The ground beetles (Coleoptera, Carabidae) of the Karatepa and Chakilkalyan mountains (west part of Zarafshan Mountains Range, Uzbekistan)

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Ground beetles (Coleoptera, Carabidae) are one of the most numerous and well-studied families of Coleoptera. However, the study of the biodiversity of these beetles in Uzbekistan lags far behind other Central Asian countries. This research was carried out during 2018–2019 in two areas in the west part of the Zarafshan Mountain Range – in the Chakilkalyan and Karatepa mountains. In total, 49 species of ground beetles belonging to 31 genera, 16 tribes and 8 subfamilies were recorded. The most representative was the subfamily Harpalinae (32 species from 20 genera, 65.3%). By the number of individuals, representatives of Harpalinae made up 85.6% of all collected ground beetles. The Trechinae subfamily included five species from three genera (10.2%), the Scartitinae subfamily – four species from two genera (8.2%), the Carabinae subfamily – three species from two genera (6.1%), the Berosinae subfamily – two species from the same genus (4.1%). The subfamilies Brachininae, Cicindelinae and Nebrinae are represented by one species (2.0% each).

In the Karatepa Mountains, 34 species from 23 genera were identified, and in the Chakilkalyan Mountains, 34 species from 21 genera. 19 species of ground beetles were common to the two mountains. The fauna of ground beetles in these mountains differed significantly in the composition of the dominant species. In the Karatepa Mountains, the dominant species were Zabris morio, Eocterurus chondhenticus, Amara aenea, and Aenomys lavigatus, and the subdominant ones were Brachinus explodens, Calathus ambiguus, and Poecilus longiventer. In the Chakilkalyan Mountains, Anomomerus dorsalis, Harpalus rufipes, and Chlaenius extensus are dominant, while Amara aenea, Harpalus distinguendus, Dolichus halensis turned out to be subdominant. However, the composition of dominant species varied at different sites. The rarest species were Anisodactylus binotatus, Cymindis andreae, Taphoxenus goiath, Calosoma sycopha, Sarcites subcheliferus, Chilotomusus gentensis, Calathus pelikans and Broscus punctatus. Different areas of both mountains differed significantly in the diversity of ground beetle fauna. In both mountains, the lowest diversity was noted at the highest altitude areas. In four areas of the Karatepa Mountains, the average value of the Zhanar and Chekanovsky-Sørensen indices was 0.27 and 0.11, and in five areas of the Chakilkalyan Mountains – 0.24 and 0.25. And the similarities between the communities of the two mountains were also insignificant (0.39 and 0.11).

Keywords: degree of dominance; faunal peculiarities; species composition; Cicindelinae; Carabinae; Harpalinae; Trechinae; Brachininae; Nebrinae.

Introduction

Ground beetles are a very large and diverse taxon among Coleoptera, and about 100 new species are discovered every year (Lorenz, 2005; Kotzer et al., 2011). They are an important link in food chains and play a huge role in energy transformation (Skalski et al., 2011; Schirmer et al., 2012). They are sensitive to environmental changes, exhibiting strong habitat specificity and low ability to spread rapidly to neighbouring areas (Work et al., 2008). Therefore, ground beetles have been widely used to compare the ecology of pristine forests and artificial plantations (Finch, 2005), in the environmental monitoring of post-industrial ecosystems (Skalski et al., 2015; Bell et al., 2017; Kędzior, 2020). Many carabid species, as universal predators with a wide food spectrum, can enter as universal predators with a wide food spectrum, can enter as

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ties, has not been carried out. There are studies on individual groups of ground beetles in other Central Asian republics (Kryzhanovsky, 1965, 1994; Kabak, 2015). Furthermore, the data on the territory of Uzbekistan is outdated, and the new data is mainly based on museum exhibits. In general, ground beetles of Uzbekistan have been more or less studied in agroecosystems of cotton (Dadamirzaev, 1978; Bekmetova, 1991) and vegetable crops (Khalimov, 2008) as entomophages of agricultural pests.

