

**REPUBLIC OF AZERBAIJAN**

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**ABSTRACT**

of the dissertation for the degree of Doctor of Philosophy

**FAUNA, SYSTEMATICS AND ECOLOGY OF  
ERYTHRAEIDES (ACTINEDIDA: ERYTHRAEIDAE) MITES  
OF THE NATURAL REGION OF THE GREAT CAUCASUS**

Specialty: 2401.01 – Zoology

Scientific field: History

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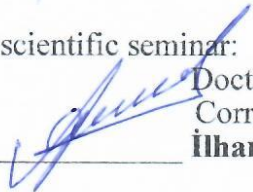
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## INTRODUCTION

**Relevance and development of the topic.** Mites are one of the most common groups in the insect kingdom. Currently, there are 171 genera , 2 subspecies (Acariformes, Actinedida) and more than 50,000 species of mites in the world. 1301 species of mites have been found in Azerbaijan. In the Caucasus, including Azerbaijan, Erythraeidae is a poorly studied family of mites. The study of these mites carries great theoretical and practical importance. Erythroid mite larvae are carriers of various diseases caused by ectoparasites of arthropods and invertebrates.

Daytonymphs and mature individuals are active predators and effective regulators of the number of pests of agricultural and forest plants. For example, *Balaustium murorum* (Hermann, 1804) is an effective predator of the *Halotydeus destructor* mite (Wang et al., 2000) (family Penthaleidae). *Balaustium putmani* Smiley, 1968 regulates sucking pests in Canadian orchards. *Balaustium leander* (Haitlinger, 2000) feeds on significant plant pests in greenhouses and is used in biological control as a regulator of their numbers<sup>1</sup>. Individuals of some species of the genus *Balaustium* attack humans and develop dermatids.

Poor study of the fauna, taxonomy, biology and ecology of erythroid mites prevents their use in biological control of plant pests in Azerbaijan. In total, there were 6 species belonging to 5 genera of 5 subfamilies of erythroid mites- *Eatoniana plumifera* (Birula, 1893), *Leptus molochinus* (CLKoch, 1837), *Leptus species*, *Abrolophus species*, *Charletonia cardinalis* (Pallas, 1772), *Myrmicothrombium species* were found in the republic.<sup>2</sup> Poor knowledge of the theoretical and practical significance of

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<sup>1</sup> Haitlinger, R. New larval mites (Acari: Prostigmata: Erythraeidae, Microtrombididae, Trombididae) from Turkey, Peru and Poland // *Wiadomosci Parazytologiczne*, -2000b, 46 (3), -p. 379-396.

<sup>2</sup> Aslanov, O.X., Musayeva, Z.Y. Azərbaycan akarofaunasının öyrənilməsinə dair // Bakı: Azərbaycan Zooloqlar cəmiyyəti I qurultayın materialları (məqalələr toplusu), – 2003, – s. 144-146; Aslanov, O.X. К изучению хищных актинедидных клещей (Acariformes: Actinedida) виноградников Азербайджана // – Bakı: Azərbaycan Zooloqlar Cəmiyyətinin əsərləri, – 2008. № 1, – s. 210-216; Aslanov, O.X., Рубцова, Л.Е., Ханбекова, Е.М. Клещи, ассоциированные с медоносной пчелой *Apis mellifera* саuc. Gorb. в Азербайджане // – Bakı: Azərbaycan Zooloqlar Cəmiyyətinin əsərləri, – 2015, 7 (2): – s. 119-126; Aslanov, O.X. К изучению актинедидных клещей (Acariformes: Actinedida) Азербайджана // – Bakı: Zoologiya İnstitutunun əsərləri, – 2015a, 33 (1), – s. 168-176.

erythroid mites in the country shows the relevance of studying the fauna, taxonomy and ecology of erythroid mites in the natural region of the Greater Caucasus.

**Purpose and objectives of the research.** The main purpose of the research is to study the species composition and landscape-biotope distribution of erythroid mites in the Greater Caucasus natural region of Azerbaijan, determine the distribution of species over landscapes, conduct a zootechnical analysis of the fauna, as well as identify erythroid mites for biological control of insects and mites. In order to achieve this purpose, the following issues need to be examined:

1. Determine the species composition of the erythroid mites of the natural region of Greater Caucasus;
2. Analysis of bioecological features of erythroid mites in the natural region of the Greater Caucasus;
3. Study of the distribution of erythroid mites in high-altitude and landscape zones, biochores and biotopes;
4. Zoographic analysis of erythroid mites in the study area, their division into ecological groups;
5. Compilation of tables for the identification of subspecies, genera and species of erythroid mites in the natural region of the Greater Caucasus.

**Research methods.** The material was collected using generally accepted entomological methods and techniques adopted in acrology. These techniques include whipping method, swing with a butterfly net, visual technique, eklektor, Barber snare techniques. The material was also taken from the topsoil. The species were diagnosed using various identification tables. The average number of individuals per unit area of the studied species was calculated using the abundance coefficient. At the end, the collected mites were marked and micropreparations were prepared under an MBS-1 microscope.

**The main provisions of the defence:**

1. Review of erythroid mite species in the natural region of the Greater Caucasus;
2. Distribution of erythroid mites in the natural region of the Greater Caucasus by physical-geographical regions, landscape zones and landscapes;

3. Distribution of erythreid mites in the natural region of the Greater Caucasus by altitudinal zones, biochores and forest biotopes;

4. Zoographic analysis of the species included in the fauna of erythreid mites of the natural regions of Greater Caucasus.

**Scientific innovations of research work.** The research is the first planned and large-scale study conducted in the physical-geographical region of the Greater Caucasus. 25 species of erythroid mites (*Erythraeus gorcensis* Gabrys, 2016, *E.opilionoides* (C.L.Koch, 1837), *E.phalangoides* (De Geer, 1778), *E.adpendiculatus* (Schrank, 1781), *E.regalis* (C.L.Koch, 1837), *Curteria episcopalis* (C.L.Koch, 1837), *Eatoniana plumifera* (Birula, 1893), *Leptus rubricatus* (C.L.Koch, 1837), *L.longipilis* (Berlese, 1910), *L.slivovi* Beron, 1975, *L.molochinus* (C.L.Koch, 1837), *L.clethrionomydis* Haitlinger, 1987, *Abrolophus artemisiae* (Schrank, 1803), *A.miniatus* (Hermann, 1804), *A.crassitarsus* (Schweizer, 1951), *A.rhopalicus* (C.L.Koch, 1837), *A.passerinii* (Berlese, 1904), *A.strojnyi* Gabrys, 1992, *A.norvegicus* (Thor, 1900), *A.quisquiliarus* (Hermann, 1804), *Charletonia globigera* (Berlese, 1885), *C.cardinalis* (Pallas, 1772), *Balaustium xerothermicum* Gabrys, 2000, *B.unidentatum* (Tra-gardh, 1904), *Neobalaustium* species belonging to 8 genera (*Erythraeus* Latreille, 1806, *Curteria* Southcott, 1961, *Eatoniana* Cambridge, 1898, *Leptus* Latreille, 1776, *Charletonia* Oudemans, 1910, *Abrolophus* Berlese, 1891, *Balaustium* Heyden, 1826, *Neobalaustium* Wilmann, 1951) were found in the Azerbaijani part of the Greater Caucasus. Of these, 1 subfamily (Balaustiinae Grandjean, 1947), 4 genera (*Erythraeus*, *Curteria*, *Balaustium*, *Neobalaustium*) and 22 species (*Erythraeus gorcensis*, *E.opilionoides*, *E.phalangoides*, *E.adpendiculatus*, *E.regalis*, *Curteria episcopalis*, *Leptus rubricatus*, *L.longipilis*, *L.slivovi*, *L.clethrionomydis*, *Abrolophus artemisiae*, *A.miniatus*, *A.crassitarsus*, *A.rhopalicus*, *A.passerinii*, *A.strojnyi*, *A.norvegicus*, *A.quisquiliarus*, *Charletonia globigera*, *Balaustium xerothermicum*, *B.unidentatum*, *Neobalaustium* species) are new to the Caucasian fauna.

