DISTRIBUTION AND ABUNDANCE OF *Calosoma auropunctatum* HERBST 1784 (COLEOPTERA: CARABIDAE) IN SOME AGRICULTURAL CROPS IN ROMANIA, 1977-2010

VARVARA Mircea, CHIMIŞLIU Cornelia, ŠUSTEK Zbyšek

Abstract. The present paper is a synthesis of the data on the occurrence, quantitative representation and autecology of *Calosoma auropunctatum* HERBST 1784 in seven agricultural crops during 26 growing seasons 1977-2010 (wheat 22 localities in 1977-2002; maize 18 localities in 1978-2010; potatoes 38 localities in 1978-1999; sugar beet 12 localities in 1977-2001, sunflower 11 localities 1981-2010, vineyards 4 localities in 1992, apple orchards 6 localities in 1979-2000). The localities represented all significant agricultural zones of Romania. The beetles were pitfall-trapped using predominantly 12 traps in each site. According to the total number of individuals collected and their dominance, the agroecosystems are arranged in descendent order as it follows: maize - 219 individuals (50.58%), wheat - 129 individuals (29.79%), sugar beet - 64 individuals (14.78%), vineyards - 8 individuals (1.85%), sunflower - 7 individuals (1.62%), potato - 6 individuals (1.39%). The presence of *Calosoma auropunctatum* in the studied crops was: vineyards 75%, wheat 62%, sunflower 36%, maize 35%, apple orchards 17% and potato 3%. The quantitative representation of this species showed a considerable spatial and temporal variability, with predominant preference for cereal fields and absence in localities lying at altitudes above 500 m. The highest recorded dominance was 18.4%, which also represents the highest value published so far. A slight appearance of about 3-4 year periodicity of fluctuation on quantitative representation of *C. auropunctatum* can be distinguished in frame of the material. About 80-83% of the individuals in wheat fields occurred in June.

Keywords: Romania, Carabidae, *Calosoma auropunctatum*, crops: wheat, maize, potatoes, sugar beets, sun flowers, vineyards, apple orchards, ecological requirements, abundance, dominance.

Rezumat. Răspândirea şi abundenţa speciei *Calosoma auropunctatum* HERBST 1784 (Coleoptera: Carabidae) în unele culturi agricole din România, 1977-2010. Lucrarea este sinteza datelor originale de colectare a indivizilor speciei *Calosoma auropunctatum* HERBST 1784 din şapte tipuri de culturi agricole (grâu 22 localităţi 1977-2002; porumb 18 localităţi 1978-2010; cartofi 38 localităţi 1978-1999; sfecla de zahăr 12 localităţi 1977-2001; floarea soarelui 11 localităţi 1981-2010; viţă de vie 4 localităţi 1992; livezi de meri 6 localităţi 1979-2000). Localităţile reprezintă toate zonele agricole caracteristice României. Pentru colectarea materialului s-au folosit capcane Barber, preponderent câte 12 în fiecare staţionar. În raport de numărul total de indivizi colectaţi din fiecare cultură faţă de numărul total de indivizi colectaţi, culturile se ierarhizează, astfel: porumb - 219 indivizi (50,58%), grâu - 129 indivizi (29,79%), sfeclă de zahăr - 64 indivizi (14,78%), viţă de vie - 8 indivizi (1,85%), floarea-soarelui - 7 indivizi (1,62%), cartof - 6 (1,39%). Prezenţa speciei *C. auropunctatum* în culturile investigate este: viţă de vie 75 %, grâu 62 %, floarea soarelui 36 %, porumb 35%, livezi de meri 17 %, cartofi 3%. Reprezentarea acestei specii a fost foarte variabilă în spaţiu şi în timp, cu preferinţa evidentă în culturile de cereale. Nu a fost găsită la altitudini de peste 500 m. Cea mai înaltă dominanţa a fost de 18,4%, ceea ce reprezintă şi cea mai înaltă valoarea publicată până în prezent. O indicaţie a fluctuaţiilor de reprezentare cantitativă a speciei *C. auropunctatum* cu periodicitate de aproximativ 3-4 ani poate fi identificată în materialul analizat. Aproximativ 80-83% din indivizi din cultura de grâu au fost colectaţi în luna iunie.

Cuvinte cheie: România, Carabidae, *Calosoma auropunctatum*, culturi: grâu, porumb, cartofi, sfeclă de zahăr, floarea soarelui, viţă de vie, livezi de meri, date ecologice, abundenţă, dominanţă.

INTRODUCTION

Calosoma auropunctatum HERBST 1784, treated earlier as a subspecies of *Calosoma maderae,* belongs to a complex of species included into the subgenus *Campalita* MOTSCHULSKY 1865 which strongly differ by their bionomy and habitat preference from other congeners. They live on ground surface, prefer open dry habitats, often without a continuous herbage cover, do not ascend on trees and are preferably, but not exclusively nocturnal. They are macropterous and especially the East Asian *Calosoma chinesnsis* flies very well, coming even on the light. Their ecological requirements allow them to live in deserts, semi-deserts and steppes, and of course, also in agricultural landscape and even in urban ecosystems. At the same time, their distribution is limited to warmer parts of the Palaearctic subregion and to lowlands and lower hilly landscapes (BURMEISTER, 1939; DESENDER, 1986; LINDROTH, 1949; NIEDEL, 1960). Owing to these ecological properties, *Calosoma auropunctatum* is the only large Carabid able to successfully survive the profound changes in the structure of agricultural landscape in Central and East Europe and act as predator of different insect pests. The existing papers on Carabids in agroecosystems (ŠTEPANOVIČOVÁ & BELÁKOVÁ, 1960; KABACIK-WASYLIK, 1975, 1980; SEKULIČ *et al.,* 1973; SOBOLEVA-DOKUCHAEVA, 1995; ŠUSTEK, 1994; PORHAJAŠOVÁ *et al.,* 2008; VICIAN *et al.,* 2010), however, show that its representation in various sites is, unlike many Carabid species, characteristic of fields, temporally and spatially very variable, even in the same site, in two subsequent years or in very similar conditions. In an enormous number of papers on Carabid field fauna in Central Europe (e.g. PETRUŠKA, 1971; NOVÁK, 1972; BASEDOW, 1976) this species was not found at all.

A great number of papers on Carabids in agroecosystems was also published in Romania (ANDRIESCU *et al.,* 1983; CÂRLAN & VARVARA, 1998-1999; POPESCU & ZAMFIRESCU, 2004; TĂLMACIU, 1995; VARVARA *et al.,* 1981, 1985, 1992, 1995; VARVARA & ANDRIESCU, 1986, 2003; VARVARA & BRUDEA, 1999; VARVARA, 2001, 2005, 2005a,

2008; VARVARA & BULIMAR, 2002; VARVARA & ZAMFIRESCU, 2008) and include many data on the occurrence of *Calosoma auropunctatum* in this country.

In Oltenia, BANIŢĂ *et al*. (1994) mention the species of Carabids in wheat fields from Şimnic and Dăbuleni, while BOBÂRNAC *et al*., 1981 published the results of observations on the dynamics of terrestrial entomofauna in the fields of sugar beet, wheat and maize in southern Oltenia. In Banat, BICĂ (2005), in her PhD thesis shows the results of quantitative collecting on Carabids in the wheat fields. MALSCHI (2000) mentions the species of Carabids found in the cereal fields from the centre of Transylvania.

In the Republic of Moldova, NECULISEANU (2003) published the results of his quantitative research on Carabids (1986-1988, 1989, 1992) from fields of alfalfa, winter wheat, maize, soybeans, barley, sunflower and peas. DĂNILĂ (2005), in the same geographical region, published his data on the structure of Carabid communities in alfalfa and wheat fields and vineyards in the central and northern parts of this country.

The great variability of results obtained by individual authors raised the question, what abiotic factors (soil type, temperature and humidity at the soil surface, exposure etc.) and biotic factors in interaction with the respective crops (wheat, maize, potatoes, sugar beet, sunflower, orchards, vineyards etc.) are responsible for such variability. The aim of the present paper is a synthesis of the data on the distribution, abundance and dominance of *C. auropunctatum* in seven types of agroecosystems based on long-termed quantitative collecting and their comparison with data published in other countries.