Information about ground beetles of the Zarafshan Valley can be found in faunistic works (Alimjanov & Bronstein, 1956) or for the southern slopes of the Zarafshan Ridge located on the territory of Tajikistan (Milyaylov, 1998).

Our research aimed to study the species diversity and taxonomic composition of ground beetles of the Chakilkalyan and Karatepa mountains of the Zarafshan Ridge, located on the territory of Uzbekistan.

### Material and Methods

The studies were conducted in the period 2018–2019 in the territories of the Chakilkalyan and Karatepa mountains, as well as in the foothill zones. The Karatepa Mountains are bordered on the east by the Chakilkalyan Mountains and join the Zinbulak Mountains. In this direction, the height of the mountains above sea level also decreases. According to the direction of the mountains, 4 areas were selected for the study: Takhitakorachia (39°17'47" N, 66°56'36" E), Yul-say (39°29'33" N, 66°95'04" E), Ettiuyli-say (39°43'42" N, 66°98'25" E) and Agalik-say (39°29'26" N, 66°51'46" E). All selected sites are characterized by meadow vegetation with a scattering of tree species. Artificially created forest biotopes prevailed only on the Ettiuyli-say site.

From the south, the Chakilkalyan Mountains start from the border of Uzbekistan with Tajikistan (Pejkent Province) and continue to the northwest 60–70 km to the Karatepa Mountains. Five sites were selected for research, one of which is on the southern slope (Hazrat Bashir, (39°15'58" N, 67°06'00" E), and the other four are on the northern slope (Yalpoqtepa – 39°26'14" N, 67°14'31" E, Qumbel-say – 39°22'05" N, 67°12'02" E, Kamangaron-say – 39°22'05" N, 67°12'02" E, Siidudaqon – 39°19'53" N, 67°13'48" E). One site (Yalpoqtepa) is a cultivated landscape (vineyards). The Chakilkalyan Mountains differ from the Karatepa Mountains by the absence or scarcity of forest vegetation (except for the Kamangaron-say site).

In 2018, three expeditions were organized at each site (April, May, September), and in 2019, four expeditions (March, April, May, August). In order to collect beetles, soil traps of the Barber – Heideman type (Barber, 1931; Heydemann, 1955), light traps, exhauster, and manual collection were used. Glass jars (Karpova, 1992) with a capacity of 0.5 L and a hole diameter of 72 mm were used as traps (the jars were buried in the soil so that the edges were at the level of the soil) installed in a line of 10 traps at a distance of 5 m from each other. Some of the traps were without a retainer, and some with a fixing liquid. As a fixative, a 4% formalin solution was used, which filled soil traps in 1/3–1/2 volumes. Traps were sampled once every 10–12 days. Collected beetles were identified by species, counted and compiled.
Table 1

Taxonomic composition of ground beetles of the Karatep and Chakilikalyan mountains of Uzbekistan

