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**ABSTRACT**

Of the dissertation for the degree of Doctor of Philosophy

**THE FAUNA AND ECOLOGY OF SPIDERS  
(ARACHNIDA, ARANEA) OF GANJA – GAZAKH ZONE**

Speciality: 2401.01 - Zoology

Field of science: Biology

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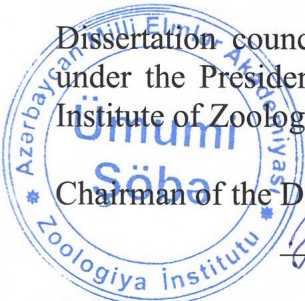
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## INTRODUCTION

**Relevance of the theme:** Spiders are among the most diverse orders in animal world. Recently 49180 species are known, distributed in 4208 genera and 128 families<sup>1</sup>. They can be found in almost all landscapes and climatic belts in the Earth (from polar areas and high mountains to dry steppes and hot deserts)<sup>2</sup>. Spiders were observed on Greenland glaciers, Antarctic islands and even on Everest Mount at the height of 7000 meters<sup>3</sup>.

Investigation of spiders is important both from practical and theoretical point of view. They feed on various groups of invertebrate animals, primarily on insects. At the same time they are readily eaten by different other predators. Spiders play significant role in decreasing population densities of harmful insects. They are considered as one of the most important predators preventing the growth of agricultural pest populations. According to literature data birds together with other entomophagous animals kill much less insects as compared to spiders. Recently, the role of spiders in suppression of pest insect populations is best studied in forest biocenoses.

Moreover, spiders frequently prey on blood-sucking invertebrates and other vectors of infectious diseases. The role of spiders in destruction of malaria mosquitoes is especially remarkable. Spiders were also reported to prey on bed bugs and some species of orsiksoid ticks<sup>4</sup>.

Up to present the use of spiders as biological control agents was not taken into account in Azerbaijan. The reason is that in many

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<sup>1</sup> Platnick, N.I. World Spider Catalog: Version 21.0, [Electronic resource] / Natural History Museum Bern. - accessed on 24 January, 2020. URL: <http://wsc.nmbm.ch/>.

<sup>2</sup> Foelix, R. Biology of the Spiders / R.Foelix. New York: - Oxford University, - 2011. - 419 p.

<sup>3</sup> Жизнь животных: [в 6 томах] / гл.ред. Л.А.Зенкевич. – Москва: - 1969. – т.3. – 1969. – 575 с.

<sup>4</sup> Ndava, J., Llera, S., Manyanga, P. The future of mosquito control: The role of spiders as biological control agents: A review // International Journal of Mosquito Research, - 2018. - p. 6-11.

regions of Azerbaijan the fauna, systematics, biology, ecology and phenology of spiders are poorly studied. One of such regions is Ganja-Gazakh zone. Spiders (Araneae) of Ganja-Gazakh zone are poorly investigated. Up to now nobody conducted regular studies of fauna and bioecology of spiders in this region and very little literature data are available about its araneofauna.

**The goal and objectives of investigation:** The main goal was to reveal the species composition and bioecological characteristics of spiders of Ganja-Gazakh zone, to analyze their distribution among different landscapes and to conduct zoogeographical analysis of local araneofauna.

To achieve this goal the following objectives were scheduled:

1. To reveal the species composition and taxonomic structure of spider fauna of Ganja-Gazakh zone.
2. To analyze bioecological characteristics of species of spiders of Ganja-Gazakh zone.
3. To investigate the distribution of spiders among different landscapes.
4. To conduct zoogeographical analysis of araneofauna of Ganja-Gazakh zone.

**Research methods.** The material was collected with using widely accepted common entomological and arachnological methods. These methods included sampling by hands and sweeping by entomological net, as well as using forceps, exhaustor and glass jars. Also spiders occurring in the litter were sifted with using Vinkler apparatus. Spiders inhabiting soil surface were collected with using pitfall traps (Barber traps).

Species identification were made with using NIKON SMZ 1270, MBS-9 and MBS-1 microscopes.

The similarity between spider faunas of different landscapes was calculated using Chekanovski-Serensen index.

Species faunistic similarity indexes and graph plotting were made using "BioDiversity professional" software.

**The main provisions:**

1. Investigation of spider fauna of Ganja-Gazakh zone
2. Bioecological analysis of local species
3. Distribution of spider species between different landscapes

#### 4. Zoogeographical analysis of spider fauna of Ganja-Gazakh zone

**Scientific novelty of research.** Among species found during investigation 6 (*Clubiona frutetorum* L.Koch, 1867, *Philodromus poecilus* (Thorell, 1872), *Pseudicius palaestinensis* Strand, 1815, *Monaeses israeliensis* Levy, 1973, *Ozyptila claveata* (Walckenaer, 1837), *Zelotes aeneus* (Simon, 1878)) proved to be new records for Caucasus, 1 genus (*Olios* Walckenaer, 1837) and 9 species (*Zygiella atrica* (C.L.Koch, 1845), *Anagraphis pallens* Simon, 1893, *Drassodes caspius* Ponomarev & Tsvetkov, 2006, *Drassyllus villicus* (Thorell, 1875), *Pardosa prativaga* (L.Koch, 1870), *Pisaura novicia* (L.Koch, 1878), *Rhysodromus rikhteri* (Logunov & Huseynov, 2008), *Synema caucasicum* Utochkin, 1960, *Xysticus bifasciatus* C.L.Koch, 1837) are new to the fauna of Azerbaijan, and 195 species are recorded in the fauna of Ganja-Gazakh zone for the first time.

Also a new synonymies are established for two species (*Talanites aculeatus*=*Anagraphis pallens* and *Prothesima (Zelotes) semibadius*=*Trachyzelotes jaxartensis*, recently *Marinarozelotes jaxartensis*).

#### **The theoretical and practical significance of the work.**

The detailed investigation of spider fauna of Ganja-Gazakh zone, including many new data have important significance as theoretical scientific base not only for local fauna, but also for the whole fauna of Azerbaijan. So, the obtained data on faunistic composition, systematics and zoogeographical complexes could be used for compilation of regional catalogue. At the same time the results of the work could be used in educational process in higher educational Institutions of corresponding profile. On the basis of materials of dissertation and used methods of identification “The Key book” of local spider fauna can be prepared.

