

Complexes of ground beetles (Coleoptera, Carabidae) in agrocenoses of cultivated crops of Krasnodar Territory

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Abstract. The paper presents new data on the species composition of ground beetles of row crops in 10 municipalities of the Krasnodar Territory. Pursuant to the research results, 45 species of Carabidae were identified. The chorological analysis and the analysis of the ecological groups noted in the model areas were performed.

1 Introduction

This study continues long-term observations of the local fauna of ground beetles in agrocenoses of the Northwest Caucasus, namely, the study of the structure of the community of ground beetles formed on row crops (sunflower and corn) of the Kuban **Region**. This kind of research has already been performed both abroad [15-22] and in Russia, in particular, in the central zone of the Krasnodar Territory [1-13], but, at the moment, these observations have been performed most fully, since they cover all the main zones of the region. Obviously, the faunas of ground beetles of various agrocenoses are not constant, their composition is influenced by many factors that form a special microclimate, which is confirmed by the researches performed by the domestic and foreign authors at the agricultural landscapes. We should note that, together with other studies on this topic, these materials allow to track the fauna transformations, associated with the influence of climate change or anthropogenic impact.

2. Materials and methods

The material was collected using modified Barber soil traps [14] in 13 localities (Table 1) from April to October in 2019 and 2020. The traps were 0.5 L plastic cups with an inlet diameter of 95 mm. Herewith, the edges of the glasses were at the same level with the soil surface. A 4% formaldehyde aqueous solution was used as the fixing liquid. In order to

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prevent the traps from flooding during rain and excessive evaporation of the fixing liquid, plastic covers were installed above them. Means of accounting were placed in a line of 20 pieces, at a distance of 5 m from each other.

Table 1. Characterization and localization of model areas

No	Municipal formation of Krasnodar Region	Crop	Abbreviation
1	Timashevsky district	sunflower	Tim 1
2	Timashevsky district	corn	Tim 2
3	Dinskoy district	sunflower	Din
4	Tbilisky district	corn	Tbil
5	Gulkevichsky district	sunflower	Gulk 1
6	Gulkevichsky district	sunflower	Gulk 2
7	Armavir	corn	Arm
8	Starominsky district	sunflower	Star
9	Kanevskoy district	corn	Kan
10	Kushchevsky district	corn	Kush
11	Pavlovsky district	corn	Pavl
12	Tikhoretsky district	sunflower	Tikh 1
13	Tikhoretsky district	corn	Tikh 2

Based on the results of identification of the material selected from the traps, the species composition of ground beetles in the model areas was determined, and analyzes of the similarity of local faunas, global ranges of species and their landscape-cenotic confinement were performed.

The Jaccard's coefficient of community was used to compare localities by species similarity of ground beetles. The calculation and construction of the dendrogram was performed in the Biodiversity Pro 2.0 software application. For the classification of habitats, as well as ecological groups, the nomenclature provided by the authors earlier was used [4, 5]. The analysis of the landscape-cenotic confinement of ground beetles was performed considering the available data on the occurrence of the species under consideration in natural biocenoses.

3 Results and discussion

Pursuant to the results of research in the fields of row crops, 45 species of ground beetles were identified (Table 2). In each individual model area, there were from 23 to 35 species. The greatest species diversity was in the field of corn in the Tbilisky district, the smallest - in the field of sunflower No. 1 in the Gulkevichsky district.

Table 2. Species composition and occurrence of ground beetles on row crops in the Krasnodar Territory

No	Species	Locality												
		Tim 1	Tim 2	Din	Tbil	Gulk 1	Gulk 2	Arm	Star	Kan	Kush	Pavl	Tikh 1	Tikh 2
1	<i>Cicindela germanica</i> Linnaeus, 1758				+				+					
2	<i>Calosoma auropunctatum</i> (Herbst, 1784)		+		+			+		+	+	+		+