2 subfamilies (Callidosomatinae Southcott, 1961 vø Abrolophinae Witte, 1995) 2 genera (*Charletonia* vø *Abrolophus*) and 1 species [*Charletonia cardinalis* (Pallas, 1772)] are new for the Greater

Caucasus natural region.

For the first time in the Caucasus, the distribution of erythroid mites, landscapes, altitudes, biocoenoses, as well as forest biotopes have been studied. For the first time, a zoogeographic analysis of the erythroid mite fauna of the Natural Region of the Greater Caucasus has been carried out. Also, for the first time in the Caucasus, erythroid mites were studied by dividing them into ecological groups.

**Theoretical significance of the research.** Since the investigated mite fauna in the natural region of the Greater Caucasus has not been studied in detail, and the results obtained are new, it is important as a theoretical and scientific basis not only for Azerbaijan, but also for the fauna of the Greater Caucasus. The fauna of erythroid mites of the Greater Caucasus and the peculiarities of their distribution have been studied in detail. The data obtained in the study of the species composition, ecology and biology of mites can be used to study the taxonomy and zoogeography of mites.

**Practical significance of the research.** Descriptive tables of subfamilies, genera and species of erythroid mites have been prepared. Descriptive tables can be used as practical tools by acrologists and university teachers and students whose profiles are the same. The promising species for biological control of insect pests and mites, sucking pests of agricultural crops have been identified.

**Approbation and application of research.** The main results of the dissertation work are published in authoritative scientific journals of the Republic and abroad. My article called "Erythraeid mites (Acariformes: Actiniedida: Erythraeidae) Greater Caucasus region of Azerbaijan" was listened to and discussed at conferences in the Ukrainian Journal of Ecology that included in the system of external indexing (web of science), at the Republican Scientific Conference called "Biologiyanın müasir problemləri" (Sumgayit, 2018), at the conference called "Gənc alimlərin III beynəlxalq elmi konfransı" (Ganja, 2018), XXII Republican Scientific Conference of Doctoral Students and Young Researchers dedicated to the 100th anniversary of the Azerbaijan People's Republic (Baku, 2019), at the International Scientific Conference titled "Müasir tə-

biət və iqtisad elmlərinin aktual problemləri” (Ganja, 2019), at the VIII Republican Scientific Conference named “XXI əsrdə ekologiya və torpaqşünaslıq elmlərinin aktual problemləri” dedicated to the 96th anniversary of national leader Heydar Aliyev (Baku, 2019), at the XXIII Republican Scientific Conference of Doctoral Students and Young Researchers, at the conference called Научный диалог: молодой ученый. Сборник статей по материалам XXV международной научно-практической конференции.

Based on the materials of dissertations, 18 scientific works were published. Of these, 11 articles (4 foreign, 7 local) and 7 theses.

The research results can be used in the educational process in higher educational institutions, when writing books and monographs, when choosing promising species for biological control of plant pests.

**The name of the organization in which the dissertation work is carried out.** The research was carried out at the Department of Biology and Teaching Technology of the Azerbaijan State Pedagogical University and in the laboratory of dry invertebrates of the Institute of Zoology of the National Academy of Sciences of Azerbaijan.

**Volume and structure of the dissertation.** The dissertation is 160 pages long and consists of "Introduction", 6 chapters, including "Literary Information", "Research Material and Methodology", "Personal Research", "Results", "Recommendations" and "References". The dissertation uses 160 references in Azerbaijani, English, Russian and other foreign languages. The thesis includes 9 tables, 45 original photographs, 3 figures.

In the structure of the thesis, Introduction - 5 pages, 9181 characters, Chapter I - 13 pages, 23167 characters, Chapter II - 8 pages, 12629 characters, Chapter III - 9 pages, 11092 characters, Chapter IV - 80, 17301 characters, Chapter V is 12 pages 20159 characters, Chapter VI - 11 pages, 16182 characters, conclusion is 2 pages 2592 characters and practical suggestions 1 page 637 characters and total (without tables, figures, graphs and bibliography) the thesis consists of 220905 characters.

## **CHAPTER I. LITERARY INFORMATION. HISTORY OF STUDYING ERYTHRID MITES**

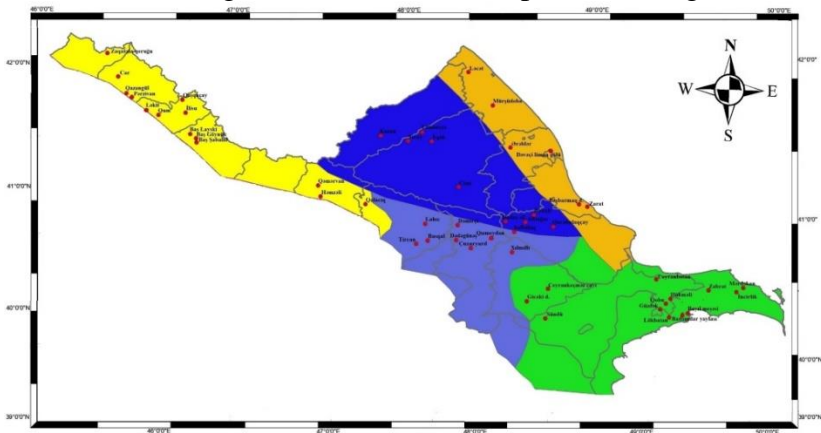
Based on the literature presented in this chapter, information is presented on the results of research carried out to date in the Azerbaijani natural region of the Greater Caucasus. From the literature it becomes clear that research into the world of mites in the natural region of the Greater Caucasus was more active at the end of the XX century than in previous years. The study of erythroid mites first began in 1758.