**Approbation and application of the work.** The main proposals of dissertation work were reported and discussed at laboratory of Terrestrial invertebrates of ANAS Zoology Institution, Academic Council of Institution annual reports and Institution scientific seminars, including below mentioned local and International scientific-practical conferences:

–“Caspian Sea, past, recent and future” International conference (Makhachkala, 2014);

-ANAS 70, International of multidisciplinary forum (Baku, 2015);

-“IV International scientific conference of young scientists” devoted to 93-rd Anniversary of National leader Heydar Aliyev (Baku, 2016);

-“Biodiversity of Caucasus and South of Russia” XVIII International scientific conference (Grozny, 2016) .

Based on the studied material, 11 scientific papers (3 abroad) and 4 theses (2 abroad) were published on the topic of dissertation.

**Name of the organization where the work was performed.**

The research was carried out in the laboratory of Terrestrial invertebrates of the Institute of Zoology of the Azerbaijan National Academy of Sciences.

**The structure and volume of the dissertation.** The dissertation is presented on 181 pages (229450 characters) and consists of Introduction (8395 characters), 6 chapters (I chapter-6143; II chapter-6689; III chapter-4568; IV chapter-170137; V chapter-15720; VI chapter-11990 characters), results (3734 characters), practical proposals (544 characters), reference list, 8 tables, 38 pictures. The list of used literature includes 161 sources (16 in Azerbaijani, 40 in Russian, 103 in other foreign languages and 2 electronic sites).

## **I CHAPTER. THE HISTORY OF SPIDERS OF GANJA-GAZAKH ZONE**

In this chapter on the basis of literature data the results of investigations conducted in Ganja-Gazakh zone of Azerbaijan are analysed. Considering the literature, it becomes clear that spiders of Ganja-Gazakh zone were studied more actively at the end of XX century as compared to previous years.

In sum, before the present study 80 spider species belonging to 22 families were reported from the territory of Ganja-Gazakh zone. In the result of our investigation now the spider fauna of Ganja-Gazakh zone accounts for 325 species from 144 genera and 30 families. Of these 245 species were recorded by us, while other 80 ones were known from previous literature. Of 80 species reported by previous authors we found only 38, while other 42 species were not sampled by us.

## **II CHAPTER. PHYSICAL-GEOGRAPHICAL CHARACTERISTICS OF THE GANJA - GAZAKH REGION**

In this chapter the data on geographical position, relief, climate, inland waters, soil cover, fauna and flora of investigated area are given.

Ganja-Gazakh zone is situated in north-eastern slope of Caucasus Minor, in the West of Republic. Together with Jeyranchol lowland situated at left bank of Kura river, Ganja-Gazakh sloped lowland are parts of Kura lowland nature area.

Ganja-Gazakh physical-geographical zone includes Goranboy, Samukh, Gyoygyol, Shamkir, Tovuz, Aghstafa, Gazakh, Dashkesan, Gedabey districts and cities of federal subordination, Ganja and Naftalan<sup>5</sup>.

By relief mostly mountainous (norh-eastern part of Caucasus Minor, Jeyranchol foothills, western part of Ganja Bozdag ridge etc.), partly lowland (Ganja-Gazakh lowland on right bank of Kura River, Garayazi lowland in North-West). Depending on the conditions, the relief of zone could be lowland, piedmountain lowland, mid and high mountain belts. The highest mounts are Gamysh (3724 m) and Beyuk Hinaldag (3367 m).

The climatic conditions are diverse.

The soil is chesnut colour, mountain-forest brown, black, mountain-meadow, etc.<sup>6</sup>

## **III CAPTER. MATERIAL AND METHODS OF RESEARCH WORK**

The research work was made both in the field and laboratory in 2013 – 2017. The field work in Ganja-Gazakh zone was conducted during the period of 5 years (2013, 2014, 2015, 2016, 2017) in spring, summer, autumn and winter. The main areas of material sampling were Aghstafa, Gazakh, Tovuz, Shamkir,

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<sup>5</sup> Azərbaycan Respublikasının coğrafiyası. Regional coğrafiya: [3 cildə]. – Bakı: - c.3. - 2015. - 399 s.

<sup>6</sup> Məmmədov, Q.Ş. Azərbaycanın torpaq ehtiyatlarından səmərəli istifadənin sosial-iqtisadi və ekoloji əsasları / Q.Ş.Məmmədov. - Bakı: Elm, - 2007. - 854 s.

Gedabey, Goranboy, Goygol district centers and adjacent villages. The material was also collected in Goygol National Park and Garayazi State Nature Reserve (Figure 1).

Additionally, material stored at the collection of ANAS Institution of Zoology was treated.

Laboratory work was conducted at the laboratory of Terrestrial arthropods of ANAS Institute of Zoology.



**Figure 1. The routes of expeditions in Ganja-Gazakh zone in 2013-2017 years.**

Over 5000 individuals of spiders were collected during the period of investigation. In the field, the material collected by various methods was placed in the vials containing 75% ethanol and provided with labels where the place and time of collection event were recorded. Material identification was made at the laboratory of Terrestrial arthropods of ANAS Institute of Zoology.

The material was sampled using widely accepted common entomological and arachnological methods, including capturing by hands, soft forcets, exhauster, jars and entomological net. With this



goal the places under stones, grasses, stumps, grass and forest litter, bark of trees were carefully searched for spiders. Also spiders occurring in the litter were sifted with using Vinkler apparatus. Spiders inhabiting higher level of shrubs and trees were collected by biting their twigs with long stick. Barber traps were used to catch ground dwelling spiders.

Spiders were identified with the aid of NIKON SMZ 1270, MBS-9 and MBS-1 microscopes.

For zoogeographical analysis of investigated araneofauna the data from World Spider Catalog<sup>7</sup>, Database of European spider fauna<sup>8</sup>, Catalogue of spider fauna of Russia and adjacent countries<sup>9</sup> and other recent literature were used.

Similarity between spider faunas of different landscapes was calculated using Cekanovski-Serensen formula:

$$K = \frac{2j}{a + b} \times 100\%$$

where: K - similarity coefficient, j – number of species found in both landscapes, a – number of species found only in the first landscape, b – number of species found only in the second landscape.

Species faunistic similarity indexes and graphs plotting were made using “BioDiversity professional” software.

#### **IV CHAPTER. ECOLOGY-FAUNISTIC ANALYSIS OF SPIDERS OF GANJA -GAZAKH ZONE**

##### **4.1. Bioecological analysis of species of spider fauna of zone.**

In this subchapter the information on distribution in Azerbaijan and short bioecological analysis are given for each species. Also the fact of synonymy for two species occurring in Ganja-Gazakh zone

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<sup>7</sup> Platnick, N.I. World Spider Catalog: Version 21.0, [Electronic resource] / Natural History Museum Bern. - accessed on 24 January, 2020. URL: <http://wsc.nmbe.ch/> .

