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COMPLEX OF CARABID BEETLES (COLEOPTERA: CARABIDAE) OF POTATO FIELD AGROCENOSIS IN EASTERN LATVIA

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Abstract. The species composition and structure of the carabid beetle community of the potato field agrocenosis on clayey-sandy soil were studied using pitfall traps in the Jēkabpils district (eastern Latvia) between 2000 and 2001. In total, 653 specimens of ground beetles representing 16 genera and 44 species were recorded. *Poecilus cupreus* L. (40.95%) and *P. versicolor* Sturm (18.71%) were found to be eudominants. The prevailing forms were open area species (61.37%), small zoophages (52.27%) and mesophilous species (38.64%). Palaearctic species (40.90%) constituted the dominant zoogeographical element in the carabid community of a potato field. Trappability peaked in the beginning of June. Rare carabid species *Poecilus punctulatus* Schall (three specimens) and *Amara erratica* Dft. (one specimen) were recorded.

Key words: Coleoptera, Carabidae, agrocenosis, potato field, Latvia

Introduction

Epigeic inhabitants, including carabids, form one of the most important components in the agrocenosis fauna. Ground beetles are predominant representatives of insect fauna in various types of agrocenoses (Cinītis 1962).
The currently available information on the species composition and ecological peculiarities of carabids of different agrocenoses in Latvia is insufficient. The majority of publications on this issue focus on the western and central parts of Latvia (Cinītis 1962; Cinītis & Vilks 1962b; Ozols 1956; Petrova *et al*. 2005; Skaldere 1981; Svikle 1970; Volkov 1990). Investigations into the impact of insecticides on the number of carabids in a potato field were performed by Cinītis and Vilks (1962a). General and brief information on ground beetles of agrocenoses in eastern Latvia is provided in several publications (Barševskis 1993, 1997; Cibuļskis 1994). Meanwhile, information on carabid species of agrocenoses in eastern Latvia is mainly found in articles (Bukejs 2005; Bukejs & Balalaikins 2008).
Our investigation shows the species composition as well as ecological and zoogeographical peculiarities of the carabid community in the agrocenosis of a potato field and contribute to the knowledge of carabids in agrocenoses of eastern Latvia.

Material and methods

The study was carried out in potato field in the Jēkabpils district, Salas parish, Sakas Island (eastern Latvia) (Fig. 1) from mid-May to mid-September during the 2000–2001 period.

Figure 1. Location of the study area: the Jēkabpils district, Salas rural municipality, Sakas Island.

The agrocenosis under study covered an area of approximately one hectare of clayey-sandy soil. The territory bordering on open habitats (meadow and agrocenosis of cereal crops) was flooded in spring.
The investigation material was collected with pitfall traps consisting of plastic jars (0.2 l capacity), which were 10 cm deep and 7 cm in diameter. The jars were filled with 5% solution of acetic acid and water. Ten traps set at an approximate distance of 1 m from one another were used. The traps were emptied at 15-day intervals.
Dominance is expressed as the percentage of specimens of a given species in the community. The following dominance classification was applied (Górny & Grüm 1981): eudominants (>10% of all community specimens),

dominants (5.1–10%), subdominants (2.1–5%), recedents (1.1–2%) and subrecedents (<1.1%).
The following publications were used for ecological characteristics of carabid beetle species: Barševskis 2003; Lindroth 1992a, b; Koch 1989; Kryzhanovskiy 1983; Müller-Motzfeld 2004; Sharova 1981; Turin 2000. The classification of carabids was made by habitat preference, by trophism and body size, by humidity requirements and by dynamic groups.
Species were classified as particular zoogeographical elements: Holarctic (H), Palaearctic (P), West Palaearctic (WP), Euro-Siberian (ESib) and European (E) in accordance with Barševskis (2003) and Turin (2000).
Systematics and nomenclature used in the article are in accordance with Barševskis (2003).
The material is kept in the collection of the Institute of Systematic Biology, Daugavpils University (DUBC).