MATERIAL AND METHODS

The beetles were collected by formol pitfall traps in fields of seven crops, viz wheat in 22 sites and 13 growing seasons (1977-2002); maize in 18 sites and 16 growing seasons (1978-2010), potatoes in 38 sites and 16 growing seasons (1978-1999), sugar beet in 12 sites and 8 growing seasons (1977-2001), sunflower in 11 sites and 8 growing seasons (1981-2010), vine in four sites, one growing season (1992) and apple orchards in 6 sites and 4 growing seasons (1979-2000). Altogether during 27 growing season between 1977 and 2010 in the following administrative regions and counties of Romania: Dobroudja (Tulcea County), Oltenia: (Gorj and Dolj Counties), Wallachia (Brăila County), Transylvania (Braşov and Covasna Counties), Moldavia (Counties: Galaţi, Vaslui, Bacău, Iaşi, Neamţ, Suceava and Botoşani). The parameters of collecting in individual crops and years (number of traps and length of their exposition of traps, time span of collecting) are generally characterized in table 1, while in details they are surveyed in table 2. In the collectings from 2010 *C. auropunctatum* was not represented and these collectings are omitted in the tables and figures.

Table 1. General characteristics of the investigation of the species *Calosoma auropunctatum* from seven agricultural crops in Romania.
Tabel 1. Caracteristicile generale ale investigării speciei *C. auropunctatum* din şapte culturi agricole din România.

Specifications	Wheat	Maize	Potatoes	Sugar beet	Sunflower	Vineyards	Apple orchards
Years of sampling	1977-2002	1978-2010	1978-1999	1977-2001	1981-2010	1992	1979-2000
Total years of sampling	13	16	16	8	8	1	4
Total number of traps	168	54	430	106	72	48	72
Average of pitfalls per site	12	9	12	13	12	12	12
Limits of number of traps	12	5-12	5-17	12-22	12	12	12
Total of days of trap exposition	1,160	702	3,994	1,066	580	551	598
Average length of trap exposition	83	117	77	133	97	138	149
Limits	62-96	103-144	20-183	97-168	95-102	125-142	128-183
Number of analysed samples	1,176	436	8,542	1,118	648	528	504
Average per locality	84	73	224	140	108	132	84
Limits	72-108	42-180	24-520	84-192	108	120-144	120-144

Table 2. Localities and parameters of sampling *Calosoma auropunctatum* in fields of seven agricultural crops.
Tabel 2. Localităţile şi parametrii de colectare ai speciei *C. auropunctatum,* în şapte culturi agricole.

Crop, locality (county)	Year	Expositions of traps		Days	Traps	Collecting	Samples
Wheat (sum)				**1,160**	**168**	**98**	**1,176**
Brăila, Terasă (Brăila County)	1981	May 24	September3	103	12	6	72
Brăila, Terasă (Brăila County)	1982	May 28	August 30	95	12	9	108
Brăila, Terasă, (Brăila County)	1983	May 10	July 20	71	12	7	84
Brăila, Terasă (Brăila County)	1984	May 10	July 11	63	12	6	72
Brăila, Terasă (Brăila County)	1985	April 10	July 10	91	12	6	72
Brăila, Lacul Sărat (Brăila County)	1982	May 28	August 30	95	12	7	84
Brăila, Lacul Sărat (Brăila County)	1983	May 28	August 30	95	12	7	84
Corod (Galaţi County)	1983	April 25	July 10	77	12	8	96
Vaslui (Vaslui County)	1977	May 1	July 20	81	12	7	84
Perieni (Vaslui County)	1989	April 24	July 28	96	12	8	96
Căbeşti (Bacău County)	1983	April 25	June 25	62	12	6	72
Letea –Veche (Bacău County)	1996	May 1	July 15	76	12	6	72
Miroslava (Iaşi County)	1981	April 20	July 15	87	12	8	96
Leţcani (Iasi County)	1981	May 10	July 17	68	12	7	84

Potato							
Secuieni (Neamţ County)	1997	May 15	July 30	77	12	5	60
Maize (sum)				**702**	**54**	**47**	**436**
Brăila, Terasă (Brăila County)	1978	April 4	July 29	116	10	6	60
Brăila, Terasă (Brăila County)	1979	April 26	August 22	118	12	5	60
Brăila, Terasă (Brăila County)	1980	April 26	August 14	110	9	6	54
Brăila, Terasă (Brăila County)	1981	April 24	August 13	111	6	7	42
Brăila, Terasă (Brăila County)	1984	May 10	Sept 30	144	12	15	180
Osoi (Iaşi County)	1988	May 8	August 18	103	5	8	40
Sugar beet (sum)				**1,066**	**106**	**89**	**1,118**
Giurgiu (Giurgiu County)	1985	May 15	September 15	123	12	7	84
Dobridor (Dolj County)	1977	May 17	September 30	136	12	7	84
Dobridor (Dolj County)	1979	April 29	August 17	111	22	5	110
Corod (Galaţi County)	1983	May 26	September 30	128	12	15	180
Pogoneşti (Vaslui County)	1983	April 15	September 30	168	12	16	192
Căbeşti (Bacău County)	1983	April 25	September 30	159	12	16	192
Leţcani (Iaşi County)	1981	May 10	September 30	144	12	14	168
Roman (Neamţ County)	1992	May 15	August 20	97	12	9	108
Sun flower (sum)				**580**	**72**	**54**	**648**
Brăila, Terasă (Brăila County)	1981	May 26	August 31	97	12	9	108
Brăila, Terasă (Brăila County)	1982	May 28	August 30	95	12	9	108
Brăila, Terasă (Brăila County)	1983	May 28	August 30	95	12	9	108
Brăila, Lacul Sărat (Brăila County)	1981	May 25	September 3	102	12	9	108
Brăila, Lacul Sărat (Brăila County)	1982	May 28	August 31	96	12	9	108
Brăila, Lacul Sărat (Brăila County)	1983	May 27	August 29	95	12	9	108
Vineyards (sum)				**551**	**48**	**44**	**528**
Dealul Bujorului (Galaţi County)	1992	May 31	October 2	125	12	10	120
Huşi (Vaslui County)	1992	June 7	October 27	142	12	12	144
Iaşi (Iaşi County)	1992	June 1	October 20	142	12	12	144
Cotnari (Iaşi County)	1992	June 5	October 25	142	12	10	120
Apple orchards							
Chicerea (Iaşi County)	1979	May 1	October 2	155	12	8	96

The beetles were identified by the senior author, but a considerable part of the material was collected by Mărcuţă Costache (Pogoneşti, 1983), Proca Constanţa (Căbeşti, 1983), Paşa Virginia (Corod, 1984), Antoniu Ioan (Iaşi, 1985), Dascălu Alexandru (Zvoriştea, 1992), Radu Stratia, (Letea-Veche, 1995), Ştenţel Maria (Secuieni, 1997), Apostol (Cercel) Elena (Broscăuţi, 1999, 2010) and Găluşcă Simona (Truşeşti, 1999, 2010).

The used data originating from Moldova were published by ANDRIESCU *et al.* (1983), CÂRLAN & VARVARA (1998-1999), POPESCU & ZAMFIRESCU (2004), TĂLMACIU (1995), VARVARA *et al.* (1981, 1985, 1992, 1995), VARVARA & ANDRIESCU (1986, 2003), VARVARA & BRUDEA (1999), VARVARA (2001, 2005, 2005a, 2008), VARVARA & BULIMAR (2002) and VARVARA & ZAMFIRESCU (2008).

Climatic characteristics of the localities

Table 3 gives the type of climate, the annual average temperature and fluctuation of precipitation sums for four major regions of Romania, in which the beetles were collected.

Table 3. Climatic characteristics in four regions between 1977 and 2010.
Tabel 3. Regimul climatic în cele patru regiuni între anii 1977-2010.

Region	Climate	Annual average temperature ºC	Precipitation (mm)
Oltenia	Temperate-Continental	10.5	529.6-865.3
Wallachia (Brăila)	Temperate-Continental	10.5	400- 500
Moldavia	Temperate-Continental	7-9	450 -650
Ţara Bârsei	Temperate-Continental	7.8	548-782

Ţara Bârsei region has an area of 2,406 km^2 and altitude between 504 m (The Feldioara zone) and 723 m (The Braşov zone). Due to its geographical position within Romania, the climate of Ţara Bârsei region is temperate continental, moderately humid mesophilous, with annual average temperature of 7.8ºC; the annual average rainfall varies between 548-782 mm, reaching a maximum in the Braşov 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^{o}C.

Târgu Jiu basin comprises floodplain meadows and terraces. 80% of the basin surface has a temperate continental climate. The annual average temperature is 10.2ºC 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 crop plants occupy large surfaces in the centre and south of the county: cereals, potatoes and vegetables. The average yields are below the Romanian average.