<sup>8</sup> Nentwig, W., Blick, T., Bosmans R. [et al.] Aranea, Spiders of Europe: [Electronic resource] / Version 2020, URL: <https://araneae.nmbe.ch/>.

<sup>9</sup> Mikhailov, K. The spiders (Arachnida: Aranei) of Russia and adjacent countries: a non-annotated checklist // Arthropoda Selecta, Supplement, - 2013 b. v. 3, - p. 1-262.

(*Anagraphis pallens* Simon, 1893 and *Trachyzelotes jaxartensis* (Kroneberg, 1875) recently *Marinarozelotes jaxartensis* (Kroneberg, 1875)) was established<sup>10</sup>.

For some species dynamics of activity based on presense of mature specimens were determinated during investigation. Majority of species start to mature in April – May and reach the peak in May – June. However, some species become adult in Oktober and even in December.

**4.2. Taxonomical spectrum of spider fauna of Ganja-Gazakh zone.** The spider fauna of Ganja-Gazakh zone includes 325 species belonging to 144 genera and 30 families (Table 1). Among these 6 species (*Clubiona frutetorum* L.Koch, 1867, *Philodromus poecilus* (Thorell, 1872), *Pseudicius palaestinensis* Strand, 1815, *Monaeses israeliensis* Levy, 1973, *Ozyptila claveata* (Walckenaer, 1837), *Zelotes aeneus* (Simon, 1878)) proved to be new for the fauna of Caucasus, 1 genus (*Olios* Walckenaer, 1837) and 9 species (*Zygiella atrica* (C.L.Koch, 1845), *Anagraphis pallens* Simon, 1893, *Drassodes caspius* Ponomarev & Tsvetkov, 2006, *Drassyllus villicus* (Thorell, 1875), *Pardosa prativaga* (L.Koch, 1870), *Pisaura novicia* (L.Koch, 1878, *Rhysodromus rikhteri* (Logunov & Huseynov, 2008), *Synema caucasicum* Utochkin, 1960, *Xysticus bifasciatus* C.L.Koch, 1837) are reported for the first time for the fauna of Azerbaijan, 195 species are new records for the local fauna.

35 species in the list are marked as “sp”. It is not excluded that some of these are new species for science.

According to the number of species the most diverse families are Lycosidae (43 species, 13,2%) and Gnaphosidae (42 species, 13%). Also Salticidae (38 species, 11,7%), Theridiidae (33 species, 10,2%), Thomisidae (28 species, 8,6%), Araneidae (24 species, 7,4%), Linyphiidae (20 species, 6,1%), Philodromidae (19 species, 5,8%), Tetragnathidae (14 species, 4.3%) are represented by

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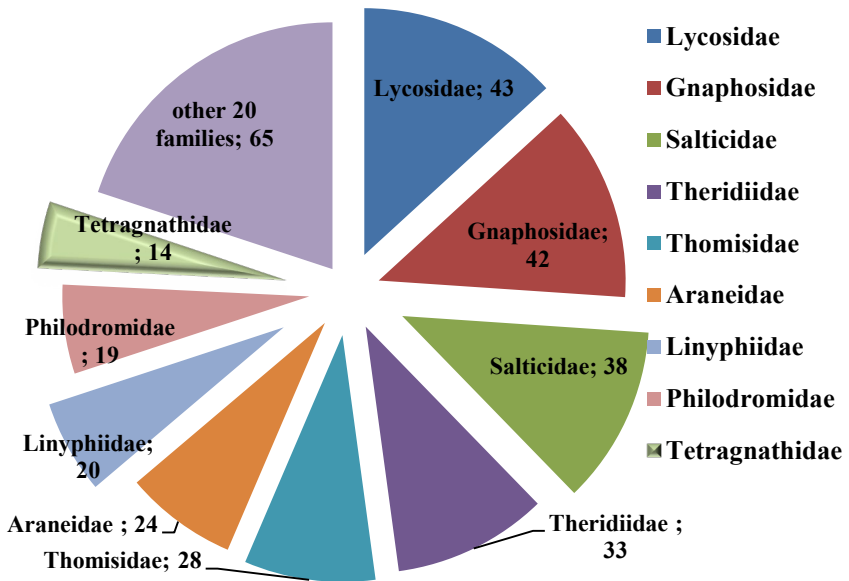
<sup>10</sup> Khasayeva, Sh. To the study of Gnaphosidae spiders (Araneae, Gnaphosidae) of Western Azerbaijan with suggestion of two new synonyms / Sh.Khasayeva, E.Huseynov // *Arthropoda Selecta*, - 2017. v. 26, No 2, - p.125-132.

considerable number of species. The remaining 21 families contain much lower number of species, from 1 to 7 (0,3-2,1%) (Figure 2).

**Table 1**

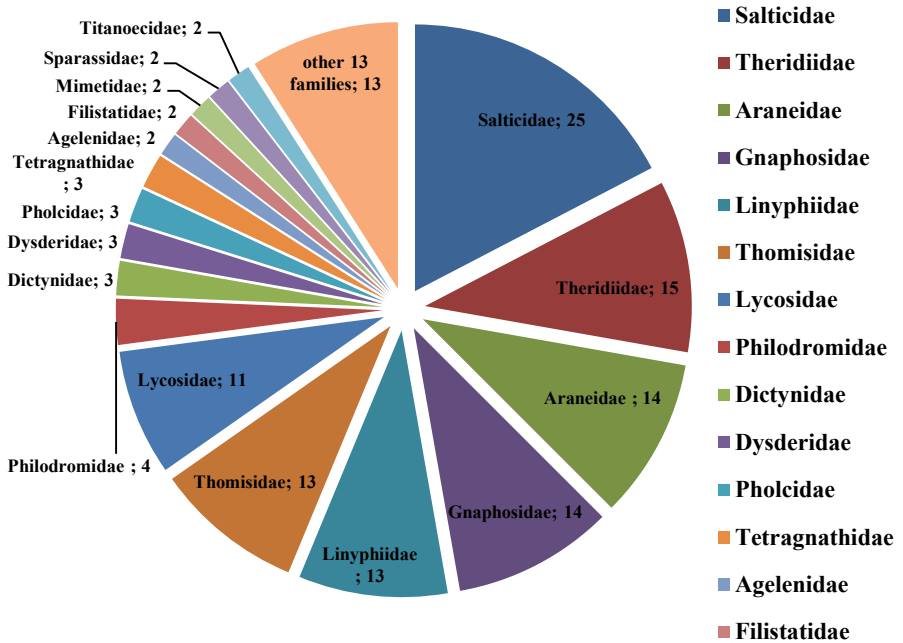
**Taxonomical structure of the spider fauna of Ganja-Gazakh zone**