## **CHAPTER II. BRIEF OVERVIEW OF PHYSICAL AND GEOGRAPHICAL FEATURES OF THE NATURAL REGION OF GREAT CAUCASUS**

Chapter II of the study examines information on the geographic location, topography, climate, rivers, vegetation, fauna and flora of the natural region of the Greater Caucasus and the 5 physical regions (Gonaqkend, Samur-Davachi, Zaqatala-Lahige, Shamakhi (Daghlig Shirvan), Gobustan-Absheron) that are part of this region.

## **CHAPTER III. MATERIAL AND METHODOLOGY**

The studies were carried out in 2017-2019 in the physical and geographical region of the Greater Caucasus (Zagatala, Gakh, Sheki, Gabala, Ismayilli, Shamakhi, Gobustan, Khizi, Siyazan, Shabran, Guba, Gusar, Khachmaz regions and the Absheron peninsula) (figure 3.1).



**Figure 3.1. Observation platforms and collection points for materials in the studied territories**



Materials were collected in spring, summer and autumn. The collected materials were studied in the laboratory "Dry invertebrates" of the Institute of Zoology of ANAS.

The material was collected in 2017 in Siyazan, Guba, Khizi and Zagatala regions. In 2018, material was collected and preparations were made from 13 regions of the Greater Caucasus and the Absheron Peninsula. In 2019, the material was collected from Siyazan, Shabran, Shamakhi, Gobustan and Zagatala regions.

### **3.1. Object of research, collection of materials and methods**

The object of the study is a complex of larvae and adults of erythroid mites collected from different biotopes of the Azerbaijani part of the natural region of the Greater Caucasus.

During the study, more than 2,500 samples of grasses, semishrubs, shrubs, trees, mosses, sedges, ferns, stones, sedges, soil, floors, wood chips, as well as arthropods (insects and spiders) were studied.

In the course of the experiment, more than 2000 erythroid mites were individually collected and more than 200 preparations were prepared. In addition, a collection of mites stored in the laboratory "Dry invertebrates" of the Institute of Zoology of ANAS was examined.

The figures used in the dissertation belong to the author.

## **CHAPTER IV. MITE FAUNA OF THE GREAT CAUCASUS NATURAL REGION**

### **4.1. Erythraeidae mite fauna of the Greater Caucasus natural region**

This chapter provides an overview of the fauna of erythroid mites found by us in the study areas. Prior to our research, the fauna of erythroid ticks in the Caucasus, including Azerbaijan, was almost never studied. From the study of the literature, it is clear that before our research, only 6 species (*Eatoniana plumifera* (Birula, 1893), *Leptus molochinus* (C.L.Koch, 1837), *Leptus species*, *Abrolophus species*, *Charletonia cardinalis* (Pallas, 1772), *Myrmicothrombium species*) belonging to 5 genera (*Erythraeus*, *Leptus*, *Abrolophus*, *Charletonia*, *Myrmicothrombium*) of 5 subspecies (*Erythraeinae* Robineau-Desvoidy, 1928, *Leptinae*, Southcott, 1957, *Abrolophinae*, Witte, 1995, *Callidosomatinae*, Southcott, 1961, *Myrmicothrombiinae*, Southcott, 1957)

were found in the Caucasus.<sup>3</sup> In the Greater Caucasus of Azerbaijan, only 2 species (*Leptus molochinus*, *Eatoniana plumifera*) of 2 genera (*Leptus*, *Eatoniana*) have been identified.<sup>4</sup>

At present, as a result of our research, 28 species (*Erythraeus phalongoides* (De Geer, 1778), *E.regalis* (C.L.Koch, 1837), *E.adpendiculatus* (Schrank, 1781), *E.opilionoides* (C.L.Koch, 1837), *E.gorcensis* Gabrys, 2016, *Curteria episcopalis* (C.L.Koch, 1837), *Eatoniana plumifera*, *E.plumipes* (L.Koch, 1856), *Leptus slivovi* (Beron, 1975), *L.clethrionomydis* Haitlinger, 1987, *L.molochinus* (C.L.Koch, 1837), *L.rubricatus* (C.L.Koch, 1837), *L.longipilis* (Berlese, 1910), *Leptus species*, *Abrolophus quisquiliarum* (Hermann, 1804), *A.artemisiae* (Schrank, 1803), *A.miniatus* (Hermann, 1804), *A.crassitarsus* (Schweizer, 1951), *A.rhopalicus* (C.L.Koch, 1837), *A.passerinii* (Berlese, 1904), *A.strojnyi* Gabrys, 1992, *A.norvegicus* (Thor, 1900), *A.species*, *Charletonia globigera* (Berlese, 1885), *Ch.cardinalis* (Pallas, 1772), *Balaustium xerothermicum* Gabrys, 2000, *B.unidentatum* (Tragardh, 1904, *Neobalaustium species*) of erythroid mites belonging to 9 genera (*Erythraeus* Latreille, 1806, *Curteria* Southcott, 1961, *Eatoniana* Cambridge, 1898, *Leptus* Latreille, 1776, *Charletonia* Oudemans, 1910, *Abrolophus* Berlese, 1891, *Myrmicotrombium* Womersley, 1934, *Balaustium* v.Heyden, 1826, *Neobalaustium* Willmann, 1951) of 6 subfamilies (*Erythraeinae*, *Leptinae*, *Callidosomatinae*, *Abrolophinae*, *Myrmi-*

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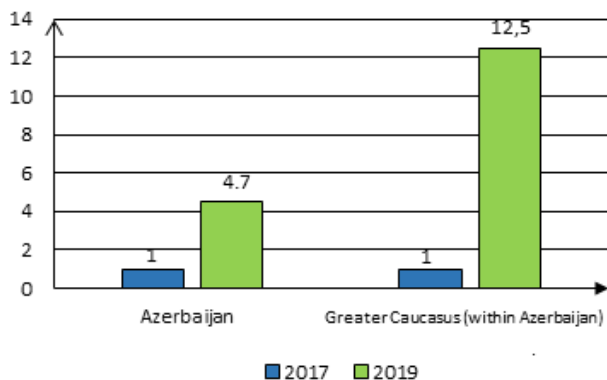
<sup>3</sup> Aslanov, O.X., Musayeva, Z.Y. Azərbaycan akarofaunasının öyrənilməsinə dair // Bakı: Azərbaycan Zooloqlar cəmiyyəti I qurultayın materialları (məqalələr toplusu), – 2003, – s. 144-146; Aslanov, O.X. К изучению хищных актинедидных клещей (Acariformes: Actinedida) виноградных Азербайджана // – Bakı: Azərbaycan Zooloqlar Cəmiyyətinin əsərləri, – 2008. № 1,– s. 210-216; Aslanov, O.X., Рубцова, Л.Е., Ханбекова, Е.М. Клещи, ассоциированные с медоносной пчелой *Apis mellifera* саuc. Gorb. в Азербайджане // – Bakı: Azərbaycan Zooloqlar Cəmiyyətinin əsərləri, – 2015, 7 (2): – s. 119-126; Aslanov, O.X. К изучению актинедидных клещей (Acariformes: Actinedida) Азербайджана // – Bakı: Zoologiya İnstitutunun əsərləri, – 2015a, 33 (1),– s. 168-176; Beron, P. Acarorum Catalogus I Acariformes: Calyptostomatoidea (Calyptostomatoidea) (Calyptostomatoidea) (Calyptostomatoidea) (Calyptostomatoidea) (Calyptostomatoidea) (Calyptostomatoidea) / P.Beron. -Sofia: Pensoft and Nat. Mus. Natur. Hirst. -2008. -271 p.