Results and discussion

In total, 653 specimens of ground beetles representing 16 genera and 44 species were recorded, which accounts for about 13.4% of the Latvian Carabidae fauna. The analysis of the species composition shows that the genera *Amara* Bon. (with 8 species), *Harpalus* Latr. (with 7 species) and *Bembidion* Latr. (with 6 species) are represented most widely. Representatives of these genera mostly occur in open habitats, therefore they dominate the carabid fauna of the agrocenosis. Less widely represented were the genera *Calathus* Bon. and *Pterostichus* Bon. (with 4 species), and *Poecilus* Bon. (with 3 species).
Cinītis (1962) reported 44 carabid species for the potato field agrocenosis. The number of species recorded in other types of agrocenoses in Latvia is slightly different: barley agrocenosis – 41 species (Skaldere 1981), wheat field – 41 species (Bukejs & Balalaikins 2008), cereal crops – 48 species (Ozols 1956), sandy agrocenosis with mixed cultures – 64 species (Bukejs 2005), cabbage agrocenosis – 68 species.
The two-year-long study showed that the main eudominant in the potato field agrocenosis was *Poecilus cupreus* L., whose specimens accounted for 40.95% of the carabid community (Table 1). Another eudominant was *Poecilus versicolor* Sturm (18.71%). These two species, which were found to be eudominant during the two-year-long study, constituted more than half of the collected material (59.66% or 389 specimens).
These species are considered to be eudominant in different agrocenoses (Bukejs & Balalaikins 2008; Huruk 2002a, b, 2005; Kolesnikov & Sumarokov 1993; Koval 1999; Skaldere 1981) and open habitats (Bulokhova 1995) by many authors.
However, Cinītis (1962), investigating the carabid fauna of a potato field on sandy soil in the Rīga district points out *P. cupreus* L. as a subdominant species and *P. versicolor* Sturm only as a subrecedent species. Similarly, Bulokhova (1995) studying the species composition and structure of carabid dominance in meadow ecosystems of southwestern Russia, characterizes the species *P. cupreus* L. as dominant in some parts of meadows, which are used as pastures for cattle.
Koval (1999) mentions *P. cupreus* L. as one of the most important entomophages of colorado potato beetles (*Leptinotarsa decemlineata* Say).
The group of subdominants included: *Anchomenus dorsalis* Pont. (4.91%), *Harpalus laevipes* Zett. (3.37%), *Bembidion femoratum* Sturm (2.91%), *Carabus cancellatus* Ill. (2.45%) and *Calathus ambiguus* Pk. (2.30%).
Judging from the whole material, six species were recedents and 31 species were subrecedents (Table 1, Fig. 2).
The correlation among five dominant groups (eudominants, dominants, subdominants, recedents and subrecedents) in the carabid community of a potato field in the Jēkabpils district varied in different years of the investigation (Fig. 2).
Analysis across living environments showed the predominance of open area species (27 species or 61.37%). Individuals belonging to this group constituted 83.12% of the cumulative community. Species typical of open-forest areas were also numerous and were represented by 12 species (27.27% of all the recorded species) and 98 individuals (15.01%). The share of forest species was

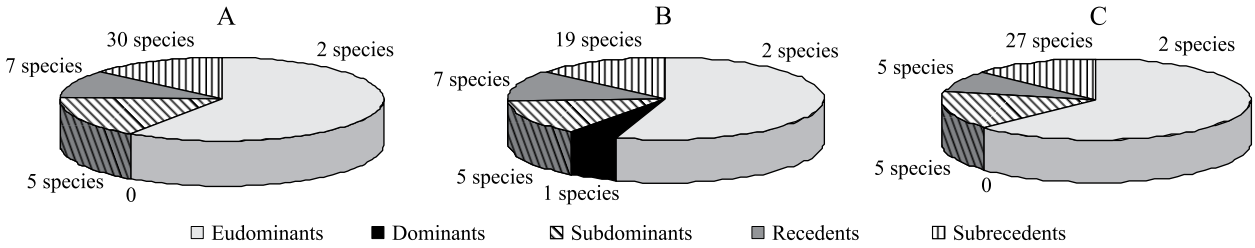

Figure 2. Dominance structure of the ground beetle community in the agrocenosis of a potato field (in terms of specimen numbers): A – total data for two years, B – 2000, C – 2001.

Table 1. List and ecological characteristics of ground beetle species of the potato agrocenosis: n – number of specimens, % – percentage share in community, Hab. – habitat preferences (Oa – open area, OaF – open area and forest, F – forest), Hum. – Humidity requirements (X – xerophilous, M – mesophilous, H – hygrophilous), Troph. – Trophism and body size (Lz – large zoophages with body mass >100 mg, Sz – small zoophages with body mass <100 mg, Hz – hemizoophages feeding on both animal and mixed diets), Dyn. – dynamic groups (m – macropterous, b – brachypterous, d – dimorphic), Zoog. – zoogeographical characteristics (H – Holartic, P – Palaeartic, WP – West Palaearctic, ESib – Euro-Siberian, E – European).