№	Family	Number of genera	Number of species
1.	Agelenidae	2	3
2.	Amaurobiidae	1	1
3.	Araneidae	14	24
4.	Cheiracanthiidae	1	4
5.	Clubionidae	1	5
6.	Dictynidae	3	7
7.	Dysderidae	3	7
8.	Eresidae	1	1
9.	Filistatidae	2	2
10.	Gnaphosidae	14	42
11.	Linyphiidae	13	20
12.	Lycosidae	11	43
13.	Mimetidae	2	3
14.	Miturgidae	1	2
15.	Oecobiidae	1	5
16.	Oxyopidae	1	3
17.	Palpimanidae	1	1
18.	Philodromidae	4	19
19.	Pholcidae	3	4
20.	Phrurolithidae	1	2
21.	Pisauridae	1	2
22.	Salticidae	25	38
23.	Scytodidae	1	1
24.	Sparassidae	2	2
25.	Tetragnathidae	3	14
26.	Theridiidae	15	33
27.	Thomisidae	13	28
28.	Titanoecidae	2	5
29.	Uloboridae	1	2
30.	Zodariidae	1	2
	30	144	325



**Figure 2. Percentage of number of species in different families of spider fauna of Ganja-Gazakh zone.**

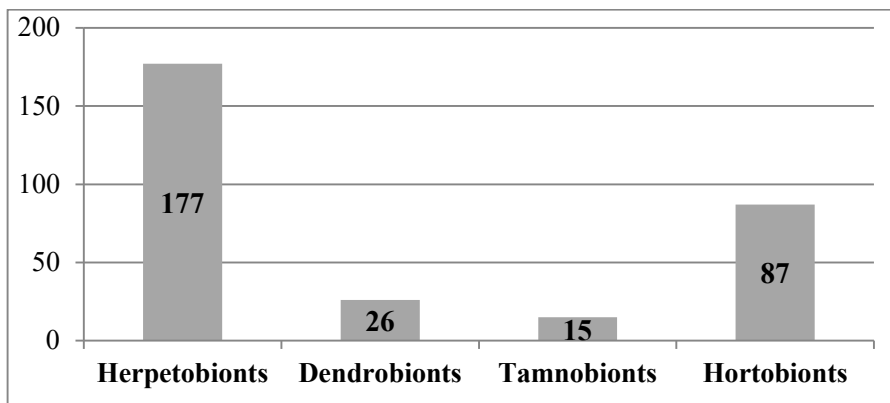
The genera as species also unevenly distributed between families. By number of genera Salticidae (25 genera≈17,4%) is the most diverse family, followed by Theridiidae (15 genera≈10,4%), Araneidae (14 genera≈10,7%), Gnaphosidae (14 genera≈10,7%), Linyphiidae (13 genera≈9%), Thomisidae (13 genera≈9%), Lycosidae (11 genera≈7,6%), Philodromidae (4 genera≈2,7%), Dictynidae, Dysderidae, Pholcidae, Tetragnathidae (3 genera≈2%), Agelenidae, Filistatidae, Mimetidae, Sparassidae, Titanoecidae each by 2 genera (1,3%) and other 13 families (Amaurobiidae, Clubionidae, Eresidae, Eutichuridae, Miturgidae, Oecobiidae, Oxyopidae, Palpimanidae, Phrurolithidae, Pisauridae, Scytodidae, Uloboridae, Zodariidae) each by 1 genus (0,6%) (Figure 3).



**Figure 3. Percentage of number of genera in different families of spider fauna of Ganja-Gazakh zone.**

**4.3. Ecological groups of species.** The studied species of spiders can be classified according to preferred habitats, prey composition and predatory tactics, life style, the shape of web etc. For example, according to habitats spiders are divided into 4 ecological groups (Figure 4):

1. Dendrobionts- species living on bark and leaves of trees.
2. Tamnobionts- inhabitants of shrubs.
3. Hortobionts- species occurring in herbaceous vegetation.
4. Herpetobionts- ground surface dwellers.



**Figure 4. Classification of spiders of Ganja-Gazakh zone according to preferred habitats.**

By species diversity the most rich group is herpetobionts (177 species-54,5%). The second species rich group including 87 species (26,8%) - hortobionts. Dendrobionts and tamnobionts are groups that characterized by small number of species (26 -8% and 15-4,6% respectively). By preferred substrate, herpetobionts can be divided into 3 groups : litter dwellers, psammophils (*Asianellus festivus* and *A.potanini*) and occupants of spaces under stones.

Some part of spider species are found near human dwellings (20 species-6,2%). These spiders could be divided into 2 groups: eusynantrops and hemisynantrops. Eusynantrops - real synantropous spiders. They are found only in or on human dwellings. In the spider fauna of Ganja-Gazakh zone this group consists of 12 species (3,7%): *Tegenaria domestica*, *Filistata insidiatrix*, *Oecobius cellariorum*, *O.nadie*, *O.putus*, *O.maculatus*, *Oecobius* sp., *Pholcus opilionoides*, *P.phalangioides*, *Asagena phalerata*, *Steatoda castanea*, *S.grossa*. Hemisynantrops are half-synantropous species. These spiders occur both near human dwellings and in the field. In spider fauna of Ganja-Gazakh zone they are represented only by 8 (2,5%) species: *Araneus marmoreus*, *Neriene peltata*, *Holocnemus pluchei*, *Spermophora senoculata*, *Menemerus semilimbatus*, *Menemerus taeniatus*, *Philaeus chrysops*, *Theridion melanurum*.

By prey composition spiders are divided into two groups:

1) Polyphagous species feed primarily on different kinds of invertebrate animals. They constitute majority of species of Ganja-Gazakh fauna (297 species-91,4%).

2) Stenophagous species feed primarily on a certain group of prey. These species could be divided into 3 groups:

Araneophagous spiders – feed mostly on other spiders. In the fauna of Gyandja-Gazakh zone 6 (1.8%) species could be considered as araneophagic (*Aphantaulax trifasciata*, *Ero aphana*, *Mimetus laevigatus*, *Mimetus* sp., *Palpimanus* sp., *Cyrba algerina*).