<sup>4</sup> Aslanov, O.X., Musayeva, Z.Y. Azərbaycan akarofaunasının öyrənilməsinə dair // Bakı: Azərbaycan Zooloqlar cəmiyyəti I qurultayın materialları (məqalələr toplusu), – 2003, – s. 144-146.

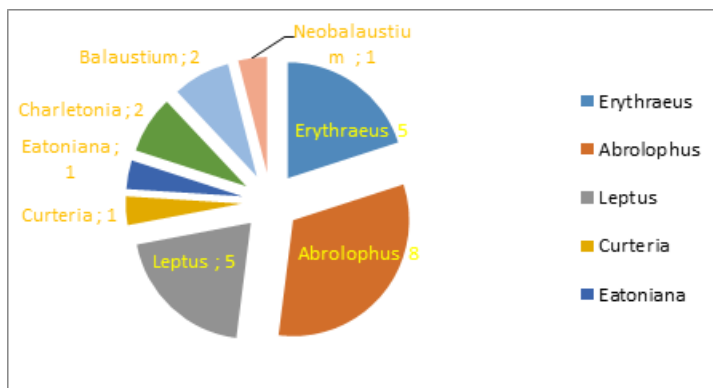
*cothrombiinae*, *Balaustiinae* Grandjean, 1947) have been found in the fauna of the Caucasus. Based on the results of our research, it can be said that the number of species of erythroid ticks in the Caucasus has increased 4.7 times. (Figure 4.1.1.).

In the Azerbaijani part of the Greater Caucasus, the number of species found increased 12.5 times, from 2 species (*Leptus molochinus*, *Eatoniana plumifera*) known to our research to 25 species.

Information on the distribution of species of the family Erythraeidae in the natural region of the Greater Caucasus by sex is shown in Figure 4.1.2.



**Figure 4.1.1. Numerical dynamics of Eritreid mites of registered species in Azerbaijan and the Greater Caucasus (within Azerbaijan)**



**Figure 4.1.2. Distribution of species of the family Erythraeidae in the natural region of the Greater Caucasus**

As can be seen from the data on the figure, the number of species in genera is unevenly distributed. *Erythraeus* (5 species = 20%) is the largest genus in terms of the number of species. The number of species of other genera was as follows:

- *Abrolophus* 8 species = 32 %,
- *Leptus* 5 species = 20%;
- *Curteria* 1 species = 4%;
- *Eatoniana* 1 species = 4%;
- *Charletonia* 2 species = 16 %;
- *Balaustium* 2 species = 16%;
- *Neobalaustium* 1 species = 4%.

#### **4.2. Determinants of subfamilies, genera and species of erythroid mites of the Greater Caucasus**

According to the results of the studies carried out in this subsection, defining tables are given on the stages of development and species of the Erythraeidae family, the post-marting stages of Erythraeid mites by subfamilies (on larvae), genera and species, subtypes belonging to the Erythraeidae family on larvae), species belonging to the Greater Caucasus (within Azerbaijan) *Leptus* species.

#### **4.3. Species composition of erythroid mites on the territory of Azerbaijan in the natural region of the Greater Caucasus**

*Neobalaustium* species, that is a species of the genus *Neobalaustium* Willmann, was found in the Azerbaijani part of the Greater Caucasus. The genus *Neobalaustium* is new to the fauna of the Caucasus.

Mites belonging to the Erythraeidae family in the natural region of the Greater Caucasus in Azerbaijan are based on 3 species, they are *Erythraeus* (represented by 5 species in the fauna of the region), *Leptus* (represented by 5 species in the fauna of the region) and *Abrolophus* (represented by 8 species in the fauna of the region). In total, these 3 genera are represented by 18 species in the natural region of the Greater Caucasus. This is 72% of the total number of erythroid mites found in the province.

Table 4.3.1

## List of erythreid mites of the Greater Caucasus (within Azerbaijan)

№	Name of species
subfamily: Erythraeinae Robinean-Desvoidy, 1928	
1	<i>Erythraeus gorcensis</i> Gabrys, 2016 <sup>++</sup>
2	<i>Erythraeus opilionoides</i> (C.L.Koch, 1837) <sup>++</sup>
3	<i>Erythraeus phalangoides</i> (De Geer, 1778) <sup>++</sup>
4	<i>Erythraeus adpendiculatus</i> (Schrank, 1781) <sup>++</sup>
5	<i>Erythraeus regalis</i> (C.L.Koch, 1837) <sup>++</sup>
6	<i>Curteria episcopalis</i> (C.L.Koch, 1837) <sup>++</sup>
7	<i>Eatoniana plumifera</i> (Birula, 1893)
subfamily: Leptinae Southcott, 1957	
8	<i>Leptus rubricatus</i> (C.L.Koch, 1837) <sup>++</sup>
9	<i>Leptus longipilis</i> (Berlese, 1910) <sup>++</sup>
10	<i>Leptus slivovi</i> Beron, 1975 <sup>++</sup>
11	<i>Leptus molochinus</i> (C.L.Koch, 1837)
12	<i>Leptus clethrionomydis</i> Haitlinger, 1987 <sup>++</sup>
subfamily: Callidosomatinae Southcott, 1961 <sup>+</sup>	
13	<i>Charletoniaglobigera</i> (Berlese, 1885) <sup>++</sup>
14	<i>Charletoniacardinalis</i> (Pallas, 1772) <sup>+</sup>
subfamily: Abrolophinae Witte, 1995 <sup>+</sup>	
15	<i>Abrolophus artemisiae</i> (Schrank, 1803) <sup>++</sup>
16	<i>Abrolophus miniatus</i> (Hermana, 1804) <sup>++</sup>
17	<i>Abrolophus crassitarsus</i> (Schweizer, 1951) <sup>++</sup>
18	<i>Abrolophus rhopalicus</i> (C.L.Koch, 1837) <sup>++</sup>
19	<i>Abrolophus passerinii</i> (Berlese, 1904) <sup>++</sup>
20	<i>Abrolophus strojnyi</i> Gabrys, 1992 <sup>++</sup>
21	<i>Abrolophus norvegicus</i> (Thor, 1900) <sup>++</sup>
22	<i>Abrolophus quisquiliarus</i> (Hermann, 1804) <sup>++</sup>
subfamily: Balaustiinae Granjena, 1947 <sup>++</sup>	
23	<i>Balaustium xerothermicum</i> Gabrys, 2000 <sup>++</sup>
24	<i>Balaustium unidentatum</i> (Trägårdh, 1904) <sup>++</sup>
25	<i>Neobalustium</i> species <sup>++</sup>