| Subfamily | Tribe     | Species                                                                 | Mt. Karatep | Mt. Chakilikyan | Share of species, % |
|-----------|-----------|------------------------------------------------------------------------|-------------|-----------------|---------------------|
| Nebriinae | Nebriini  | Nebria psammophila Solsky, 1874                                       | –           | +               | 0.7                 |
| Carabinae | Carabini  | Calosoma aureopectinatum dzhurugursum Gilber, 1833                     | –           | +               | 0.8                 |
|           |           | C. cyclopanta (Linnaeus, 1758)                                         | +           | –               | 0.2                 |
|           |           | Carabus fuscusdens Solsky, 1874                                        | +           | –               | 1.8                 |
| Cicindelinae | Cicindelini | Cicindela turkestanica Ballion, 1871                                  | +           | –               | 1.7                 |
| Scartinae | Scartini  | Scartites basiplicatus Heyden, 1884                                    | +           | +               | 1.0                 |
|           |           | S. terricola Bonelli, 1813                                              | +           | +               | 1.0                 |
|           |           | S. subcylindricus Chaudoir, 1843                                        | –           | +               | 0.2                 |
|           | Clivinini | Clivina collaris Herbst, 1784                                          | +           | –               | 0.3                 |
| Broscinae | Broscini  | Broccus punctatus (Dejean, 1828)                                       | –           | +               | 0.2                 |
|           |           | B. asiaticus Ballion, 1871                                              | –           | +               | 5.3                 |
| Trechinae | Bembidini | Asphalidion flavicornum(Solsky, 1874)                                   | –           | +               | 0.5                 |
|           |           | Bembidion picoccusanum Solsky, 1874                                    | –           | +               | 0.3                 |
|           |           | B. boridcornum Solsky, 1874                                             | +           | –               | 1.3                 |
|           |           | B. saecilis flavicapae Notolitiky, 1930                                 | +           | –               | 0.5                 |
|           | Trechini  | Trechus quadrilaterus(Schmück,1781)                                    | +           | +               | 1.8                 |
| Brachininae | Brachini | Brachinus explodens Duftschmid, 1812                                   | +           | +               | 1.3                 |
| Harpalinae | Chlaeniini | Chlaenius flavicorn(Fischer von Waldheim, 1842)                        | +           | +               | 1.1                 |
|           |           | Ch. extensus Mannerheim, 1825                                           | +           | +               | 4.9                 |
|           |           | Ch. festivus (Panzer, 1796)                                             | +           | +               | 0.3                 |
| Harpalini |           | Acinops laevigatus Membrيز,1832                                        | +           | +               | 7.7                 |
|           |           | Anisodactylus binotatus (Fabricius, 1787)                               | +           | –               | 0.2                 |
|           |           | Chilotomaeus genitoris Schuabanger, 1932                               | +           | –               | 0.3                 |
|           |           | Carvenocharis araneus Solsky,1874                                       | –           | +               | 0.7                 |
|           |           | Dixus eremit Dejean, 1825                                               | +           | +               | 3.5                 |
|           |           | D. semicertidactylus Pochard de la Brèilanie, 1872                      | +           | –               | 0.5                 |
|           |           | Eoccateros cholinchositis (Ballion, 1871)                               | +           | +               | 10.0                |
|           |           | Harpalus reflexus (De Geer, 1774)                                      | +           | –               | 3.3                 |
|           |           | H. griseus (Panzer, 1796)                                               | +           | +               | 0.3                 |
|           |           | H. degeeri Duftschmid, 1812                                             | –           | +               | 2.5                 |
|           |           | H. rubripes (Duftschmid, 1812)                                          | +           | –               | 0.7                 |
|           |           | Stereophanes abdominalis Gené, 1836                                    | +           | +               | 0.3                 |
| Lebini    |           | Lebia cyanoccephala Linnaeus, 1758                                      | +           | –               | 1.5                 |
|           |           | Cymindis arenella Menétriers, 1832                                      | +           | –               | 0.2                 |
| Platynini |           | Agonum viridicupreum (Goeze, 1777)                                     | +           | +               | 0.3                 |
|           |           | Anchomenus dorsalis (Pontoppidan, 1763)                                | +           | +               | 5.3                 |
| Pterostichini | Pterostichus | Pterostichus nigro (Schaller, 1873)                                   | +           | –               | 0.8                 |
|           |           | P. coccyx Solsky,1758                                                  | +           | +               | 2.8                 |
|           |           | P. laticornis Chaudoir,1876                                             | +           | +               | 2.8                 |
|           |           | P. longivertex Solsky, 1874                                             | +           | –               | 1.3                 |
|           |           | P. sp.                                                                  | +           | –               | 0.2                 |
| Sphodrini |           | Callathus ambigus (Paykull, 1790)                                       | +           | +               | 2.9                 |
|           |           | C. pollius Kolenati, 1845                                               | +           | –               | 0.2                 |
|           |           | C. melanopogon (Linnaeus, 1758)                                         | +           | +               | 0.5                 |
|           |           | Dolichus halensis (Schaller, 1873)                                      | –           | +               | 1.8                 |
|           |           | Taphrotes gelidus (Feldermann, 1836)                                    | +           | –               | 0.2                 |
| Zabini    |           | Anama similis (Gyllenhal,1810)                                          | –           | +               | 0.3                 |
|           |           | A. aenea (De Geer,1774)                                                | +           | +               | 11.0                |
|           |           | Zabrus morio Menétriers, 1832                                           | +           | –               | 9.7                 |