Moldavia is (KISS, 1970) characterized by a continental climate, with the annual average temperature between 7.0 and 9.0ºC, annual average precipitations of 450-650 mm. The climate of Moldavia is temperate continental. According to

the altitudinal gradient two zones can be distinguished here. The cooler western zone of Moldavia with an annual average temperature of 8.5ºC and precipitations of 600-700 mm, and the eastern zone with the annual average temperature of 9.5ºC and precipitations of 450-550 mm. Within the western zone three climatic districts are differentiated. The northern zone with the southern boundary southerly of Iasi; the central zone with the southern boundary southerly of the Huşi town and the southern one. They differ each from other by annual average temperature and precipitations.

RESULTS

Altogether 449 individuals of *Calosoma auropunctatum* were obtained in all localities during the whole investigation period. These individuals were very unequally distributed in individual localities and years and in many places they were absent.

In wheat, *C. auropunctatum* was found only in 14 (62%) localities (Table 4). 129 individuals were collected, with an average of 10 individuals per locality and a variation between one (Letea Veche, 1996 - Bacău County; Vaslui, 1977 - Vaslui County; Perieni, 1989 - Vaslui County; Căbeşti, 1983- Bacău County and 30 individuals Brăila, Terrace, 1982 and 1984 - Brăila County). In communities from individual localities and years, the dominance of *C. auropunctatum* varied between 0.06% (subrecedent, 1996, Letea Veche, Bacău County) and 15.30% (eudominant, 1984, Brăila - Terrace, Brăila County) (Table 4).

In total, 219 individuals were collected in the maize fields, with an average of 36 individuals per locality and a wide variation from one (Osoi, 1988) to 143 individuals (Brăila, Terrace, 1980). The dominance of the species varied between 2.78% (subdominant, Osoi, 1988) and 18.43% (eudominant, Brăila, Terrace 1980) (Table 4).

In sugar beet fields, 79 individuals were collected, on average 8 individuals per locality with variation between 5 (Dobridor, 1977) and 12 individuals (Corod, 1983). The dominance varied between 0.42% (subrecedent, Corod 1983) and 0.85% (subrecedent, Giurgiu 1985) (Table 4).

In the sunflower fields 7 individuals of this species were collected only in the Brăila County, with a variation between one individual (Brăila, Salt Lake, 1981 and 1983, Terrace, 1981) and 4 individuals (Brăila, Terrace, 1982). The dominance varied between 0.14% (subrecedent, Salt Lake, 1983) and 0.69% (subrecedent, Brăila, Terrace, 1982) (Table 4).

In vineyards, in 1992, using 12 pitfalls in each locality there were collected only 8 individuals in total in four localities (TĂLMACIU, 1995). They were found only in three localities, with a variation between 2 (Huşi, 1992) and 3 individuals (Dealul Bujorului, Galaţi County and Cotnari, Iaşi County). The dominance varied between 0.08% (subrecedent, Huşi, 1992) and 0.31% (subrecedent, Dealul Bujorului and Cotnari).

In potato fields, the material was collected in the following administrative regions: Dobroudja (1987), Oltenia (1987-1998, Dolj County), Vallachia (Brăila County), Transylvania (1984-1998, Braşov and Covasna counties), Moldavia (1978-1999, Bacău, Iaşi, Neamţ, Suceava and Botoşani counties). In the locality Târgu Jiu, the beetles were collected for nine years, while in the locality Braşov for 12 years, but in spite of very extensive collecting effort no individual of *C. auropunctatum* was found there.

In Moldavia, in the locality Secuieni (1997 Neamţ County), there were collected six individuals of *C. auropunctatum.*

The presence of *C. auropunctatum* in the crops investigated was as it follows: wheat 63.64%, maize 33.33%, sugar beet 66.67%, sunflower 36%, potatoes 2.63%, apple orchards 6.67% and vineyards 75% (in Moldavia).

Depending on the total number of individuals collected from each crop referred to the total number of individuals collected, 449, the crops rank as it follows: maize 219 individuals (48.78%), wheat 129 individuals (28.73%), sugar beet 79 individuals (17.59 %), vineyard 8 individuals (1.78%), sunflower 7 individuals 1.56%) potatoes 6 individuals (1.34%), apple orchards 1 individual (0.22%).

Table 4. Distribution, activity abundance (A) and dominance (D) of *Calosoma auropunctatum* in the investigated agricultural ecosystems from Romania.
Tabel 4. Răspândirea, abundenţa activităţii (A) şi dominanţa (D) speciei *C. auropunctatum* în ecosistemele agricole investigate din România.

Locality and year and crop	A	D [%]	Locality and year and crop	A	D [%]
Wheat			**Sugar beet**		
Brăila, Terasă, 1981	2	0.73	Giurgiu, 1985	7	0.85
Brăila, Terasă, 1982	30	11.71	Dobridor, 1977	5	0.20
Brăila, Terasă, 1983	14	4.22	Dobridor, 1979	7	0.38
Brăila, Terasă, 1984	30	15.30	Corod, 1983	12	0.42
Brăila, Terasa, 1985	3	1.77	Pogoneşti, 1983	11	0.74
Brăila, Lacul Sărat, 1982	2	0.54	Căbeşti, 1983	7	0.85
Brăila Lacul Sarat, 1983	3	0.08	Leţcani, 1981	22	0.33
Corod, 1983	14	4.28	Roman, 1992	8	0.89
Vaslui, 1977	1	0.40	**Total of individuals**	**79**	
Perieni, 1989	1	0.41	**Sun Flower**		
Căbeşti, 1983	1	1.96	Brăila, Terasă, 1981	1	0.38
Letea-Veche, 1996	1	0.06	Brăila, Terasă, 1982	4	0.69
Miroslava, 1981	12	3.29	Brăila, Terasă, 1983	-	-

Leţcani, 1981	15	1.43	Brăila, Lacul Sărat, 1981	1	0.38
Total of individuals	**129**		Brăila, Lacul Sărat, 1982	-	-
Potato			Brăila, Lacul Sărat, 1983	1	0.14
Secuieni, 1997	6	0.54	**Total of individuals**	**7**	
Total of individuals	**6**		**Vitis vinifera**		
Maize			Dealul Bujorului, 1992	3	0.19
Brăila, Terasă, 1978	22	1.99	Huşi, 1992	2	0.08
Brăila, Terasă, 1979	7	0.38	Iaşi, 1992	-	-
Brăila, Terasă, 1980	143	18.43	Cotnari, 1992	3	0.31
Brăila, Terasă, 1981	43	4.53	**Total of individuals**	**8**	
Brăila, Terasă, 1984	3	0.86	**Apple tree orchard**		
Osoi, 1988	1	2.78	Miroslava, 1991	1	0.16
Total of individuals	**219**		**Total of individuals**	**1**	

The annual variation of the numbers of individuals collected in the locality Brăila - Terrace, in the wheat and maize crops is given in figures 1 and 2. In both crops a wide between-year variation was observed, but the maximum occurrence in wheat in 1984 does not temporarily correspond with the minimum in maize in the same year. This indicates a considerable spatial variability of the occurrence of *C. auropunctatum* in this area.

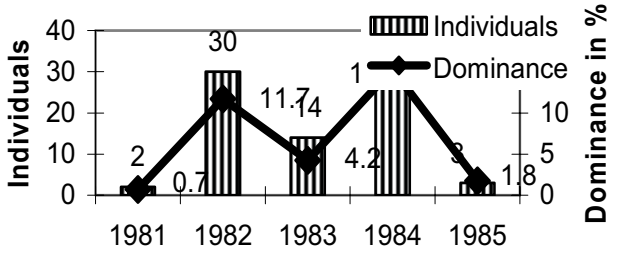

Figure 1. Annual variation of abundance and dominance of *Calosoma auropunctatum* in the wheat crop, Brăila, Terrace, 1981-1985.
Figura 1. Variaţia anuală a abundeţei şi dominanţei speciei *C. auropunctatum* în cultura de grâu, Brăila, Terasă, 1981-1985.

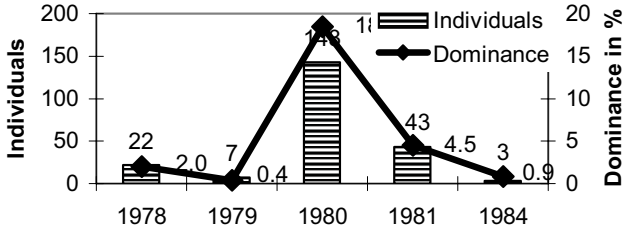

Figure 2. Long-term changes in the abundance and dominance of *Calosoma auropunctatum* in maize fields in Brăila, Terrace 1978-1984.
Figura 2. Variaţia anuală a abundenţei şi dominanţei speciei *C. auropunctatum* în cultura de porumb, Brăila, Terasă, 1978-1984.

