela, Sari Sabina, Ursachi Ramona; to the teachers from the pre-university education: Agachi Lucia, Antoniu Ioan, Dascălu Alexandru, Mărcuță Costache, Pașa Virginia, Proca Constanța, Radu Stratia, and Ștențel Maria.

REFERENCES

- BANIȚĂ EMILIA, COJOCARU DOINA, VOICU M., KIS B., CANTOREANU MARGARETA, LUCA EMILIA, PAULIAN MIHAELA, AFTENIE MARIANA. 1994. *Cercetări privind structura faunei dăunătoare și utile în culturile de grâu din Oltenia*. Analele Institutului de Cercetări pentru Protecția Plantelor Tehnice, Fundulea. București. **61**: 169-182.
- BASEDOW TH., BORG A., DECLERQ R., NIJVELDT W., SCHERNEY F. 1976. *Untersuchungen über das Vorkommen der Laufkäfer (Col., Carabidae) auf europäischen Getreidefeldern*. Entomophaga. **21**(1): 59-72.
- BERINDEI MATEI. 1985. *Ghidul fermierului. Cultura cartofului*. Edit. Ceres. București. 355 pp.
- BICA VALERICA. 2005. *Cercetări asupra carabidelor din culturile de cereale cultivate în Câmpia de Vest*. Teza de doctorat. Universitatea de Științe Agricole și Medicină Veterinară a Banatului. Timișoara (Forma electronică).
- BURMEISTER F. 1939. *Biologie, Ökologie und Verbreitung der europäischen Käfer I, Adephaga – Caraboidea*. Krefeld (Goecke und Evers). 206 pp.
- CÂRLAN V. & VARVARA M. 1999. *The Fauna of Carabidae from two Agricultural Crops of Moldavia (Romania)*. Analele Științifice ale Universității "Alexandru Ioan Cuza", Iași. Biologie animală. **64-65**: 83-92.
- CHIRECEANU CONSTANTINA, MARGARIT G., JINGA V., PASCU GH., MANOLE D. 2009. *The Invertebrate Fauna Associated with the Wheat Agroecosystem in Amzacea, Constanța County*. Romanian Journal for Plant Protection. Published by the Research-Development Institute for Plant Protection, Bucharest.
- DONESCU DANIELA & ENOIU MARIA. 1995. *Lucrările celei de a doua Conferințe Naționale pentru Protecția mediului prin metode și mijloace biologice și biochimice*. Universitatea Transilvania din Brașov: 66-75.
- DUSHENKOV V. M. 1984. *Sezonaya dinamika aktivnosti zhuzhelits v agrotsenozakh*. In: Fauna i Ekologia Bespozvonochnykh, Moskva: 69-76.
- KABACIK-WASLIK DANUTA. 1970. *Ökologische Analyse der Läuikäfer (Carabidae) einiger Agrarkulturen*. Ekologia Polska. **18**(7): 137-209.
- KARPOVA V. E. 1984. *Vidovoi sostav i osobenosti raspredeliniya zhuzhelits v agrotsenozah iuga Moldavii*. In: Fauna i Ekologia bezpozvonocinih Jivotnih, Moskva: 82-86 [In Russian].
- KIS B. 1970. *Raionarea zoogeografică a României pe baza faunei de Orthoptere*. Studia Universitatis Babeș-Bolyai. Biologia. Cluj-Napoca. **1**: 113-125.
- KNECHTEL W. H. & PANIN S. A. 1944. *Oekologisch-zoogeographisches Studium an Coleopteren des Rumänisches Faunengebietes*. Etudes et recherches. Académie Roumaine. Bucharest. **25**: 1-225.
- LINDROTH K. 1949. *Die Fennoskandischen Carabidae, I, Spezieller Teil*. Wettergren & Krebs Verlag, Göteborg. 711 pp.
- MÜLLER-MOTZFELD G. 1970. *Der Sexual-Index bei Carabiden als ökologische Kriterium*. Entomologische Berichte. **14**: 12-18.
- NECULISEANU Z. 2003. *Carabidele (Coleoptera, Carabidae) din zona de interferență biogeografică (Taxonomie, Diversitate, Zoogeografie, Biologie) și importanța lor practică*. Teza de doctor habilitat în științe biologice. Chișinău. (manuscris). 260 pp.
- NOVÁK B. 1967. *Veränderungen der Sexualindexes von Pterostichus vulgaris L in den Erdfallenfangen aus den Rübefeldern (Col. Carabidae)*. Acta Universitatis Palackianae Olomucensis, Faculata. Rerum Naturalium, Series Biologica. **25**: 95-114.