Myrmecophagous spiders feed mostly on ants (worker individuals). In the fauna of Ganja-Gazakh zone 16 species-4,9% belongs to this group (*Callilepis nocturna*, *Nomisia aussereri*, *N.conigera*, *N.exornata*, *N.ripariensis*, *Oecobius cellariorum*, *O. nadi*, *O. putus*, *O. maculatus*, *Oecobius* sp., *Asianellus festivus*, *A.potanini*, *Monaeses israeliensis*, *Tmarus punctatissimus*, *Zodarion caucasicum*, *Z. thoni*).

Oniscophagous spiders – species feeding on woodlice. In the fauna of Ganja-Gazakh zone 6 species-1,8% (*Dysdera azerbaijdzhanica*, *D.karabachica*, *D.raddei*, *D.caspica*, *D.sp.1.*, *D.sp2.*) are oniscophagous.

By manner of hunting spiders are divided into two large groups: wandering spiders and web-building spiders. Wandering spiders (207 species-63,7%) actively search for prey or wait it in ambush. Spiders from the second group (118 species-36,3%) capture their victims with the aid of silken traps.

Depending on the shape of web, spiders are usually divided into four groups

Funnel web spiders of families Agelenidae, Amaurobidae, Filistatidae and Lycosidae (*Aulonia albimana* and *A. kratochvili*) include 8 species (2,5%).

Orb-weaving spiders – Araneidae, Tetragnathidae, Uloboridae include 40 species (12,3%).

Sheet-web spiders–Eresidae, Linyphiidae include 21 species (6,5%).

Tangle web spiders - Dictynidae, Pholcidae, Theridiidae, Titanoecidae include 49 species (15,1%).

According to daily activity spiders can be divided into 3 groups:

1) Species which are active at night. These spiders spend the day in hidden places in nests and depart them to hunt at night. For example, most Gnaphosidae.

2) Species which are active at day. These spiders spend the night in hidden places in nests and depart them to hunt at day. For example, Salticidae.

3) Both day and night active species. These spiders are active or inactive at certain time of the day independent of light. For example, Thomisidae.

#### 4.4 Comparison of species composition of spider fauna of Gyandja-Gazakh zone with other spider faunas of Azerbaijan.

In this subchapter based on own and literature data calculations were made on degree of similarity and difference between different areas of Azerbaijan (Lenkoran nature area, Absheron-Gobustan physic-geographical district, Ganja-Gazakh and Sheki-Zagatala zones). Personal and literature data revealed 325 spider species in Ganja-Gazakh zone. According to literature data in the fauna of Lenkoran nature area 279, in Absheron-Gobustan physical-geographic district 299, and in Sheki-Zagatala zone 289 spider species are registered. To estimate diversity and similarity of above mentioned areas Brey-Kertis analysis of faunistic similarity was used (Figure 5).

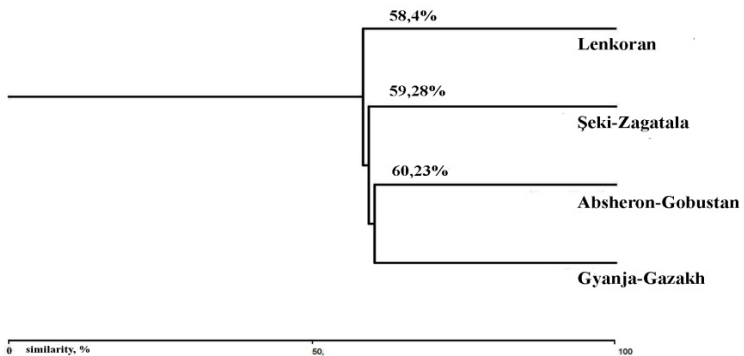


Figure 5. The index of similarity between spider faunas of physic-geographical areas and zones of Azerbaijan (by Brey-Kertis).



The obtained dendrogram indicates the greatest similarity between Ganja-Gazakh and Absheron-Gobustan spider faunas (60.2%). The index of similarity between Ganja-Gazakh zone and Absheron-Gobustan district and Sheki-Zagatala zone constituted 59.2%. The degree of similarity between three above areas with Lenkoran nature area made up 58.4% .

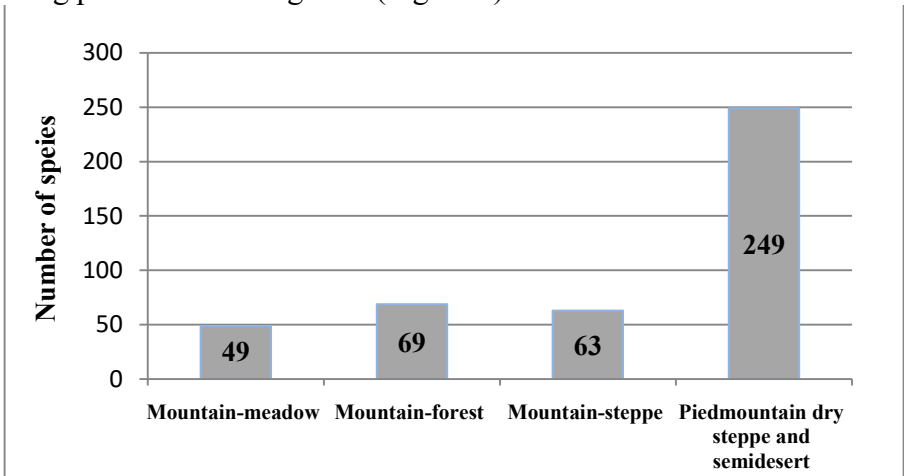
During ecological analysis it became clear that similarity or difference between Ganja-Gazakh zone, situated in the West of Azerbaijan, and other areas is related to their physical-geographical characteristics.

## V CHAPTER. DISTRIBUTION OF SPIDERS BETWEEN LANDSCAPES

Five types of landscapes are recognized in Ganja-Gazakh zone:

1. Rocky-subnival landscape
2. Mountain-meadow landscapes
3. Mountain-forest landscapes
4. Mountain-steppe landscapes
5. Piedmountain dry steppe and semidesert landscapes

It should be noted that of these types of landscapes only in four (mountain-meadow, mountain-forest, mountain steppes, piedmountain lowland dry steppes and semideserts landscapes) spiders were found during period of investigation (Figure 6).