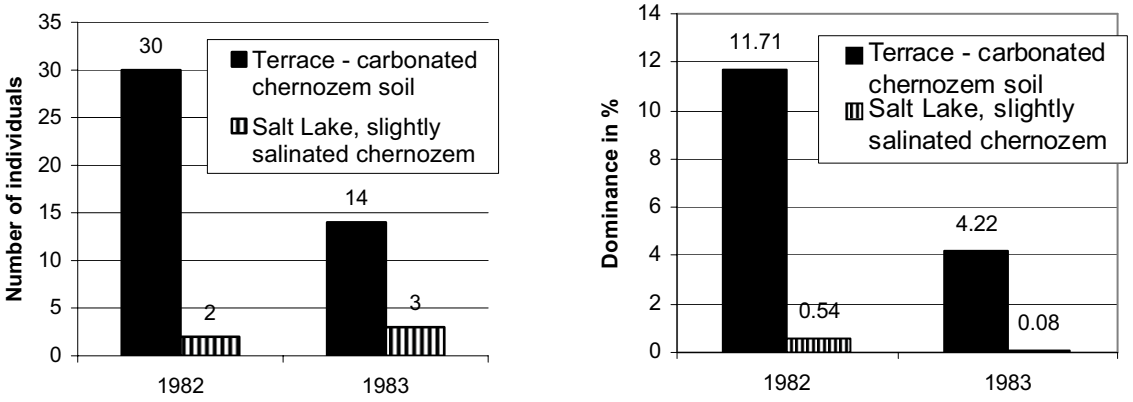

Figure 3. Annual and local variation in the abundance (left) and dominance (right) of *Calosoma auropunctatum* in wheat, Brăila, 1982 and 1983.
Figura 3. Variaţia anuală şi locală a abundenţei (stânga) şi dominanţei (dreapta) a speciei *C. auropunctatum* în cultura de grâu, Brăila, 1982 şi 1983.

The preference of *C. auropunctatum* for soils substrate is illustrated in figure 3, where a 5-15-times large abundance of *C. auropunctatum* was observed in carbonated chernozem than in the slightly salinated chernozem. Still larger difference in preference is indicated by dominance of this species.

The variation of the abundance and dominance of *C. auropunctatum* in different crops in Moldavia is presented in figures 4a, 4b and 5. Both figures show that these two parameters are positively correlated, but zoocoenotic position of this species considerably changes in relation to other species, especially in sugar-beet, where the number of caught individuals is very similar (Figs. 4a, 4b) with wheat, but its dominance is much lower than in wheat (Fig. 5). In addition, a clear preference for wheat is obvious here.

The annual numerical and percentage variation in the abundance of the species *C. auropunctatum* in the sugar beet fields in Moldavia is presented in figure 5.

The comparison of the dominance of *C. auropunctatum* in seven agricultural crops is given in figure 6; in the majority of sites this species absented and in most sites its representation ranges between subrecedent to subdominant position, while only rarely it is a really abundant species in the fields. Also this diagram indicates a clear preference of *C. auropunctatum* for wheat.

A very unequal spatial distribution of *C. auropunctatum* can be shown along an about 2.5 km long line transect crossing, at regular 250 m distances, fields of different crops in the surroundings of Sereď in Slovakia in the growing season of 1982 (Fig. 7). There is evident a focus-like spatial distribution with number of individuals ranging from 1 to 12, but dominance 0.1 to 1.6% (subrecedent to subdominant). There is obvious a preference for stands of cereals (wheat and barley) and a striking discontinuity of occurrence in sugar-beet, between a zone of occurrence in wheat.

Autecology and geographic distribution

C. auropunctatum is a zoophagous, mesohydrophilous, open landscape spring-breeding species with one generation a year. It was found in the wheat fields in June, July and August (Brăila, 1982), while in sugar beet in July and August (Dobridor).

In accordance with our collectings from seven different crops, the occurrence and quantitative representation were bigger in wheat, maize and sugar beet than in sunflower and vineyards.

Adults feed on larvae and pupae (chrysalis) of Lepidoptera, meadow caterpillar, hairy caterpillars, larvae of wasps with saw of cereals (BABAN, 2006).

Seasonal dynamics of the abundance and dominance of adults is shown in table 5. The species occurs in the wheat crops from the last decade of May until August, but the activity culminates in June, when 80-83% of adults were captured. This corresponds with the prevailing time of laying eggs in this month (BURMEISTER, 1939).

C. auropunctatum is a west Palaearctic species distributed in southern and Central and Europe, South of Scandinavia, Balkan Peninsula, Asia Minor, Caucasus, South-West Asia, Kazakhstan, Himalayas, Western China (GUEORGUIEV & GUEORGUIEV, 1995). In Romania it occurs in lowlands, rarely in highlands.

DISCUSSIONS

In the frame of our investigations, *C. auopunctatum* was collected in seven crops, viz wheat, potatoes, maize, sugar beet, vineyards and apple orchards. BICĂ (2005), Banat (1999-2002) found the species only in wheat fields as a subrecedent species. BANIŢĂ *et al*. (1994) during a two-years collecting (1991, 1992) in two localities (Şimnic and Dăbuleni) found this species in the favourable zone of culture of wheat (Oltenia). In the Republic of Moldova, NECULISEANU (2003) collected this species in crops of wheat, soybean, sunflower, peas and alfalfa, while DĂNILĂ (2005) in alfalfa and vineyards.

The presence of species in the researched ecosystems is very variable: wheat 63.64%, (present in 14 sites of 22 investigated), sugar beet 66.67% (8 of 12 sites), maize 33.33% (6 of 18 sites); vineyards 75% (3 of 4 sites, Moldova), potatoes 2.63% (1 of 38 sites) (Fig. 4). In the potato fields, the species was found only in one locality (Secuieni, 1997, Neamţ County), in spite of the fact that the beetles were collected in 38 localities in seven counties (Tulcea, Dolj, Braşov, Covasna, Iaşi, Suceava, Botoşani). The presence of a substance (a pesticide) in the potato fields would be one of possible suppositions to explain the absence of species in various and favourable regions for potato crops (Ţara Bârsei, Northern of Moldova). Another explanation could be, at least in the case of potato fields in Ţara Bârsei, the unfavourable altitude for *C. auropunctatum* (cf. NIEDL, 1960).

The complex interactions of abiotic factors (soil type and moisture, temperature) influence the local and temporal changes of abundance of species and its position within the whole community. In Brăila County, at the point Terrace, in the wheat crop, the conditions were much more favourable (94% of individuals) in the years 1982, 1983 and 1984 than in the years 1981 and 1985 (6% of individuals) (Figs. 5, 6).

The carbonated chernozem is much more favourable (90%) than the weakly salinated chernozem (Fig. 3). In Moldova, the conditions of cultivation of wheat and sugar beet and especially the humidity are more favourable for *C. auropunctatum*, because 89% of individuals were collected from these crops, in contrast to maize, sunflower, apple orchards and vineyards, in which only 11% of individuals were collected (Fig. 4a).

In all localities and crops, the species was recorded as subrecedent in variable percentages, but in contrast as recedent, subdominant or eudominant it was found only in the wheat and maize (Figs. 5, 6). In the wheat and maize in the locality Brăila-Terrace, the species occurred in an especially high number of individuals and achieved even the eudominant position (Table 4). Most individuals were captured in June.