**Note:** <sup>++</sup> – New taxon to the fauna of the Caucasus;

<sup>+</sup> – New taxon for the studied area

#### **4.4. Fauna of predatory actinid mites of the natural region of Greater Caucasus**

In connection with the poor knowledge of predatory actinide mites in Azerbaijan, it was considered expedient to study the predatory actinide mites, which we encountered together with erythritic mites in the studied territories. Actinated mites are a large group of more than 21,000 species, including more than 80 out of 35 genera. They are found everywhere, in high mountains (in the Himalayas at an altitude of 5200 m above sea level) and in the depths of the abyss (up to 8000 m), in hot deserts and Antarctic ice, hot springs and tundra, bare rocks devoid of vegetation and soil, caves, swamps, wells, in various water bodies, etc. Many actined mites are of medical and veterinary importance.<sup>5</sup>

21 species of 9 genera were found in the territory of Zagatala region of Azerbaijan, of which *Leptus clethrionomydis* Haitlinger, 1987 was first mentioned for the Caucasian fauna. *Labidostomma caucasica* Reck, 1940 species has been identified as an indicator of the landscape of the mountain forest zone and broad-leaved lowland forests.

On the territory of the Altyaghadj National Park, 30 species of actinide mites were found, belonging to 17 seasons. In the Khachmaz region, 16 species of predatory actinid mites were found belonging to 8 seasons.

### **CHAPTER V. DISTRIBUTION OF ERYTHREIDS IN THE NATURAL REGION OF THE GREAT CAUCASUS BY PHYSICAL AND GEOGRAPHICAL REGIONS, LANDSCAPE ZONES AND LANDSCAPES**

#### **5.1. Distribution of erythroid mites of the Greater Caucasus natural region by physical-geographical regions**

It was found that in the natural region of the Greater Caucasus, erythroid mites are unevenly distributed over the physical and geographical regions. Thus, the richest species was recorded in Gobustan-

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<sup>5</sup> Aslanov, O.X., Əlizadə, G.Ə. Aktinedid gənələr (Acari: Actinedida: Acariformes) // Biologiyanın müasir problemləri Respublika elmi konfransının materialları, – Sumqayıt: – 2018, – s. 198-200; Aslanov, O.X., Əlizadə, G.Ə. Azərbaycanın çay plantasiyalarının yırtıcı aktinedid gənələri (Acari: Acariformes: Actinedida) // – Bakı: Pedaqoji universitetin xəbərləri, – 2018 a, 66 (3), – s. 92-97.

Apsheon (12 species from 7 genera) and Zagatala-Lakhidzha (13 species from 7 genera) physical-geographical regions. In the physical-geographical region of Gonakkend, 11 species of 4 genera were found. The smallest number of species was found in Shamakhi (7 species from 5 genera) and Samur-Davachi (3 species from 3 genera) physical-geographical regions.

Erythroid mites of the genus *Leptus* were found in the physical-geographical regions of Gonagkend, Zagatala-Lahij, Gobustan-Absheon and Samur-Davachi, and erythroid mites of the genus *Abrolophus* - in the regions of Gonagkend, Shamakhi, Zagatala-Lahij and Gobustan-Absheon. Species belonging to the genus *Leptus* have not been found in the physical-geographical region of Shamakhi, and species belonging to the genus *Abrolophus* have not been found in the physical-geographical region of Samur-Davachi.

## 5.2. Distribution of erythroid mites in the landscape zones of the Greater Caucasus

In the natural region of the Greater Caucasus, our research was carried out in 4 landscape zones - a semi-desert landscape zone, a mountain-steppe landscape zone, a mountain-forest landscape zone and a subalpine landscape zone. The results of our research have shown that erythroid mites in the natural region of the Greater Caucasus are unevenly distributed over landscape zones. (table 5.2.1).

**Table 5.2.1**

**Distribution of erythroid mites in the landscape zones of the Greater Caucasus**

№	Name of the mites	Landscape zones			
		A	B	C	D
<i>Erythraeus Latreille, 1806</i>					
1	<i>Erythraeus gorcensis</i>				+
2	<i>Erythraeus opilionoides</i>		+	+	
3	<i>Erythraeus phalangoides</i>				+
4	<i>Erythraeus adpendiculatus</i>				+
5	<i>Erythraeus regalis</i>		+	+	+
<i>Curteria Southcott, 1961</i>					
6	<i>Curteria episcopalis</i>		+		+

**Continuation of the table 5.2.1**

<i>Neobalaustium</i> Wilmann, 1951					
7	<i>Neobalaustium</i> species		+	+	+
<i>Eatoniana</i> Cambridge, 1898					
8	<i>Eatonia plumifera</i>				+
<i>Leptus</i> Latreille, 1776					
9	<i>Leptus rubricatus</i>		+		
10	<i>Leptus longipilis</i>		+		
11	<i>Leptus slivovi</i>		+	+	
12	<i>Leptus molochinus</i>		+		+
13	<i>Leptus clethrionomydis</i>		+		
<i>Abrolophus</i> Berlese, 1891					
14	<i>Abrolophus artemisiae</i>				+
15	<i>Abrolophus miniatus</i>		+	+	+
16	<i>Abrolophus crassitarsus</i>		+	+	+
17	<i>Abrolophus rhopalicus</i>			+	
18	<i>Abrolophus passerinii</i>		+		+
19	<i>Abrolophus strojnyi</i>		+		
20	<i>Abrolophus norvegicus</i>	+	+		
21	<i>Abrolophus quisquiliarus</i>		+	+	+
<i>Charletonia</i> Oudemans, 1910					
22	<i>Charletonia globigera</i>		+	+	+
23	<i>Charletonia cardinalis</i>				+
<i>Balaustium</i> v. Heyden, 1826					
24	<i>Balaustium xerothermicum</i>		+		
25	<i>Balaustium unidentatum</i>			+	+

**Note:** A - subalpine zone; B - mountain-forest zone; C - mountain-steppe zone;  
D - semi-desert (desert-steppe zone)

### **5.3. Distribution of erythreid mites in the natural region of the Greater Caucasus over landscapes**

In the course of our research, the distribution of erythreid mites in the natural region of the Greater Caucasus by landscapes was studied (presented in Table 5.3.1). It has been established that the most diverse species are low-lying broad-leaf forests (13 species) and mid-mountain broad-leaf forests and post-forest meadow-shrub (9 species) landscapes. The smallest species diversity was recorded in the meadow-forest landscape of the highlands and the eolian-sandy landscape of the plains (2 species in each). Three species are found in tugai forests and lowland agrolandscapes.

The degree of biocentric similarity of the landscapes of these mite species was calculated using the Chekanovsky-Sørensen index



by comparing them in pairs; the results are presented in Table 5.3.2.

