BIODIVERSITAS
Volume 25, Number 8, August 2024
Pages: 2619-2628

ISSN: 1412-033X
E-ISSN: 2085-4722
DOI: 10.13057/biodiv/d250834

The spread and fauna of orthopterans (Insecta: Orthoptera) in Namangan Region, Uzbekistan

A.A. NURJANOV[1], M.J. MEDETOV[2], M.Q. BEGJANOV[3], B.R. KHOLMATOV[2], S.A. KHALILLAYEV[4], F.A. GAPPAROV[5], F.A. NURJONOV[5,♥], N.K. TUFLIYEV[5], M.Y. RADJAFOV[4]

[1]Urganch State University. Kh.Alimdjan str 14, 220100, Urganch, Xorazm Viloyati, Uzbekistan
[2]Institute of Zoology Academy of Sciences of Uzbekistan. 100053, 232b, Bagishamol Street, Yunusabad District, Tashken City, Uzbekistan
[3]Karakalpak State University. Nukus, Qoraqalpog'iston Respublikasi, Uzbekistan
[4]National University of Uzbekistan. Guliston, Universitet street 4, 100174, Tashkent, Uzbekistan
[5]Scientific Research Institute of Plant Quarantine and Protection. Kibray, Tashkent, Uzbekistan. ♥email: nfozilbeka@gmail.com

Manuscript received: 30 March 2024. Revision accepted: 16 August 2024.

Abstract. *Nurjanov AA, Medetov MJ, Begjanov MQ, Kholmatov BR, Khalillayev SA,* Gapparov *FA, Nurjonov FA, Tufliyev NK, Radjafov MY. 2024. The spread and fauna of orthopterans (Insecta: Orthoptera) in Namangan Region, Uzbekistan. Biodiversitas 25: 2619-2628.* The Namangan Region, which makes up one-third of the Fergana Valley, is separated from other regions of Uzbekistan by the Kurama and Chatkal mountain ranges. Because of this, the region's fauna differs from the central, northern, and southern areas. During the research (2018-2023), data on the biological diversity, features of inter-landscape distribution, density, and number of orthopterans identified from natural and agrolandscapes of Namangan Region has been analyzed. Samples were collected from 48 coordinates. The results recorded 65 species and subspecies belonging to 8 families, 12 subfamilies, and 46 genera. Furthermore, 38 species (59.4%) of orthopterans found in the territories of Namangan Region are distributed in different agro landscapes, 29 species (45.3%) in hills, and 44 species (68.7%) in mountains. Based on a comparison of species diversity between landscapes using the Jaccard method, it was discovered that there was a 70% difference between species of agrolandscapes (wheat and cotton field) and mountain, a 65% difference between species of mountain and hills, and a 64% difference between species of hills and agrocenosis. In the analysis of species distribution based on density, the following species ranges were found to exist: 8 species are classified as extremely rare, 38 species are classified as constantly distributed, 16 species are classified as common, and 3 species are classified as swarming species. Based on the information obtained from the experiments, it is recommended to add the extremely rare species to the list of unique species and to carry out the control measures against swarming species.

Keywords: Agrolandscape, Ferghana Valley, grasshoppers, insects, rare species, species composition

INTRODUCTION

Orthopterans are widespread in almost all climatic regions, from tropical and subtropical regions to the vastness of Western Siberia. Some species prefer to live near water bodies in mountainous areas with dense grass. Other species have always attracted researchers as components of rare shrubs and herbs in desert and semi-desert regions (Sergeev 2021).

There are more than 22,500 species of Orthopteran insects on our planet (Chapman et al. 2013), including about 520 species and subspecies found in Central Asian countries and the territories of the Republic of Uzbekistan, the number of which exceeds 162 (Nurjanov 2020). Among the Central Asian countries, Uzbekistan has always attracted the attention of researchers with its enormous richness of entomofauna and biological diversity.

Information on the fauna, species taxonomy, and ecology of Orthopterans in the Commonwealth of Independent States (CIS) were described in the works of Fedchenko (Hollier and Heads 2015), Saussure, Jakobson, Uvarov, Mistshenko, Bey-Biyenko, Pravdin, Sergeev (Nurjanov 2020), Childebaev and Storozhenko (2004), Shcherbakov and Savitsky (2015), Temreshev and Esenbekova (2017), Tan and Wahab (2018), Popova et al. (2020), Sergeev (2021), Çiplak (2021), Latchininsky (Latchininsky et al. 2002, Latchininsky 2020, Latchininsky et al. 2023). It is necessary to mention that similar research was carried out in Dompu, Sumbawa Island (Indonesia). According to Leksono et al. (2022), 2,264 samples belonging to 26 species and four families were collected, and species similarity between farmland and adjacent savannahs was analyzed. During the research, it has analyzed abundance, species richness, diversity and similarity of species between research sites. At the result of the research, it has been identified that species composition of grasshoppers on agricultural landscapes are very similar to the adjacent savannas

The scientific research conducted in Uzbekistan on orthopteroids mainly concentrated on particular geographic regions, resulting in insufficient generalization and, therefore, insufficient provision of a comprehensive enough description of Uzbekistan insect fauna. Bekuzin (1961) discovered 80 species of Orthopteroids after studying the fauna of natural and agricultural environments in the Fergana Valley and the Syrdarya River Basin. In this work, information has been given on the distribution and life forms of seven species belonging to two families of the

order Manteoptera, two species belonging to two families of the order Dermaptera, 71 species and subspecies belonging to eight families of the order Orthoptera. As a result of Ergashev's research on the cricket fauna of Uzbekistan, 23 species were identified. Of these, two species (*Gryllomorpha miramae* and *Botropylax semenovi*) are identified as a new species for the fauna of Uzbekistan, and information about their distribution and bioecology is provided (Begjanov 2020).

The most important research has been carried out mainly in areas newly developed and adapted for the cultivation of agricultural crops. For example, 10 different landscapes were obtained on scientific trips during the studies of the insects of the Kashkadarya Region. This research discusses the distribution of 84 species belonging to 50 genera and 7 families of Orthopteran insects (Nurjanov et al. 2023). Moreover, 51 species of Orthoptera, comprising 6 species of grasshoppers, 5 species of crickets, 2 species of mole crickets and tetrigids, and 38 species of true locusts belonging to 19 genera, have been collected into a guide by R.A. Olimzhanov for Uzbekistan (Begjanov 2020).