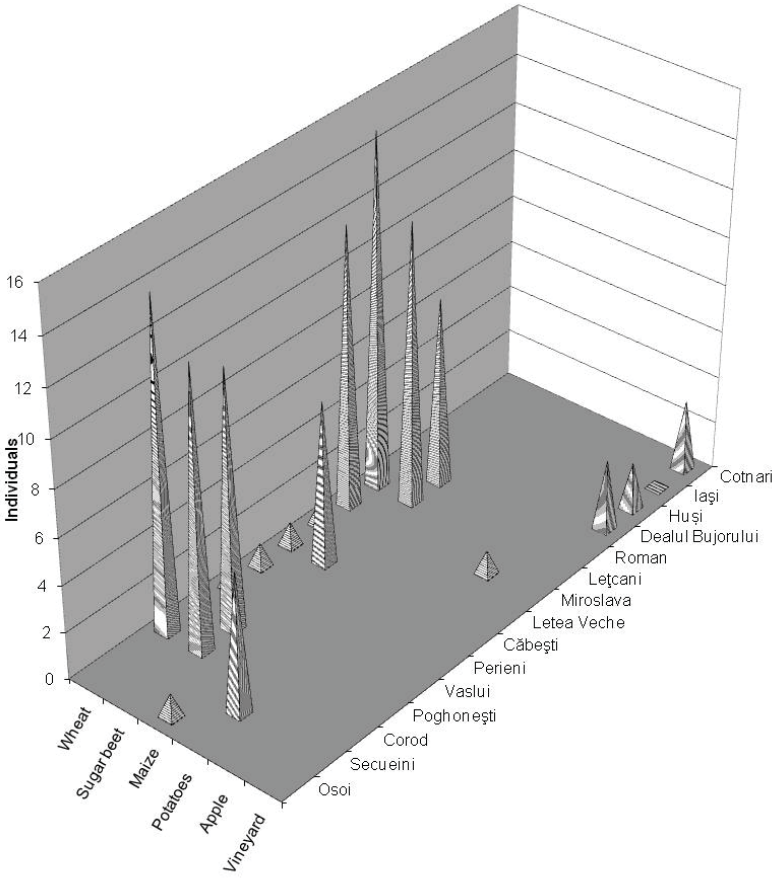

Figure 4a. Variation in the abundance of *Calosoma auropunctatum* in different crops in Moldavia.
Figura 4a. Variaţia abundenţei speciei *C. auropunctatum* în diferite culturi din Moldova.

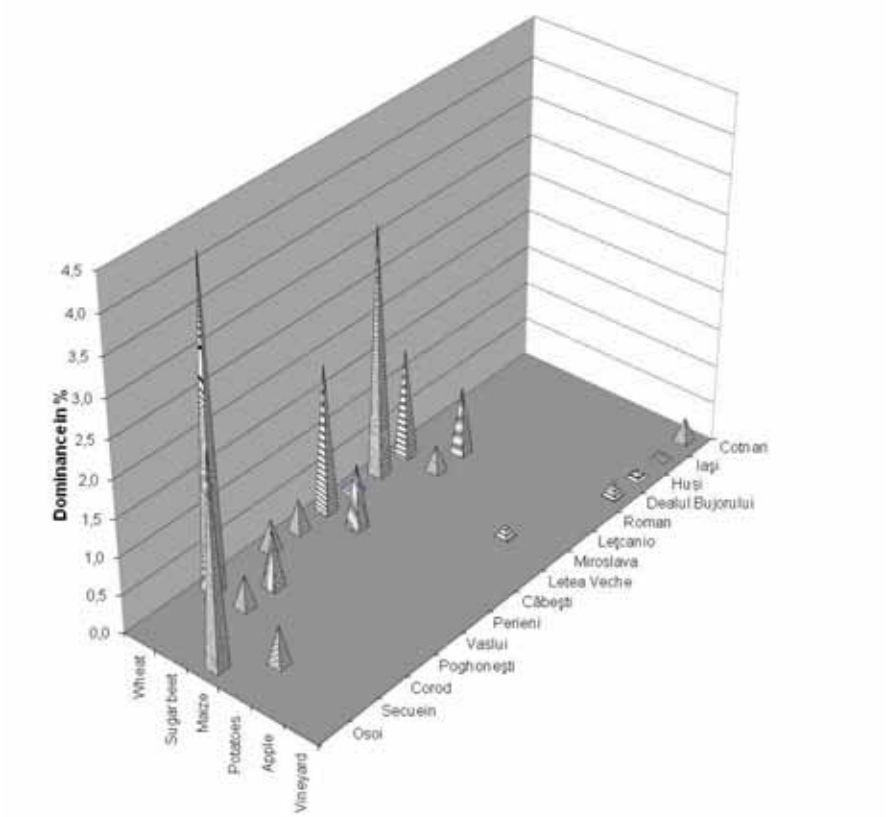

Figure 4b. Variation in the dominance of *Calosoma auropunctatum* in different crops in Moldavia.
Figura 4b. Variaţia dominanţei (jos) a speciei *C. auropunctatum* în diferite culturi din Moldova.

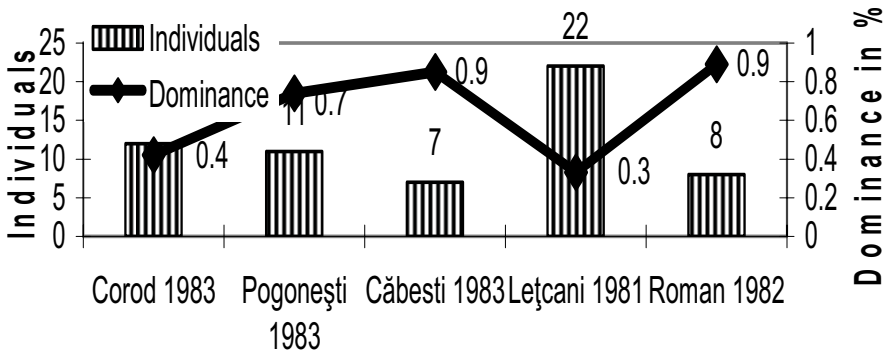

Figure 5. Variation in the abundance and dominance of *Calosoma auropunctatum* in the sugar beet crop, Moldavia, 1981-1983.
Figura 5. Variaţia abundenţei şi dominanţei speciei *C. auropunctatum* în cultura de sfeclă de zahăr, Moldova, 1981-1983.

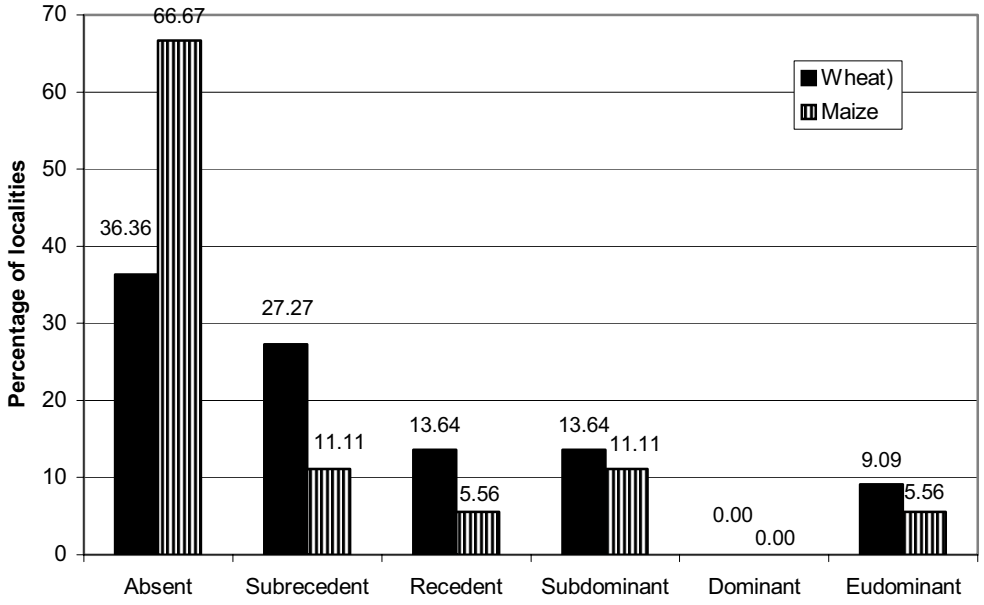

Figure 6. Variation in the dominance of the species *Calosoma auropunctatum* in wheat and maize fields.
Figura 6. Variaţia dominanţei speciei *C. auropunctatum* în culturile de grâu şi porumb.