**Table 5.3.1**

**Distribution of erythreid mites in the natural region of the Greater Caucasus over landscapes**

№	Landscapes	No of species		No of specific species	
		item	%	item	%
1	Meadow forest landscape of high mountains	2	8	-	-
2	Broad-leaf forests of middle mountains and postforest meadow-shrub landscapes	9	36	-	-
3	Lowland broadleaf forests	13	52	2	8
4	Forest-steppe landscape of low-lying (partly mid-mountain) foothills and inclined plains	5	20	-	-
5	Steppe and dry steppe (friganoid) landscapes with the participation of low and medium mountains, shrubs, meadows, landslides and clayey false karst	5	20	1	4
6	Low-mountain, partly flat, arid forest-pubescent (arid woodland) landscape with rocky slopes with mountain xerophiles	5	20	-	-
7	Tugai forests of low mountains	3	12	-	-
8	Low-mountain or subtropical semi-desert (desert-steppe) landscape	4	16	1	4
9	Aeolian-sandy plains landscape	2	8	1	4
10	Artificial forests	6	24	4	16
11	Agrolandscapes	3	12	1	4
12	Settlements	1	4	-	-

From the data in the table it can be seen that the similarity index was calculated for 6 landscapes. The greatest similarity was observed between the broad-leaf forests of the middle mountains and postforest meadow-shrub landscapes and the forest-steppe landscape of lowlands (partly of the middle mountains), foothills and gentle plains (57.14%). No similarities were observed between the broad-leaf forests of the middle mountains and postforest meadow-shrub landscapes and the forest-steppe landscape of artificial forests and foothills and gentle plains of lowlands (partly of the middle mountains) forest-steppe and artificial woodlands.

**Table 5.3.2**

**Coefficient of biogenetic similarity of the landscape by species composition ( $I_{CS}$ )**

Landscapes	A	B	C	D	E	F
A		54,55	57,14	21,43	21,43	-
B	54,55		11,11	11,11	22,22	10
C	57,14	11,11		20	20	-
D	21,43	11,11	20		10	8,33
E	21,43	22,22	20	10		8,33
F	-	10	-	8,33	8,33	

**Note:** A- broad-leaf forests of the middle mountains and post-forest meadow-shrub landscapes; B - broad-leaf lowland forests; C - forest-steppe landscape of lowland (partly middle mountainous) foothills and sloping plains; D - steppe and dry-steppe (friganoid) landscapes with the presence of low and medium mountains, shrubs, meadows, landslides and clayey false karst; E - foothills - lowland, partly plain, arid forest-shrub (arid sparse forest) landscape with rocky xerophiles on rocky slopes; F - artificial forests.

The results are calculated in Table 5.3.3 by calculating the Low and Medium Land Broadleaf Forest Index.

**Table 5.3.3**

**Calculation of the abundance index of lowland broadleaf forests**

Calculation of the abundance index of broad-leaved forests in low mountains.				
	Species	No of collected individuals by species (N)	No of individuals of all species (N)	Significant abundance (O)
1	<i>Erythraeus regalis</i>	2	31	6,45
2	<i>E.opilionoides</i>	1	31	3,23
3	<i>Leptus longipilis</i>	1	31	3,23
4	<i>L.molochinus</i>	1	31	3,23
5	<i>L.rubricatus</i>	3	31	9,68
6	<i>Abrolophus crassitarsus</i>	2	31	6,45
7	<i>A.miniatus</i>	1	31	3,23
8	<i>A.strojnyi</i>	5	31	16,13
9	<i>A.passerinii</i>	3	31	9,68
10	<i>A.norvegicus</i>	1	31	3,23
11	<i>A.quisquiliarus</i>	2	31	6,45
12	<i>Charletonia globigera</i>	7	31	22,58
13	<i>B.xerothermicum</i>	2	31	6,45

In the landscape of broad-leaf forests of the middle mountains, the highest abundance index is for the species *Abrolophus crassitarsus* (30.74%), as shown in Table 5.3.4. The abundance index of *Curteria episcopalis*, *Leptus molochinus*, *L.rubricatus*, *Charletonia globigera* is the lowest (3.85%).

As shown in Table 5.3.3, 2 *Erythraeus regalis* species have been found in broadleaf lowland forests. The ratio of these species to the total number is expressed as a percentage. The largest number in lowland broadleaf forests belongs to the species *Charletonia globigera* (22.58%). The smallest abundance in this landscape belongs to (3.23%) *Erythraeus opilionoides*, *Leptus longipilis*, *L.molochinus*, *Abrolophus norvegicus*, *A.miniatus* species.

**Table 5.3.4**

**Calculation of the significant abundance of broad-leaved forests of the middle mountains and species in the meadow-shrub landscape after this forest**

Indicators of the abundance of broad-leaved forests in the middle mountains and meadow-shrub landscapes after this forest				
	Species	Abundance of different species	Total abundance	Significant abundance
1	<i>Curteria episcopalis</i>	1	26	3,85
2	<i>Leptus slivovi</i>	5	26	19,23
3	<i>L.molochinus</i>	1	26	3,85
4	<i>L.rubricatus</i>	1	26	3,85
5	<i>Charletonia globigera</i>	1	26	3,85
6	<i>Abrolophus miniatus</i>	3	26	11,54
7	<i>A.crassitarsus</i>	8	26	30,74
8	<i>A.passerinii</i>	3	26	11,54
9	<i>Neobalaustium species</i>	3	26	11,54

**CHAPTER VI. ECOLOGICAL-FAUNISTIC REVIEW AND ZOOGEOGRAPHIC ANALYSIS OF ERYTHREID MITES IN THE NATURAL REGION OF THE GREAT CAUCASUS**

**6.1. Distribution of erythreid mites in the natural region of the Greater Caucasus along the altitudinal zones**

In the natural region of the Greater Caucasus there are 5 high-altitude zones- low-lying, foothill, low-mountain, middle and high-mountain. Table 6.1.1 shows the distribution of erythreid mites by height. In the course of the study, the distribution of Erythraeidae mites in the natural region of the Greater Caucasus by species belong-

ging to the Erythraeidae family was studied.

**Table 6.1.1**  
**Distribution of erythreid mites in the natural region of the Greater Caucasus along the altitudinal zones**

№	Names of the mites	Elevation zones				
		A	B	C	D	E
<i>Erythraeus Latreille, 1806</i>						
1	<i>Erythraeus gorcensis</i>	+				
2	<i>Erythraeus opilionoides</i>			+		
3	<i>Erythraeus phalangoides</i>	+				
4	<i>Erythraeus adpendiculatus</i>	+				
5	<i>Erythraeus regalis</i>	+		+		
<i>Curteria Southcott, 1961</i>						
6	<i>Curteria episcopalis</i>	+			+	
<i>Neobalaustium Wilmann, 1951</i>						
7	<i>Neobalaustium species</i>	+	+	+	+	
<i>Eatoniana Cambridge, 1898</i>						
8	<i>Eatonia plumifera</i>	+				
<i>Leptus Latreille, 1776</i>						
9	<i>Leptus rubricatus</i>			+	+	
10	<i>Leptus longipilis</i>			+		
11	<i>Leptus slivovi</i>		+	+	+	
12	<i>Leptus molochinus</i>	+		+	+	
13	<i>Leptus clethrionomydis</i>		+			
<i>Abrolophus Berlese, 1891</i>						
14	<i>Abrolophus artemisiae</i>	+				
15	<i>Abrolophus miniatus</i>		+	+	+	
16	<i>Abrolophus crassitarsus</i>	+	+	+	+	
17	<i>Abrolophus rhopalicus</i>			+		
18	<i>Abrolophus passerinii</i>	+		+		
19	<i>Abrolophus strojnji</i>			+	+	
20	<i>Abrolophus norvegicus</i>			+		+
21	<i>Abrolophus quisquiliarus</i>	+		+		
<i>Charletonia Oudemans, 1910</i>						
22	<i>Charletonia globigera</i>	+	+	+		
23	<i>Charletonia cardinalis</i>		+			
<i>Balaustium v. Heyden, 1826</i>						
24	<i>Balaustium xerothermicum</i>			+		
25	<i>Balaustium unidentatum</i>	+		+		