No	Species	2000	2001	Total		Hab.	Hum.	Troph.	Dyn.	Zoog.
				n	%					
1.	*Cicindela hybrida* L.	-	3	3	0.15	OaF	X	LZ	m	E
2.	*C. campestris* L.	4	6	10	1.53	OaF	X	Lz	m	WP
3.	*Notiophilus aquaticus* L.	4	-	4	0.61	OaF	M	Sz	d	H
4.	*Carabus cancellatus* Ill.	5	11	16	2.45	OaF	M	Lz	b	P
5.	*C. nemoralis* Mull.	6	4	10	1.53	OaF	M	Lz	b	E
6.	*Clivina fossor* L.	5	2	7	1.07	Oa	H	Sz	m	P
7.	*Broscus cephalotes* L.	2	3	5	0.77	Oa	X	Lz	b	ES
8.	*Asaphidion flavipes* L.	-	1	1	0.15	OaF	M	Sz	m	WP
9.	*Bembidion lampros* Hbst.	1	-	1	0.15	Oa	M	Sz	d	H
10.	*B. properans* Steph.	3	5	8	1.23	Oa	H	Sz	d	H
11.	*B. quadrimaculatum* L.	1	2	3	0.46	Oa	M	Sz	m	H
12.	*B. dentellum* Thumb.	-	1	1	0.15	Oa	H	Sz	m	WP
13.	*B. tetracolum* Say	3	1	4	0.61	Oa	H	Sz	m	P
14.	*B. femoratum* Sturm	7	12	19	2.91	Oa	X	Sz	m	P
15.	*Anchomenus dorsalis* Pont.	14	18	32	4.91	OaF	M	Sz	m	P
16.	*Agonum muelleri* Hbst.	1	-	1	0.15	OaF	H	Sz	m	WP
17.	*Calathus fuscipes* Gz.	-	2	2	0.30	Oa	M	Sz	b	WP
18.	*C. ambiguus* Pk.	6	9	15	2.30	Oa	X	Sz	m	WP
19.	*C. micropterus* Dft.	-	1	1	0.15	F	M	Sz	b	P
20.	*C. melanocephalus* L.	5	6	11	1.69	OaF	M	Sz	d	WP
21.	*Poecilus versicolor* Sturm	52	70	122	18.71	OaF	M	Sz	m	P
22.	*P. cupreus* L.	93	174	267	40.95	OaF	M	Sz	m	ES
23.	*P. punctulatus* Schll.	1	2	3	0.46	Oa	X	Sz	m	WP
24.	*Pterostichus melanarius* Ill.	2	1	3	0.46	OaF	H	Lz	d	ES
25.	*P. oblongopunctatus* F.	-	3	3	0.46	F	M	Sz	m	P
26.	*P. anthracinus* Ill.	-	1	1	0.15	Oa	H	Sz	d	WP
27.	*P. strenuus* Pz.	3	7	10	1.53	F	H	Sz	d	P
28.	*Amara plebeja* Gyll.	2	-	2	0.30	Oa	X	Hz	m	P
29.	*A. aenea* Deg.	2	-	2	0.30	Oa	M	Hz	m	P
30.	*A. famelica* Zimm.	1	-	1	0.15	OaF	H	Hz	m	P
31.	*A. communis* Pz.	1	2	3	0.46	Oa	M	Hz	m	P
32.	*A. erratica* Dft.	-	1	1	0.15	Oa	H	Hz	m	H
33.	*A. fulva* Mull.	3	4	7	1.07	Oa	X	Hz	m	ES
34.	*A. consularis* Dft.	1	1	2	0.30	Oa	X	Hz	m	WP
35.	*A. apricaria* Pk.	5	4	9	1.38	Oa	M	Hz	m	H
36.	*Harpalus rufipes* Deg.	2	3	5	0.77	Oa	X	Hz	m	P
37.	*H. affinis* Schrnk.	6	7	13	1.99	Oa	X	Hz	m	P
38.	*H. laevipes* Zett.	12	10	22	3.37	F	H	Hz	m	H
39.	*H. latus* L.	-	1	1	0.15	F	M	Hz	m	P
40.	*H. rufipalpis* Sturm	3	1	4	0.61	Oa	X	Hz	m	WP
41.	*H. tardus* Pz.	2	3	5	0.77	Oa	X	Hz	m	ES
42.	*H. froelichii* Sturm	2	2	4	0.61	Oa	X	Hz	m	P
43.	*Badister meridionalis* Puel.	4	3	7	1.07	OaF	H	Sz	m	WP
44.	*Microlestes minutulus* Gz.	-	2	2	0.30	Oa	X	Sz	m	P
	Total number of specimens	264	389	653						