In the carabid complex of the studied mountains from small ground beetles of the subfamily Trechinae, there are five species from two tribes and three genera. The Trechini tribe is represented only by Trechus quadrilaterus, and the Bembidini tribe includes 4 species (the Asphalidion genus – one species, the Bembidion genus – three species). Although in anthropogenic landscapes these species are widespread and numerous, in the studied mountains their number is low. In general, representatives of the subfamily Trechinae account for 4.4% of all individuals of ground beetles. Four species of beetles from the subfamily Scartinae belonging to the genera Scarites (three species) and Clivina (one species) have been identified. The subfamily Carabinae is represented by three species of two genera (genus Carabus – one species, genus Calosoma – two species). The Brosciinae subfamily is represented by two species from the genus Broscius. The most abundant is Broscius asiaticus.

The subfamilies Brachininae, Cicindelinae, and Nebriinae are the only species in the complex of ground beetles in the studied territories.

Anama aenea, Eoccateros cholinchosits, and Zabrus morio are the dominant species in the Chakilikalyan and Karatep Mountains, while...
Actinopus laevigatus, Calathus ambigua, Broscus asiaticus, Anochomenus dorsalis and Chlaenius extensus are subdominant species.

Among the few species, several species can be distinguished, which, in terms of the degree of dominance, are close to subdominant species. These are Dixus eremita and Harpalus rufipes. 27 species of ground beetles, the dominance of which is less than 1%, together account for 11.5% of the total carabid fauna. The only rare specimens in our collections are Anisodactylus binotatus, Cymindis andreae, Taphrophus goliah, Calosoma sycophanta, Scartites subcylindricus (Ettiiuyl-say Gorge) and Chilostomus sogenensis (Yul-say Gorge) from the Karatepa Mountains, Calathus peltatus (Kumbel-say gorge), Broscus punctatus (Kamangaron-say) from the Chaklikalyan Mountains.

**Diversity in the Karatepa Mountains.** As studies show, the fauna of ground beetles of the Karatepa Mountains includes 34 species belonging to 6 subfamilies and 23 genera (Table 2). The highest diversity was recorded in the Ettiuyl-say gorge, which is the middle part of the mountain (27 species), and the lowest diversity was observed in the upper part of the mountain, Takhitkorach (8 species).

Among the identified species only Eocarurus chodhenticus, Poecilus lividicupreus, and Cicindela turkestanica were noted in all study sites. The dominant species of ground beetles of the Karatepa Mountains are Zabrus morio (14.8%), Eocarurus chodhenticus (13.6%), Amara aenea (13.1%), and Actinopus laevigatus (9.8%) and the degree of their dominance is quite high. Although Zabrus morio is the most abundant species, this species was not recorded in the highest (1550 m a. s. l.) site of Takhitkorach, and its abundance increases with decreasing altitude. The same tendency is observed in relation to Amara aenea, as this species is noted and quite numerous in the Ettiuyl-say and Agalik-say areas. As for Eocarurus chodhenticus, on the contrary, its population grows with increasing altitude. Although this species is common in all study sites, it is the most numerous at the Takhitkorach site. The Takhitkorach site has one specific species, Agonum viridicupreum, which has not been recorded in other sites.