**Figure 6. Distribution of species between landscapes.**

However, because of intensive relief fragmentation, high rock ledges, strong inclination of slopes, deep ravines, stone slopes, glacial types of relief, duration of snow cover, mountain-tundra climate, lack of vegetation cover etc. spiders are not found in subnival landscape.

In mountain-meadow landscape 49 spider species (15.1%) from 16 families were found: *Araniella opisthographa*, *Argiope bruennichi*, *Larinioides patagiatus*, *Mangora acalypha*, *Neoscona adianta*, *Nuctenea umbratica*, *Zilla diodia*, *Clubiona frutetorum*, *C.neglecta*, *C.pseudoneglecta*, *Dictyna arundinacea*, *Dysdera raddei*, *Harpactea zjuzini*, *Callilepis nocturna*, *D.lapidus*, *D.pubescens*, *Gnaphosa lugubris*, *G.modestior*, *G.taurica*, *Micaria albovittata*, *Zelotes latreillei*, *Z.longipes*, *Linyphia triangularis*, *Pardosa hortensis*, *P.prativaga*, *Trochosa ruricola*, *Oxyopes heterophthalmus*, *Pholcus phalangioides*, *Pisaura mirabilis*, *P.novicia*, *Euophrys frontalis*, *Evarcha arcuata*, *Philaeus chrysops*, *Hypositticus relictarius*, *Metellina segmentata*, *Pachygnatha degeeri*, *Asagena phalerata*, *Parasteatoda lunata*, *Phylloneta impressa*, *Steatoda bipunctata*, *S.castanea*, *S.paykulliana*, *Theridion melanurum*, *T.petraeum*, *Misumena vatia*, *Xysticus cristatus*, *X.lanio*, *Uloborus walckenaerius*.

17 of these species were collected only in mountain-meadow landscape.

In mountain-forest landscape 69 species of spiders (21.2%) from 19 families were found: *Agelena labyrinthica*, *A.orientalis*, *Agalenatea redii*, *Araniella opisthographa*, *Argiope bruennichi*, *Cercidia prominens*, *Mangora acalypha*, *Neoscona adianta*, *Dysdera armenica*, *Filistata insidiatrix*, *Anagraphis pallens*, *Drassodes lapidosus*, *Drassyllus praeficus*, *Haplodrassus dalmatensis*, *Nomisia exornata*, *Marinarozelotes barbatus*, *Urozelotes rusticus*, *Agyneta sp.*, *Tenuiphantes tenuis*, *Arctosa tbilisiensis*, *Aulonia kratochvili*, *Lycosa praegrandis*, *Pardosa hortensis*, *P.prativaga*, *P.proxima*, *P.vittata*, *Trochosa terricola*, *Zora silvestris*, *Oecobius cellariorum*, *O.nadiae*, *Oxyopes heterophthalmus*, *O.lineatus*, *Philodromus aureolus*, *P.dispar*, *P.poecilus*, *Tibellus oblongus*, *Holocnemus pluchei*, *Pholcus phalangioides*, *Pisaura novicia*, *Ballus chalybeius*, *Cyrba algerina*,

*Evarcha arcuata*, *Heliophanus cupreus*, *Menemerus semilimbatus*, *Mogrus neglectus*, *Philaeus chrysops*, *Phintella castrisiana*, *Plexippus devorans*, *Micrommata virescens*, *Tetragnatha montana*, *Tetragnatha* sp., *Cryptachaea riparia*, *Enoplognatha thoracica*, *Kochiura aulica*, *Parasteatoda lunata*, *Phylloneta impressa*, *Platnickina tincta*, *Steatoda albomaculata*, *S. paykulliana*, *S. triangulosa*, *Theridion melanurum*, *Runcinia grammica*, *Synema globosum*, *Thomisus onustus*, *Tmarus punctatissimus*, *Xysticus bifasciatus*, *X.kochi*, *Nurscia albomaculata*, *Uloborus walckenaerius*.

15 of these species occur only in mountain-forest landscape in Gyandja-Gazakh zone.

In mountain steppe landscape 63 species of spiders (19,4%) from 12 families were revealed: *Agalenatea redii*, *Araneus diadematus*, *Hypsosinga albovittata*, *Larinioides patagiatus*, *Mangora acalypha*, *Nuctenea umbratica*, *Zygiella x-notata*, *Clubiona alpicola*, *Dysdera* sp.1, *Dysdera* sp.2, *Anagraphis pallens*, *Drassodes lapidosus*, *Drassyllus crimeaensis*, *D.jubatopalpis*, *Micaria albovittata*, *Nomisia conigera*, *Zelotes longipes*, *Z.petrensis*, *Z. subterraneus*, *Diplostyla concolor*, *Alopecosa cursor*, *Alopecosa* sp., *Arctosa cinerea*, *Aulonia albimana*, *Hogna radiata*, *Pardosa hortensis*, *P.italica*, *P.proxima*, *Pardosa* sp.1., *Pardosa* sp.2., *Pardosa* sp.3., *Pardosa* sp.4., *Pardosa* sp.5., *Pardosa* sp.6., *Pardosa* sp.7., *Pardosa* sp.8., *Pardosa* sp.9., *Pirata piraticus*, *Trochosa ruricola*, *T.spinipalpis*, *Philodromus* sp.1, *Philodromus* sp.2, *Holocnemus pluchei*, *Pholcus phalangioides*, *Phrurolithus* sp., *Chinattus caucasicus*, *Cyrba algerina*, *Menemerus semilimbatus*, *Philaeus chrysops*, *Phlegra bresnieri*, *Plexippoides gestroi*, *Metellina merianae*, *M.segmentata*, *Pachygnatha degeeri*, *Pachygnatha* sp., *Tetragnatha extensa*, *Cryptachaea riparia*, *Robertus arundineti*, *Steatoda albomaculata*, *S.paykulliana*, *Psammitis ninnii*, *P.sabulosus*, *Bassaniodes tristrami*.

33 of these species do not frequent other areas except for this type of landscape.