Table 2. Continued

3	<i>Carabus cumanus</i> Fischer von Waldheim, 1823				+	+	+	+						
4	<i>Carabus plamus</i> Géhin, 1885	+	+	+	+			+			+			
5	<i>Carabus exaratus</i> Quensel, 1806	+	+	+	+	+	+	+	+	+	+	+	+	+
6	<i>Clivina fossor</i> (Linnaeus, 1758)								+					
7	<i>Brosicus semistriatus</i> (Dejean, 1828)	+	+	+	+	+	+	+	+	+	+	+	+	+
8	<i>Poecilus cupreus</i> (Linnaeus, 1758)	+	+	+	+	+	+	+	+	+	+	+	+	+
9	<i>Poecilus sericeus</i> Fischer von Waldheim, 1824	+	+	+	+	+	+	+	+	+	+	+	+	+
10	<i>Poecilus crenuliger</i> Chaudoir, 1876	+	+	+	+	+	+	+	+	+	+	+	+	+
11	<i>Pterostichus niger</i> (Schaller, 1783)	+	+	+	+	+	+	+	+	+	+	+	+	+
12	<i>Pterostichus longicollis</i> (Duftschmid, 1812)	+	+						+			+		
13	<i>Pterostichus strenuus</i> (Panzer, 1796)		+		+					+				
14	<i>Calathus fuscipes</i> (Goeze, 1777)	+	+	+					+	+	+	+	+	+
15	<i>Calathus ambiguus</i> (Paykull, 1790)		+		+			+		+	+	+		+
16	<i>Calathus melanocephalus</i> (Linnaeus, 1758)	+	+	+	+			+						
17	<i>Calathus halensis</i> (Schaller, 1783)	+	+	+	+	+	+	+	+	+	+	+	+	+
18	<i>Anchomenus dorsalis</i> (Pontoppidan, 1763)	+	+	+	+	+	+	+	+	+	+	+	+	+
19	<i>Synuchus vivalis</i> (Illiger, 1798)								+				+	
20	<i>Amara aenea</i> (DeGeer, 1774)	+	+	+	+	+	+	+	+	+	+	+	+	+
21	<i>Amara familiaris</i> (Duftschmid, 1812)				+			+	+					+
22	<i>Amara ovata</i> (Fabricius, 1792)								+					
23	<i>Zabrus tenebrioides</i> (Goeze, 1777)								+		+		+	+
24	<i>Anisodactylus binotatus</i> (Fabricius, 1787)			+	+			+	+	+	+	+		+
25	<i>Anisodactylus signatus</i> (Panzer, 1796)	+	+	+	+	+	+	+	+	+	+	+	+	+
26	<i>Stenolophus mixtus</i> (Herbst, 1784)	+	+	+	+	+	+	+	+	+	+	+	+	+
27	<i>Harpalus griseus</i> (Panzer, 1796)	+	+	+	+	+	+	+	+	+	+	+	+	+
28	<i>Harpalus rufipes</i> (DeGeer, 1774)	+	+	+	+	+	+	+	+	+	+	+	+	+

Table 2. Continued

29	<i>Harpalus attenuatus</i> Stephens, 1828							+		+					
30	<i>Harpalus flavescens</i> (Piller & Mitterpacher, 1783)	+	+	+					+	+			+	+	+
31	<i>Harpalus tardus</i> (Panzer, 1796)	+	+	+	+	+	+	+	+	+	+	+	+	+	+
32	<i>Harpalus latus</i> (Linnaeus, 1758)				+				+						+
33	<i>Harpalus smaragdinus</i> (Duftschmid, 1812)									+					
34	<i>Harpalus cupreus</i> Dejean, 1829	+	+	+	+	+	+	+	+	+	+	+	+	+	+
35	<i>Harpalus affinis</i> (Schrank, 1781)	+	+	+	+	+	+	+	+	+	+	+	+	+	+
36	<i>Harpalus distinguendus</i> (Duftschmid, 1812)	+	+	+	+	+	+	+	+	+	+	+	+	+	+
37	<i>Ophonus azureus</i> (Fabricius, 1775)		+		+	+		+		+	+	+			+
38	<i>Ophonus diffinis</i> (Dejean, 1829)				+							+			
39	<i>Ophonus sabulicola</i> (Panzer, 1796)			+									+		+
40	<i>Chlaenius aeneocephalus</i> Dejean, 1826		+		+		+	+					+		
41	<i>Microlestes minutulus</i> (Goeze, 1777)			+	+		+	+		+				+	+
42	<i>Brachinus alexandrii</i> F. Battoni, 1984	+	+	+	+	+	+	+	+	+	+	+	+	+	+
43	<i>Brachinus crepitans</i> (Linnaeus, 1758)	+	+	+	+	+	+	+	+	+	+	+	+	+	+
44	<i>Brachinus ejaculans</i> Fischer von Waldheim, 1828	+	+	+	+	+	+	+	+	+	+	+	+	+	+
45	<i>Brachinus elegans</i> Chaudoir, 1842	+	+	+	+	+	+	+	+	+	+	+	+	+	+

To determine the similarity of the complexes of ground beetles in the studied agrocenoses, a cluster analysis was performed on the basis of the Jaccard coefficient and a dendrogram of similarity was constructed (Fig. 1). The local faunas of the Carabidae in the area under consideration are characterized by a fairly high level of similarity. With a threshold distance of 74%, 4 classes are distinguished, including from 1 to 5 localities. Class 1, which is the most different from all of them (the similarity level is 68%), includes a sunflower field complex in the Starominsky district. The second class is formed by the faunas of the corn fields of Armavir and Tbilisky region. The third class, the closest to the previous one, included the complexes of ground beetles in corn fields in the Kushchevsky, Tikhoretsky, Kanevsky, Pavlovsky and Timashevsky districts. The fourth class is represented by local faunas of sunflower fields in the Gulkevichsky, Tikhoretsky, Dinskoy and Timashevsky districts. Therefore, there is the dependence of the similarity of the local faunas of ground beetles on the cultivated crop, with individual groupings of fields of sunflower and corn. Only the carabid complex of the sunflower field in the Starominsky district differs significantly from all the others. Herewith, the territorial proximity matters for the fields of the same crops. Thus, the greatest similarity of faunas (87%) was observed in sunflower fields in one municipal entity of the Krasnodar Territory - in the Gulkevichsky district (Gulk 1 and Gulk 2).