**Table 2**

| Species                | Montane habitat types | Total | Share of species, % |
|------------------------|-----------------------|-------|---------------------|
|                        | Taxtaapnacha (1550 m a. s. l.) | Yul-say (1221 m a. l.) | Ettiuyl-say (1059 m a. l.) | Agalik-say (1070 m a. l.) |
| Actinopus laevigatus   | 2 | 8 | 31 | 8 | 9.8 |
| Agonum lividicupreus   | 2 | 2 | 43 | 9 | 52 | 13.1 |
| Anochomenus dorsalis   | 5 | 5 | 3 | 4 | 2.0 |
| Anisodactylus binotatus| 1 | 1 | 1 | 1 | 0.2 |
| Bembidion haridcorne   | 2 | 2 | 1 | 0.2 |
| Brachinus explodens    | 28 | 28 | 28 | 28 | 7.0 |
| Calathus ambigua       | 23 | 7 | 30 | 30 | 7.5 |
| C. melanocephalus      | 1 | 1 | 1 | 1 | 0.2 |
| Calosoma sycophanta    | 1 | 1 | 1 | 1 | 0.2 |
| Carabus fedtschenkoii  | 9 | 9 | 9 | 9 | 1.3 |
| Chilostomus genitensis | 1 | 1 | 1 | 1 | 0.2 |
| Chlaenus festivus      | 1 | 1 | 1 | 1 | 0.2 |
| Ch. flavicornis        | 1 | 1 | 1 | 1 | 0.2 |
| Ch. extensus           | 1 | 1 | 1 | 1 | 0.2 |
| Cicindela turkestanica| 3 | 2 | 2 | 2 | 10 | 2.5 |
| Chilus collaris        | 2 | 2 | 2 | 2 | 0.5 |
| Cymindus andreae       | 1 | 1 | 1 | 1 | 0.2 |
| Dixus eremita          | 11 | 11 | 11 | 11 | 3.3 |
| D. semiclyndricus      | 1 | 1 | 1 | 1 | 0.7 |
| Eocarurus chodhenticus | 37 | 37 | 37 | 37 | 13.6 |
| Harpalus distinguevae  | 1 | 1 | 1 | 1 | 0.3 |
| Lebia cyanoccephala    | 9 | 9 | 9 | 9 | 2.3 |
| Poecilus cupreus       | 1 | 1 | 1 | 1 | 0.5 |
| P. lividicupreus       | 2 | 2 | 2 | 2 | 0.5 |
| P. longiventris        | 11 | 11 | 11 | 11 | 4.3 |
| P. sp.                 | 6 | 6 | 6 | 6 | 2.0 |
| Scarites basiplicatus  | 3 | 3 | 3 | 3 | 1.0 |
| S. tentaculosa         | 1 | 1 | 1 | 1 | 0.3 |
| S. subcylindricus      | 1 | 1 | 1 | 1 | 0.3 |
| Stenolophus abdominalis persicus | 1 | 1 | 1 | 1 | 0.3 |
| Taphrophus goliah      | 1 | 1 | 1 | 1 | 0.3 |
| Trechus quadriradiatus | 8 | 8 | 8 | 8 | 2.1 |
| Zabrus morio           | 51 | 51 | 51 | 51 | 14.8 |

Number of individuals: 50 | 52 | 215 | 81 | 398 | 100.0 |
Number of species: 8 | 11 | 27 | 14 | 34 | – |
Species richness, Di: 1.79 | 2.53 | 4.84 | 2.96 | 5.53 | – |
Diversity indicator Shannon, H: 1.05 | 2.08 | 2.39 | 2.16 | 2.79 | – |
Berger – Parker dominance index, d: 0.74 | 0.21 | 0.24 | 0.35 | 0.15 | – |

Chilostomus usgnetemors is a specific species in Yuł-say (1221 m a. l.) territory, and it couldn’t be found in other researched areas. The rather large-sized species Carabus fedtschenkoii is quite abundant in this area, but in other areas this species is scarce and not recorded in the highest area (Takhitkorach). The greatest species diversity of the carabid fauna was noted in the area with a predominance of forest biotopes – Ettiuyl-say. Here, along with the aforementioned dominant species (except for Eocarurus chodhenticus), Dixus eremita, Calathus ambigua, and Lebia cyanoccephala are abundant. The fauna of ground beetles in the northern part of the Karatepa Mountains, the Agalik-say section, is peculiar. The most abundant species in this site is Brachinus explodens, which makes up 34.6% of all collected ground beetles. However, this species was not observed in other areas (Table 1). In addition, no species of the genus Dixus (D. eremita, D. semicylinydricus) were found in this area, and Chlaenius extensus is among the dominant species. Another species of this genus, Ch. festivus, was also noted, which was not found in other areas. ...Comparative analysis of the species composition of ground beetles in the studied areas shows a rather low level of similarity (Table 3). Thus, the Jaccard-Chelkanovsky-Sorensen indices varied from 0.21/0.06 to 0.39/0.17 (with an average value of only 0.27/0.11). The greatest similarity is observed between the Yul-say and Agalik-say sections (0.39/0.17), and the least similarity is between Ettiuyl-say and Takhitkorach (0.21/0.06).
Diversity in the Chakhalkalyan Mountains. 34 species of ground beetles belonging to 7 subfamilies and 21 genera were identified in the Chakhalkalyan Mountains (Table 4). The smallest diversity was noted at the highest Sariduqon site (6 species), where the bulk of the material is