In piedmountain dry steppe and semidesert landscapes 249 (76,6%) species of spiders belonging to 30 families were sampled: *Agelena orientalis*, *Tegenaria domestica*, *Amaurobius similis*, *Agalenatea redii*, *Araneus angulatus*, *A.diadematus*, *A.grossus*,

*A.marmoreus*, *Araniella cucurbitina*, *A.opisthographa*, *Argiope bruennichi*, *A.lobata*, *Cyclosa conica*, *Hypsosinga pygmaea*, *H.sanguinea*, *Larinioides cornutus*, *Mangora acalypha*, *Neoscona adianta*, *Neoscona subfusca*, *Singa hamata*, *Zygiella atrica*, *Z.x-notata*, *Clubiona corticalis*, *C.frutetorum*, *C.neglecta*, *Dictyna latens*, *D.uncinata*, *Lathus humilis*, *L.stigmatisata*, *Nigma flavescens*, *N.walckenaeri*, *Dysdera azerbaijdzhanica*, *D.karabachica*, *Dysderella caspica*, *Stegodyphus lineatus*, *Cheiracanthium erraticum*, *C.mildei*, *C.pennyi*, *Cheiracanthium sp.*, *Filistata insidiatrix*, *Pritha crosbyi*, *Anagraphis pallens*, *Aphantaulax trifasciata*, *Civizelotes caucasicus*, *Drassodes caspius*, *Drassodes lapidosus*, *D.pubescens*, *Drassyllus praeficus*, *D.pumilus*, *D.pusillus*, *D.villicus*, *Haplodrassus dalmatensis*, *H.signifer*, *Gnaphosa azerbaijdzhanica*, *G.leporina*, *G.lucifuga*, *G.steppica*, *Micaria fulgens*, *M.rossica*, *Nomisia aussereri*, *N.conigera*, *N.ripariensis*, *Talanites sp.*, *Marinarozelotes barbatus*, *M.jaxartensis*, *M.malkini*, *T.pedestris*, *Urozelotes rusticus*, *Zelotes aeneus*, *Z.longipes*, *Z.subterraneus*, *Zelotes sp.1.*, *Zelotes sp.2.*, *Agyneta fuscipalpa*, *A.mesasiatica*, *Araeoncus caucasicus*, *Centromerus minor*, *Ceratinella brevis*, *Collinsia inerrans*, *Diplocephalus latifrons*, *D.picinus*, *Linyphia hortensis*, *Linyphia tenuipalpis*, *Microneta viaria*, *Neriere clathrata*, *N.emphana*, *N.peltata*, *Savignia frontata*, *Walckenaeria antica*, *Alopecosa aculeata*, *A.cuneata*, *A.farinosa*, *A.striatipes*, *Arctosa leopardus*, *A.tbilisiensis*, *Aulonia kratochvili*, *Geolycosa dunini*, *Pardosa agrestis*, *P.colchica*, *P.morosa*, *P.nebulosa*, *P.pontica*, *P.tatarica*, *Pardosa sp.10.*, *Pardosa sp.11.*, *Pardosa sp.12.*, *Piratula latitans*, *Trochosa ruricola*, *T.terricola*, *Xerolycosa nemoralis*, *Ero aphana*, *Mimetus laevigatus*, *Mimetus sp.*, *Zora nemoralis*, *Z.silvestris*, *Oecobius nadiae*, *O.putus*, *O.maculatus*, *Oecobius sp.*, *Oxyopes globifer*, *O.heterophthalmus*, *O.lineatus*, *Palpimanus sp.*, *Philodromus azcursor*, *P.cespitem*, *P.dispar*, *P.emarginatus*, *P.histrion*, *P.poecilus*, *P.rufus*, *Philodromus sp.*, *Rhysodromus fallax*, *R.rikhteri*, *R.xinjiangensis*, *Thanatus imbecillus*, *T.kitabensis*, *T.oblongiusculus*, *T.vulgaris*, *Tibellus oblongus*, *Holocnemus pluchei*, *Pholcus opilionoides*, *P.phalangioides*, *Spermophora senoculata*, *Phrurolithus festivus*,

*Pisaura novicia*, *Asianellus festivus*, *Attulus ammophilus*, *Ballus chalybeius*, *Bianor albobimaculatus*, *Carrhotus xanthogramma*, *Chalcoscirtus infimus*, *Cyrba algerina*, *Evarcha arcuata*, *E.laetabunda*, *Heliophanus auratus*, *H.cupreus*, *H.curvidens*, *H.dunini*, *H.equester*, *H.mordax*, *Heliophanus sp.*, *Macaroeris nidicolens*, *Menemerus semilimbatus*, *M.taeniatus*, *Mogrus neglectus*, *Pellenes geniculatus*, *P.nigrociliatus*, *Philaeus chrysops*, *Phintella castrisiana*, *Phlegra bresnieri*, *P.cinereofasciata*, *P.fasciata*, *Pseudeuophrys obsoleta*, *Pseudicius badius*, *P.encarpatus*, *Salticus tricinctus*, *Sibibianor turkestanicus*, *Scytodes thoracica*, *Micrommata virescens*, *Olios sericeus*, *Metellina merianae*, *Pachygnatha clerki*, *P.degeeri*, *P.listeri*, *Tetragnatha extensa*, *T.isidis*, *T.nigrita*, *T.pinicola*, *Tetragnatha sp.*, *Tetragnatha sp.*, *Asagena phalerata*, *Crustulina guttata*, *C.sticta*, *Enoplognatha latimana*, *E.macrochelis*, *E.mediterranea*, *E.quadripunctata*, *E.oelandica*, *E.ovata*, *Enoplognatha sp.*, *Episinus truncatus*, *Heterotheridion nigrovariegatum*, *Latrodectus tredecimguttatus*, *Parasteatoda lunata*, *P.tepidariorum*, *Phylloneta impressa*, *Platnickina tincta*, *Simitidion simile*, *Steatoda albomaculata*, *S.castanea*, *S.dahli*, *S.grossa*, *S.paykulliana*, *S.triangulosa*, *Theridion melanurum*, *T.pictum*, *Theridion sp.*, *Bassaniodes loeffleri*, *Diaea dorsata*, *Ebrechtella tricuspadata*, *Monaeses israeliensis*, *Ozyptila clavata*, *O.praticola*, *O.rigida*, *O.tricoloripes*, *Ozyptila sp.*, *Pistius truncatus*, *Runcinia grammica*, *Synema caucasicum*, *S.globosum*, *S.plorator*, *Thomisus onustus*, *Tmarus punctatissimus*, *Xysticus acerbus*, *X.cristatus*, *X.kempeleni*, *X.kochi*, *X.laetus*, *X.ulmi*, *Nurscia albomaculata*, *Tinanoeca caucasica*, *T.schineri*, *T.tristis*, *T.veteranica*, *Uloborus plumipes*, *U.walckenaerius*, *Zodarion caucasicum*, *Z.thoni*.

Among recorded species 182 were found only in this type of landscape.