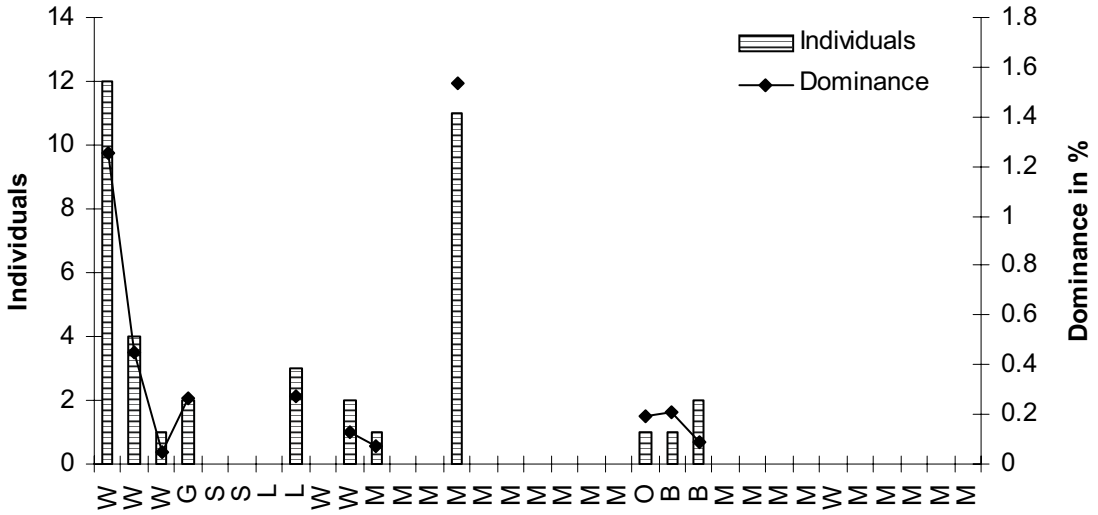

Figure 7. Distribution of *Calosoma auropunctatum* along the 2.5 km long line crossing fields of different crops at Sereď in South Slovakia, 1982 (W – wheat, G – garden, L – alfalfa, M – maize, S – sugar beets; O – orchard, B – barley).
Figura 7. Distribuţia speciei *C. auropunctatum* în lungul unei linii de 2,5 km trecând prin câmpuri cu diferite culturi în împrejurimile oraşului Sereď în Slovacia de Sud în 1982 (W – grâu, G – grădină, L – lucernă, M – porumb, S – sfeclă de zahăr, O – poiana, B – orz).

Table 5. Seasonal dynamics of adult *Calosoma auropunctatum* in the wheat fields.
Tabel 5. Dinamica sezonieră a adulţilor de *C. auropunctatum* în cultura de grâu.

Month	Locality and year			
	Brăila, Terrace, 1982		Iasi, Miroslava, 1982	
	Ind.	%	Ind.	%
May	-	-	1	8.33
June	24	80	10	83.33
July	3	10	1	8.33
August	3	10	-	-
September	-	-	-	-
Total	30	100	12	99.99

The high variability in the occurrence of *C. auropunctatum* is also characteristic for arable land in other countries. In maize in South Slovakia ŠTEPANOVIČOVÁ & BELÁKOVÁ (1960) observed its subdominant occurrence (41 individuals, 3.6%) in maize in South Slovakia in 1956, but its absence in the next year. In a wheat field in Serbia SEKULIĆ *et al*. (1973) recorded it as subrecedent species (0.14%), while POPOVIĆ & ŠTRBAC (2010) as subrecedent or subdominant species (17-25 individuals, 0.12-1.50%). ŠUSTEK (1994) observed the occurrence of *C. auropuntatum* in 32 sampling points in a 2.5 km long transect crossing fields with different crops in South Slovakia. It was present in only one third of points, never exceeded subrecedent position (1-11 individuals and 0.07-1.54%) and showed obvious local concentrations, situated in wheat and barley. This perfectly corresponds with the results from Romania. PORHAJAŠOVÁ *et al.* (2008) observed, in a relatively small field with different crops (barley, sugar beet, maize and sunflower) in six subsequent years in South Slovakia, that the representation of *C. auropunctatum* varied between absence and subdominant position (1-38 individuals, 0.07-3.53%), without any obvious relationship to the crop, but its occurrence showed a clear temporal fluctuation with about three years lasting minima and maximums. Similar fluctuations were also observed in a five-year series of collecting in wheat fields near Saratov in South Russia (ANTONENKO, 1980), where the dominance ranged from 0 to 8.1%. This corresponds to our observations of the periodicity of the abundance of *C. auropunctatum* in Brăila Terrace. At the same time, SCHRÖTER & IRMELR (2005) and PORHAJAŠOVÁ *et al.* (2008) observed that special distribution always tended to concentration in some parts of the study plots. In addition, in the investigations of PORHAJAŠOVÁ *et al.* (2008) these concentrations were positively correlated with the concentration of the most abundant species, thus the dominance of *C. auropunctatum* varied only a little. Even in warm areas of the biosphere reserve Askania Nova in South Ukraine, *C. auropunctatum* was represented as recedent species (1 individual, 0.52%) in one of the four investigates sites (PAVLOVA, 1974). Similarly, this species was not recorded in the seven orchards in the forest-steppe zone of South Russia (KASANDROVA, 1972). When compared our data with the data of other authors, the catch of 143 individuals (18.43%) is the highest representation of *C. auropunctatum* recorded so far in the available literature.

Most authors dealing with the study of Carabid communities in fields did not find it even in favourable conditions of lowlands in warm areas with the annual average temperature between 7-8ºC in Moravia (e.g. NOVÁK, 1971; PETRUŠKA, 1972) or in Lower Austria (KROMP, 1989, 1992). In general, there can be distinguished two tendencies in the representation of *C. auropunctatum* in the published data. In the earlier papers (e.g. BASEDOW *et al.,* 1976; KABACIK-WASYLIK, 1975, 1980; SOBOLEWA-DOKUCHAEWA, 1995) it misses in the fields in northwestern parts of Europe. On the contrary, in more recent papers it is also recorded in a limited number of individuals in northern areas. SCHRÖTER & IRMELR, 2005, found this species in Germany in the fields in the surroundings of Kiel in subrecedent positions and consider it as endangered species migrating from Eastern Europe. The same opinion is presented by NIEDOBOVÁ *et al.,* 2011 on the base of sampling in grassy slopes in Central Moravia at altitudes of 460-480 m. KAJAK & OLESZCZUK (2004) found it in the fields of north-western Poland. TAMUTIS *et al.* (2007) discovered *C. auropunctata* for the first time in (barley) fields in Lithuania. The earlier papers also explain the absence of this species in the catches in the surroundings of Braşov (Ţara Bârsei). Probably one of the few studies on Carabid field fauna made at higher altitudes, which recorded this species is that of VICIAN *et al*. (2010) made in Central Slovakia in conditions very similar to those in the surroundings of Braşov. But on the other hand, as indicated by more recent papers, the warming of climate might trigger the spreading of this species or initiate occupying of more dominant positions in the communities within its existing area of distribution.

The question of preference for individual crops, where more authors observed an increased affinity to wheat or barley, is probably connected with the spring type of reproduction of *C. auropuntatum* and coincidence of its seasonal activity with the presence of individual crops in fields.

The unpublished data on Carabid communities in different crops (wheat, maize, tobacco, sugar beet) in South Slovakia from 1980-s (ŠUSTEK, 1985, 1989) show a strong simultaneous decline of representation or absence of *C. auropunctatum* in arable land in comparison with earlier (ŠTEPANOVIČOVÁ & BELÁKOVÁ, 1960) and later investigations (PORHAJAŠOVÁ *et al.,* 2008), in an area, which is identical, according to NIEDEL (1960), with one of the marking patches of its occurrence in Slovakia. Its absence or low representation was also accompanied by absence of other large Carabids, i.e. of species of the genus *Carabus.* This phenomenon was put in connection with a strong homogenization of agricultural landscape, unification of fields into large complexes without dispersed woody vegetation and with the period of culminating intensive using of chemicals in agriculture in 1980-s. In more general way, based on the results of many authors, such influences on Carabid diversity were confirmed by GONGALSKY & CIVIDANES (2008).

CONCLUSIONS

The analysis of 13,846 samples from seven crops during a period of 24 years, from 1977 to 2010, we specify: *C. auropunctatum* is present in wheat (54%), maize (33%), sugar beet (67%), sunflower (40%), potatoes (3%), apple orchards (25%), vineyards (75%) (in Moldova).

The species occurred in 80% of wheat fields (Brăila), 77% (Moldova), 10% of maize fields (Brăila), 8% (Moldova) and 76% of sugar beet fields (Moldova).

The abundance and dominance of species is highly variable depending on the ecological features of crops; the number of collected individuals varying from 1 (wheat, maize, sunflower) to 143 (maize, Terrace) and dominance from 0.08% (vineyards, Moldova) to 18.43% (maize Brăila, Terrace). The dominance of 18.43% is the highest values recorded so far in the literature.