Table 4
Diversity and abundance of Carabidae in five mountain areas on Mt. Chakhalkalyan

| Species                | Yalpoqtepa (agrocenoses) (900 m a.s.l.) | Qumbel-say (1400 m a.s.l.) | Karanga river-say (1300 m a.s.l.) | Sariduqon (2350 m a.s.l.) | Hazrat Bashir (1225 m a.s.l.) | Total | Share of species, % |
|------------------------|----------------------------------------|-----------------------------|-----------------------------------|---------------------------|--------------------------------|-------|----------------------|
| Arctopus laevigatus    | 1                                      | 3                           | 1                                 | 1                         | 2                              | 8     | 3.8                  |
| Amara similata         | –                                      | 2                           | –                                 | –                         | 2                              | 10    | 0.5                  |
| A. aeneus              | 3                                      | 10                          | –                                 | –                         | 2                              | 15    | 7.2                  |
| Anchomenus dorsalis    | 3                                      | 16                          | 1                                 | 1                         | 3                              | 24    | 11.5                 |
| Asaphidion flavicorne  | 3                                      | –                           | –                                 | –                         | 3                              | 1.4   |                      |
| Bembidion hardicorne   | 5                                      | –                           | –                                 | –                         | 5                              | 2.4   |                      |
| B. picocoxanum         | –                                      | 2                           | –                                 | –                         | 2                              | 1.0   |                      |
| B. scutellum flavipes  | –                                      | 3                           | –                                 | –                         | 3                              | 1.4   |                      |
| Brachinus exploders    | 1                                      | –                           | –                                 | –                         | 4                              | 1.9   |                      |
| Broscurus asiaticus    | 7                                      | –                           | 1                                 | –                         | 8                              | 3.8   |                      |
| B. punctatus           | –                                      | –                           | 1                                 | –                         | 1                              | 0.5   |                      |
| Calathus ambiguus      | 1                                      | 3                           | 2                                 | –                         | 6                              | 2.8   |                      |
| C. pelitus             | –                                      | 1                           | –                                 | –                         | 1                              | 0.5   |                      |
| C. melanocephalus      | –                                      | 1                           | 1                                 | –                         | 2                              | 1.0   |                      |
| Calosoma auroptunctatum destagricum | 5 | – | – | – | 4 | 1.9 |
| Carenchosyn hesianus   | 4                                      | –                           | –                                 | –                         | 1                              | 0.5   |                      |
| Chilaeus festivus      | –                                      | –                           | –                                 | –                         | 1                              | 20    | 9.6                  |
| C. flavicornis         | 2                                      | –                           | –                                 | –                         | 2                              | 1.0   |                      |
| C. estrensis           | –                                      | 17                          | 1                                 | 2                         | 20                             | 9.6   |                      |
| Dixus erevita          | –                                      | –                           | 1                                 | 7                         | 8                              | 3.8   |                      |
| Dolichus halensis      | 1                                      | 9                           | –                                 | –                         | 1                              | 5.3   |                      |
| Eocarterus chodshenticus | –                                | –                           | 7                                 | –                         | 7                              | 3.3   |                      |
| Harpalus distinguendus  | 12                                     | 1                           | 1                                 | –                         | 14                             | 6.7   |                      |
| H. griseus             | 2                                      | –                           | –                                 | –                         | 2                              | 1.0   |                      |
| H. rubripes            | –                                      | 4                           | –                                 | –                         | 4                              | 1.9   |                      |
| H. rufipes             | 11                                     | 5                           | 1                                 | 2                         | 20                             | 9.6   |                      |
| Nebria psammophila     | –                                      | 4                           | –                                 | –                         | 4                              | 1.9   |                      |
| Pocelis capratus       | 3                                      | –                           | –                                 | –                         | 3                              | 1.4   |                      |
| P. liosomus            | 6                                      | 1                           | –                                 | –                         | 7                              | 3.3   |                      |
| Pterostichus niger     | 1                                      | –                           | –                                 | –                         | 1                              | 0.5   |                      |
| Scartites basiliscatus | –                                      | –                           | 2                                 | –                         | 2                              | 1.0   |                      |
| S. terricola           | –                                      | –                           | –                                 | 5                         | 5                              | 2.4   |                      |
| Stereolophus abdominalis persicus | – | – | – | 1 | 2 | 0.9 |
| Trechus quadritubata   | –                                      | –                           | 2                                 | 1                         | 3                              | 1.4   |                      |