**Note:** A - low-lying zone (-28 - 200 m); B - foothills (200 - 500 m); B - low-mountain zone (500 - 1000 m); D - middle mountain zone (1000 - 2000 m); E - alpine zone (>2000 m)

## 6.2. Distribution of erythroid mites in the natural region of the Greater Caucasus across biochores

In the natural region of the Greater Caucasus, the distribution of erythroid mites across biochores is uneven. During the study, the following results were obtained.

1. Forests. In this biochore, 16 species of erythroid mites of 7 genera (*Erythraeus regalis*, *E.opilionoides*, *Curteria episcopalis*, *Leptus slivovi*, *L.molochinus*, *L.longopilis*, *L.rubricatus*, *Charletonia globigera*, *A.miniatus*, *A.crassitarsus*, *A.passerinii*, *A.strojnyi*, *A.norvegicus*, *A.quisquiliarus*, *Balaustium xerothermicum*, *Neobalaustium species*) were found. Erythroid mites living in the natural region of the Greater Caucasus make up 64% of the total number of their species. (Table 6.2.1).

2. Arid rare forests. In this biochore, 5 species of erythroid mites of 4 genera (*Erythraeus opilionoides*, *Charletonia globigera*, *Abrolophus crassitarsus*, *A.quisquiliarus*, *Neobalustium species*) were found. They account for 20% of the total number of erythroid mites found in the Greater Caucasus (Table 6.2.1).

**Table 6.2.1**  
**Distribution of erythroid mites of the Greater Caucasus on forest biochores**

No	Biochores	No of species	
		item	%
1	Forests	16	64
2	Arid rare forests	5	20
3	Semi-deserts and deserts	7	28
4	Steppes	5	20
5	Forest-steppes	5	20
6	Artificial forests	7	28
7	Tea plantations	3	12
8	Yard farms	2	8

3. Semi-deserts and deserts. This biochore contains 7 species of erythroid mites belonging to 6 genera (*Eatoniana plumifera*, *Curteria episcopalis*, *Leptus rubricatus*, *Charletonia globigera*, *Ch.cardinalis*, *Abrolophus crassitarsus*, *Neobalaustium species*) These species ac-

count for 28% of the total number of erythroid mites found in the natural region of the Greater Caucasus. Species belonging to the genus *Erythraeus* and *Balaustium* have not yet been found in this biochord. At the same time, *Eatoniana plumifera* of the genus *Eatoniana* and *Charletonia cardinalis* of the genus *Charletonia* were found only in this biochord (Table 6.2.1).

4. Steppes. The biochore contains 5 species of erythroid mites of 4 genera (*Erythraeus regalis*, *Leptus slivovi*, *Charletonia globigera*, *Abrolophus rhopalicus*, *A.miniatus*) This is 20% of the total number of erythroid mites found in the natural region of the Greater Caucasus. (table 6.2.1).

5. In the forest-steppe biochoree, five species of erythroid mites belonging to 5 genera were found (*Leptus slivovi*, *Abrolophus miniatus*, *Charletonia globigera*, *Balaustium unidentatum*, *Neobalaustium species*) This is 20% of the total number of erythroid mites found in the natural region of the Greater Caucasus. *Erythraeus*, *Curteria*, and *Eatoniana* are not found in this biochore. (table 6.2.1).

6. Artificial forests. 7 species of erythroid mites of 2 genera were found in artificial forests (*Erythraeus phalangoides*, *E.regalis*, *E.gorcensis*, *E.adpendiculatus*, *Abrolophus artemisiae*, *A.passerinii*, *A.quisquiliarus*) This is 28% of the total number of erythroid mites found in the Greater Caucasus. This biochore is dominated by a number of species belonging to the genus *Erythraeus*. (4 species) (table 6.2.1).

7. Tea plantations. In this biochore, three species of erythroid mites were found, belonging to 3 genera (*Leptus clethrionomydis*, *Abrolophus crassitarsus* vø *Balaustium xerothermicum*) This is 12% of the total number of erythroid mites found in the Greater Caucasus. (table 6.2.1).

8. Yard farms. In this biochore, two species of erythroid mites of two genera were found (*Leptus molochinus*, *Balaustium unidentatum*) It accounts for 8% of the total number of erythroid mites found in the Greater Caucasus (table 6.2.1).

### 6.3. Distribution of erythreid mites in the natural region of the Greater Caucasus by biotopes

We also studied the distribution of erythreid mites in the forest biotope of the Greater Caucasus natural region. As a result of our research, it was shown that the fauna of erythreid mites of low-lying hornbeam forests is relatively rich among the studied biotopes. 7 species of erythreid mites of 5 genera were found here. In other biotopes, only 1-4 erythreid mites were found. (table 6.3.1).