As subrecedent the species was recorded in all seven crops, as recedent, subdominant or eudominant it was recorded only in the wheat and maize crops. Most individuals were collected in June, in accordance with its reproduction cycle. There is observable a slight appearance of about 3-4-year fluctuation periodicity of the quantitative representation of *C. auropunctatum* that can be distinguished in frame of the material.

AKNOWLEDGEMENTS

The material used in this paper was collected by nine secondary school teachers in education for the accomplishment of their works in order to obtain the first degree in education. Our thanks and appreciations of the effort go to Mărcuţă Costache, Proca Constanţa, Paşa Virginia, Antoniu Ioan, Dascălu Alexandru, Radu Stratia, Ştenţel Maria, Cercel Apostol, Elena and Găluşcă Simona.

REFERENCES

ANDRIESCU I., VARVARA M., MOGLAN I. 1983. *The dynamics of carabids (Coleoptera, Carabidae) in the maize experimental crops (Zea mais* L.*)* treated with insecticides, 1983, Verhandlungen SIEEC X. Budapest: 143-145.

ANTONENKO O. P. 1980. *Biologicheskie osobenosti khishchnykh zhuzhelits i ihk roľ v snizhenii chislennosti vrednoj cherepashki (Eurygaster integriceps) v Saratovskoj oblasti.* Zoologicheskij zhurnal. **49**: 1634-1643. [In Russian].

BABAN ELENA. 2006. *Diversitatea coleopterelor (Coleoptera: Carabidae, Silphidae, Scarabaeidae, Cerambycidae) din ecosistemele forestiere ale Podişului Moldovei Centrale.* Teză de Doctorat. Institutul de Zoologie al Academiei de Ştiinţe a Moldovei. Chişinău. 103 pp.

BANIŢĂ EMILIA, COJOCARU DOINA, VOICU M., KISS B., CANTOREANU MARGARETA, LUCA EMILIA, PAULIAN MIHAELA, AFTENE MARIANA. 1994. *Cercetări privind structura faunei dăunătoare şi utile în culturile de grâu din Oltenia.* Analele Institutului de Cercetări pentru Cereale şi Plante Tehnice Fundulea, Bucureşti: 169-182.

BASEDOW TH., BORG A., CLERGEU R., NIJVELDT W. & SCHERNEY F. 1976. *Untersuchungen über das Vorkommen der Laufkäfer (Col.: Carabidae) auf Europäischen Getreidefelder*. Entomophaga. **21**: 59-72.

BICĂ VALERICA. 2005. *Cercetări asupra carabidelor din culturile de cereale cultivate în Câmpia de Vest.* Teză de doctorat. Universitatea de Stiinţe Agricole şi Medicină Veterinară a Banatului, Timişoara (Forma electronică). 274 pp.

BOBÎRNAC B., IONESCU MARIA, MATEI IULIA. 1981. *Aspectes de la dynamique de l'entomofaune terrestre dans les cultures de betteraves, de ble et de mais du sud de L'Oltenie.* Analele Universităţii din Craiova. **12**(22): 131-145.

BURMEISTER F. 1939. *Biologie, Ökologie und Verbreitung der Europäischen Käfer auf systematischer Grundlage. I. Band: Adephaga, I. Familiengruppe: Caraboidea*. Hans Goecke Verlag, Krefeld. 307 pp.

CÂRLAN V. & VARVARA M. 1998-1999. *The fauna of Carabidae from two agricultural crops of Moldova (Romania*). Analele Stiinţifice ale Universităţii "Al. I. Cuza", Iaşi. Biologie animală. **44-45**: 83-92.

DĂNILĂ A. 2005. *Structura cenozelor de Carabidae (Coleoptera, Carabidae) în culturile de grâu, lucernă şi viţă de vie din Republica Moldova.* Oltenia. Studii şi Comunicări. Stiinţele Naturii. Muzeul Olteniei Craiova. **21**: 103-106.

DESENDER K. 1986. *Distribution and ecology of Carabid beetles in Belgium (Coleoptera, Carabidae). Part 1, Species 1-80 (Cicindelini, Omophronini, Carabini, Cychrini, Nebriini, Notiophilini, Elaphrini, Loricerini, Scaritini, Broscini, Patrobini, Trechini).* Studie documenten – Documents de Travail. Brussel. **26**. 30 pp.

GONGALYSKI K. B. & CIVIDANES F. J. 2008. *Distribution of Carabid beetles in agroecosystems across spatial scales – a review.* Baltic journal of Coleoptera. **8**: 15-30.

GUEORGUIEV V. & GUERGUIEV B. 1995. *Catalogue of the ground-beetles of Bulgaria (Coleoptera: Carabidae).* Pensoft Publishers. Series faunistica. Sofia-Moscow. 279 pp.

KABACIK-WASYLIK DANUTA. 1975. *Research into the number, biomass and energy flow of Carabidae (Coleoptera) communities in Rye and Potato fields.* Polish ecological studies. **1**: 111-121.

KABACIK-WASYLIK DANUTA. 1980. *Carabidae communities of potato and Cereal crops in industrial environment of Silesia*. Polish ecological studies. Warszawa. **6**: 673-684.

KAJAK ANNA & OLESZCZUK MARIAK 2004. *Effect of shelterbelts on adjoining cultivated fields: patrolling intensity of Carabid beetles (Carabidae) and spiders (Araneae).* Polish journal of ecology. **52**: 155-172.

KASANDROVA LARISA IVANOVNA. 1972. *Fauna zhuzhelits plodovykh sadov*. Fauna i ekologija zhivotnykh. Sbornik statej, Moskovskij Ordena trudovogo krasnogo znameni Gosudarstvennyj pedagogicheskij institut imeni V. I. Lenina, Moskva: 65-73. [In Russian].

KISS B. 1970. *Raionarea zoogeografică a României pe baza faunei de Orthoptere.* Studia Universitatis Babeş-Bolyai. Biologia. Cluj-Napoca. **1**: 113-125.

LINDROTH C. H. 1949. *Die Fennoskandischen Carabidae I. Specieller Teil*. Wettergren & Kerbers Förlag, Göteborg. 710 pp.

LŐVEI G. L., TOFT S., AXELSEN J. A. 2003. *Composition and diversity of spring-active carabid beetle assemblages in relation to soil management in organic wheat fields in Denmark*. Proceedings of the 11th European Carabidologist Meeting: 173-182.

NECULISEANU Z. 2003. *Carabidele (Coleoptera, Carabidae) din zona de interferenţă biogeografică (Taxonomie, Diversitate, Zoogeografie, Biologie) şi importanţa lor practică.* Teza de doctor habilitat în ştiinţe biologice. Institutul de Zoologie al Academiei de Ştiinţe a Moldovei, Chişinău (manuscris). 260 pp.

NIEDEL J. 1960. *Monografie československých druhů tribu Carabini VI*. Přírodovědecký sborník Ostravského kraje. **21**: 167-186.

MALSCHI DANA. 2000. *Investigaţii asupra importanţei entomofagilor prădători în agroecosistemele cerealiere din Transilvania.* Simpozionul Internaţional: Dezvoltare rurală şi agricultură ecologică, Iulie 2000, Cluj-Napoca. Revista BIO TERRA a Societății Bioagricultorilor din România: 11-14.

NIEDOBOVÁ JANA, HUA V., ŠŤASTNÁ PAVLA 2011. *Ground beetles (Carabidae) from slopes of Macošská stráň and Vilémovická stráň (Protected landscape area of Moravský kras, Czech Repulic*. Acta Universitatis agriculturae et silviculturae mendelianae brunensis. **59**: 143-149.

NOVÁK B. 1972. *Saisondynamik der tageszeitlichen Aktivität bei Carabiden in einem Feldbiotop*. Acta Universitatis Palackianae Olomucensis, Dacultas rerum naturalium. **39**: 59-104.

PAVLOVA GALINA NIKOLAEVNA 1974. *Izmenenie kompleksa zuzhelits (Coleoprea, Carabidae) iuzhnoi tipchakovo-kavylnoi stepi pri ee iskusstvennom vostonovlenii.* Zoologicheskii zhurnal. **53**: 1023-1029. [In Russian].

PETRUŠKA F. 1971. *The influence of the agricultural plants on the development of the populations of Carabidae living in the fields.* Acta Universitatis Palackianae Olomucensis. Facultas rerum naturalium: Olomouc. **34**: 151-194.

POPESCU E. I. & ZAMFIRESCU R. ŞT. 2004. *Synecological Analysis of a Wheat Field Ground Beetles Community from Letea (Bacău District).* Analele Stiinţifice ale Universităţii "Al. I. Cuza", Iaşi. Seria Biologie animală. **50**: 173-180.