smaller (Table 2). It was established that the absence or presence of such species and the number of individuals in the agrocenosis are predetermined by the neighbouring habitats. In our case, this was clearly seen when only open habitats surrounded the agrocenosis under study.
Considering humidity requirements, mesophilous species definitely prevailed, accounting for 17 species (38.64%) or 74.73% of the total number of captured carabids in the community (Tables 1, 2).
From the viewpoint of the trophic type and body size, the dominant group was that of small zoophages (23 species – 52.27%). Individuals representing these species constituted 80.40% of the total number of carabids captured in the agrocenosis of a potato field (Tables 1, 2).
As to dynamic groups, the community was dominated by macropterous species (72.73%) (Tables 1, 2).

Table 2. Ecological characteristics of the carabid community of the potato field in the Jēkabpils district: S – number of species, n – number of specimens, % – percentage share in the community.

Ecological characteristics	Ecological elements	S	%	n	%
Habitat	Open area species	27	61.37	518	79.32
	Forest species	5	11.36	37	5.67
	Open area and forest species	12	27.27	98	15.01
Humidity requirement	Xerophilous	15	34.09	99	15.16
	Mesophilous	17	38.64	488	74.73
	Hygrophilous	12	27.27	66	10.11
Trophic type	Large zoophages	6	13.64	47	7.2
	Small zoophages	23	52.27	525	80.4
	Hemizoophages	15	34.09	81	12.4
Dynamic groups	Macropterous	32	72.73	581	88.97
	Brachypterous	5	11.36	34	5.21
	Dimorphic	7	15.91	38	5.82

The investigated fauna of ground beetles comprised five zoogeographical elements: Holarctic, Palaearctic, West Palaearctic, Euro-Siberian and European species (Tables 1, 3). The zoogeographical structure of ground beetles of a potato field was characterised by the predominance of species with wide distribution areas (Table 3). Palaearctic and West Palaearctic species constituted 70.45% of the total number of captured species. The largest number of species represented the Palaearctic element (18 species or 40.90%). In terms of the number of specimens, the community was dominated by West-Palaearctic species (325 specimens or 49.7%). Predominance of widespread species is a characteristic feature of human-managed territories (meadows and agricultural fields) (Huruk 2002a, b, 2005; Huruk & Huruk 2004; Soboleva-Dokuchaeva 1995). Holarctic, Euro-Siberian and European species were represented very poorly.

Table 3. Shares of zoogeographical elements in the carabid community of the potato field: S – number of species, n – number of specimens, % – percentage share in the community.

Zoogeographical element	S	%	n	%
Holarctic	7	15.91	48	7.35
Palaearctic	18	40.90	247	37.83
West Palaearctic	13	29.55	325	49.77
Euro-Siberian	4	9.09	20	3.06
European	2	4.55	13	1.99
Total	44	100	653	100

The study showed that the number of carabids changes during the season. Maximum periods are related with breeding and hibernation of beetles. We did not record any distinct peaks in seasonal activity dynamics, which are mentioned for Poland (Huruk 2002a, 2005). The highest abundance of ground beetles was generally recorded in the beginning of June (Fig. 3), indicating the predominance of spring species, which exhibit peak activity in the first half of the growing season.

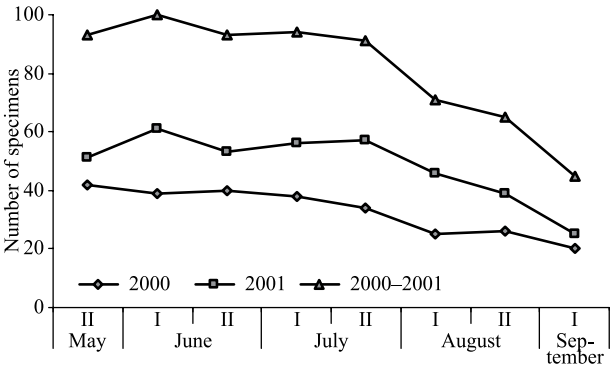

Figure 3. Seasonal dynamics of the carabid community in the potato agrocenosis.