The degree of similarity between spider faunas of different landscapes was calculated with Chekanovski-Serensen index ( $I_{CS}$ ) by paired comparison (Table 2).

**Table 2****The coefficient of similarity (Ics) of landscapes by species composition**

Landscapes	A	B	C	D
A		28,8	23,2	13,4
B	28,8		22,7	30,8
C	23,2	22,7		14,1
D	13,4	30,8	14,1	

Note: A-mountain-meadow, B-mountain-forest, C-mountain-steppe, D-semidesert and steppe.

The highest value of Chekanovski-Serensen index (30.8%) was between mountain-forest and semidesert and lowland steppe landscapes, relatively lower value (28,8%) between mountain-meadow and mountain-forest landscapes. The index of similarity between mountain-meadow and mountain-steppe landscapes was 23.2%. The difference in geological structure, climate specificity, floral composition, and other biotic and abiotic factors probably influenced lower similarity of spider faunas between both mountain-meadow and mountain steppe landscapes and semidesert and dry steppe landscape complex, with degree of similarity (13,4% and 14,1% respectively).

## **VI CHAPTER. ZOOGEOGRAPHICAL ANALYSIS OF SPIDER FAUNA OF GANJA - GAZAKH ZONE**

Based on results of our investigation and detailed analysis of ranges of spider species 20 different zoogeographical complexes are recognized: Palearctic (66 species), Amfi Palearctic (4 species), West Palearctic (7 species), Holarctic (32 species), Cosmopolit (11 species), Euro - Siberian (36 species), Euro - Caucasus (20 species), Europe-Central Asia (33 species), East Mediterranean (2 species), East Mediterranean - Central Asia (12 species), Mediterranean - Caucasian (15 species), Mediterranean - Siberian (2 species), Mediterranean - Central Asian (19 species), Caucasus - Central Asia (9 species), Caucasus - Siberian (1 species), Caucasian endemics (8 species), Azerbaijan endemics (6 species), Turanian (2 species), Old World (3 species), Caucasus – Asia Minor (3 species).

## RESULTS

1. The fauna of Ganja-Gazakh zone is investigated for the first time and as a result 325 species of spiders from 144 genera and 30 families are revealed.
2. Among recorded species 6 (*Clubiona frutetorum* L.Koch, 1867, *Philodromus poecilus* (Thorell, 1872), *Pseudicius palaestinensis* Strand, 1915, *Monaeses israeliensis* Levy, 1973, *Ozyptila claveata* (Walckenaer, 1837), *Zelotes aeneus* (Simon, 1878)) to be new records for Caucasus, 1 genus (*Olios* Walckenaer, 1837) and 9 species (*Zygiella atrica* (C.L.Koch, 1845), *Anagraphis pallens* Simon, 1893, *Drassodes caspius* Ponomarev & Tsvetkov, 2006, *Drassyllus villicus* (Thorell, 1875), *Pardosa prativaga* (L.Koch, 1870), *Pisaura novicia* (L.Koch, 1878, *Rhysodromus rikhteri* (Logunov & Huseynov, 2008), *Synema caucasicum* Utochkin, 1960, *Xysticus bifasciatus* C.L.Koch, 1837) are new to the fauna of Azerbaijan, and 195 species are recorded in the fauna of Ganja-Gazakh zone for the first time.
3. A new synonymies are established for two species (*Talanites aculeatus*=*Anagraphis pallens* vø *Prosthesima (Zelotes) semibadius*=*Trachyzelotes jaxartensis*, recently *Marinarozelotes jaxartensis*).
4. Bioecological peculiarities of most spider species of Ganja-Gazakh zone were analysed and they were classified from ecological point of view. It was revealed that some part of species (20 species-6,1%) live near human dwellings. These species are eusynantrops (real synantrops, 12 species - 4%) and hemisynantrops (half-synantrops, 8 species - 2,5%). Other species according to preferred habitats can be divided into 4 groups: herpetobionts (177 species -55%), hortobionts (87 species - 27%), dendrobionts (26 species - 8%) and tamnobionts (15 species - 5%).
5. By prey composition spiders are divided into 2 ecological groups: poliphagous (297 species - 92%) and stenophagous (myrmecophagous (16 species - 4,9%), araneophagous (6 species - 1,8%), oniscophagous (6 species - 1,8 %)). By manner of prey hunting spiders are divided into two large groups: wandering (207 species - 64%) and web-building (118 species - 36,3%) .
6. To assess diversity and similarity of spider fauna of Ganja-Gazakh

zone with those of other areas of Azerbaijan Brey-Kertis coefficient of faunistic similarity was used. The greatest similarity was recorded (60,2%) between Ganja-gazakh zone and Absheron-Gobustan district spider faunas. Ganja-Gazakh zone and Absheron-Gobustan district similarity in spider fauna with Sheki-Zagatala area constituted 59,2%. The similarity between three above areas and Lenkoran nature area was of 58.4%.

7. Distribution of spiders of Ganja-Gazakh zone between different landscapes is thoroughly studied. In this way, 49 species from 16 families (15%) in mountain-meadow, 69 species from 19 families (21,2%) in mountain-forest, 63 species from 12 families (19,4%) in mountain steppes and 249 species from 30 families (77%) in piedmountain lowland dry steppes and semideserts landscapes were revealed.
8. Zoogeographical analysis of spider fauna of Ganja-Gazakh zone was made for the first time. The following zoogeographical complexes are established: Palearctic (66 species), Amfi Palearctic (4 species), Western Palearctic (7 species), Holarctic (32 species), Cosmopolite (11 species), Euro-Siberian (36 species), Euro-Caucasian (20 species), Europe-Central Asia (33 species), East -Mediterranean (2 species), East-Mediterranean – Central Asia (12 species), Mediterranean-Caucasian (15 species), Mediterranean-Siberian (2 species), Mediterranean-Central Asia (19 species), Caucasus-Central Asia (9 species), Caucasus-Siberian (1 species), Caucasian endemics (8 species), Azərbayjan endemics (6 species), Turanian (2 species), Old World (3 species), Caucasus-Asia Minor (3 species).

### **PRACTICAL SUPPOSALS**

1. Based on the obtained data on zoogeographical complexes, faunistic composition and systematics of spiders of zone compilation of regional catalogue.
2. Using the results, both from practical and theoretical point of view in educational process in higher educational Institutions of appropriate profile.
3. Using spiders as entomophages against pests in nature and agricultural biocenoses to reduce using chemicals.

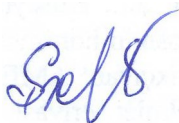


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