In recent years, more attention has been paid to studying Orthopterans in Uzbekistan. In particular, Medetov (2012; 2018) studied the formation of the fauna of Orthoptera of the southern Aral Sea Region (2012) and the arid zones of Uzbekistan (2018). According to the research results, 75 species and subspecies belonging to 50 genera and 7 families of orthopterans have been identified in the southern Aral Sea Region. According to the arid regions of Uzbekistan, it has identified 129 species belonging to 71 genera and 7 families and 11 sub-families of orthopterans (Medetov 2018).

Kholmatov (2019) researched orthopteroid insects (Insecta, Orthopteroidea) of Southern Uzbekistan. According to the other research results, the modern status of the insect fauna of South Uzbekistan was analyzed, and 121 species and subspecies belonging to 7 orders, 18 families, 25 subfamilies, and 78 genera were identified (Kholmatov 2019).

Those researchers devoted to the study of Orthopterans in Uzbekistan are mainly focused on studying the fauna of the northern and southern regions of Uzbekistan. The available data on the research conducted in the eastern regions do not fully reflect the current status of the insect. Therefore, it is of great theoretical and practical importance to research the modern status of the fauna and ecology of grasshoppers in the eastern part of Uzbekistan. Importance of researching orthopteran fauna of the eastern part of Uzbekistan is connected with Ferghana Valley. This region is separated with mountains from other bordering territories. Moreover, natural and climatic conditions of the valley significantly differ from western zones of Uzbekistan. Accordingly, species composition of Orthopterans and its density also differs in this region. Research results are important when conducting control measures against swarming species of grasshoppers and for protecting the extremely rare species.

MATERIALS AND METHODS

The research was conducted between 2018 and 2023 in the Namangan Region (Figure 1). Namangan Region is located in the east of the republic of Uzbekistan, in the northwestern part of the Fergana Valley, on the slopes of the Kurama and Chatkal Mountains, branches of the Tianshan Mountain range. It borders Jalalabad Region of the Kyrgyz Republic to the north and northeast, Andijan to the southeast, Fergana to the south, Tashkent Region to the north and northwest, and Sughd Region of Tajikistan. The area is 7,440 km^2.

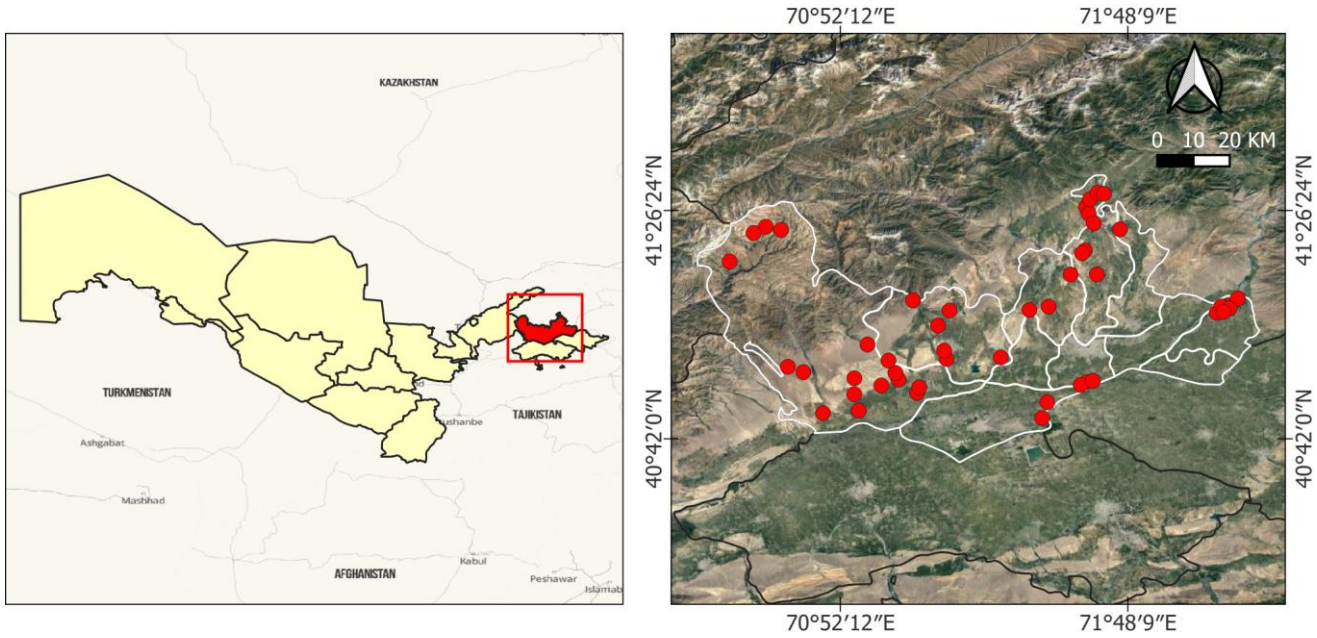

Figure 1. Map of the coordinates of the collection sites of orthopterans in Namangan Region, Uzbekistan

Figure 2. Landscapes of Namangan Region, Uzbekistan (photo by M.J. Medetov)

More than half of the region's territory comprises mountain and sub-mountain areas. The hills occupy a much larger area than the neighboring regions. In this respect, the land fund of Namangan Region is even bigger. However, its extreme northwestern consists of high mountains up to 4,000 masl (meters above sea level). From the orographic point of view, the Chatkal, Kurama, and Fergana ranges in the western and northern parts of the region belong to the Western Tianshan mountain range; the main part of them is in the Pop District. The topography of this district is quite complex, and the height amplitude is 3,640 m asl from the southernmost 365-367 m asl to 4,008 m asl points. The climate is strongly continental throughout the region. The average temperature in January is +4°C, in July it is +35°C. The amount of precipitation in the plains ranges from 135 mm to 370 mm per year and from 460 mm to 640 mm in the mountainous regions.

Therefore, to study the patterns of distribution and formation of Orthopterans in the landscapes, materials were obtained from the eight sections of the agro landscape (cotton, grain, rice stalks, alfalfa, corn, legumes, field, and garden) and four sections from the surroundings of water bodies and hills (high, medium-altitude, low hills and depressions between hills and river valleys), also from mountainous areas were analyzed. During the years 2018-2023, from the first half of March to the end of October, samples were collected from the districts of the Namangan Region (Kosonsoy, Mingbulok, Namangan, Norin, Pop, Torakorgon, Uychi, Uchkorgon, Chortoq, Chust, Yangikurgan). In total, 1,849 square kilometers were investigated. The total length of the route is about 616.3 km (Figure 1).