- PETRUŠKA F. 1971. *Vlyv pěstované plodiny na vývoj populací střevlíkovitých (Col. Carabidae)*. Acta Universitatis Palackianae Olomucensis, Facultata. Rerum Naturalium, Series Biologica. **34**: 151-191.
- POPESCU I. & ZAMFIRESCU S. 2004. *Synecological analysis of a wheat field ground beetles community from Letea (Bacău County)*. Analele Științifice ale Universității „Alex. I. Cuza”, Iași, seria Biologie animală. **50**: 173-180.
- PORHAJAŠOVÁ JANA, PETŘVALSKÝ V., ŠUSTEK Z., URMINSKÁ JANA, ONDŘIŠIK P., NOSKOVIČ J. 2008. *Long-termed changes in ground beetle (Coleoptera. Carabidae) assemblages in a field treated by organic fertilizers*. Biologia, Bratislava. **63**(6): 1184-1195.
- ŠUSTEK Z. 1984. *The bioindicative and prognostic significance of sex ratio in Carabidae*. Ekológia (ČSSR). 3: 3-22.
- ŠUSTEK Z. 2001. *Restitution of carabid communities after catastrophic floods in floodplain forests*. In: Majerčák Juraj, Hortalová Tatiana (Eds.): IXth International poster Day Transport of Water, Chemicals and Energy in the System Soil-Crop Canopy-Atmosphere, Bratislava 29.11.2001: 1-8.
- TEODOREANU M. 1970. *Contribuții la cunoașterea răspândirii genului Pterostichus (Ord. Coleoptera, Fam. Carabidae) în România*. Studia Universitatis „Babeș-Bolyai”, Biologie. Cluj-Napoca. **2**: 117-122.
- TEODORESCU IRINA, VĂDINEANU A., SIMIONESCU A. 1999. *Managementul capitalului natural*. Studii de caz. Edit. ARS DOCENDI. Universitatea București. 232 pp.
- TIETZE F. 1973. *Zur Ökologie, Soziologie und Phänologie der Laufkäfer (Coleoptera, Carabidae) des Gründlandes im Süden der D.D.R. Hercynia*. **2**: 111-126.
- VARVARA M., DONESCU DANIELA, VARVARA V. 1990. *Contributions to the Knowledge of Carabid Beetles in Potato Crops in the Barsei Country*. Lucrările Simpozionului Entomofagii și rolul lor în păstrarea echilibrului natural, Iași: 95-101.
- VARVARA M., PISICĂ C., CÂRLAN V. 1991. *Contributions to the Knowledge of Carabid Communities in Wheat Crops of Moldavia*. Proceedings of the ECE/13. SIEEC, GÖDÖLÖ: 818-823.
- VARVARA M. 1991. *Abundența unor coleoptere epigeice în cultura de grâu din Moldova*. Studii și comunicări științifice (Secția Biologie-Ecologie). Universitatea Bacău: 43-46.
- VARVARA M. & MOGLAN I. 1993. *Contributions to the Study of Epigeic Coleoptera in three Biocoenoses of the Danube Delta*. Bulletin of the Academy of Agricultural and Forestry Sciences: 85-89.
- VARVARA M., DONESCU DANIELA, DASCĂLU A. 1999. *Coenological Observations on the Populations of Carabidae (Insecta, Coleoptera) from some Potato Crops from Moldavia*. Analele științifice ale Univ. „Al. I. Cuza” Iași. **44-45**: 105-116.
- VARVARA M. & BRUDEA V. 1999. *The Fauna of Carabidae (Coleoptera, Carabidae) in the Maize Crops from Moldavia*. Studii și cercetări. Universitatea Bacău. **4**: 79-84.