On the Qumbel-say site, the most numerous are Chilaeus festivus, Anchomenus dorsalis, and Amara aeneus. The only research point, located on the southern slope of Chakhalkalyan, Hazrat Bashir is characterized by the same species that are common on the northern slope. However, there are some species that have been recorded only in this area (Chilaeus festivus and Scartites terricola). Dixus erevita and Scartites terricola are relatively abundant in this zone.

In general, only Anchomenus dorsalis and Harpalus rufipes were recorded in all sites studied. In the complex of ground beetles of the Chakhalkalyan Mountains, the dominant species are Anchomenus dorsalis (11.5%), Harpalus rufipes (9.6%) and Chilaeus festivus (9.6%) (Table 4).

Although the number of individuals collected from the Chakhalkalyan Mountains is not very large, we tried to analyze the coefficients of similarity between different study points (Table 5). The value of the Jaccard index varied 0.10–0.38, which means the minimum similarity of the studied territories. Moreover, the Chekanovsky-Sørensen index varied 0.12–0.50. However, the Sariduqon and Hazrat Bashir sites are the most similar (Jaccard coefficient 0.38).

In general, the species diversity of the ground beetle fauna of the Chakhalkalyan and Karatepa mountains is very close. In our collections, the number of species identified in each territory is the same (34 species each), of which 19 species are characteristic of both territories. However, a comparison of different indices of species richness shows that the species richness of the biocenoses of the Chakhalkalyan Mountains is slightly higher in comparison with the biocenoses of the Karatepa Mountains (Table 6). However, the measures of dominance, that is, the proportion of dominant species, is higher in the community of the Karatepa Mountains, which means a low levelling and diversity. Furthermore, the similarity of the

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The similarity of the Carabidae species composition of the five areas on Mt. Chakilkalyan (Jaccard/Chekanovsky-Sørensen indices)

| Sites                  | Chakilkalyan Mountains | Karatepa Mountains |
|------------------------|------------------------|--------------------|
| Margalef Index         | 6.18                   | 5.51               |
| Shannon Index          | 3.15                   | 2.79               |
| Menhinick Index        | 2.35                   | 1.70               |
| Shannon Alignment      | 0.89                   | 0.79               |
| Simpson Index          | 0.052                  | 0.083              |
| Berger Parker Index    | 0.115                  | 0.148              |
| Jaccard coefficient    | 0.112                  | 0.39               |

Discussion

Our primary data on the fauna of ground beetles of the Karatepa and Chakilkalyan mountains of the Zarafshan Range did not show a very high biodiversity. The fauna of ground beetles in the eastern part of the Zarafshan Range has a fairly high diversity (204 species), while the neighbouring Turkestani and Alai ranges located in Tajikistan include 145 species, the Eastern Pamirs – 47 species (Mikhaylov, 1998). In general, the data obtained on the fauna of ground beetles in different mountain ranges of Asia are ambiguous. So, according to the data of Dudko et al. (2010), the ridges located in the Altai (Russia) differ significantly in the diversity of ground beetles (the Shapshal Ridge includes 23 species, the Chigachev Ridge 32 species, the Saryshyrgan Ridge 46 species, the South Chuya Ridge 48 species, the Southern Altai Ridge 24 species). In the Chinese Changhui Mountains, which coincide in altitude range with our mountains, but is a forest ecosystem, the diversity of the ground beetle fauna was 47 species (Zou et al., 2014), and in the Beijing Mountains, 23 species (Warren-Thomas et al., 2014).