Samples were collected according to the method of Bey-Bienko (1954). The number of species per square meter of land was counted. Sweep nets were used to collect samples. During the survey, the distribution of species and their density were counted per hour and indicated by conventional signs: if 1-3 insects were collected per hour, their number was marked as "rare species - rs"; when 4-10 insects were collected per hour – "few species – fs"; 11-20 insects per hour – "permanent species – ps"; 20-100 insects per hour – "abundant, but non-swarming species – abs"; more than 100 insects per hour – "swarming species – sw" (Bey-Bienko 1954). The collected specimens were pinned onto display boards and labeled with information about the collection site, coordinates, duration, and habitat. Collections were conducted in the morning, midday, and around sunset times a day. Experiments were repeated each year during the same season. The taxonomic status of grasshoppers was conducted according to Latchininsky (2002) and crickets and bush crickets by Sergeev et al. (2022). In addition, several identifiers were used to identify species (Bey-Bienko 1954). Collections were prepared from the specimens of identified species.

When collecting materials, the coordinates of the places were determined using Google Earth and QGIS (Figure 1). Furthermore, to compare orthopterans across regions, the degree of similarity of species in the fauna was determined using the Jaccard similarity coefficient and cluster analysis was performed (Chao et al. 2005).

$$K_j = \frac{c}{a+b-c}$$

Where: K_j: similarity coefficient of Jaccard; c: the number of similar species; a and b: the total number of species in the compared faunas;

RESULTS AND DISCUSSION

Analysis of the obtained results showed that 36% of the orthopterans collected in Namangan Region during 2018-2023 were imago and 64% nymphs. These insects were collected from natural and agro landscapes, and the areas where they spread were divided into 3 landscapes. According to observations of 2018, in the third decade of April, 65.7% of orthopterans in the wheat field of Pop District, Namangan Region were Nymphs (Table 1).

There are five species such as *Tettigonia caudata* (Nymphs), *Acrotylus insubricus* (Nymphs, imago), *Calliptamus turanicus* (Nymphs), *Tetrix subulata* (Nymphs, imago), and *Pyrgomorpha bispinosa deserti* (Nymphs, imago) are considered dominant. At the beginning of May month, a slight increase in the number of insects was observed (124 samples per hour), but the dominant species maintained their position, that is, their number was as follows: *P. b. deserti* 26 samples per hour, *A. insubricus* 21 samples per hour, *T. subulata* 14 samples per hour, *T. caudata* 13 samples per hour. The number of Nymphs has decreased by 14%.

Orthoptera fauna in cotton agrocenoses comprises 16 species; 42% of the total 16 species of 199 samples collected from the cotton fields of Turum Saray Village, Pop District, Namangan Region (07.09.2021) were species of the genus *Calliptamus*. By the first decade of July, Nymphs and imagos of grasshoppers *Sphingoderus carinatus*, *P. b. deserti*, *Duroniella kalmyka*, *Calliptamus italicus italicus*, *Calliptamus barbarus cephalote* dominated, and it was observed that the imago of Asian migratory locust - *Locusta migratoria migratoria* appeared. It should be noted that Asian migratory locust has swarming behavior, and they are considered dangerous pests of crops (Table 2).

In the first half of August, it was observed that the number of Orthopteran insects in the cotton fields increased slightly, and their species composition increased (Table 3).

In this period, the Nymphs of the species *Tropidopola turanica turanica*, *Truxalis eximia*, *Aiolopus thalassinus thalassinus*, *Duroniella gracilis*, *D. kalmyka,* and the imagos of the species *Oecanthus turanicus*, *Melanogryllus desertus*, *S. carinatus*, *C. i. italicus*, *C. b. cephalotes*, *Heteracris adspersa* dominated.

Nymphs of these species are known to be found in agrocenoses at the end of summer and the beginning of autumn. This indicates that they are a spring species and the emergence of new wintering nymphs. Later, after entering the preimaginal phase, they go into the hibernation phase. Also, at this time, it was observed that species of locusts that multiply in agrocenoses are widespread.

Among the permanent species found in the Cucurbitaceae crops, the following species are closely related to the cotton agro landscape: *P. b. deserti*, *C. i. italicus*, *C. b. cephalotes*, *H. adspersa*, *A. t. thalassinus*, *Aiolopus oxianus*, *L. m. migratoria*. Therefore, the area of cotton planted in this area in previous years may have been the most important and main source of food in their ecosystem.

Table 1. Quantity and species composition of the Orthopterans in the wheat field (Pop District, Namangan Region, Uzbekistan, 23 April 2018, samples per hour, coordinates: 40°52°17.85 N, 71°0°15.67 E)

Species	Imagoes		Nymphs	All	Percentage (%)
	♀	♂			
Tettigonia caudata (Charpentier, 1845)	-	-	12	12	11.4
Bothriophylax semenovi (Miram, 1930)	1	3	-	4	3.5
Gryllotalpa gryllus (Linnaeus, 1758)	5	-	3	8	7.6
Acrotylus insubricus (Scopoli, 1786)	5	7	11	23	21.9
Pyrgomorpha bispinosa deserti (Bey-Bienko, 1951)	6	2	17	25	23.8
Calliptamus turanicus (Tarbinsky, 1930)	-	-	18	18	17.1
Tetrix subulata (Linnaeus, 1758)	2	3	7	12	11.4
T. tartara tartara (Saussure, 1887)	3	1	1	5	4.7
Total	22	16	69	107	100

Table 2. Quantity and species composition of orthopteran insects in the cotton field (Turum Saroy Village, Pop District, Namangan Region, Uzbekistan, 7 September 2021, samples per hour, coordinates: 40°52°17.85 N, 71°0°15.67 E)

Species	Imagoes		Nymphs	All	Percentage (%)
	♀	♂			
Tettigonia viridissima (Linnaeus, 1758)	3	-	-	3	1.5
Platycleis intermedia (Serville, 1838)	9	3	-	12	6
Melanogryllus desertus (Pallas, 1771)	6	6	-	12	6
Eumodicogryllus bordigalensis (Latreille, 1804)	3	-	-	3	1.5
Gryllotalpa unispina (Saussure, 1874)	-	3	6	9	4.5
Bothriophylax semenovi (Miram, 1930)	3	-	-	3	1.5
Sphingoderus carinatus (Saussure, 1888)	6	9	-	15	7.6
Ramburiella foveolata Tarbinsky, 1931	1	1	-	2	1
Acrotylus insubricus (Scopoli, 1786)	6	-	-	6	3
Pyrgomorpha bispinosa deserti (Bey-Bienko, 1951)	12	6	-	18	9.1
Acrida oxycephala (Sars, 1862)	-	-	9	9	4.5
Locusta migratoria migratoria (Linnaeus, 1758)	3	6	-	9	4.5
Duroniella kalmyka (Adelung, 1906)	9	6	-	15	7.6
Calliptamus italicus italicus (Linnaeus, 1758)	17	14	3	34	17.1
C. turanicus (Tarbinsky, 1930)	6	5	-	11	5.5
C. barbarus cephalotes (Fisch. von Wald., 1846)	19	17	2	38	19.1
Total	103	76	20	199	100

During the research, it was found that the reduction or change of the permanent food plant does not pose a serious threat to these insects. Due to their high density, *Calliptamus* species are also found in agro landscapes and occupy an important place in the food chain. In addition to agro-landscapes, materials were collected for landscapes along rivers, canals, ditches, and collectors. It was noted that the fauna of this area is very poor.