**Table 6.3.1**

**Distribution of erythreid mites in the natural region of the Greater Caucasus by biotopes**

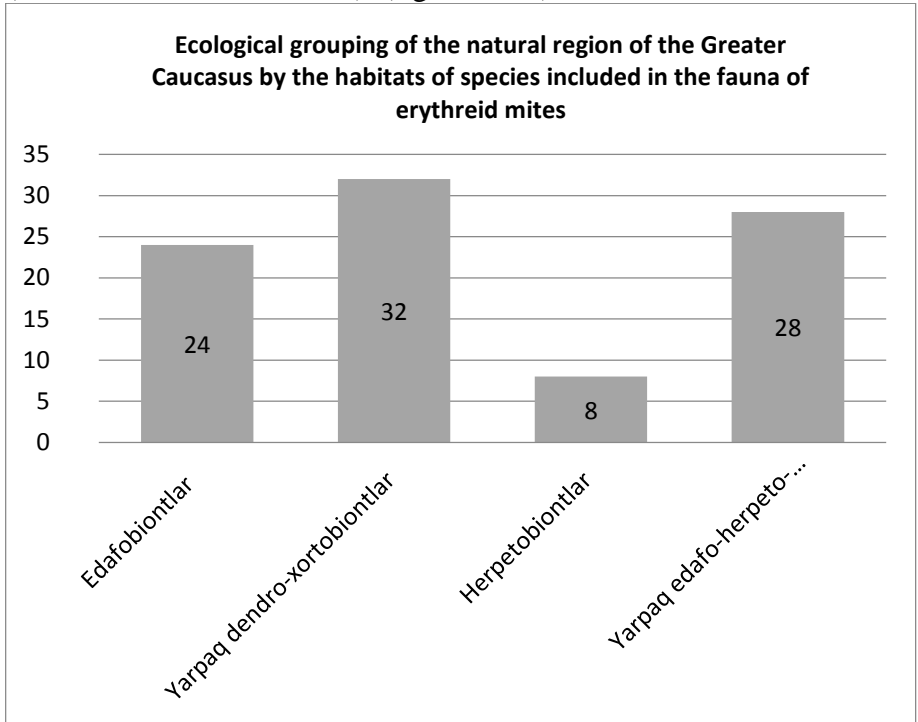
№	Biotopes	No of species	
		item	%
1	Low hornbeam forests	7	28
2	Lowland Chestnut Forests	1	4
3	Low-mountain oak forests (with Georgian oak)	4	16
4	Low mountain maple forests	2	8
5	Beech and hornbeam forests of the middle mountains	3	12
6	Mediterranean oak and oak-beech forests (with oriental oak)	2	8
7	Mediterranean rainforests alder (with gray alder) forests	2	8
8	Alpine birch forests (with Radde birch)	2	8
9	Tugai forests	3	12

As a result of our research, it can be seen from the above data that erythreid mites and low-lying hornbeam forests are richer among forest biotopes. In these forests, 7 species of 5 species of erythreid mites were found. The smallest number of erythreid mites was found in lowland chestnut and tugai forests (only 1 species in each of these forests).

### 6.4. Distribution of erythreid mites in the natural region of the Greater Caucasus by ecological groups

Mites belonging to the Erythraeidae family can be divided into several ecological groups. An analysis of the population habitats of the resin species of erythreid mites in the Greater Caucasus makes it

possible to divide these mites into the following ecological groups (mature and deuteronomies). (figure 6.4.1).



**Figure 6.4.1. Ecological grouping of the natural region of the Greater Caucasus by the habitats of species included in the fauna of erythreid mites**

Thus, as a result of the ecological grouping of species in the fauna of erythreid mites of the Greater Caucasus natural region by habitats, 6 species in the group of edaphobionts (24%), 8 species in the group of leafy dendrochortobionts (32%), 2 species in the group of herpetobionts (8%), leafy edaphobionts -herpeto – dendrochortobionts 7 species (28%) of erythreid mites were identified.

### **6.5. Zoogeographic analysis of erythroid mites of the Greater Caucasus**

We have carried out a zoogeographic analysis of erythroid mites in the natural region of the Greater Caucasus. Erythreid mites



of this natural region are divided into 9 zoogeographic groups. At the same time, it was determined that the core of the fauna of erythroid mites in the natural region of the Greater Caucasus consists of 3 geographic groups. These are Europe (9 species or 36% of the total number of erythroid mite species found in the natural region of the Greater Caucasus), Central Europe (5 species or 20% of the total number of erythroid mite species found in the natural region of the Greater Caucasus) and Holarctic species (4 species or 16% of the total number of erythroid mite species found in the natural region of the Greater Caucasus). In total, these three groups include 19 species. This is 76% of the total number of erythroid mites found in the natural region of the Greater Caucasus.

## CONCLUSIONS

1. At present, the fauna of erythroid mites of the Greater Caucasus includes 25 species belonging to 8 genera of 5 subfamilies. For the first time given for 1 subfamily, 4 genera, 22 species of the Caucasian fauna. For the first time, 2 subfamilies, 2 genera and 1 species were found within Azerbaijan in the natural region of the Greater Caucasus.
2. Böyük Qafqaz təbii vilayətinin eritroid gənələrinin faunasının əsasını The fauna of erythroid ticks in the Greater Caucasus is based on 3 genera: *Abrolophus* Berlese, 1891 (8 species), *Erythraeus* Latreille, 1806 (5 species) and *Leptus* Latreille, 1776 (5 species). In total, 18 species of erythroid mites have been identified, belonging to these 3 genera. (*Erythraeus phalangoides*, *E.regalis*, *E.adpendiculatus*, *E.opilionoides*, *E.gorcensis*, *Letus slivovi*, *L.clethronomydis*, *L.molochinus*, *L.rubricatus*, *L.longipilis*)
3. For the first time, the distribution of erythroid mites in the natural region of the Greater Caucasus within Azerbaijan has been studied in landscape zones and landscapes. The greatest species richness is revealed in the mountain-forest (17 species of 7 genera) and semi-desert (16 species of 8 genera) landscape zones. The smallest species (2 species in total) were found in the subalpine landscape.
4. In the dissertation, the distribution of erythroid mites of the natural

region of the Greater Caucasus along the altitudinal zones was studied and it was established that the greatest diversity (17 species) is in the low-altitude zone. The smallest species (2 species in total) was found in the highlands. It was found that three species (*Eatoniana plumifera*, *Abrolophus artemisiae*, *Balaustium unidentatum*) live only in lowland altitude, and one species, *Balaustium xerothermicum*, only in lowlands. Two species (*Leptus clethrionomydis*, *Charletonia cardinalis*) have so far been recorded only in the foothills. It was found that the species composition of the genus *Abrolophus* is richer in the lowlands.

5. For the first time, the population of habitats of erythreid mites of the Greater Caucasus natural region was analyzed and divided into 4 ecological groups: edaphobionts (6 species), leaf dendro-hortobionts (8 species), herpetobionts (2 species), leaf edafo-dendrohortobionts (7 species).
6. Zoogeographic analysis of the natural region of the Greater Caucasus shows that the core of the fauna of erythreid mites consists of 3 groups: European (9 species or 36%), Central European (5 species or 20%) and Holarctic species (4 species or 16%).
7. *Abrolophus passerinii*, *A. norvegicus* and *A. quisquiliarum* species have been identified as important regulators of the number of sucking pests in the lowland oak forests of the Khizi region (with Georgian oak).

### PRACTICAL SUGGESTIONS

1. The data obtained as a result of the study can be used in the compilation and application of catalogs (faunistic analysis and taxonomy, distribution of zoographic complexes) of erythreid mites in the natural region of the Greater Caucasus.
2. From the information obtained as a result of research can be used when writing books, monographs, textbooks, teaching in specialized universities.
3. To reduce the use of pesticides in natural and agrocenoses, we recommend using *Abrolophus passerinii*, *A. norvegicus* and *A. quisquiliarum* as entomophages against sucking insect pests.

**The main content of the dissertation is reflected in the following published scientific works of the author:**

1. Асланов, О.Х., Ализаде, Г.А. Эритреиды (Acariformes: Actinedida: Erythraeidae) // -Bakı: AMEA Zoologiya İnstitutunun əsərləri, -2018. Cild 36, №1, -s.129-133.
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