- VARVARA M. & BULIMAR FELICIA. 2003. *Long-Term Faunistic and Ecological Research of Carabid Communities (Coleoptera, Carabidae) In the Winter Wheat Crops From Eastern Romania*. Complexul Muzeal de Științele Naturii „Ion Borcea”. Studii și comunicări. Bacău: 143-150.
- VARVARA M. 2001a. *Observations on the Carabid Coenosis (Coleoptera, Carabidae) in the Potato Crops from Suceava District*. Simpozionul Jubiliar Consacrat Aniversării a 30 ani de la Formarea Rezervației „Codrii”, 27-28 Septembrie, Chișinău. **2**: 78-79.
- VARVARA M. 2001b. *Variation of Diversity of Carabidae (Coleoptera, Carabidae) in some Potato Crops from Romania*. Analele Științifice. Universitatea „Alexandru Ioan Cuza”, Iași. **47**: 53-63.
- VARVARA M. 2003. *Aspects of Knowledge of Numerical Variations and Biodiversity of Epigeic Invertebrates in the Forest Ecosystem of Poplars from Moldavia (Eastern Romania)*. Analele științifice ale Universității „Alexandru Ioan Cuza” Iași, seria Biologie animală. **49**: 7-17.
- VARVARA M. 2005. *The Taxonomic and Ecological Spectra of Carabids (Coleoptera, Carabidae) In Three Agrocoecosystems from Moldavia*. Lucrările Simpozionului Entomofagii și rolul lor în păstrarea echilibrului natural. Universității „Al. I. Cuza”, Iași: 131-146.
- VARVARA M. 2008. *The Diversity and Main Ecological Requirements of the Epigeic Species of Carabidae (Coleoptera, Carabidae) in the Ecosystem Crop of Sugar Beet from Moldavia, 1981-2001*. Lucrările Simpozionului Entomofagii și rolul lor în păstrarea echilibrului natural, Universitatea „Al. I. Cuza”, Iași: 175-192
- VARVARA M. & APOSTOL E. 2008. *Diversity and the Main Ecological Requirements of the Epigeic Species of Carabidae (Coleoptera, Carabidae) in the Sun Flower Ecosystem, Broscauti (Botoșani County)*. Analele științifice ale Universității „Al. I. Cuza”, Iași. Biologie animală. **54**: 8-89
- VARVARA M. 2011. *Distribution and the Relative Abundance of the Species Pseudophonus rufipes De Geer (Coleoptera, Carabidae) in some Wheat and Potato Crops in Romania, 1977-2002*. Analele științifice ale Universității „Al. I. Cuza”, Iași, seria Biologie animală. In press.
- VARVARA M. 2011. *Distribution and the Relative Abundance of the Species Pterostichus melanarius Illiger 1798 (Coleoptera, Carabidae) in some Wheat and Potato Crops in Romania, 1977-2002*. Analele Științifice ale Universității „Al. I. Cuza”, Iași, seria Biologie animală. In press.

Varvara Mircea

“Alexandru Ioan Cuza” University, Faculty of Biology
Bd. Carol I, 20 A, 700506 Iași, Romania
E-mail: mvarvara@uaic.ro

Šustek Zbyšek

Institute of Zoology, Slovak Academy of Sciences,
Dúbravská cesta 9, 845 06 Bratislava, Slovakia,
E-mail: zbysek.sustek@savba.sk

Received: March 24, 2011

Accepted: August 2, 2011