According to the results, 51 orthopteran specimens collected in one hour belong to 6 species. These species are hydrophilic. Namely, *Xya variegata*, which live around the typical river and feed on small invertebrates along the water, have been studied by a few scientists (Gapparov and Latchininsky (2000). It was found that during the monitoring, the were 20 nests found per square meter. Results of research on nests showed that pairs of insects lived in seven of ten nests. There were female members identified in three nests. The way of life characteristic of the species of insects living in a group requires the continuation of our research on the biology and ecology of these species. Moreover, 303 species of locusts were collected for one hour from the medium-altitude hill area located at the coordinates 40°54°56.83 N, 70°45°0.45 E of Pop District, Namangan Region (between two posts of Chodak) (Table 4).

When we divided the locusts collected from this coordinate into taxonomic species, it turned out that they belonged to 9 species. *Calliptamus*, *Dociostaurus*, and *Duroniella* species are dominant among identified species. Analyzing 177 samples collected on 29.05.2019 in the village of Ertash, Namangan Region, shows that 94 (50.2 %) were females, 65 (34.7 %) were males, and 18 (9.7 %) were nymphs. The collected samples were determined to belong to 9 species and 4 subspecies belonging to 11 genera (Table 5).

Table 3. Quantity and species composition of the orthopterans in the wheat field (Turum Saroy Village, Pop District, Namangan Region, Uzbekistan, 08 August 2021, samples per hour, coordinates: N 40°52°17.85, E 71°0°15.67)

Species	Imagoes		Nymphs	All	Percentage (%)
	♀	♂			
Platycleis intermedia (Serville, 1838)	9	6	-	15	4
Tettigonia viridissima (Linnaeus, 1758)	3	1	-	4	1.1
Oecanthus turanicus (Uvarov, 1912)	15	11	-	26	7
Melanogryllus desertus (Pallas, 1771)	14	8	4	26	7
Modicogryllus bordigalensis (Latreille, 1804)	7	5	7	19	5.1
Gryllotalpa unispina (Saussure, 1874)	2	-	-	2	0.5
Tetrix tartara tartara (Saussure, 1887)	5	2	-	7	2
Acrida oxycephala (Sars, 1862)	6	3	8	17	4.6
Truxalis eximia (Eichwald, 1830)	3	-	12	15	4
Aiolopus thalassinus thalassinus (Fabricius, 1781)	4	2	28	34	9.1
Duroniella kalmyka (Adelung, 1906)	4	3	16	23	6.2
D. gracilis (Uvarov, 1926)	7	1	13	21	5.6
Pyrgomorpha bispinosa deserti (Bey-Bienko, 1951)	3	3	4	10	2.7
Locusta migratoria migratoria (Linnaeus, 1758)	3	-	-	3	0.8
Sphingoderus carinatus (Saussure, 1888)	13	9	-	22	6
Calliptamus italicus italicus (Linnaeus, 1758)	19	14	-	33	8.9
Calliptamus barbarus cephalotes (Fisch. von Wald., 1846)	24	15	-	39	10.4
Heteracris adspersa (Redtenbacher, 1889)	14	12	-	26	7
Eyprepocnemis unicolor (Tarbinsky, 1928)	5	4	-	9	2.4
Tropidopola turanica turanica (Uvarov, 1926)	-	-	21	21	5.6
Total	160	99	113	372	100

Table 4. The quantity and species composition of orthopterans in the low hills of the region (Pop District, Namangan Region, Uzbekistan, 12 August 2022, samples per hour, coordinates: 40°54°56.83 N, 70°45°0.45 E)

Species	Imagoes		Nymphs	All	Percentage (%)
	♀	♂			
Pyrgomorpha bispinosa deserti (Bey-Bienko, 1951)	16	15	1	32	10.5
Duroniella gracilis (Uvarov, 1926)	13	11	-	24	7.9
Anacridium aegyptium (Linnaeus, 1758)	-	-	12	12	3.9
Calliptamus italicus italicus (Linnaeus, 1758)	37	25	-	62	20.4
C. turanicus (Tarbinsky, 1930)	14	11	-	25	8.2
C. barbarus cephalotes (Fisch. von Wald., 1846)	42	37	-	79	26
Oedipoda miniata miniata (Pallas, 1771)	10	12	-	22	7.2
Dociostaurus (S.) *kraussi kraussi* (Ingen., 1897)	2	-	-	2	0.6
D. (s.str.) *maroccanus* (Thunberg, 1815)	26	19	-	45	14.8
Total	160	130	13	303	100

Table 5. Species composition of orthopterans in the mountain (Namangan Region, Uzbekistan, Ertosh 29 May 2019, samples per hour, 2,700 m asl.)

Species	Imagoes		Nymphs	All	Percentage (%)
	♀	♂			
Tettigonia caudate (Charpentier, 1845)	1	-	7	8	4.5
Platycleis intermedia (Serville, 1838)	2	2	5	9	5.1
Glyphonothus alactaga (Miram, 1925)	1	-	-	1	0.6
Tessellana 2624ubercu (veyseli) (Charpentier, 1825)	3	1	-	4	2.3
Acrotylus insubricus insubricus (Scopoli, 1786)	12	8	2	22	12.4
Dociostaurus (s.str.) *maroccanus* (Thunberg, 1815)	23	17	-	40	22.6
Dociostaurus tartarus (Stshelkanovtzev, 1921)	6	5	-	11	6.2
Oecanthus turanicus (Uvarov, 1912)	3	1	-	4	2.3
Calliptamus coelesyriensis (Giglio-Tos, 1893)	1	-	-	1	0.6
Duroniella kalmyka (Adelung, 1906)	3	2	-	5	2.8
Pyrgomorpha bispinosa deserti (Bey-Bienko, 1951	14	9	4	27	15.3
Conophyma semenovi semenovi (Uvarov, 1914)	16	12	-	28	15.8
Conophyma sokolovi decorum (Mistshenko, 1951)	9	8	-	17	9.6
Total	94	65	18	177	100