POPOVIĆ ALEKSANDRA & ŠTRBAC P. 2010. *Occurrence and fauna composition of ground beetles in wheat fields*. Journal of Central European Agriculture. **11**: 423-432.

PORHAJAŠOVÁ JANA, PETŘVALDSKÝ V, ŠUSTEK Z, URMINSKÁ JANA, ONDRIŠÍK P., NOSKOVIČ J. 2008. *Long-termed changes in ground beetle (Coleoptera: Carabidae) assemblages in a field treated by organic fertilizers*. Biologia. Bratislava. **63**: 1184-1195.

SCHRÖTTER L. & IRMLER I. 2005. *Biodiversity change on arable fields during conversion from conventional to organic farming*. http://www.landscape-ecology.uni-kiel.de/download/ritzerau/poster/ gfoe_zoologie_II.pdf, downloated in June 2012.

SEKLULIĆ R., HORVATOVICH S., ŠILEŠ I. 1973. *Prilog proučivanju faune fam. Carabidae na poljima pod pšenicom u okolini Osijeka*. Zbornik za prirodne nauke. **44**: 85-90.

SOBOLEVA-DOKUCHAEVA IRINA IVANOVNA. 1995. *Osobennosti formirovania fauny zhuzhelits (Coleoptera, Carabidae) agrocenozov nechernozemja pri kontakte s lesom*. Entomologicheskoe obozrenije. **74**: 551-567.

ŠTEPANOVIČOVÁ OĽGA & BELÁKOVÁ ADÉLA. 1960. *Entomofauna kukuričného poľa*. Acta Facultatis rerum naturalium Univesitatis comeniane. Zoologia. **4**(6-8): 301-332.

ŠUSTEK Z. 1985. *Use of selected families of beetles for bioindication of chemization in selected agrocoenozes.* pp. 51, Annex V. Final report of the Partial research program VI-2-7/03 Ethology and ecology of selected groups of soil fauna in the geobiocoenoses influenced by chemisation. Coordinator A. Šály, Institute of experimental biology and ecology, Slovak academy of science. Bratislava. 36 pp. [In Slovak].

ŠUSTEK Z. 1989. *Influence of chemization and other human activities of Carabids and Staphylinids*. 34 pp. Annex VI. Final report of the Partial research program VII-1-6/09 Soil fauna, its significance and influencing by human activities. Coordinator A. Šály, Institute of experimental biology and ecology, Slovak academy of science, Bratislava. 49 pp. [In Slovak].

ŠUSTEK Z. 1994: *Impact of pollution by nickel leaching rest on Carabidae, Silphidae and Staphylinidae in the surroundings of the nickel smelting plant at Sereď (Slovakia).* Biologia, Bratislava. **49**: 709-721.

TĂLMACIU M. 1995. *Studiul faunei carabidelor (Coleoptera, Carabidae) insecte prădătoare, din punct de vedere sistematic, morfologic, biologic şi ecologic, în vederea combaterii dăunătorilor din plantaţiile de viţă de vie din Moldova*. Rezumatul tezei de doctorat.Universitatea Agronomică din Iaşi. 87 pp.

TAMUTIS V., ŽIOGAS A., ŠALUCHAITĖ AURELIJA, KAZLAUSKAITĖ SONATA, AMŠIEJUS A. 2007. *Epigeic beetle (Coleoptera) communities in summer barley agrocoenoses*. Baltic Journal of Coleopterology. **7**: 123-145.

VARVARA M. 2001. *Observations on the Carabid Coenosis (Coleoptera,Carabidae) in the Potato Crops from Suceava District.* Simpozionul Jubiliar Consacrat Aniversării a 30 de ani de la Formarea Rezervaţiei „Codrii", 27-28. September, Chisinău. **2**: 78-79.

VARVARA M. 2005. *The Taxonomic and Ecological Spectra of Carabids (Coleoptera: Carabidae) in three Agroecosystems from Moldavia.* Lucrările Simpozionului „Entomofagii şi rolul lor în păstrarea echilibrului natural" Universitatea."Al. I. Cuza", Iaşi: 117-129.

VARVARA M. 2005a. *Diversity and the Main Ecological Requirements of the Epigeic Species of Carabidae (Coleoptera, Carabidae) in three types of Agricultural Ecosystems from Suceava County (Moldavia).* Studii şi Cercetări, Biologie. Universitatea Bacău. **10**: 53-61.

VARVARA M. 2008. *Diversity and Main Ecological Requirements of the Epigeic species of Carabidae (Coloeptera, Carabidae) in the Ecosystem crop of sugar beet from Moldavia, 1981-2001.* Lucrările Simpozionului "Entomofagii şi rolul lor în păstrarea echilibrului natural". Universitatea "Al. I. Cuza ", Iaşi: 175-192.

VARVARA M. & ZAMFIRESCU ŞT. 2008. *Composition and the structure of Ecological Requirements of the Species of Carabidae (Coleoptera, Carabidae) in the Maize Crop from Moldavia, 1984-2000.* Oltenia. Studii şi Comunicări. Ştiinţele Naturii. Muzeul Olteniei Craiova. **24**: 97-108.

VARVARA M., ANDRIESCU I., PETCU I. 1981. *Aspects of the fauna of Carabidae in sugar beet crop Dobridor, Dolj County.* Analele Stiinţifice ale Universităţii "Al. I. Cuza", Iaşi. Biologie. **27**: 75-80.

VARVARA M., ANDRIESCU I., MOGLAN. 1985. *Structura cenozei de Caraboidea (Coleoptera) din culturile experimentale de porumb, tratate cu insecticide pe sol cernoziom de la Brăila.* Analele Stiinţifice ale Universităţii "Al. I. Cuza", Iaşi. Biologie animală. **31**: 31-32.

VARVARA M. & ANDRIESCU I. 1986. *Die Konstanz und Abundanz der Carabidae in der Zückerrübenkultur der Moldau (Osten Rumaniens).* Analele Stiinţifice ale Universităţii "Al. I. Cuza", Iaşi. Biologie. Supliment. **32**: 109-113.

VARVARA M., PISICĂ C., CÂRLAN V. 1992. *Contributions to the Knowledge of Carabid Communities in Wheat Crops of Moldavia*. Proceedings of the fourth European Congress of Entomology, 1-6 September, 1991, Gödölő, Hungary: 818-823.

VARVARA M., TĂLMACIU M., GEORGESCU TH. 1995. *Structura speciilor de carabidae (Ord. Coleoptera, Carabidae) în câteva culturi viticole din Moldova.* Cercetări Agronomice în Moldova. Universitatea de Stiințe Agricole şi Medicină Veterinară „Ion Ionescu de la Brad." Iasi, An XXVIII. **3-4**(104): 159-165.

VARVARA M. & BRUDEA V. 1999. *The Structure and Distribution of the Carabid Communities in the Maize Crops from Moldavia.* Studii şi Comunicări Ştiinţifice. Universitatea Bacău: 79-84.

VARVARA M. & BULIMAR FELICIA**.** 2002. *Long –Term Faunistic and Ecological Research of Carabid Communities in the Winter Wheat Crops from Eastern Romania.* Studii şi Comunicări. Edit. "Ion Borcea", Bacău. **18**: 143-150.

VARVARA M. & ANDRIESCU I. 2003. *The Coenosis of Carabidae (Coleoptera, Carabidae) in the Apple Trees Orchard Ecosystem from the Iasi County.* Analele Stiinţifice ale Universităţii "Al. I. Cuza", Iaşi. Biologie animală. **49**: 31-39.

VICIAN V., STAŠIOV S., KOČÍK K., HAZUCHOVÁ LENKA. 2010. *Štruktúra Carabidae (Coleoptera) na rôzne obhospodarovaných poľnohospodárskych plochách v oblasti Podpoľania***.** Acta facultatis ecologiae. **22**: 133-146.

Varvara Mircea,
University "Alexandru Ioan Cuza" Iaşi, Str Bulevardul Carol 1, Nr 11, Iaşi, Romania
E-mail: mvarvara@uaic.ro

Chimişliu Cornelia,
Museum of Oltenia Craiova, Str. Popa Şapca, No. 8,
200422 Craiova, Romania
E-mail: chimişliu_cornelia@yahoo.com

Zbyšek Šustek
Institute of zoology, Slovak Academy of Scienced, Dúbravská cesta 9,
845 06 Bratislava, Slovakia
E-mail: zbysek.sustek@savba.sk

Received: March 12, 2012
Accepted: July 30, 2012