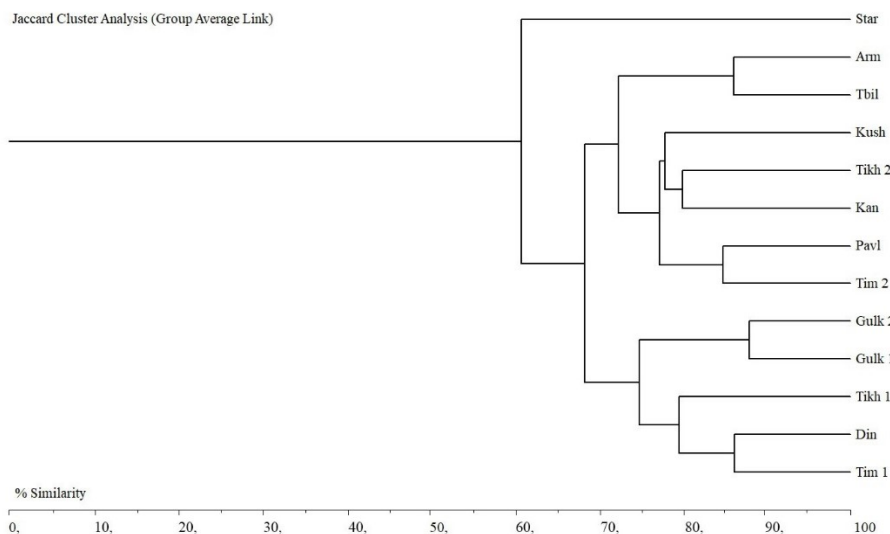


Fig. 1. Dendrogram of the similarity of complexes of ground beetles in the fields of row crops in the Krasnodar Territory. Locality designations are shown in Table 1.

The arealogical analysis of the local faunas of ground beetles of row crops in the area under consideration showed that species with wide polisector and polyzonal ranges prevailed in all localities: Holarctic, Transpalaeartic, Amphipalaeartic, West Palaeartic, Euro-Siberian, etc. Their share ranged from 47% (corn field in Pavlovsky district) to 58% (sunflower field in Starominsky district). In most observation points, a high proportion were European-Mediterranean species - from 13% (field of sunflower No. 2 in Gulkevichsky district) to 24% (field of corn in Kushchevsky district), as well as steppe (Scythian, European-Scythian, partly polisector) - from 13% (sunflower fields in Gulkevichsky and Starominsky districts) to 19% (sunflower and corn fields in Timashevsky district). In general terms, such proportions are typical not only for the carabid complexes under consideration, but also for carabid complexes of completely different agrocenoses in the Krasnodar Territory, including for orchards and vineyards [3].

Pursuant to the results of the analysis of the ecological groups of ground beetles identified in the fields of row crops in the area under consideration, the prevalence of polytopic mesophiles was established. Their share varied from 51.7% (corn field in Kushchevsky district) to 62.5% (sunflower field No. 2 in Gulkevichsky district and corn field in Armavir). The share of steppe mesophiles was also quite high, ranging from 25% (corn field in Armavir) to 34.6% (sunflower field in Tikhoretsky district). The share of other ecological groups was significantly lower, none of them exceeded 7% in any of the localities.

4 Conclusions

Pursuant to the results of the study of carabid complexes in the fields of row crops of the area under consideration, 45 species of ground beetles were identified. There is a fairly high similarity of local faunas. Herewith, the groups characteristic of corn fields and sunflower fields are clearly differentiated. This is probably due to the difference in microclimatic conditions in the area of the soil surface and its upper layer inhabited by most species. Only the fauna of ground beetles in the sunflower field differs significantly from all other groups.

Pursuant to the results of the arealogical analysis, a sufficiently high similarity of the proportions of chorological complexes was established for all model areas. In addition, similar proportions are observed in most other agrocenoses in the Krasnodar Territory. The dominance of species with wide polisector and polyzonal ranges was noted. The European-Mediterranean species also accounted for a significant share. Herewith, in contrast to other agrocenoses, the set of chorological groups in the fields of row crops was much poorer.

Pursuant to the results of the analysis of ecological groups of ground beetles in the model areas, a significant predominance of polytope mesophiles was established, the proportion of which in none of the areas was less than half. Other large group was created by steppe mesophiles. Other ecological groups showed the poor species diversity. The main proportions of the ecological groups of ground beetles were broadly similar and did not depend on the cultivated crop or the territorial distribution of the model plot.

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