Table 6. Quantitative indicators of taxa of orthopterans in Namangan Region, Uzbekistan

Family	Subfamily	Genera		Species	
		Number	Percent	Number	Percent
Tettigonidae	Tettigoniinae	7	15.2	9	13.8
	Conocephalinae	1	2.17	1	2.17
Gryllidae	Grylloinae	4	8.7	4	6.1
	Nemobiinae	1	2.17	1	2.17
	Myrmecophilinae	1	2.17	1	2.17
	Oecanthinae	1	2.17	1	2.17
Gryllotalpidae	-	1	2.17	1	2.17
Tridactylidae	Tridactylinae	1	2.17	1	2.17
Tetrigidae	Tetriginae	1	2.17	2	3.07
Pyrgomorphidae	-	1	2.17	1	2.17
Pamphagidae	Thrinchinae	2	4.3	3	4.6
Acrididaye	Catantopinae	6	13	12	18.4
	Acridinae	19	41.3	28	43.07
8	12	46	100	65	100

Discussion

As a result of the analysis of the obtained results, 65 species and subspecies belonging to 8 families, 12 subfamilies, and 46 genera of Orthopteran insects of Namangan Region were identified. Among them, 10 species belong to Tettigonioidae, 7 species belong to Grylloidae, and one belonging to Gryllotalpidae are distributed in the studied area. Furthermore, 47 species belonging to 5 families of grasshoppers were identified. Acrididae is the largest family in terms of number of species, and 40 species belonging to this family are distributed in this area. Also, one species of the Tridactylidae, two species of the Tetrigidae family, three species of the Pamphagidae family, and one species of the Pyrgomorphidae were found to be distributed (Table 6).

The research areas in the Namangan Region have been categorized into two groups: natural and agrolandscapes. The natural landscapes include the region's hills, mountains, and foothills, while the anthropogenic landscape comprises areas occupied by agricultural fields and irrigation ditches. Based on this classification, the species composition of Orthopterans in this area was analyzed across three landscape sections (Table 7). From the given data, it is known that 38 species (59.4%) of Orthopteran insects found in the territories of the Namangan Region are distributed in different agro landscapes, 29 species (45.3%) are distributed in hilly regions, and 44 species (68.7%) are distributed in mountainous regions (Figure 2).

Thus, in the territories of Namangan Region, the following species are distributed in all regions of the studied area: *P. b. deserti*, *Anacridium aegyptium*, *C. i. italicus*, *C. turanicus*, *C. b. cephalotes*, *H. adspersa*, *Heteracris littoralis littoralis*, *Acrida oxycephala*, *A. t. thalassinus*, *D. gracilis*, *Dociostaurus maroccanus*, *A. i. insubricus*, *Chorthippus albomarginatus karelini*, while some species are adapted to live in only one region: *T. caudata*, *Tessellana vittata*, *Conocephalus fuscus*, *Miramiola pusilla*, *Decticus albifrons*, *Glyphonothus alactaga*, *Gryllus bimaculatus*, *Pteronemobius heydeni concolor*, *Eremogryllodes semenovi*, *Gryllatalpa unispina*, *Bruntridactylus tartarus*, *T. subulata*, *Atrichotmethis semenovi*, *Pezotmethis ferghanensis*, *T. t. turanica*, *Conophyma sokolovi decorum*, *Calliptamus coelesyriensis carbonarius*, *Eyprepocnemis unicolor*, *Epacromius tergestinus*, *Aiolopus simulatrix*, *Oedipoda fedtschenkoi fedtschenkoi*, *Sphingonotus kirgizicus*, *Dociostaurus tartarus*, *Dociostaurus kraussi nigrogeniculatus*, *Notostaurus albicornis*, *S. carinatus*, *Chorthippus apricarius*, *Bryodemella tuberculata tuberculata*, *Omocestus haemorrhoidalis haemorrhoidalis*.

Table 7. Geographic distribution of orthopteran insects of Namangan Region, Uzbekistan

Species, family, superfamily	Landscapes		
	Agrolandscape	Hill	Mountain
Superfamily Tettigonioidea Family – Tettigonidae Subfamily – Tettigoniinae			
Tettigonia caudata **(**Charpentier, 1845)	++	-	-
T. viridissma (Linnaeus, 1758)	++	-	++
Platycleis intermedia (Serville, 1838)	+	-	+++
Tessellana vittata (veyseli) (Charpentier, 1825)	-	-	++
Conocephalus fuscus (Fabricius, 1793)	-	-	+
Miramiola pusilla (Miram, 1927)	-	-	+
Decticus verrucivorus (Linnaeus, 1758)	-	+	+++
Decticus albifrons (Fabricius, 1775)	-	-	++
Glyphonothus alactaga Miram, 1925	-	-	+
Semenoviana plotnikovi (Uvarov, 1914)	-	+	+++
Superfamily – Grylloidea Family – Gryllidae			
Oecanthus turanicus (Uvarov, 1912)	+	-	++
Velarifictorus bolivari (Uvarov, 1912)	++	-	+
Pteronemobius heydeni concolor (Walker, 1871)	+	-	-
Gryllus bimaculatus (De Geer, 1773)	++	-	-
Modicogryllus bordigalensis (Latreille, 1804)	++	+	-
Melanogryllus desertus (Pallas, 1771)	++	++	-
Eremogryllodes semenovi (Miram, 1930)	++	-	-
Family – Gryllotalpidae			
Gryllotalpa unispina (Saussure, 1874)	++	-	-
Superfamily– Tridactylidea Family – Tridactylidae			
Bruntrydactilus tartarus (Saussure, 1874)	++	-	-
Superfamily – Tetrigoidea Family – Tetrigidae			
Tetrix subulata (Linnaeus, 1758)	++	-	-
T. tartara tartara (Saussure, 1887)	++	-	-
Superfamily – Acridoidea Family – Pyrgomorphidae			
Pyrgomorpha bispinosa deserti (Bey-Bienko, 1951)	++	+++	+++
Family – Pamphagidae			
Atrichotmethis semenovi (Zubovski, 1899)	-	++	-
Pezotmethis tartarus tartarus (Saussure, 1884)	-	++	++
Pezotmethis ferghanensis (Uvarov 1925)	-	-	+
Family – Acrididae			
Tropidopola turanica turanica (Uvarov, 1926)	++	-	-
Conophyma semenovi semenovi (Zubovski, 1898)	-	+	++
C. sokolovi decorum (Mistshenko, 1951)	-	-	++
Anacridium aegyptium (Linnaeus, 1758)	+	++	+
Calliptamus italicus italicus (Linnaeus, 1758)		+++	sw
C. turanicus (Tarbinsky, 1930)	+++	+++	++
C. barbarus cephalotes (Fischer von Waldheim, 1846)	++	++	+++
C. coelesyriensis carbonarius (Uvarov, 1914)	-	-	++
Heteracris littoralis littoralis (Rambur, 1838)	++	+	+++
H. adspersa (Redtenbacher, 1889)	++	+	+
H. pterosticha (Fischer von Waldheim, 1833)	++	-	++
Eyprepocnemis unicolor (Tarbinsky, 1928)	++	-	-
Acrida oxycephala (Pallas, 1771)	++	+	++
Truxalis eximia (Eichwald, 1830)	+	-	++
Duroniella gracilis (Uvarov, 1926)	+	+++	+
D. kalmyka (Adelung, 1906)	+	+++	-
Epacromius tergestinus (Megerle von Mühlfeld, 1825)	-	-	++
Aiolopus thalassinus thalassinus (Fabricius, 1781)	+++	++	++
A. oxianus (Uvarov, 1926)	+	-	++
A. simulatrix (Walker, 1870)	-	-	++
Locusta migratoria migratoria (Linnaeus, 1758)	sw	-	+++
Oedaleus decorus (Germar, 1825)	++	++	-
Pyrgodera armata (Fischer von Waldheim 1846)	-	+	+
Oedipoda miniata miniata (Pallas, 1771)	-	+++	++