Huruk (2005) also recorded two very weak activity peaks in June and in August in the carabid community inhabiting wasteland in Poland.
In different years of this study, the number of recorded specimens and dynamics of seasonal carabid activity varied (Table 1, Fig. 3). The year 2000 was rather wet and cool, and that was reflected in the total number of collected specimens and weak peaks of seasonal activity. Skaldere (1981) obtained similar results while studying carabids of the barley agrocenosis and also pointed out the dependence of seasonal activity dynamics on climatic conditions of a concrete growing season.
Dynamics of seasonal activity of eudominant carabid species (*Poecilus cupreus* L. and *P. versicolor* Sturm)

of the potato field agrocenosis was analysed. According to Larsson's (1939) classification, these species have a spring type of breeding. In his monograph Turin (2000) states that the maximum peak of seasonal activity of these species occurs in May and a weaker one in September. Our results are slightly different (Fig. 4). During the two-year-long study, the peak of *P. cupreus* seasonal activity was recorded in the second half of July (Fig. 4A) and that of *P. versicolor* in the second half of August. Seasonal activity of these species, especially that of *P. versicolor* (Fig. 4B) varied in concrete years of the study.

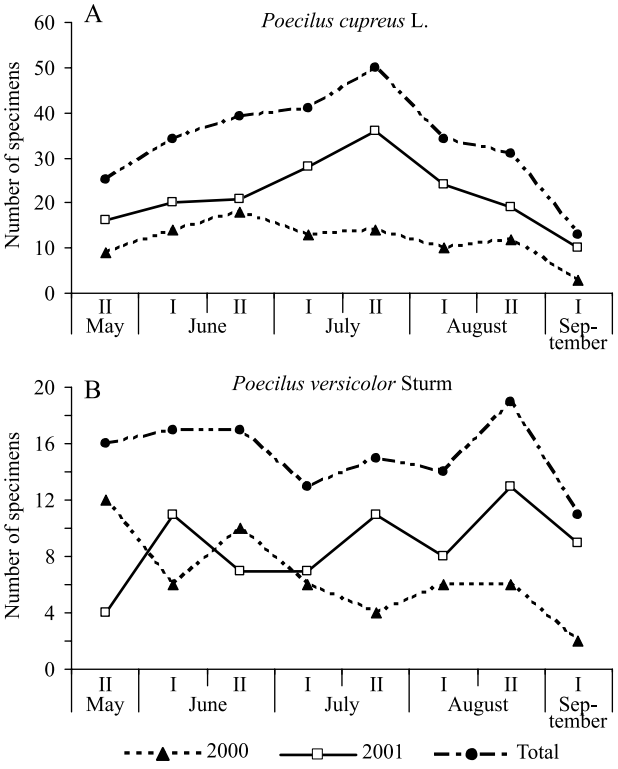

Figure 4. Seasonal dynamics of eudominant ground beetles species in the potato agrocenosis. A – *Poecilus cupreus* L., B – *Poecilus versicolor* Sturm.

Two rare carabid species were recorded. *Poecilus punctulatus* Schall. (three specimens), is a very rare species in Latvia. Over the last 100 years, this species was recorded in a few localities in the southeastern part of the country. It is a eurytopic and xerophilous species, which occurs in different dry and open habitats: sandy fields and meadows, heaths, dunes, forest edges with sparse vegetation, etc. (Koch 1989).

Amara erratica Dft. (one specimen), is a rare and insufficiently known in Latvia species; it is known only from two localities. It is a eurytopic and hygrophilous species which inhabits different open habitats: gardens, meadows, forest edges, etc. (Koch 1989).

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Bulvių agrocenozės žygiai (Coleoptera: Carabidae) Rytų Latvijoje

A. Bukejs

Santrauka

Žygių bendrijos rūšių sudėtis ir struktūra buvo tirti Jekabpilio rajono (Rytų Latvija) bulvių agrocenozėje, molio-smėlio dirvožemyje. Tyrimas atliktas 2000–2001

metais, naudojant gaudykles. Iš viso buvo užregistruoti 653 žygiai, priklausantys 16 genčių ir 44 rūšims. Tyrimo metu buvo nustatyta, kad *Poecilus cupreus* L. (40,95%) ir *P. versicolor* Sturm (18,71%) rūšys yra eudominantinės. Dominavo atvirų buveinių rūšys (61,37%), smulkieji zoofagai (52,27%) ir mezofilinės rūšys (38,64%). Dominuojantį zoogeografinį elementą žygių bendrijoje sudarė palearktinės rūšys (40,90%). Sugavimų pikas buvo birželio pradžioje. Buvo užregistruotos retos žygių rūšys *Poecilus punctulatus* Schall (3 ind.) ir *Amara erratica* Dft. (1 ind.).

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