The diversity of the ground beetle fauna largely depends on the vegetation cover and the location of the area above sea level. Thus, in mixed mountain forests, the ground beetle fauna is richer than that of pine or oak forests (Finch, 2005; Warren-Thomas et al., 2014). The species richness of the carabid complex decreased with increasing altitude (Hanski & Hammond 1986; Maveety et al., 2011; Dudko et al., 2010). Besides, agroecosystems located in mountainous regions are richer in species composition of ground beetles than natural censuses. Our results also confirm this. However, the dominance measures disagree with some volatile data (Warren-Thomas et al., 2014), where the share of the most abundant species in different mountain biotopes ranged 42–64%.

Ground beetles are highly sensitive to environmental changes, showing strong habitat specificity and low rates of distribution between sites (Work et al., 2008; Koivula, 2011). Apparently, this can also be the reason for the low coefficients of similarity of the ground beetle fauna in different parts of the mountain territories in our studies. In our studies, the main part of the ground beetle fauna of the studied mountains was represented by species of the subfamily Harpalinae. In addition to adapting to the soil environment, Harpalinae also have morphological adaptations to life on plants (Ober, 2003). In addition, they are also adapted to feed on seeds, mainly the seeds of herbaceous plants (Homok et al., 2003). Thus, this ability can lead to the presence of a large number of Harpalinae species in the ability of the mountains (Qodri et al., 2016).

Conclusion

In the course of our initial research in the Chakilkalyan and Karatepa mountains of the Zarafshan Ridge, 49 species of ground beetles were recorded belonging to 31 genera, 16 tribes and 8 subfamilies. The most representative was the subfamily Harpalinae (32 species from 20 genera (65.5%)). The Trechinae subfamily included five species from three genera (10.2%), the Scirtinae subfamily – four species from two genera (8.2%), the Carabinae subfamily – three species from two genera (6.1%), the Brotroinae subfamily – two species from the same genus (4.1%).

The subfamilies Brachichirinae, Cicindelinae and Nebriinae are represented by one species (2.0% each).

In the Karatepa Mountains, 34 species from 23 genera have been identified, and in the Chakilkalyan Mountains, 34 species from 21 genera. These two mountains have 19 common types and 15 unique ones. In the Karatepa Mountains, the dominant species are *Zabrus morio*, *Eocarters chadshenticus*, *Amara aenea*, and *Acinopus laevigatus*, and the subdominant ones are *Brachimus explodens*, *Calathus ambigua*, and *Poechus longiventris*. In the Chakilkalyan Mountains, *Anchomenus dorsalis*, *Harpalus rufipes*, and *Chlaenius extensus* are dominant, while *Amara aenea*, *Harpalus distinguendus*, *Dolichus halesius* turned out to be subdominant. However, at different sites, the dominant species vary. The variation in dominant and subdominant species in different parts of the mountains is explained both by differences in food resources and by microclimatic conditions corresponding to the ecological characteristics of a particular taxon.

Different areas and mountains differ significantly in the diversity of ground beetle fauna. In both mountains, the lowest diversity was noted at the highest altitudes (Sariduqon and Takhakonakha). The similarity of the fauna of different parts of both mountains, on average, was low. Thus, in four areas of the Karatepa Mountains, the average value of the Jaccard and Chekanovsky-Sørensen indices was 0.27 and 0.11, and in five areas of the Chakilkalyan Mountains – 0.24 and 0.25. And the similarity of the mountains is explained both by differences in food resources and by microclimatic conditions corresponding to the ecological characteristics of a particular taxon.

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