O. caerulescens (Linnaeus, 1758)	-	++	+
O. fedtschenkoi fedtschenkoi (Saussure, 1884)	-	-	+
Acrotylus insubricus insubricus (Scopoli, 1786)	+++	+	++
Sphingonotus (Sphingonotus) kirgisicus (Mistshenko, 1937)	-	-	+
Sphingoderus carinatus (Saussure, 1888)	+++	-	-
Ramburiella faveolata (Tarbinsky, 1931)	+	++	-
Dociostaurus (s.str.) *maroccanus* (Thunberg, 1815)	sw	sw	sw
Dociostaurus tartarus (Stshelkanovtzev, 1921)	-	++	-
D. kraussi nigrogeniculatus (Tarbinsky, 1928)	-	++	-
Notostaurus albicornis (Eversmann, 1848)	-	-	++
Chorthippus (s.str.) *albomarginatus karelini* (Uvarov, 1910)	+	++	+++
Chorthippus (s.str.) *dichrous* (Eversmann, 1859)	+++	-	+
Ch. Apricarius (Linnaeus, 1758)	-	-	+++
Glyptobothrus biguttulus (Linnaeus, 1758)	-	+	++
Bryodemella tuberculate tuberculate (Fabricius, 1775)	-	-	++
Omocestus haemorrhoidalis haemorrhoidalis (Charpentier, 1825)	-	-	++
Total	38	29	44
%	59.4	45.3	68.7

Note: (+): Rare species, (++): Permanent species, (+++): common but non-swarming species. (sw): swarming species

Table 8. The coefficient of similarity of orthopteran fauna of the compared areas

Location	Agrolandscape	Hills	Mountain
Agrolandscape	1	-	-
Hills	0.36	1	-
Mountains	0.30	0.35	1

Table 9. The spread of orthopteran insects of Namangan Region in biotopes and their distribution based on the amount of density

The number of species encountered	Total	%	Species	Total	%
Permanent species and subspecies	38	58.4	Species	32	49.2
			Subspecies	6	9.2
Common species and subspecies	16	24.6	Species	10	15.4
			Subspecies	6	9.2
Very rare species and subspecies	8	12.3	Species	6	9.2
			Subspecies	2	3.1
Abundant and swarm-forming species	3	4.6	Species	1	1.5
			Subspecies	2	3.1
Amount of species	65	100		65	100

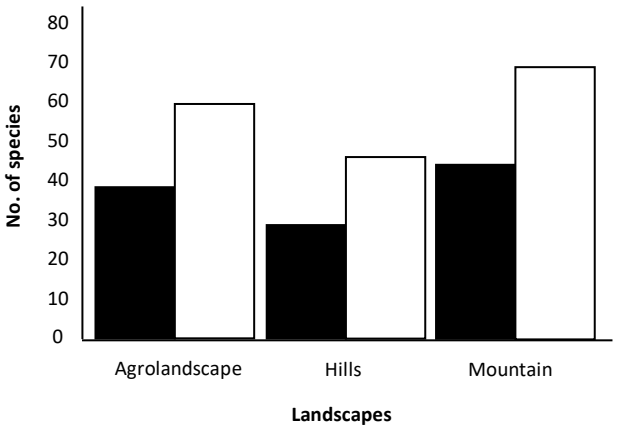

Figure 3. Distribution of orthopterans in the Namangan Region according to different landscapes

Also, studies were carried out on similarity clusters in different biocenoses of Namangan Region, i.e., agro landscapes, hilly and mountainous areas. As a result, the orthopteran species found in hilly and mountain regions are the closest, i.e., 36% similarity, which is explained by the fact that they are adjacent regions and species that migrate to each other. Orthopteran species found in mountain and agrolandscape make up the longest 30% similarity, based on the fact that these are high mountain species (Table 8).

Based on the obtained data, the population of Orthopteran insects in the studied area consists of very rare, permanent, abundant, and swarming species (Table 9).

There are 6 species and 2 subspecies are listed as very rare Orthopteran insects in the region, of which the following species can be included among the species in need of protection: *C. fuscus, M. pusilla, G. alactaga, P. h. concolor, P. ferghanensis, Pyrgodera armata, S. kirgizicus,* and *O. fedtschenkoi.*

It turned out that the number of common species and subspecies is 16. They are *Platycleis intermedia, Decticus verrucivorus, Semenoviana plotnikovi, P. b. deserti, C. turanicus, C. b. cephalotes, H. l. littoralis, D. gracilis, D. kalmyka, Oedipoda miniata miniata, A. t. thalassinus, A. i. insubricus, S. carinatus, C. a. karelini, Chorthippus dichrous,* and *C. apricarius.* There are 38 species and subspecies of permanent insects, including *T. caudata, Tettigonia viridissima, D. albifrons, T. vittata, O. turanicus, Velarifictorus bolivari, G. bimaculatus, Modicogryllus bordigalensis, M. desertus, E. semenovi, Gryllotalpa unispina, B. tartarus, Tetrix bolivari, T. subulata, A. semenovi, Pezotmethis tartarus tartarus, C. s. decorum, Conophyma semenovi semenovi, A. aegyptium, C. c. carbonarius, Heteracris pterosticha, H. adspersa, T. t. turanica, E. unicolor, E. tergestinus, A. oxycephala, T. eximia, A. oxianus, A. simulatrix, Oedaleus decorus, Oedipoda caerulescens, Ramburiella foveolata, D. tartarus, D. k. nigrogeniculatus, N. albicornis, Glyptobothrus biguttulus, B. t. tuberculata, O. h. haemorrhoidalis.* Based on the distribution and density of orthopteran insects in biotopes of Namangan Region, 38 species (58.4%) are permanent species and subspecies, 16

species (24.6%) are common species and subspecies, 8 species (12.3%) are very rare species and subspecies, 3 species (4.6%) are abundant and swarming species (Figure 4).

Common and swarming species of Orthopteran insects were also identified in the studied area. This group includes 3 species and subspecies: *L. migratoria*, *D. maroccanus*, and *C. i. italicus*.

Orthopteran insects of Namangan Region have not been studied separately. Only Bekuzin (1961) studied the orthopteran fauna in the natural and agro landscapes around the Fergana Valley and the lower part of the Syrdarya and provided information on the distribution and ecological life forms of 71 species and subspecies belonging to 8 families of the Orthoptera family. Some species live among shrubs and perennial plants near rivers, deserts, and plains. Also, the following 17 species were not found in this area: *Ruspolia nitidula*, *Semenoviana tamerlana*, *Tridactylus variegatus*, *Chrotogonus turanicus*, *Mesasippus kozhevnikovi*, *Mesasippus nudus*, *Ochrilidia hebetata kazaka*, *Ochrilidia mistchenkoi*, *Oxya fuscovittata*, *E. tergestinus*, *Gonista sagitta*, *Helithera turanica*, *Sphigonotus maculatus*, *Sphipgonotus satrapes*, *Hyalorrhipis clause*, *Leptoternis iliensis*, *Leptoternis gracilis*. On the other hand, 13 species were not identified in Bekuzin's work but were recorded in our research: *M. pusilla*, *D. verrucivorus*, *G. alactaga*, *E. semenovi*, *A. semenovi*, *P. t. tartarus*, *P. ferghanensis*, *C. s. semenovi*, *C. s. decorum*, *C. c. carbonarius*, *A. simulatrix*, *O. fedtschenkoi*. Also, during the monitoring process, one genus, *Miramiola* Uvarov, 1939, and one species, *M. pusilla*, were identified for the first time for Uzbekistan's fauna from the Namangan region's mountain area. Many species identified from different high-relief areas of the Namangan Region, a high-mountain area, indicate the richness of various types of insects and warrant scientific research (Begjanov 2020).

In conclusion, of more than 3,000 samples collected from 2018 to 2023 in the Namangan Region, 36% were imagoes, and 64% were Nymphs. Moreover, 65 species and subspecies of orthopterans belonging to 8 families, 12 subfamilies, and 46 genera were studied. Among them, 10 species from the Tettigonioidae family, 7 species from the Grylloidae family, one species from the Gryllotalpidae family, 40 species from the Acrididae family are the largest, one species from each of the Tridactylidae and Pyrgomorphidae families, two species from the Tetrigidae family, three species from the Pamphagidae family are found in the study area. Among these species, one genus, *Miramiola* and one species, *M. pusilla* of locusts from the mountain area of Namangan Region were determined for the first time for the fauna of Uzbekistan.

The distribution area of orthopteran insects identified in the Namangan Region is as follows: 38 species (59.4%) are distributed in different agro landscapes, 29 species (45.3%) in hilly regions, and 44 species (68.7%) in mountainous regions. In different biocenoses of Namangan Region, the orthopteran species found in the hills and mountains are 36% similar, which is explained by the fact that they are adjacent regions and species that migrate to each other. Based on the distribution and density of Orthopteran insects in Namangan Region's biotopes, 38 species (58.4%) are permanent species and subspecies, 16 species (24.6%) are common species and subspecies, 8 species (12.3%) are very rare species and subspecies, and 3 types (4.6%) are abundant and swarm-forming species.

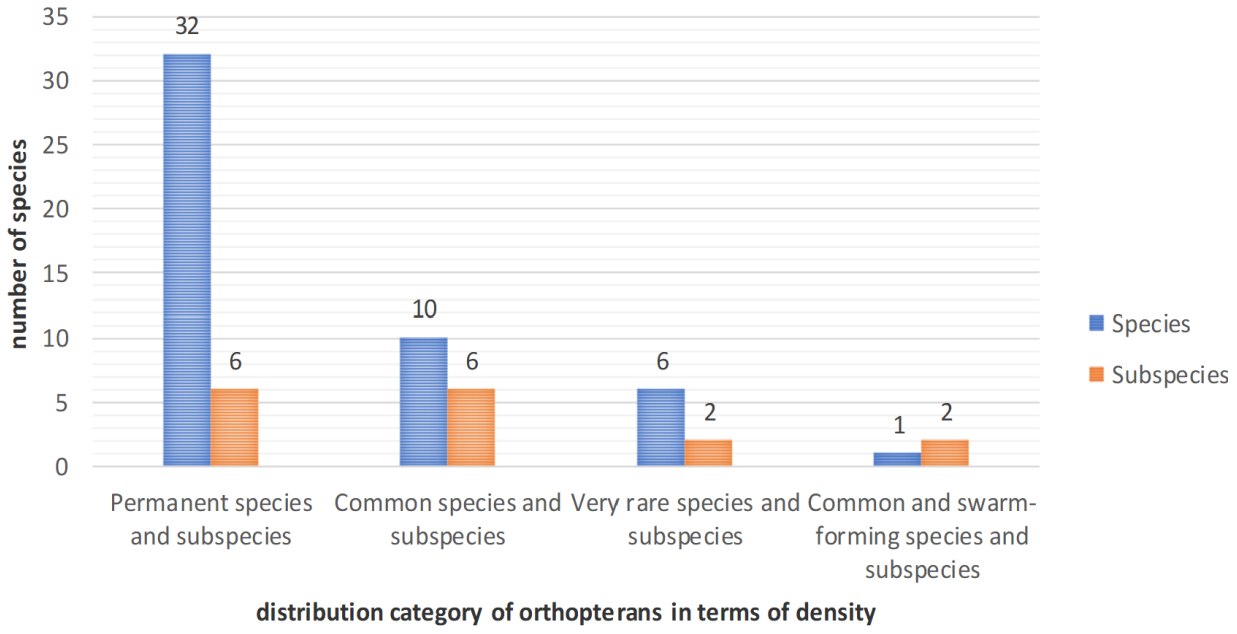

Figure 4. Results of analysis of species distribution based on density

ACKNOWLEDGEMENTS

We are grateful to the Laboratory of Entomology of the Institute of Zoology of the Science Academy of the Republic of Uzbekistan. Anonymous referees and an English editor improved the manuscript.

REFERENCES

Begjanov MQ. 2020. Fauna and Ecology of Orthoptera Insects of the Fergana Valley (Insecta: Orthoptera) [Dissertation]. Institute of Zoology, Tashkent. [Uzbekistan]

Bekuzin AA. 1961. A new species of the genus *Eumetrioptera* Mir. (Orthoptera, Tettigonioidea) from Mt. Cheese-Darinsky Karatau. Entomol Rev 40 (4): 870-871. [Russian]

Bey-Bienko GY. 1954. Fauna of the USSR. Orthoptera. Grasshoppers. Subfamily. Leaf grasshoppers (Phaneropterinae). In: Bey-Bienko GY Pavlovsky EN (eds). Publishing House of the USSR Academy of Sciences, Leningrad, Moscow.

Chao A, Chazdon RL, Colwell RK, Shen T-J. 2005. A new statistical approach for assessing the similarity of species composition with incidence and abundance data. Ecol Lett 8 (2): 148-159. DOI: 10.1111/j.1461-0248.2004.00707.x.

Chapman RF, Stephen JS, Douglas AE. 2013. The Insects: Structure and Function, Fifth Edition. Cambridge University Press, New York.

Childebaev MK, Storozhenko SY. 2004. An annotated list of the long-horned Orthopterans (Orthoptera, Ensifera) of Kazakhstan. Tethys Entomol Res IX: 209-224.

Çiplak B. 2021. Locust and grasshopper outbreaks in the near east: Review under global warming context. Agronomy 11 (1): 111. DOI: 10.3390/agronomy11010111.

Gapparov FA, Latchininsky AV. 2000. What are the consequences of ecosystem disruption on acridid diversity and abundance? In: Lockwood JA, Latchininsky AV, Sergeev MG (eds). Grasshoppers and Grassland Health. NATO Science Series, Vol 73. Springer, Dordrecht. DOI: 10.1007/978-94-011-4337-0_3.

Hollier J, Heads SW. 2015. An Annotated List of the Orthoptera (Insecta) Species Described by Henri de Saussure, with an Account of the Primary Type Material Housed in the Muséum d'histoire Naturelle de Genève. Revue Suisse de Zoologie, Genève, Kundig.

Kholmatov BR. 2019. Orthopteroid (Insecta, Orthopteroidea) Insects of Southern Uzbekistan [Thesis]. Institute of Zoology, Tashkent. [Uzbekistan]

Latchininsky AV, Sergeev MG, Childebaev MK, Chernyakhovskii ME, Lockwood JA, Kambulin VE, Gapparov FA. 2002. Locusts of Kazakhstan, Central Asia and Adjacent Areas. The International Association of Applied Acridology and the University of Wyoming, Laramie.

Latchininsky AV, Sergeev MG, Fedetova AA, Childebaev MK, Temreshev II, Gapparov FA, And Kokanova EO. 2023. Moroccan locust *Dociostaurus maroccanus* (Thunberg, 1815). Morphology, Distribution, Ecology, Population Management. FAO, Rome. DOI: 10.4060/cc7159ru.

Latchininsky AV. 2020. A Guide to Three Gregarious Locust Species in the Caucasus and Central Asia. Biology, Ecology and Behavior. FAO, Rome. DOI: 10.4060/cb0879ru.

Leksono AS, Yanuwiadi B, Khotimah A, Zairina A. 2022. Grasshopper diversity in several agricultural areas and savannas in Dompu, Sumbawa Island, Indonesia. Biodiversitas 23 (1): 75-80. DOI: 10.13057/biodiv/d230110.

Medetov MZ. 2012 Fauna and Formation (Insecta: Orthoptera) of Southern at Aral. [Abstract]. Diss Cand of Biological Sciences. Tashkent. [Russian]

Medetov MZH. 2018. Orthoptera (Insecta: Orthoptera) in Arid Zones of Uzbekistan. [Dissertation]. Institute of Zoology, Tashkent. [Uzbekistan]

Nurjanov AA, Medetov MZH, Gapparov FA, Kholmatov BR, Abdullayev II, Tufliyev NKH, Nurjonov FA. 2023. Orthoptera (insecta) fauna of the Kashkadarya Region, Uzbekistan. Biodiversitas 24 (1): 112-121. DOI: 10.13057/biodiv/d240115.

Nurjanov AA. 2020. Fauna and Ecology of Orthopteroid Insects of the Southern Aral Sea. Fan. Tashkent.

Popova KV, Molodtsov VV, Sergeev MG. 2020. Rare grasshoppers (Orthoptera, Acridoidea) of the Baraba and Kulunda steppes (South Siberia). Acta Biol Sib 6: 595-609. DOI: 10.3897/abs.6.e59519.

Sergeev MG, Childebaev MK, Vankova IA, Gapparov FA, Kambulin Ve, Kokanova, EO, Molodtsov VV. 2022. Italian Locust *Calliptamus italicus* (Linnaeus, 1758): Morphology, Ecology, Distribution, Population Management. Food and Agriculture Organization of the United Nations.

Sergeev MG. 2021. Distribution patterns of grasshoppers and their kin over the Eurasian Steppes. Insects 12 (1): 77. DOI: 10.3390/insects12010077.

Shcherbakov EO, Savitsky VY. 2015. New data on the fauna, taxonomy and ecology of praying mantises (Dictyoptera, Mantodea) from Russia. Entomol Rev 95 (2): 181-199. DOI: 10.1134/S0013873815020049.

Tan MK, Wahab RHA. 2018. Preliminary study on the diversity of Orthoptera from Kuala Belalong Field Studies Centre, Brunei Darussalam, Borneo. J Orthoptera Res 27 (2): 119-142. DOI: 10.3897/jor.27.24152.

Temreshev II, Esenbekova PA. 2017. Ortopteroid insects (Insecta, Orthopteroidea) of the Tasotkel water reservoir area (Kazakhstan). Acta Biol Sib 3 (1): 13-22. DOI: 10.14258/abs.v3i1.2178.